ecology & heritage partners

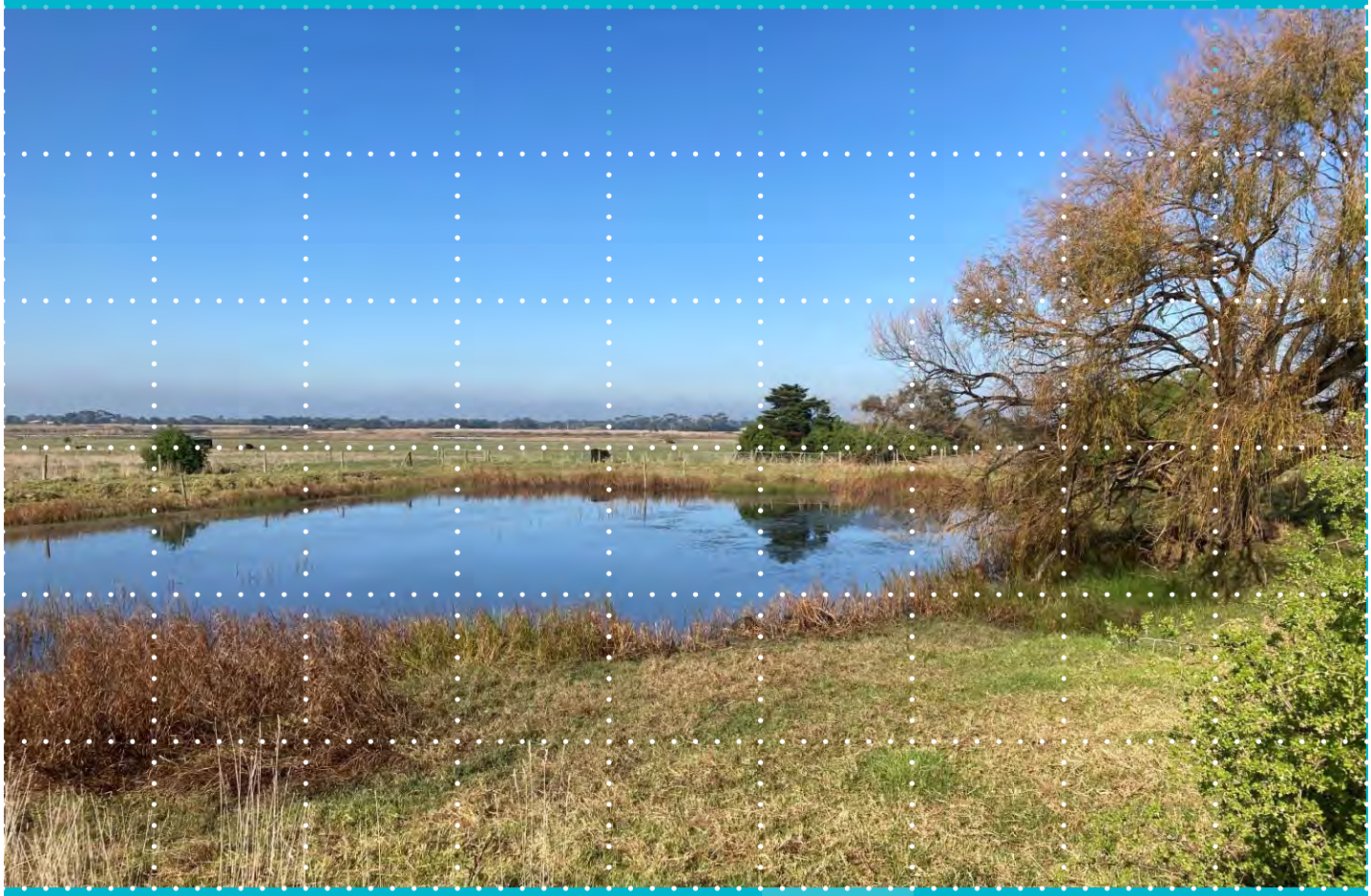
Final Report

Preliminary Documentation: Residential Development at 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357).

Prepared for

AC Manager Pty Ltd

January 2024



Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road Ascot Vale VIC 3032 **GEELONG:** PO Box 8048 Newtown VIC 3220

BRISBANE: Level 22, 127 Creek Street Brisbane QLD 4000 **ADELAIDE:** 22 Greenhill Road Wayville SA 5034

CANBERRA: Level 6, 39 London Circuit, Canberra ACT 2601 **SYDNEY:** Level 5, 616 Harris Street, Ultimo, NSW, 2007

DOCUMENT CONTROL

Assessment	Preliminary Documentation (EPBC 2022/09357)
Address	78-88 Groves Road, Armstrong Creek, Victoria
Project number	16303
Project manager	Alex Wilkinson (Consultant Zoologist)
Report reviewer	Aaron Organ (Director/Principal Ecologist)
Other EHP Staff	Sarah Hill (Field Ecologist); Sara Petrovic (Zoologist); Claire Ranyard (Senior Botanist)
Mapping	Monique Elsley (GIS Co-Ordinator)
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Ecology and Heritage Partners acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

liability for any damages or loss incurred as a result of reliance placed upon the report and its contents.

GLOSSARY

Acronym	Description
CMA	Catchment Management Authority
CMP	Conservation Management Plan
CHMP	Cultural Heritage Management Plan
DAWE	(former) Department of Agriculture, Water and Environment
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEECA	Victorian Department of Energy, Environment and Climate Action
DELWP	(former) Victorian Department of Environment, Land, Water and Planning
DSEWPaC	(former) Commonwealth Department of Sustainability, Environment, Water, Populations and Communities.
ESD	Ecologically Sustainable Development
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988*
FY	Financial Year
GGF	Growling Grass Frog *Litoria raniformis*
NES	National Environmental Significance
NVIM Tool	Native Vegetation Information Management Tool (DEECA)
NVPP	Native Vegetation Precinct Plan
OMP	Offset Management Plan
PMST	Protected Matters Search Tool (DCCEEW)
RAP	Registered Aboriginal Party
TfN	Trust for Nature
VBA	Victorian Biodiversity Atlas (DEECA)
WTOAC	Wadawurrung Traditional Owners Aboriginal Corporation

SUMMARY

Ecology and Heritage Partners Pty Ltd were commissioned by AC Manager Pty Ltd to prepare the Preliminary Documentation for the proposed development of 200 residential lots and raising of a section of Groves Road to facilitate access to 78-88 Groves Road, Armstrong Creek, Victoria (the study area) (EPBC 2022/09357).

It has been determined under Section 75 of the EPBC Act that the proposed action is a 'controlled action', and that the residential development of the study area will likely have a significant impact on 'Listed threatened species and communities' (Section 18 and Section 18A). It has also been determined that the proposed action will be assessed by Preliminary Documentation.

Specifically, the Matter of National Environmental Significance (MNES) that the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) has requested additional information for concerns the EPBC Act-listed Growling Grass Frog *Litoria raniformis* and Spiny Peppercress *Lepidium aschersonii.* It has been requested that more information regarding the proposed habitat creation for Growling Grass Frog be provided.

The study area covers approximately 41.48 hectares and is currently used for agriculture and farming, with a residence, outbuildings, and five decommissioned broiler sheds on site. Two effluent treatment ponds are present in the centre of the site, and a dam is located in the south-west corner (see Section 3 for detailed description of the site and surrounding environment). The proposed residential development will occur across one phase, with the delivery of the new wetlands planned to occur prior to construction commencing.

An Ecological Assessment and Growling Grass Frog Habitat Assessment were completed by Ecology and Heritage Partners in 2021, during which suitable habitat for Growling Grass Frog was identified within the study area. The species was confirmed present during targeted surveys completed later the same year. Previous records also indicated that the species was present in proximity to the site (i.e. Sparrovale and Baenches Wetland to the north and south of the study area, respectively).

Growling Grass Frog foraging and breeding habitat is present within the study area in the form of the two effluent ponds and surrounding terrestrial land. The resident population constitutes an 'important population' in accordance with the significant impact guidelines for the species (DEWHA 2009). Based on the proposed action, 16.502 hectares of Growling Grass Frog habitat will be removed, including all aquatic habitat and some areas of terrestrial dispersal habitat. The habitat quality of one effluent pond is considered high, with remaining aquatic and terrestrial habitat considered low quality and degraded.

To mitigate against the potential impacts (i.e. impact to aquatic and terrestrial habitat) to the resident Growling Grass Frog population, habitat creation and improvement will be undertaken within a first-party offset site at 78-88 Groves Road, Armstrong Creek (see Section 4 for a discussion of potential impacts). The proposed offset area is described below (Table S1; Appendix 1) and will provide additional breeding, dispersal and foraging habitat for Growling Grass Frog. Areas identified for habitat creation have the primary aim of ensuring there is an overall improvement for the species (i.e. provision of high-quality breeding and foraging habitat). The proposed avoidance and mitigation measures are detailed in Section 5, and residual impacts and proposed offsets in Section 6.

Table S1. Offset Area breakdown

Description	Area of Habitat (Ha)
Smaller wetland waterbody	0.5
Larger wetland waterbody	1.0
Terrestrial habitat surrounding the wetlands (augmented through provision of rock banks, logs, ground debris, and ongoing management of weed and pest animal species)	6.7

The development of the study area will impact on existing habitat and has the potential to create a barrier to movement between the resident Growling Grass Frog population and nearby wetlands (i.e. Sparrovale and Baenches Wetlands). Therefore, a dedicated dispersal corridor will first be constructed to facilitate frog dispersal between existing effluent ponds and the constructed wetlands. The offset site has been sited so that there are no impediments to the dispersal of frogs within the protected habitat at the offset site, or between the offset site and adjacent habitat in Sparrovale and Baenches Wetland. The wetlands will have a multifaceted water delivery system. The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Groundwater, rainwater and recycled water (post-residential construction) will then be used to maintain water levels in the wetlands, including during periods of low rainfall (e.g. drought). If groundwater is found to be unsuitable water quality, then Balog Channel water will be used to supplement rainwater and recycled water (post-completion of residential development). The specifics of the groundwater water delivery system are to be finalised but are likely to utilise a self-sustaining solar-powered groundwater pump system.

With existing Growling Grass Frog habitat at the site proposed to be impacted by the residential development, the offset site will be enhanced through the creation of two wetland waterbodies, designed in accordance with the *Growling Grass Frog Habitat Design Standards* (DELWP 2017). Augmentation of terrestrial habitat with features such as rock, logs and other ground debris will also be completed to provide shelter and overwintering resources. There will be ongoing management of threatening processes such as weed and pest animal control, and there will be no introduction of additional predatory species within the created wetlands.

The proposed residential development will not impact any other species or ecological community listed under the EPBC Act. The constructed waterbodies and associated terrestrial habitat will create a net increase in the availability of breeding habitat for Growling Grass Frog. While a total of 16.502 hectares of Growling Grass Frog habitat will be removed as part of residential development, the provision of two created waterbodies in strategic locations within the site and the improvement of suitable terrestrial habitat will adequately offset the removal of habitat for the species.

CONTENTS

1 INTRODUCTION

1.1 Project Background

Ecology and Heritage Partners Pty Ltd were commissioned by AC Manager Pty Ltd to prepare the Preliminary Documentation for the proposed development of 200 residential lots and raise a section of Groves Road to facilitate access to 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357) (Figure 1).

On 23 December 2022, it was determined by a delegate for the Department under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that the proposed action is considered a controlled action, and that the development of the study area will likely have a significant impact on 'Listed threatened species and communities (Section 18 & Section 18A)'. It has also been determined that the proposed action will be assessed by Preliminary Documentation.

Owing to the known presence of a population of the nationally significant Growling Grass Frog *Litoria raniformis* within the study area, a referral (EPBC 2022/09357) was submitted to the Commonwealth Minister of Climate Change, Energy, the Environment and Water (DCCEEW) under the EPBC Act on 16 September 2022, to determine potential impacts to Matters of National Environmental Significance (MNES). On 14 October 2022, DCCEEW determined that amendments to, or additional information on, the proposed action were required to be considered valid, and that a resubmission was required. The referral was amended and resubmitted to DCCEEW on 1 November 2022. This referral was deemed a 'Controlled Action' by DCCEEW on 23 December 2022 based on likely impacts to listed threatened species and communities protected under Part 3 of the EPBC Act.

In September 2019, Ecology and Heritage Partners was engaged by Spiire to undertake a Growling Grass Frog Habitat Assessment and Targeted Surveys within the study area, and engaged again in March 2021 to undertake an Ecological Desktop Assessment of the study area. The purpose of these assessments was to determine Growling Grass Frog presence and identify the extent and type of habitat present within the study area, to determine the likely presence of significant flora and fauna species, and to discusses the potential ecological and legislative implications associated with the proposed action.

In April 2022, Ecology and Heritage Partners was commissioned by AC Manager Pty Ltd to prepare a Growling Grass Frog Conservation Management Plan (CMP) and Spiny Peppercress *Lepidium aschersonii* Targeted Surveys, and an evaluation of potential impacts under Commonwealth and State environmental policy and legislation. The overall objective of the Growling Grass Frog CMP was to provide detailed measures to ensure the proposed activity did not have a significant impact on the resident Growling Grass Frog population and associated habitats.

A residential development plan was prepared as part of the planning permit application for the proposed commercial development, and this plan includes the provision of dedicated Growling Grass Frog habitat, including a large pond and one smaller pond in a movement corridor that will be constructed to facilitate frog breeding habitat and dispersal to adjacent habitat. Additional Growling Grass Frog habitat is proposed to be designed and constructed. As part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral ponds) will be retained and enhanced where possible. Enhanced existing and constructed new habitat will result in the provision of an unbroken series of waterbodies situated along a large dispersal corridor to allow unimpeded frog breeding and dispersal. These waterbodies will be designed and constructed taking into consideration the *Growling Grass Frog Habitat Design Standards 2017* (DELWP 2017).

Ecology and Heritage Partners has prepared a Growling Grass Frog Offset Management Plan (OMP) for the proposed development which includes detail on how the proposed impacts to the species will be mitigated and offset, and measures to ensure that the resident population at the site remains viable in the future. The proposed residential development will not impact any other species or ecological community listed under the EPBC Act.

The following information includes that outlined in the EPBC Act referral, as well as additional information requested by DCCEEW regarding impacts of the action and the strategies proposed to avoid, mitigate and/or offset those impacts. The contents page of this report provides a reference table detailing where each of the requirements of the Preliminary Documentation request is addressed.

2 DESCRIPTION OF THE ACTION

The Preliminary Documentation must provide a detailed description of the proposed action, including:

a) The location, boundaries, and size (in hectares) of the proposed action, and the development and disturbance footprint, which may include areas indirectly impacted;

b) A description of areas adjoining the proposed action (including but not limited to Sparrovale Wetland, Balog Channel, Hospital Swamp, and Baenches Wetland);

c) A description of all components and stages of the action, including:

   i. the proposed activities associated with each stage/phase (pre-construction, construction, and operational)

   ii. the anticipated timing and duration of stages/phases

   iii. indicative design for the proposed residential development

Some of this information is already provided in the referral material, please expand upon this in relation to all stages of the action. This information will support the Department in appropriately considering the full scale and scope of the proposed action.

2.1 Response

2.1.1 Location, boundaries and size of the proposed action

The size of the study area is a 41.45 hectare parcel of land located at 78-88 Groves Road (1/PS810421), and has been acquired for the subdivision and development of the land for residential purposes. The study area is bordered by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and future potential residential development (private property) to the west.

The study area is currently used for agriculture and farming, with a residence, outbuildings, and five decommissioned broiler sheds on site. Two effluent treatment ponds exist in the centre of the site, and a dam is located in the south-west corner. The study area is generally flat, with a gradual slope towards the south and drains into Balog Channel. There are no ridges or crests within or immediately adjacent to the site. It is accessible from the northern boundary (Groves Road) only, however this is an interim solution, with the ultimate solution being road access from the eastern boundary as per Armstrong Creek East Precinct Structure Plan, with timing dependent on neighbouring properties being developed.

The study area is located within the Greater Geelong. The following zoning and overlays apply:

- Urban Growth Zone – Schedule 2 (UGZ2);
- Development Contributions Plan Overlay – Schedule 3 (DCPO3);
- Environmental Significance Overlay – Schedule 2 (ESO2);
- Floodway Overlay (FO); and,
- Public Acquisition Overlay – Schedule 12 (PAO12).

The study area is covered by the Armstrong Creek East NVPP, as part of the Armstrong Creek East Precinct Structure Plan.

The study area is located across two bioregions: the Otway Plain and Victorian Volcanic Plain as defined by the Department of Energy, Environment and Climate Action (DEECA) NatureKit Map. It is situated within the Corangamite Catchment Management Authority (CMA) and the City of Greater Geelong Council municipality. No major events (e.g. bushfire, flood) have occurred in the study area in recent history.

Size and disturbance footprint of the proposed action

The study area is proposed to be subject to future residential development, with a section of Groves Road road reserve proposed to be raised in order to provide access to the future 78-88 Groves Road development. The residential development is proposed to be undertaken over one phase and is proposed to include 200 residential lots. The overall disturbance footprint in the study area is 28.42 hectares.

This plan includes the creation of dedicated habitat for Growling Grass Frog, including a large pond and one smaller pond in a movement corridor that will be constructed to ensure ongoing connectivity to adjacent frog breeding habitat and dispersal corridors. As part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral ponds) will be retained and enhanced where possible. Enhanced existing and constructed new habitat will result in the provision of an unbroken series of waterbodies situated along a large dispersal corridor to allow unimpeded frog breeding and dispersal. These waterbodies will be designed and constructed taking into consideration the *Growling Grass Frog Habitat Design Standards* (DELWP 2017)

As part of residential development works, direct and indirect impacts to the environment include the following. Effluent Pond 1, 2 and surrounding foraging habitat is proposed to be directly impacted by construction works, including access, road construction, grading of land and construction of residences. Potential indirect effects to the species include noise impacts to the Growling Grass Frog population in Sparrovale and Baenches Wetlands. However, this is likely to be minor given the large buffer (minimum 100 metres) between the residential development area and neighbouring breeding populations. Both ponds are proposed to be removed while surrounding foraging habitat is proposed to be partially removed.

In summary, the following direct impacts to Growling Grass Frog habitat in the study area are proposed.

A total of 16.502 hectares of habitat, comprising:

- 0.216 hectares of high quality aquatic foraging and potential breeding habitat (Effluent Pond 1);
- 0.576 hectares of low quality aquatic foraging habitat (Effluent Pond 2);
- 15.710 hectares of low quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock; and,
- 0.033 hectares of native vegetation assessable under Clause 52.17 of the Victorian Planning Scheme is proposed to be impacted by the residential development.

Potential indirect impacts to Growling Grass Frog include noise and lighting and other construction impacts (i.e. spread of chemicals/sediment/disease/weeds via machinery and equipment) to both Growling Grass Frog and Spiny Peppercress habitat in adjacent wetlands. Potential indirect impacts for these species are proposed to be mitigated through the application of a minimum 100 metre construction and residential development buffer to adjacent wetlands. Further, potential impacts include but are not limited to erosion, sedimentation, plant disease, and pest plant spread, with specific mitigation measures proposed for all potential impacts. Mitigation measures include appropriate storage of materials, use of water-sensitive urban design principles,

frequent washdown of vehicles during construction among a range of other measures proposed in the Ecological Assessment, Offset Management Plan and forthcoming Construction and Environmental Management Plan (Ecology and Heritage Partners 2023a, 2023b)

A small portion of Coastal Saltmarsh EVC (2.47 hectares) is present within subdivided lots in the development plan and is not represented of EPBC listed Subtropical Coastal Saltmarsh Community. No development works will occur within these areas, however there may be minor direct impacts to mapped Coastal Saltmarsh due to boundary fencing between lifestyle lots and the future proposed shared path (Figure 2). Construction mitigation measures (described above) are sufficient to avoid direct impacts to Spiny Peppercress recorded in adjacent wetlands.

Overall, the following disturbance scenario would occur due to the proposed action:

- Disturbance footprint: 28.42 hectares (including 16.502 hectare area of GGF habitat impact)
- Area of avoidance: 1.89 hectares
- Area of GGF habitat creation/mitigation: 8.21 hectares.

Please see included spatial files for details.

The project action is proposed to be undertaken under one phase and is not part of a staged development or related to other actions or proposals in the region.

2.1.2 Description of areas adjacent to the study area

The study area is bound by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and private property to the west. Importantly, Baenschs Wetland (which is adjacent to the Armstrong Creek Water Frontage) forms part of a large wetland complex which is protected under the EPBC Act, as the Port Phillip Bay (Western Shoreline) and Bellarine Ramsar Site. The Sparrovale Wetland also drains into this site via the Barwon River.

Higher-quality aquatic and terrestrial habitat for Growling Grass Frog is present in areas adjacent to the study area, including in Sparrovale and Baenches Wetlands. These areas contain large ephemeral and permanent waterbodies as well as terrestrial areas, all of which is currently managed for weed reduction, habitat improvement and restoration of floristic diversity and structural complexity, among other actions (CoGG 2020). A population of the nationally significant Growling Grass Frog *Litoria raniformis* is known to occur within Baenches Wetland to the south of the study area (Shannon LeBel *pers. obs.*). Spiny Peppercress was previously identified by Ecology and Heritage Partners immediately south of the study area in Baenches Wetland (Ecology and Heritage Partners 2018).

The recent construction of the Balog Channel immediately south of the study area demonstrates a strategic approach to the 'wise use' principles as defined by the Ramsar Convention and will ensure that existing attributes of the Ramsar site will not be compromised by ongoing development within the Armstrong Creek locality.

2.1.3 A description of all components and stages of the action

Wetland Construction

Prior to commencement of construction, two new wetlands will be constructed to provide habitat for Growling Grass Frog, and the existing effluent ponds subsequently decommissioned. However, prior to the removal of

existing habitat, no construction activities will occur between existing and constructed habitat for the length of a breeding season, in order to allow for 'frog migration' into the new habitat. The new wetland waterbodies will cover a total area of 1.5 hectares as per the Offset Management Plan (Ecology and Heritage Partners 2023), with a further 6.7 hectares of surrounding terrestrial habitat protected and enhanced. Associated access easements will also be created during these works.

Residential Development

The study area is proposed to be subject to future residential development, with a section of Groves Road road reserve proposed to be raised in order to provide access to the future 78-88 Groves Road development. The development is proposed to be undertaken over one phase and include 200 residential lots, including a small number of larger 'lifestyle' lots, along a key local access road loop and several access streets (MD Plan 16/05/2023). No filling is proposed within the boundary of the revised C339 LSIO. Minimum floor levels will be the 1% AEP level plus 600mm (3.3m AHD). The 23 lifestyle lots (> 700 square metres) will be above the flooding extent..

A shared path is proposed to provide a 'green link' connection to the northern boundary of the residential development into Sparrovale Wetland. Groves road is proposed to be raised along the existing road alignment to minimise hydrological impacts to Sparrovale and other adjacent wetlands, with temporary access to the subject site proposed to occur from Groves Road, until this connection is established through the adjacent land parcel to the west (as per the Armstrong Creek East Precinct Structure Plan (SMEC 2010)). Construction of residential development is currently forecast to commence in January 2025 and run for approximately 12 months.

The project action is not part of a staged development or related to other actions or proposals in the region.

3 DESCRIPTION OF THE ENVIRONMENT AND MNES

The Preliminary Documentation must provide a general description of the environment affected by, and surrounding, the proposed action, in both the short and long term. Specific matters this section must address include, but are not limited to:

a) A description of any potential MNES that occur or have the potential to occur in the proposed project and adjacent area, including but not limited to the Growling Grass Frog (*Litoria raniformis*) and Spiny Peppercress (*Lepidium aschersonii*)

b) Results from any targeted surveys to confirm the status and extent of the Growling Grass Frog and Spiny Peppercress within the proposed project area. The Growling Grass Frog surveys should be undertaken in accordance with the survey guidelines outlined in the Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*) (https://www.dcceew.gov.au/sites/default/files/documents/litoria-raniformis.pdf)

c) An assessment of the adequacy of any surveys undertaken, including survey effort, timing, and accordance with the Department's relevant scientific and policy guidance

d) Information about other resources used to identify and assess the environmental values on site, including survey data and historical records

e) Consultation and advice sought from local community groups and experts.

All discussions and conclusions should include a full justification based on the best available information including relevant conservation advices, recovery plans, threat abatement plans and guidance documents, if applicable. Departmental documents regarding protected matters can be found at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Surveys for the referenced species have already been undertaken as a part of the proposed action. Surveys and records of the species should be referenced to provide overall context for the reader of the Preliminary Documentation.

3.1 Response

3.1.1 Description of MNES

An ecological assessment was completed by Ecology and Heritage Partners in August 2021 (Ecology and Heritage Partners 2023b). The purpose of this assessment was to review the Armstrong Creek East Native Vegetation Precinct Plan (NVPP) to determine any native vegetation implications associated with the study area, and to determine the likely presence of significant flora and fauna species and/or ecological communities.

The results of the Ecological Assessment demonstrated that Growling Grass Frog was recorded within the nearby Baenches Wetland in 2020, and although the waterbodies on-site are artificial, they may provide potential habitat depending on the quality of the water and presence of emergent and fringing vegetation. As such, Ecology and Heritage Partners completed a Growling Grass Frog Habitat Assessment in October 2021 to determine the quality of the waterbodies and determine the presence of suitable habitat features for the species. The entire study area was assessed with all attributes of habitat quality for the Growling Grass Frog recorded.

Two recent records of Spiny Peppercress exist just outside the south-east boundary of the study area (Ecology and Heritage Partners 2018). Spiny Peppercress is classified as Vulnerable under the EPBC Act and listed as Endangered under the *Flora and Fauna Guarantee Act 1988* (FFG Act) and favours heavy clay soils near salt lakes on the volcanic plains (Entwisle 1996). Given the proximity to the nearby high-quality brackish wetlands, potential habitat present along the southern boundary of the site and previous records identified by Ecology and Heritage Partners immediately south of the study area (Ecology and Heritage Partners 2018), the study area was considered to support potential habitat for the nationally significant Spiny Peppercress.

Growling Grass Frog habitat

The waterbodies within the study area visited during the Habitat Assessment were identified as having moderate quality habitat for Growling Grass Frog. This was based on the permanent hydrology of the sites, the good cover of fringing and emergent vegetation and the occasional presence of other refuges.

The entire edge of the first effluent treatment pond (Site 1), located in the centre of the site, was fringed by Rushes *Juncus* sp. and Sedges *Carex* sp. and small patches of planted vegetation occurred near the water's edge. The water was relatively deep and turbid with red algal blooms present on the surface, and few refuges in the form of rocks or logs were noted during the assessment. The second effluent pond (Site 2), located to the south of the first treatment pond, was surrounded by Rushes and Sedges, with a low percentage of emergent vegetation also present. The water was deep and turbid and a number of rocks were observed along the creek banks, which would provide areas of refuge for the Growling Grass Frog. The banks of the dam located within the southwest corner of the study area (Site 3) were moderately covered by groundcover vegetation with the occasional planted shrub present. Observations made from Site 2 during the habitat assessment could not ascertain whether the dam currently held any water. Subsequently, confirmation was received from the landowner that this dam was dry and no longer captures water. As such, this dam is not considered further as part of this report.

Given the presence of moderate quality habitat for the species within these artificial waterbodies, and the proximity of previous records of Growling Grass Frog within the nearby Baenches Wetland in 2020 (S. LeBel pers. obs.), it was considered that a low to moderate likelihood that Growling Grass Frog would rely on habitat within the study area for foraging and/or breeding purposes.

Plate 1. Site 1 (Ecology and Heritage Partners Pty Ltd 18/10/2021).

Plate 2. Site 2 (Ecology and Heritage Partners Pty Ltd 18/10/2021).

3.1.2 *Targeted Surveys for MNES*

Growling Grass Frog

In November 2021, Ecology and Heritage Partners undertook Targeted Growling Grass Frog surveys at Site 1 and Site 2 within the study area. The sites visited were two of three identified during a preliminary habitat assessment (undertaken on 18 October 2021) as potentially supporting moderately suitable habitat for the species (i.e. the permanent hydrology of the sites, the good cover of fringing and emergent vegetation and the occasional presence of other refuges). Surveys were not able to be undertaken within Site 3 due to the presence of cattle (i.e. bulls) within the surrounding paddock.

Growling Grass Frog Surveys were undertaken in accordance with the methods outlined in the *Significant Impact Guidelines for the Vulnerable Growling Grass Frog* (DEWHA 2009). Three nights of surveys (18, 24 and 29 November 2021) took place during the species' active season (October - March), in weather conditions considered optimal for detection (i.e. warm and humid, overnight temperature not less than 14°C, preferably post rain) and when the species was known to be active elsewhere in the region (Table 3). The surveys were conducted with reference to the prescribed methodology detailed in the Significant Impact Guidelines for the Vulnerable Growling Grass Frog (*Litoria raniformis*) EPBC Act Policy Statement 3.14 (DEWHA 2009), and the Survey Guidelines for Australia's Threatened Frogs (DEWHA 2009).

Based on the survey protocols to be adhered to for this study, this would achieve a probability detection threshold of 0.99 as per the probability thresholds specified by DEECA (Heard *et al*. 2010).

The survey effort involved spotlighting surveys, call identification, and active searching for adults and metamorphs. Each survey consisted of:

- Two qualified zoologists, experienced in Growling Grass Frog detection, systematically walked along (or around) each watercourse (or waterbody);
- An initial period of five minutes was spent listening to any calling frogs (all species) in and adjacent to habitats;
- The advertisement call was broadcast to elicit a response from any adult males present;
- Surveyors used "Olight" LED hand-held spotlights (up to 1020 lumens/8.4 volts) to locate any calling males on floating vegetation in the waterbody and around the perimeter of waterbodies;
- Surveyors actively searched ground-level habitat including surface rocks, underneath hard litter, and at the base of vegetation for frogs; and,
- Surveyors used the resulting information to determine the significance of any recorded Growling Grass Frog populations.

Growling Grass Frog were also confirmed to be calling at known reference sites prior to undertaking surveys (i.e. Baenches Wetland adjacent to the study area and at the Western Treatment Plant).

The following habitat features were recorded as part of the assessment:

- Landscape connectivity;
- Visual water quality;
- Flow and depth;
- Cover of fringing, emergent, floating and submerged vegetation;
- Overall habitat quality;
- Waterbody type; and,
- *In situ* water quality using a calibrated Horiba™ multiprobe measuring; dissolved oxygen, pH, electrical conductivity, temperature and total dissolved solid.

During the habitat assessments, attributes of the land traversed on foot between sites was also noted for the presence (or otherwise) of suitable dispersal and/or foraging habitat. Results of the habitat and water quality assessment is provided below (Table 1 and Table 2).

Table 1. Percentage cover of aquatic vegetation type at survey sites

Aquatic Vegetation Type	Site Number		
	1	2	3
Emergent (%)	5	10	0
Floating (%)	15	0	0
Open water (%)	60	70	0
Fringing Aquatic Vegetation (%)	20	20	10

Table 2. Habitat features at survey sites

Habitat Features	Site Number		
	1	2	3
(Approx.) Water depth (metres)	1.0 – 2.0	1.0 - 2.0	Unknown
Hydrology	Permanent	Permanent	Unknown
Water flow	Still	Still	Unknown
Litter	Absent	Absent	Unknown
Introduced fauna species	Unknown	Unknown	Unknown

Table 3. Summary of Growling Grass Frog survey results

Survey Date	Survey Time	Weather conditions						GGF (No.)	Other Species
		Survey Temp C°	Wind direction	Wind speed (km/hr)	Relative Humidity (%)	Cloud Cover (%)	Rain		
18/11/2021	20:06 – 21:10	22.1	W	24	30	10	0 mm	0	Spotted Marsh Frog Eastern Common Froglet Brown Tree Frog

Survey Date	Survey Time	Weather conditions							Other Species
		Survey Temp C°	Wind direction	Wind speed (km/hr)	Relative Humidity (%)	Cloud Cover (%)	Rain	GGF (No.)	
24/11/2021	20:28 – 21:45	16	S	26	79	30	1.2 mm	0	Spotted Marsh Frog Eastern Common Froglet
29/11/2021	20:34 – 21:32	18	S	11	71	5	8.2 mm	2 – Site 1	Spotted Marsh Frog Eastern Common Froglet

Based on the findings of detailed survey and habitat assessments, Site 1 supports high-quality Growling Grass Frog potential breeding and foraging habitat, and currently supports a resident Growling Grass Frog population.

Site 1 contained a moderate percentage cover of fringing and floating vegetation, and active searching for Growling Grass Frog during the targeted surveys located several rocky ledges and banks that provide suitable microhabitats for the species (likely to be used for thermoregulation and overwintering). The deep and permanent pond provides suitable breeding and refuge sites for the species and the extensive areas of fringing vegetation provide high quality habitat for tadpoles, and floating vegetation provides suitable habitat for calling males. Areas adjacent to Site 1 are dominated by open paddocks supporting pasture/introduced grasses, which provide low quality foraging habitat for the species. This site did not contain any pugging by cattle and fencing surrounding the site adequately excluded cattle from the area.

The targeted surveys did not record any Growling Grass Frog at Site 2, however the assessed waterbody is still considered to provide low quality habitat for the species based on the following characteristics:

- The permanent hydrology of the site;
- The presence of a low cover of fringing and emergent vegetation; and,
- The presence of terrestrial refuge sites (i.e. rocks)

Site 2 was heavily pugged due to its use as a watering hole for a large herd of cattle. This ongoing disturbance will likely continue to degrade the quality of habitat in this site for Growling Grass Frog as well as other frog species.

The presence of records within the nearby Baenches Wetlands and Balog Channel makes it likely that the species would occasionally visit or at least use Site 2 within the study area as a foraging habitat between additional areas of higher quality habitat in Site 1 and the surrounding Sparrovale and Baenches Wetlands.

Spiny Peppercress

Targeted surveys for Spiny Peppercress were undertaken by two qualified ecologists on 20 May 2022. All areas of potential habitat within the study area were traversed on foot, with surveys conducted along transect lines roughly five metres apart, as per the recommended survey guidelines for significant flora detailed in the Biodiversity Precinct Planning Structure Kit (DSE 2010).

No individuals of Spiny Peppercress were detected within the study area during the targeted surveys, despite the surveys being undertaken in all areas of potential habitat. The habitat within the site was low in quality, consisting predominately of exotic grass species, with grazing cattle were also present within the study area at the time of the survey. The southern portion of the study area appears to have been subject to agricultural ground disturbance based on the onsite conditions and a review of the historical aerial photography.

Outside of the patches of native vegetation detailed above, the study area did not support the common native or exotic species typically associated with habitat where Spiny Peppercress are known to occur. The lack of suitable habitat and ongoing ground disturbance in the form of cattle grazing and pugging, combined with the efforts of the targeted survey indicate that Spiny Peppercress is absent from the study area. As such, a significant impact to the Spiny Peppercress as part of the proposed residential development within the study area is considered highly unlikely.

Other Matters of National Environmental Significance

Given the proximity to the nearby wetlands, there are many records of significant fauna - mostly waterbirds - within three kilometres of the study area. The apparent degraded condition of most of the study area and its proximity to large areas of high-quality habitat makes it unlikely that these species would rely on habitat within the study area for foraging or breeding purposes. They may use the use the site opportunistically or fly over on their way to more suitable habitat.

Seven nationally listed ecological communities are predicted to occur within 10 kilometres of the study area (DCCEEW 2023):

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community;
- Giant Kelp Marine Forests of South East Australia;
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain;
- Natural Damp Grassland of the Victorian Coastal Plains;
- Natural Temperate Grassland of the Victorian Volcanic Plain;
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains;
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Given the absence of native vegetation mapped within the study area and the apparent degraded and modified condition of the study area, the presence of any significant ecological communities is highly unlikely.

3.1.3 Adequacy of Surveys

Targeted surveys for Growling Grass Frog were undertaken during optimal seasons for the identification of the targeted fauna species. It is considered that the survey effort, timing and results presented meet the objectives of the surveys and provide sufficient information to support the approvals processes. Known reference sites were checked prior to the commencement of surveys to confirm that the species was calling on survey days.

Staff experienced in undertaking targeted flora surveys and were trained in identification of Spiny Peppercress prior to visiting the study area. Spiny Peppercress was previously observed in the southern adjacent property during a Biodiversity Assessment and annual compliance monitoring at Balog Channel, including in April / May within the past three years (Ecology and Heritage Partners 2020, 2022). Although the species may have

finished flowering by May in most years, it remains conspicuous in May, particularly in landscapes (including the study area) where the majority of other vegetation is grazed to a low level, and annual grasses have died off. In this context, the timing of surveys targeted surveys for Spiny Peppercress was adequate.

3.1.4 Other Resources

Relevant literature, online-resources and databases were reviewed to provide an assessment of flora and fauna values associated with the study area. The following information sources were reviewed:

- The DEECA NatureKit Map (DEECA 2023a) and Native Vegetation Information Management (NVIM) Tool (DEECA 2023b) for:
    - Modelled data for location risk, native vegetation patches, scattered trees and habitat for rare or threatened species; and,
    - The extent of historic and current Ecological Vegetation Classes (EVCs).
- EVC benchmarks (DEECA 2023c) for descriptions of EVCs within the relevant bioregion;
- The Victorian Biodiversity Atlas (VBA) for previously documented flora and fauna records within the project locality (DELWP 2022a);
- The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) for matters of National Environmental Significance (NES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DCCEEW 2023);
- Relevant listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act), including the latest Threatened (DELWP 2022b) and Protected (DELWP 2019) Lists;
- The online VicPlan Map (DTP 2023) to ascertain current zoning and environmental overlays in the study area;
- The Armstrong Creek East Native Vegetation Precinct Plan (NVPP) (SMEC 2010);
- Aerial photography of the study area;
- Previous ecological assessments relevant to the study area, including:
    - Targeted Surveys for Growling Grass Frog and Legislative Advice: 78-88 Groves Road, Armstrong Creek, Victoria. Ecology and Heritage Partners, 2021.
    - Ecological Assessment: 78-88 Groves Road, Armstrong Creek, Victoria. Ecology and Heritage Partners 2023.
    - Biodiversity Assessment: 1-87 and 76-77 Groves Road (Balog Land). Ecology and Heritage Partners 2020
    - Armstrong Creek, Victoria.Growling Grass Frog Habitat Assessment: 78-88 Groves Road, Armstrong Creek, Victoria. Ecology and Heritage Partners 2021.
    - Growling Grass Frog Management Plan, 78-88 Groves Road, Armstrong Creek, Victoria. Ecology and Heritage Partners, 2022.

- Offset Management Plan, 78-88 Groves Road, Armstrong Creek, Victoria. Ecology and Heritage Partners 2023.

3.1.5 Consultation and Advice

There has been on-going consultation with Greater Geelong City Council and the Corangamite Catchment Management Authority in the development of the project. Specific advice has been received and incorporated into the development of a Concept Plan for the protection of nearby Ramsar Wetland sites and enhancement of Growling Grass Frog habitat.

To date, there has been broad stakeholder support for the current proposal. Further stakeholder engagement and statutory public consultation will occur in accordance with state and Commonwealth requirements as the development progresses.

4 RELEVANT IMPACTS

The Preliminary Documentation must include an assessment of potential impacts (including direct, indirect, facilitated, and cumulative impacts) that may occur as a result of all stages and activities associated with the proposed action on MNES (e.g. pre-construction, construction, and post-construction).

Consideration of impacts must not be confined to the immediate area of the proposed action but must also consider the potential for impacts on adjacent areas that are likely to contain MNES populations or habitat.

For listed threatened species and communities this must include, but not be limited to:

a) An assessment of the direct and indirect impacts including but not limited to:

i. Loss and/or disturbance of habitat including the type and quality of the habitat impacted;

ii. Fragmentation of habitat and loss of connectivity;

iii. Spread of weeds and disease (chytrid fungus); and,

iv. Indirect impacts/disturbance to retained population.

b) An assessment of the likely duration of impacts to MNES as a result of the proposed action.

Some of this information regarding impacts has already been provided in the referral documentation. Please summarise the information for the background and context of the Preliminary Documentation reader. Specifically, for the impacts identified in the referral material, please provide any details on whether any impacts are likely to be unknown, unpredictable, or irreversible.

Full justification of all discussions and conclusions should be based on the best available information, including relevant conservation advices, recovery plans, threat abatement plans and guidance documents. Departmental documents regarding listed threatened species can be found at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

4.1 Response

4.1.1 Ramsar Wetland

The study area is adjacent to Baenches and Sparrovale wetlands. A small portion of Baenches wetland is Ramsar listed, and forms part of a large Ramsar site, situated over one kilometre to the east. Given the proximity to the nearby Ramsar wetlands, there are many records of significant fauna - mostly waterbirds - within five kilometres of the study area (Ecology and Heritage Partners 2023b). The degraded condition of habitats within the majority of the study area and its proximity to large areas of high-quality habitat makes it unlikely that that significant migratory waterbird species would rely on habitat within the study area for foraging or breeding purposes. They may use the use the site opportunistically or fly over on their way to more suitable habitat.

In relation to stormwater impacts, all stormwater is designed to flow into the Balog Channel (subject to completion of a Stormwater Strategy). The proposed creation of Growling Grass Frog habitat, including constructed wetlands, will be implemented in the eastern extent of the study area with two waterbodies removed from the centre of the study area. Constructed wetlands will primarily utilise rainwater and

groundwater as the ongoing water supply. This is not expected to directly or indirectly significantly impact the hydrology of adjacent wetlands or the Ramsar site as the constructed wetlands will not be hydrologically connected to adjacent wetlands, and due in part to the presence of the Balog Channel and construction mitigation measures (Ecology and Heritage Partners 2023b).

The proposed action will not result in any wetlands being destroyed or substantially modified within the Port Phillip Bay (Western Shoreline) and Bellarine Ramsar site. The Ramsar wetland is situated approximately one kilometre east of the study area. To mitigate against any potential indirect impacts to these values, a non-construction buffer of 100 metres will be applied from the edge of the wetlands. A number of additional mitigation measures designed to prevent construction impacts to adjacent wetlands and the Ramsar site are also proposed as part of the proposed action in the Ecological Assessment (Ecology and Heritage Partners 2023b), and will be addressed in comprehensive Construction Environmental Management Plan and Weed Management Plan for the site (Appendix 4; Appendix 6). These will cover mitigation measures such as, but not limited to erosion, sedimentation, plant disease, and pest plant spread, with specific mitigation measures proposed for all potential impacts.

The proposed action is not likely to result in any invasive species that are harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the Ramsar site. The proposed action aligns with the management actions of Sparrovale Wetlands, including the Sparrovale Wetland – Weed Management Plan and Sparrovale -Wetland Monitoring & Management Plan.

Additionally, the proposed upgrades to Groves Road is not anticipated to significantly impact adjacent wetlands or the Ramsar site. According to the Stormwater Management Strategy, raising Groves Road to 2.92 meters AHD (the 1% AEP flood level estimate plus 300 millimetres of freeboard) to provide access into the proposed residential development will not adversely impact the floodplain and/or its function (SWS 2022).

The proposed action will result in the removal of a small patch of coastal saltmarsh vegetation as part of works associated with the proposed action. No significant impacts associated with the removal of vegetation or any works associated with the proposed action are predicted to occur at the Ramsar site.

As such, the proposed action is unlikely to have any direct and/or indirect impact on the nearby Ramsar site.

4.1.2 Growling Grass Frog

The proposed action is likely to have a Significant Impact for one EPBC Act listed species - Growling Grass Frog.

According to the Significant Impact Guidelines for Growling Grass Frog, any viable population is considered an important population (DEWHA 2009). A viable population is 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. Interaction with nearby populations and colonisation of newly available water bodies occurs via the dispersal of individual frogs across suitable movement habitat. Removal or alteration of available terrestrial or aquatic habitat corridors (including alteration of connectivity during flood events) for an important population is likely to mean a significant impact to the species.

Effluent Pond 1 contains high-quality Growling Grass Frog dispersal habitat. While no tadpoles were recorded during targeted surveys, Effluent Pond 1 provides suitable breeding habitat. Extensive areas of submerged vegetation provide high quality habitat for tadpoles, and floating vegetation provides suitable habitat for calling males. Two Growling Grass Frog individuals were recorded at this site during targeted surveys (Ecology

and Heritage Partners 2023b). In addition, Effluent Pond 2 is likely to provide aquatic foraging habitat between other areas of suitable habitat within the immediate locality (i.e. Baenches Wetland, Sparrovale Wetlands).

Given the confirmed presence of a viable population that utilises habitat within the study area, it is considered that this population is an 'important population' as described in the significant impact guidelines for the species. As part of residential development works, the proposed action is likely to have direct and indirect impacts to Growling Grass Frog habitat. These impacts will result from construction activities (including removal of known habitat), and impacts resulting from the construction of a potential barrier to movement between habitat within the study area and potential habitat in Sparrovale wetlands and drainage lines to the north.

No direct or indirect impacts will occur to Spiny Peppercress or any other Matter of National Environmental Significance (MNES).

4.1.3 Direct Impacts

Effluent Pond 1 and 2, and surrounding foraging habitat is proposed to be directly impacted by construction works, including road construction, grading of land and construction of residences. Both effluent ponds are proposed to be removed as part of the proposed action, and impacts are therefore likely to be irreversible. This includes the proposed removal of all aquatic (including breeding) Growling Grass Frog habitat in the study area, while a portion of terrestrial habitat is also proposed to be removed. Given the removal of an aquatic habitat corridor (i.e. removal of Effluent Pond 1 and 2) there is the potential for a significant impact to the species as a result of the proposed action.

In summary, the following direct impacts to Growling Grass Frog habitat in the study area are expected.

A total of 16.502 hectares of habitat, comprising:

- 0.216 hectares of high-quality aquatic foraging and potential breeding habitat (Effluent Pond 1);
- 0.576 hectares of low-quality aquatic foraging habitat (Effluent Pond 2); and
- 15.710 hectares of low-quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock.

4.1.4 Indirect Impacts

Potential indirect impacts associated with the proposed residential development include changes in the hydrology of the constructed wetlands, the deterioration of water quality, the introduction and spread of chytrid fungus, human access, spreads of weeds, and noise and lighting impacts. The prevention and/ or management of these indirect impacts is outlined in the Growling Grass Frog Offset Management Plan (Appendix 1).

Hydrology and Water Quality

Based on known information of water quality tolerances and preferences by Growling Grass Frog it appears that the species requires waterbodies containing low levels of nitrates, nitrides and phosphates (Ashworth 1998; Organ 2002, 2003). Water quality may be particularly important for larval development and recruitment. Studies have shown conflicting findings on the relationship between basic water quality parameters and wetland occupancy (Heard *et al*. 2008). For example, Wassens (2005) found a preference for wetlands with a relatively low pH, whereas Hamer and Organ (2008) found the opposite to be the case. Similar

discrepancies have been found with conductivity (Heard *et al*. 2008), and this relationship is also confounded by the fact that conductivity may affect the prevalence of Chytrid fungus. Efforts to control basic water quality parameters for Growling Grass Frog may be unnecessary; however, conductivity should not increase beyond the approximate limit for the species of 10000 µS/cm (Heard *et al*. 2008).

All stormwater flow and discharge from the surrounding area will be directed away from the proposed offset site. There is also the potential for accidental spillage of chemicals from the construction area to runoff into the wetlands. Increase in sediment input and input of toxic substances into Victorian rivers and streams due to human activities are both threatening processes under Schedule 3 of the FFG Act. A number of additional mitigation measures designed to prevent construction impacts to adjacent wetlands and the Ramsar site are also proposed as part of the proposed action are addressed in the Ecological Assessment, Offset Management Plan and are to be further addressed in comprehensive Construction Environmental Management Plan (Appendix 4).

Chytrid fungus

There is evidence to suggest that the decline of many frog species in Australia and elsewhere could be related to the disease caused by the water-borne fungal pathogen *Batrachochutrium dendrobatidis*, commonly referred to as Chytrid fungus. Chytrid fungus is a major threat to amphibian populations in Australia, with at least one species driven to extinction and populations of other threatened species, particularly the Growling Grass Frog, severely compromised (DEWHA 2006). The disease that results from Chytrid fungus infection causes significant physical and physiological problems for frogs, such as skin flaking, reduced food intake, cardiac arrest and mortality (Peterson *et al*. 2013). Infection of amphibians with the fungus is listed as a 'key threatening process' under the EPBC Act.

There is an inherent risk of spreading the fungus within and between areas in the landscape by the movement of infected frogs and tadpoles, water, soil and vegetative material; the outcome of which can be extremely deleterious if it is introduced into Growling Grass Frog populations presently free of the disease. Chytrid prevalence has found to be decreased in wetlands with elevated salinity levels and higher temperatures (Heard *et al.* 2012). The risk for Chytrid fungus will be mitigated through the implementation of disease control measures contained in the Offset Management Plan and in accordance with Hygiene Protocols for the Control of Diseases in Australian Frogs (Murray *et.al.* 2011).

Human Access

Human occupancy within the study area has the potential to result in disturbance by persons entering the existing and proposed species habitat. This may lead to the degradation of habitat in or around the waterbody due to rubbish dumping, mechanical disturbance of vegetation from trampling, and weed invasion.

The placement of walking and/or bicycle paths and trails will be prohibited within the 'no impact' buffer zone within the existing Growling Grass Frog habitat and proposed constructed habitat to minimise human disturbance in these areas, with exclusion fencing proposed in these areas.

Weeds

Increased weed encroachment into areas of indigenous or planted terrestrial and aquatic vegetation in wetland complexes may occur due to runoff from residential development. Weeds may also be transported via construction equipment and machinery, and people/animals entering the site. 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 /or foraging site.

Consequently, a Weed Management Plan was be prepared to identify potential threats associated with pest plant species, that may impact environmental values within the study area. The Weed Management Plan provides appropriate management actions to address weed infestations and vertebrate pest species, to ensure environmental values within the study area are maintained and enhanced (Appendix 6).

Noise

The Growling Grass Frog population in Sparrovale and Baenches Wetlands may be affected by potential noise impacts, however, this is likely to be minor given the large buffer (minimum 100 metres) between the residential development area and neighbouring breeding populations. This buffer is considered to provide sufficient protection for frogs from noise pollution created by construction activities. Nonetheless, noise from building and other works relating to the development will comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), and Section 3(1)(a) of the Environment Protection Act 2017 (the Act) and the Environment Protection Regulations 2021 (the Regulations)(EPA 2021), where building or other works may not emit excessive or offensive noise.

Works can only be carried out on any land between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays and public holidays. Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species.

Light Pollution

Growling Grass Frog are a predominantly nocturnal species. Artificial light pollution may increase the risk of predation of Growling Grass Frog by foxes and cats and may also disrupt mating activities of the species. As such, sources of artificial light from the surrounding residential development will be directed away from the existing and proposed constructed habitat. There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution. Overall, there are likely to be no significant impacts related to noise and light pollution associated with the project during and post-construction.

Dogs, Cats and Exotic Predators

Unrestrained Dogs *Canis familiaris* and Cats *Felis catus* have the potential to roam into Growling Grass Frog wetlands within the site. Cats in particular are known to predate upon dispersing or sheltering frogs. Predation of native wildlife by Cats is a threatening process under Schedule 3 of the FFG Act. Future residential development is likely to introduce unrestrained cats that may also hunt and kill Growling Grass Frog. It is understood that a Cat curfew is currently enforced in the City of Greater Geelong with domestic cats required to be indoors from sunset to sunrise, which will minimise the risk to frogs. The entire constructed wetland habitat and surrounding 50 metre terrestrial buffer will be appropriately fenced to exclude public access and avoid unrestrained access into the offset area by dogs and their owners.

The introduced Eastern Gambusia *Gambusia holbrooki* has been identified as a possible factor in the decline of species in the "bell frog species complex", which includes Growling Grass Frog (Mahony 1999; White and

Pyke 1996; Hamer *et al*. 2002) because it eats the eggs and tadpoles of these species (Morgan and Buttermer 1996). This species may reduce the potential of a site to support breeding populations, although the extent of predation depends on aquatic vegetation and habitat complexity, and waterbody permanency (Hamer *et al*. 2002). Predation by Eastern Gambusia on tadpoles of Growling Grass Frog may be a significant threat to the species.

Red Fox sp. is likely to move through the study area. The species is known to hunt and eat adult members of the bell frog species complex. Feral Animal Control measures will be considered for development in the study area to reduce the population size of foxes.

4.1.5 Unknown, unpredictable or irreversible impacts

Additional Growling Grass Frog habitat is proposed to be designed and constructed, and as part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral ponds) will be retained and enhanced where possible. Enhanced existing and constructed new habitat will result in the provision of an unbroken series of waterbodies situated along a large dispersal corridor to allow unimpeded frog breeding and dispersal, and improve habitat connectivity and frog dispersal within the property to allow for a future link for the study area between known Growling Grass Frog populations at Sparrovale and Baenches wetlands. These waterbodies will be designed and constructed taking into consideration the Department of Environment, Land, Water and Planning *Growling Grass Frog Habitat Design Standards* 2017 (DELWP 2017).

Local frog populations are known to vary on spatial and temporal scales depending upon habitat conditions at a particular site. There is a potential risk that the new wetlands may not support habitat characteristics that are conducive to ongoing breeding, recruitment and dispersal by the species. Unpredictable impacts that may lead to the degradation of constructed Growling Grass Frog habitat as a result of the proposed action also includes:

- Unauthorised site access and significant dumping of hard rubbish;
- Introduction of fish through routine flood events, dispersal of fish eggs by birds or artificial introduction by residents;
- Habitat degradation or chemical and/or hard rubbish influx following major flood events; and,
- Invasion and excessive growth of introduced grasses and weeds (e.g. Artichoke Thistle *Cynara cardunculus* and African Boxthorn *Lycium ferocissimum*), which can smother and reduce the quality of frog habitat for breeding and foraging.

In order to reduce the likelihood of these unpredictable impacts, the ongoing maintenance of wetlands, particularly the maintenance of aquatic vegetation diversity and structure and terrestrial habitats will be essential to ensure these habitat types become and remain suitable for the species. Once established, wetlands are expected to be self-sustaining. Maintenance of created habitats will be undertaken every six months for the first two years post habitat and vegetation installation, and on an annual basis thereafter. If necessary, additional measures such as habitat augmentation or invasive flora/fauna control will be undertaken to prevent further impacts to this Matter of NES. Such measures would be required if monitoring reveals declines in Growling Grass Frog population numbers, declines in water quality, increased pest plants and animals, increased erosion and sedimentation and/or any disturbance caused by persons entering the constructed wetland habitat (see Table 6 for further management options associated with potential impacts). In the event of a major flood event, extensive restoration measures will be undertaken to re-establish high

quality GGF habitat within the GGF offset area if any damage or destruction occurs over the 10-year duration of the Offset Management Plan. Further information regarding the prevention and/or management of these impacts is outlined in the Growling Grass Frog Offset Management Plan (Appendix 1).

4.1.6 Risk Assessment of Relevant Impacts

A risk-based assessment has been undertaken to identify the potential impacts that the proposed action may have on the existing Growling Grass Frog population and associated habitats. The results of the risk assessment are provided below (Table 4; Table 5; Table 6).

Table 4. Qualitative criteria for likelihood and consequence

Descriptor	Description
Likelihood	
1 - Almost Certain	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is expected to occur more than once over the duration of the residential development.
2 - Likely	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is likely to occur at least once over the duration of the residential development.
3 - Possible	A hazard, event and pathway exist, and harm has occurred in similar scenarios and may occur over the duration of the residential development.
4 - Unlikely	A hazard, event and pathway exist, and harm has occurred in similar scenarios but is unlikely to occur over the duration of the residential development.
5 - Rare	A hazard, event and pathway are theoretically possible on this project and has occurred to a limited extent in similar scenarios but is not anticipated over the duration of the residential development.
Consequence	
Negligible/Very Low	Where impacts from residential development will not result in any impacts to Growling Grass Frog or the environment. Negligible impacts are localised and temporary in nature, with no noticeable consequences
Minor	Where a risk from residential development will not adversely affect Growling Grass Frog or the environment, provided management actions are implemented. Minor impacts are noticeable but localised to the project footprint and short-term in nature. They can be effectively mitigated through standard mitigation measures. Values affected by Minor impacts are generally recognised as being important at a local or regional level.
Moderate	Moderate impacts directly or indirectly affect Growling Grass Frog or the environment within the broader project locality and are short or moderate term in nature. Impacts can be ameliorated with specific mitigation measures.
High	Occurs when proposed activities are likely to exacerbate threatening processes. High impacts are substantial and significant changes that affect Growling Grass Frog or the environment within the project locality and are moderate to long-term in nature. Impacts are potentially irreversible and avoidance through appropriate design responses or the implementation of specific mitigation measures is required.
Major	Arises when an impact will potentially cause irreversible or widespread harm to Growling Grass Frog or the environment that is irreplaceable because of its uniqueness or rarity. Major impacts are significant or irreversible changes that affect the Growling Grass Frog or the environment.

Table 5. Risk Evaluation Matrix

		Increasing Likelihood				
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Negligible/Very Low	Very Low	Very Low	Very Low	Low	Moderate
	Minor	Very Low	Low	Low	Moderate	Moderate
	Moderate	Low	Low	Moderate	High	High
	High	Low	Moderate	High	Major	Major
	Major	Moderate	High	Major	Major	Major

Table 6. Impact Risk Assessment Results

Risk	Potential Impact(s)	Risk Assessment Matrix Score	Management Options to Minimise Risk
Construction of a barrier to movement between the study area, Sparrovale Wetlands and Baenches Wetlands	• Decline or loss of Growling Grass Frog population within the study area • Loss of genetic diversity of the population	**Moderate** Likelihood: Unlikely Consequence: High	• Provision of a dedicated movement corridor • Habitat augmentation / provision of breeding habitat • Identification and removal of barriers to dispersal where feasible
Introduction or spread of Chytrid fungus	• Chytrid fungus infection • Death of Growling Grass Frog individuals • Decline or loss of Growling Grass frog population within the study area • Decline or loss of Growling Grass frog populations outside the study/offset areas (i.e. within surrounding wetlands)	**High** Likelihood: Possible Consequence: High	• Implement hygiene protocols (as per Murray *et al.* 2011) • Monitor health and abundance of Growling Grass Frog population within the study area (annually for the first 5-years post-construction, and again at year-10) • Regular water quality monitoring (every four months for 2-years post construction) • Constructed wetlands to be 'anti-chytrid' (high >50% rock cover, moderate salinity up to 5000 µS/cm, water temperatures between 18 to 27°C, and warm shallows between 24 to 27°C) in order to minimise the risk of Chytrid fungus within the wetlands and therefore minimise the risk of this disease spreading to surrounding wetlands (Sparrovale/Baenches) and associated frog populations. This risk will also be minimised through the implementation of extensive hygiene protocols (as per Murray *et al.* 2011).

Decline in water quality within constructed wetlands	• Decline of Growling Grass frog population within the study area • Reduced breeding activity and recruitment within constructed wetlands • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**Moderate** Likelihood: Unlikely Consequence: High	• Installation and routine maintenance of sediment and erosion controls in key areas • Installation of silt fences and other measures to prevent sediment runoff from entering the offset area. These measures are expanded on in the CEMP (Appendix 4) • Installation of rock banks, boulders and logs to stabilise soils in affected areas • Habitat augmentation • Establishment of water quality monitoring sites within constructed waterbodies immediately following wetland construction completion. Monitoring will be conducted every 4 months for two years post-construction to ensure sediment controls and other water quality issues are managed. Water quality monitoring will follow the program outlined in the GGFCMP (Appendix 5), and remedial action will be triggered if water quality parameters are detected to be outside the suitable range for Growling Grass frog (as specified in the Hygiene Protocols (Murray et al. 2011) and Habitat Design Standards (DELWP 2017).
Wetlands dry over summer	• Decline of Growling Grass frog population on site • Reduced breeding activity and recruitment within constructed wetlands • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**Low** Likelihood: Unlikely Consequence: Moderate	• Wetlands will be regularly filled in order to retain water over the entire breeding season. Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction. If required (i.e. water levels are recorded at or below 0.5 metres during Spring and Summer), supplementary groundwater will be delivered into the wetlands to ensure adequate water levels are maintained. This supplementary water is unlikely to be required due to the proposed adequate waterbody depth (between 1.5 and 4 metres) and design (clay-lined for water retention), and due to the utilisation of reliable depth gauges and water delivery systems. Additionally, a water balance (inflows, outflows, evaporation etc.) will be undertaken for each wetland to determine the required depth, and will be based on historical rainfall simulation modelling over a 10-year period (i.e. 2024-2033).

			• Overall monitoring of created habitats will also be undertaken every six months for the first two years during the residential development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas.
Growling Grass Frog killed during development works on site	• Death of individual Growling Grass Frog leading to Decline of Growling Grass frog population in the study area	**Moderate** Likelihood: Unlikely Consequence: High	• Salvage and relocation procedures will be initiated to reduce the occurrence of death, injury or displacement of individuals. Site induction will be implemented for contractors • Salvage and relocation measures will be undertaken both immediately prior to and during the residential development works, as required • Salvage measures will be undertaken by a qualified zoologist experienced with these operations • Salvage will involve a suitably qualified Zoologist actively searching for frogs immediately prior to, and during habitat improvement works
Frogs fail to successfully migrate into constructed wetlands.	• Decline of Growling Grass frog population in the study area • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**High** Likelihood: Possible Consequence: High	• Waterbodies to be designed and constructed with consideration of the Growling Grass Frog Habitat Design Standards (DELWP 2017) • Population monitoring to be undertaken annually for the first 5 years following the completion of construction of the Growling Grass Frog habitat areas • Monitoring of created habitats to be undertaken every six months for the first two years during the residential development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas • Preventative measures implemented to avoid migration failure, where sufficient time should be permitted during the breeding season migration period (including a buffer of two weeks after this period) to allow GGF migration into new habitat before permanent frog exclusion fencing is installed around the effluent pond (Table 7) • If frogs do not successfully migrate from effluent pond 1 and existing habitat proposed for removal during the breeding season migration period, they

			will be relocated by a qualified zoologist prior to habitat removal
Chemical/petroleum spill and hard rubbish dumping	• Decline of Growling Grass frog population on site • Loss of genetic diversity of the population due to reduced recruitment from outside the study area • Increased Mortality • Degradation of Growling Grass Frog Habitat quality	**Low** Likelihood: Rare Consequence: High	• Equipment to be regularly serviced and inspected daily • Personnel to undergo adequate training in equipment usage • Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc. • Chemical treatments (for rectifying acidity or alkalinity in the event of a spill) • Once-off intensive hard litter removal (if required between normal maintenance schedules) • Spill kits maintained on site in areas where chemicals are stored and in construction areas
Disturbance by persons entering the constructed wetland habitat	• Degradation of habitat • Rubbish dumping • Mechanical disturbance of vegetation from trampling • Weed invasion • Introduction of Chytrid fungus • Accidental spillage of chemicals	**Moderate** Likelihood: Possible Consequence: Moderate	• Exclusion fencing • Regular Weed Management • Informative signage • Community awareness and education.
Increased pest plants and animals	• Weed growth can smother frog habitat and harbour pest animals • Degradation of habitat • Predation of Growling Grass Frog by pest animals such as foxes • Invasion of introduced fish, particularly Eastern Gambusia and Carp leading to Growling Grass Frog eggs and tadpoles being consumed by invasive fish • Decline or loss of Growling Grass frog population on site	**Low** Likelihood: Unlikely Consequence: Moderate	• Implementation of Weed and Pest Animal Management Plan • Weed control works monitored regularly • Regular monitoring of habitat and evidence of pest animals • The control of pest animals such as foxes • Ongoing monitoring to identify waterbodies invaded by introduced fish • Assessment of feral predators within the Growling Grass Frog habitat area prior to the commencement of construction • If evidence of foxes is found, appropriate control measure to be implemented immediately • Destroying any dens discovered on site • Drainage outlet installed for removing some or all water from the system within the habitat corridor. The water would be

	• Loss of genetic diversity of the population due to reduced recruitment from outside the study area		pumped to surface and then allowed to flow to the Sparrovale wetland • Ongoing monitoring to identify wetlands invaded by introduced fish to inform if draining is required • Planting of additional native vegetation, or conversely, removal of wetland vegetation if it is smothering the waterbody
Noise and Light Pollution	• Disturbance of Growling Grass Frog breeding activity • Decline of Growling Grass frog population on site	**Low** Likelihood: Possible Consequence: Minor	• Compliance with Geelong City Council's Building Works – Local Law requirements (2014) • No additional lighting directed towards the created waterbodies
Erosion and sedimentation	• Decline in water quality • Reduced recruitment/breeding within constructed waterbodies	**Low** Likelihood: Possible Consequence: Minor	• Installation and routine maintenance of sediment and erosion controls in key areas • Installation of rock banks, boulders and logs to stabilise soils in affected areas • Increase maintenance and monitoring operations in affected areas until problem areas are improved.

4.1.7 Duration of Impacts to MNES

The proposed Growling Grass Frog habitat construction will be completed by September prior to the Growling Grass Frog Breeding season, and prior to commencement of the residential development, to allow frogs to naturally colonise the wetlands during the species active season. In the immediate vicinity of the existing and proposed constructed wetland habitat, the new habitat corridor will be constructed first to minimise development impacts to Growling Grass Frog. Residential development will then follow, subject to audit by a qualified ecologist to ensure constructed Growling Grass Frog habitat has been implemented to standards outlined in the Offset Management Plan (Ecology and Heritage Partners 2023a).

Construction of the Growling Grass Frog wetland habitat will occur primarily during the pre-construction phase. Following completion of the constructed wetland habitat, no construction will occur in the likely migration path between the effluent pond (existing habitat) and constructed wetlands (created habitat) for the duration of one breeding season (Table 7). The breeding season 'frog migration' period should allow resident Growling Grass Frog to colonise newly created wetlands from existing areas of habitat. In areas that fall outside this migration path, the construction phase may occur concurrently.

Table 7. Timeline of Growling Grass Frog migration period

Stage	April '24	May '24	June '24	July '24	Aug '24	Sept '24	Oct '24	Nov '24	Dec '24	Jan '25	Feb '25	Mar '25	April '25
Construction of GGF wetlands													
GGF migration period													
Installation of frog exclusion fencing													
Removal of dams													
Commence residential development													

Once completed and colonised, permanent frog exclusion fencing will be installed along the perimeter of the constructed wetland to prevent frogs accessing residential development areas. This will also prevent access into the site by unauthorised personnel and pest fauna species (i.e. potential predators).

No direct or indirect impacts will occur to Spiny Peppercress or any other Matter of National Environmental Significance (MNES).

A discussion of direct and indirect impacts is provided in Section 4.1.3. and Section 4.1.4., with management actions proposed to mitigate the risks where possible. An overview of residual impacts and their duration is provided in Table 8.

Table 8. Residual impacts on Growling Grass Frog and anticipated duration

Residual Impact	Duration
Potential injury or death of individuals associated with construction works	Both immediately prior to removal of effluent ponds, and during the construction of new wetlands
Potential contamination from chemical spill and hard rubbish dumping.	Ongoing
Potential introduction of chytrid fungus	During habitat construction and management of offset site
	During salvage and relocation
	Ongoing post-construction
Light and noise pollution	During construction activities
	Design and installation phase
Predation by pest fauna species	Ongoing
Potential introduction of predatory fish into wetland system	Ongoing
Potential breaches in access and site disturbance by humans	Ongoing

Residual Impact	Duration
Potential deterioration of water quality	Ongoing

5 PROPOSED AVOIDANCE AND MITIGATION MEASURES

In relation to the impacts of the proposed action on MNES, the Preliminary Documentation must include:

a) Details of habitat to be retained including the location and quantification of the total area, and protection and management measures; and,

b) Details of any measures to minimise weed and disease introduction/spread. In particular, the specific weed and disease management actions that are proposed to be implemented in the proposed project area.

This section should also include:

a) A consolidated list with a description of each measures proposed. This should include for each measure:

   i. a statement of the objectives and outcomes, the ongoing management and monitoring, and locations and timing

   ii. the party responsible

   iii. the policy basis

      This includes the *Significant impact guidelines for the vulnerable growling grass frog* (*Litoria raniformis*) (https://www.dcceew.gov.au/sites/default/files/documents/litoria-raniformis.pdf).

   iv. assessment of the expected or predicted effectiveness of the avoidance and mitigation measures.

b) if no measures are proposed, a detailed description of the assessment of why the expected or predicted effectiveness, and affordability or achievability of avoidance and mitigation options makes the measures unfeasible.

Some of this information has already been provided in the referral documentation. Please summarise the information for the background and context of the preliminary documentation reader.

5.1 Response

5.1.1 Retained Habitat

Approximately 1.9 hectares of Growling Grass Frog habitat is proposed to be retained as part of the proposed action and includes low-quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock. Some exposed rock and debris in retained habitat may provide basking and overwintering opportunities for the species. The proposed action includes the creation of dedicated habitat for Growling Grass Frog, including a large wetland (1 hectare) and one smaller wetland (0.5 hectares), as well as terrestrial habitat (6.7 hectares) in a movement corridor that will be constructed to ensure ongoing connectivity to adjacent frog breeding habitat and dispersal corridors. As part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral wetlands) will be retained and enhanced.

The improvement of retained terrestrial habitat (in conjunction with the creation of dedicated Growling Grass Frog waterbodies) will provide additional breeding and foraging habitat for the species, and improve habitat connectivity and frog dispersal within the property to allow for a future link for the study area between known Growling Grass Frog populations at Sparrovale and Baenches wetlands.

5.1.2 *Minimise Weed and Disease Introduction*

Pest Plant Control

The control of pest plants within dedicated Growling Grass Frog habitat is a major requirement for management, as habitat within the site is under continual pressure from the invasion of introduced grasses and weeds (e.g. Artichoke Thistle *Cynara cardunculus* and African Boxthorn *Lycium ferocissimum*). Excessive weed growth can smother and reduce the quality of frog habitat for breeding and foraging. In order to control and/or eradicate these weed species, several on-going techniques can be used including physical removal, brush cutting and herbicide application. Herbicide must only be applied to weeds by using the spot-spraying technique, in order to prevent off-target issues.

It is important to ensure that any weed control works using herbicides are both targeted (e.g. spot spraying) and undertaken at the right time of the year, as this can also reduce the requirement for future weed control activities.

The following controls apply to all on-site weed control works:

- Weed management must be undertaken throughout all open space areas, with attention given to vegetated areas which are not subject to routine maintenance;
- Any weed control works must be completed in a manner that minimises soil disturbance;
- Herbicide use must be minimised to avoid adverse effects on frogs and invertebrates;
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- Where herbicides are used, selective application is preferable to broad area application;
- Non-residual herbicides must not be used; and,
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen.

Weed control works must be monitored regularly to assess their effectiveness and follow-up / evaluation works must be completed where required. With any weed control works it is important to establish a cover of native species as soon as possible to limited the risk of weed infestation in areas of exposure bare soil. While native species will naturally re-colonise such areas, so will exotic species if weed seed is present in soil.

Disease Introduction

There is evidence to suggest that the decline of many frog species in Australia and elsewhere could be related to the disease caused by the water-borne fungal pathogen, commonly referred to as Chytrid Fungus. Chytrid Fungus is a major threat to amphibian populations in Australia, with at least one species driven to extinction and populations of other threatened species, particularly *L. raniformis*, severely compromised (DEWHA 2006). The disease that results from Chytrid Fungus infection causes significant physical and physiological problems for frogs, such as skin flaking, reduced food intake, cardiac arrest and mortality (Peterson *et al.* 2013). Infection of amphibians with the fungus is listed as a 'key threatening process' under the EPBC Act.

There is an inherent risk of spreading the fungus within and between areas in the landscape by the movement of infected frogs and tadpoles, water, soil and vegetative material, the outcome of which can be extremely deleterious if it is introduced into Growling Grass Frog populations presently free of the disease. Human activities and movements can exacerbate the risk of disease spread, and as such hygiene protocols for vehicles, equipment, footwear, handling, holding and transporting of frogs and tadpoles are paramount.

Such hygiene protocols will be implemented throughout the construction works. The Hygiene Protocol (Murray *et al.* 2011) will be used to guide best practice Chytrid management. This document includes, but is not exclusive to the following.

- All footwear and equipment (e.g. nets, buckets, callipers, headlamps, waders), will be thoroughly cleaned and disinfected before entering and exiting the constructed wetland habitat;
- Any equipment used to handle frogs and tadpoles will be cleaned and disinfected between each sample;
- A new pair of disposable latex gloves will be used between each frog and tadpole. Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up;
- Frogs will be placed into new and clean plastic sample bags, with a 'one bag– one frog' policy. Bags will not, under any circumstances, be reused;
- The tyres of all vehicles will be cleaned and disinfected before entering and exiting the constructed wetland habitat (if required);
- The tyres/tread and other parts of machinery and plant (e.g. the excavator bucket; pumps) involved in the habitat construction and associated activities, will be cleaned and disinfected before entering the construction area of the constructed wetlands habitat; and
- Disinfection methods will follow the procedures outlined in the Hygiene Protocol (Murray *et al.* 2011).

5.1.3 Avoidance and Mitigation Measures

A range of mitigation measures will be implemented by the construction contractor to manage direct and potential indirect impacts to Growling Grass Frog and adjacent matters of NES. Measures to mitigate impacts upon terrestrial and aquatic values present within the study area include:

- Soil disturbance and sedimentation within wetlands will be kept to a minimum, to avoid, or minimise impacts to fauna habitats;
- All habitat improvement works within the offset area will be undertaken by a qualified and experienced wetland revegetation specialist/ contractor in accordance with the provisions of the Growling Grass Frog Conservation Management Plan and the Landscape Management Plan;
- All contractors will be made aware of ecologically sensitive areas in order to minimise the likelihood of inadvertent disturbance to areas marked for retention, particularly in areas of high-quality Growling Grass Frog breeding and foraging habitat within the quarry void. Areas of sensitivity and no-go zones will be included as a mapping overlay on any construction plans;
- Construction stockpiles, machinery, roads, and other infrastructure will be placed outside the offset area, away from areas of sensitivity or wetlands. As such, there will be no direct or indirect disturbance to surrounding terrestrial dispersal habitat for Growling Grass Frog;
- Best practice sedimentation and pollution control measures will be undertaken at all times, in accordance with Environment Protection Authority guidelines (EPA 1991; EPA 2020; Victorian Stormwater Committee 1999) to prevent offsite impacts into surrounding areas (e.g. Sparrovale Wetlands);

- Given that indigenous flora provides valuable habitat for indigenous fauna, landscape plantings as part of the proposed residential development will include indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs. The *Growling Grass Frog Habitat Design Standards* (DELWP 2017) will be reviewed to provide a list of suitable species to be used when establishing vegetation within Growling Grass Frog habitat (Table A1, Appendix 7);
- Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out wetlands, thus potentially rendering them unsuitable for the species; and,
- The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Groundwater and recycled water will be the primary ongoing water source for the constructed wetlands. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Adult Eastern Gambusia grow to approximately 6-10 centimetres in length and their live born young are a minimum 6 millimetres long and 1 millimetre wide. While Eastern Gambusia is likely present within the Balog Channel, the sediment filter is suitable for excluding all individuals from the constructed wetlands.

It is not possible to avoid all impacts to Growling Grass Frog foraging and dispersal habitat in the study area. The entire eastern, northern and southern portion of the site is covered by a Flood Overlay, while a smaller portion is covered by an Environmental Significance Overlay. Residential development is not permitted or heavily restricted in these areas and is not proposed under the development plan (Ecology and Heritage Partners 2023b). The remaining 'developable' portion of the study area predominantly contains Growling Grass Frog dispersal habitat. A reduction in the construction footprint to completely avoid Growling Grass Frog habitat was considered, however it is not commercially viable to reduce the construction footprint further than its current footprint (Ecology and Heritage Partners 2023b).

The proposed residential development footprint has been situated to ensure ongoing connectivity between Baenches and Sparrovale wetlands.

Sediment/ Frog Exclusion Fencing

Temporary frog exclusion fencing will be installed around the effluent treatment ponds and constructed wetlands prior to the commencement of any residential development construction works, to provide a physical barrier between the development area habitat to be removed and/or created habitat. An example of suitable frog exclusion fencing is shown in Plate 8. The following controls apply to the installation of sediment/ frog exclusion fencing:

- Fencing must be constructed of a cloth or plastic material and only appropriate fencing material that withstands variable weather conditions over long periods of time must be used;
- Fencing must be installed at least one metre high, with an additional 0.2 metres buried below-ground. An additional 0.2 metres at the top of the fence must be bent/ angled over at less than 90 degrees to the vertical on the frog habitat side (not the excluded habitat side) to prevent frogs from climbing or hopping over the fence;
- Refugia for shelter must be placed at least one metre away from the fence and any vegetation within one metre of the fence must not exceed 0.5 metres to prevent frogs from escaping (i.e. low-growing grasses will be planted);

- Fences must be taut without creases or folds;
- Fence posts must be installed on the outer fencing side (i.e. excluded habitat side) and fastened with nails or similar, and lie flush with fencing material to prevent frogs from climbing up posts and escaping over the fence; and,
- Regular inspection of the fencing is required to ensure its effectiveness, including:
    - Inspections of fencing between May and August, prior to Growling Grass Frog breeding season and the repair or replacement of any damaged or ineffective material;
    - Maintenance of vegetation within one metre of fencing at less than 0.5 metres high; and,
    - Removal of any litter or other debris caught in fencing which could assist frogs to climb over.

Plate 8. Example of suitable frog exclusion fencing (fence posts must be on the outside and not within the Offset Area)

Safety Fencing

Prior to the completion of the residential development, the entire section of the offset area will be appropriately fenced to exclude public access to the habitat and movement of frogs into the residential construction area. Fencing will not be installed between the offset area and adjacent wetlands (Baenches and Sparrovale) to permit movement of frogs.

Integration of safety fencing and frog fencing will also be considered, as a single fence which achieves the purposes of safety, unauthorised access prevention, and a barrier for preventing frogs accessing paved areas is achievable and preferable in terms of functionality, aesthetics and maintenance.

If a combined frog and safety fence is utilised, this will not be implemented along the north-eastern boundary during the designated breeding season 'frog migration' period, following completion of the constructed wetland habitat (Table 7). Temporary frog exclusion fencing will not be used during this period, in order to allow GGF movement from existing habitat (effluent ponds), along surrounding foraging habitat to the north-east of the effluent ponds, and into the constructed wetland.

As the designated proponent for the proposed action, AC Manager Pty Ltd will have ultimate responsibility for meeting performance criteria in accordance with the environmental objectives and mitigation measures, including satisfying requirements for monitoring, reporting and should any incidents occur, ensuring they are addressed, and appropriate corrective actions are undertaken in a timely manner.

Habitat design requirements and considerations are further discussed in the Growling Grass Frog Offset Management Plan (Appendix 1).

Ongoing Management

A Growling Grass Frog Offset Management Plan has been prepared for the proposed residential development within the study area (Appendix 1). This Plan provides detailed information relating to the design of the dispersal corridor (including the proposed wetlands) to ensure the species can disperse between Sparrovale and Baenches Wetlands via the eastern corner of the study area. The Growling Grass Frog Offset Management Plan includes specific information on the proposed residential development (extent and timing), the likely and potential impacts to the species, and proposed management actions to ensure a resident population persists in the constructed habitat in the long-term.

The ongoing survival of the extant Growling Grass Frog population can be established by maintaining or enhancing wetland hydroperiods and aquatic vegetation cover. Long term persistence of the species requires a network of populations, within which migration and re-colonisation can occur. Hydroperiod and aquatic vegetation cover are considered the most important features to maintain Growling Grass Frog occupancy (Heard *et al.* 2010). A wetland's hydroperiod is important in maintaining a stable probability of Growling Grass Frog occupancy. Efforts will be made to maintain or enhance hydroperiods in the constructed wetlands through increasing inflows via the use of recycled from within the residential development.

Moderate to high aquatic vegetation cover, inclusive of emergent, submergent and floating aquatic vegetation will be provided to achieve Growling Grass Frog occupancy and persistence at the site. Most favourable is a total of 40% aquatic vegetation, comprising 30% emergent, 60% submergent and 30% floating vegetation.

Intensive management of the wetlands and dispersal corridor will be undertaken over the life of the Growling Grass Frog Offset Management Plan, followed by potential arrangements with relevant organisations (for example, Greater Geelong City Council, DEECA) to manage the sites thereafter. This will be determined during further discussions with the relevant authorities.

Monitoring

Ongoing population and habitat monitoring will be conducted in accordance with the detailed Growling Grass Frog Offset Management Plan to assess any impacts associated with proposed residential development and to ensure habitat conditions within the study area remain suitable for the species. Monitoring at the constructed Growling Grass Frog habitat will be conducted during the species' active period between September and March following the initial disturbance event, and then once annually (in the active season) for the life of the Offset Management Plan.

The results of the annual monitoring will be presented in an annual report and provided to the DCCEEW. If monitoring suggests an unacceptable population size of Growling Grass Frog at the site (i.e. not as a result of prevailing conditions), adaptive management actions will be implemented to improve Growling Grass Frog habitat. The constructed wetland colonisation rate depends on the number, proximity (taking into account barriers such as roads) and size of neighbouring populations. During each monitoring event, the proponent will also undertake surveys in the neighbouring wetlands to determine prevailing conditions of Sparrovale and Baenschs Wetlands, primarily relating to water quality and Growling Grass Frog wetland occupancy.

Local frog populations are known to vary on spatial and temporal scales depending upon habitat conditions at a particular site. For the study area, regular population monitoring will determine if Growling Grass Frog is

declining or has abandoned certain frog ponds. Due to natural variation in habitats available within the study area, it is expected that certain wetlands are likely to be occupied during some seasons, but unoccupied in others. This fluctuation in occurrence can be due to obvious causes, such as unsuitable habitat conditions (i.e. high water turbidity), and other causes which may be difficult to identify (i.e. water chemistry).

Contingency management actions will be activated if unacceptable monitoring cycle/s (i.e. trigger event) occurs (Table 9). If, at the end of the annual surveys, the results indicate a trigger event in the Growling Grass Frog population or significant degradation of Growling Grass Frog habitat, the OMP will also be re-evaluated and adapted accordingly.

Some contingency management actions that may be required to be undertaken by the proponent or council include:

- Installation of additional refuge sites if considered necessary;
- Clean out wetlands to remove silt or other debris, or to rectify chemical imbalances;
- Minimise and control erosion or active sources of sedimentation;
- The implementation of water quality improvement measures which could include supplementary vegetation planting or installation of additional rock beach or screen areas;
- Control or eradication of pest animal species throughout the constructed wetland area;
- Maintain permanent signage within and throughout the constructed wetland area adjacent to pathways, to identify dogs to be on leash throughout the area, and no fishing or introduction of fish into wetlands.

Contingency management actions will be implemented if a population trigger event occurs (Table 9). The trigger events were developed with reference to the EPBC Act triggers endorsed for Growling Grass Frog populations at other offset sites and sites containing a significant population (Ecology and Heritage Partners 2022). There are currently no guidelines for determining unacceptable population change and total. Local extinction risk is more commonly measured by the probability of occupied wetlands declining below a threshold, however given only two wetlands are proposed for construction, population levels are considered a more appropriate indicator (DELWP 2017).

Table 9. Growling Grass Frog population trigger events for contingency management

Type	Trigger
Action	Failure of Growling Grass Frog to colonise the wetland site. In the event that <3 individuals are recorded across the entire offset site for each of the first two years.
Action	Failure of Growling Grass Frog to achieve a viable population at the wetland site. In the event that <8 individuals are recorded across the entire offset site on the third and fourth breeding seasons following commencement of the OMP.
Action	An annual decline of ≥10% in any three successive years in the number of individuals recorded during annual surveys across the entire offset site.
Action	A cumulative decline of >25% in annual average number of individuals recorded across the entire offset site during annual surveys over any successive two or three-year period. This action is not triggered if the >25% decline occurs over one-year as seasonal variation is common and does not necessarily indicate a critical issue.

6 RESIDUAL IMPACTS AND PROPOSED OFFSETS

Describe the residual impacts on MNES that are likely to occur as a result of the proposed action in its entirety, after proposed avoidance and/or mitigation measures are considered. If applicable, this should include the reasons why avoidance or mitigation of impacts cannot be reasonably achieved.

If residual impacts are likely to be significant an offset package to compensate for residual impacts to the MNES should be included. This should consist of an offset proposal (Offset Strategy) and key commitments and management actions for delivering and implementing a proposed offset (i.e. an Offset Management Plan).

Offsets must directly contribute to the ongoing viability of the species and deliver an overall conservation outcome that improves or maintains the viability of the protected matter, as compared to what is likely to have occurred if neither the action nor the offset had taken place. The offset proposal should demonstrate how the conservation outcome will be delivered for the protected matter.

The proposed offset must meet the requirements of the Department's *EPBC Act Environmental Offsets Policy* (October 2012) available at: https://www.dcceew.gov.au/environment/epbc/publications/epbc-act-environmental-offsets-policy.

The Department's *Offset Assessment Guide* should be used as a guide to estimate the area of offset required to adequately compensate for the residual impacts of the project, it is available at: https://www.dcceew.gov.au/environment/epbc/publications/epbc-act-environmental-offsets-policy.

An officer within the department will assess the proposed offset based on the information provided in the offset's proposal using the offsets assessment guide. Please note that proposals with unacceptable impacts will not necessarily be approved because offsets are provided.

The package must include, but not be limited to, the following:

a) Offset Strategy

i. a description of the offset site(s) including location, size, condition, and environmental values

ii. a description of the habitat to be created or improved (aligned with type of habitat impacted)

iii. details of on-going threats to the protected matter at the offset site and how they will be managed

iv. a comparison of the environmental values as compared to the impact site

v. justification of how the offset package meets the EPBC Act Environmental Offsets Policy.

The *Growling Grass Frog Habitat Design Standards* created by the Victorian Department of Environment, Land, Water and Planning (now the Department of Transport and Planning / Department of Energy, Environment and Climate Change) (https://www.msa.vic.gov.au/__data/assets/pdf_file/0019/73414/Growling-Grass-Frog-Habitat-Design-Standards_March2017.pdf) must be considered. Where the creation of artificial habitat does not completely comply with these guidelines, clear justification must be provided as to why the species will still utilise the created habitat

b) Offset Management Plan.

i. the specific environmental outcomes to be achieved, including specific environmental characteristics for habitat creation, improvement, and connectivity

ii. details on how the offset will be secured, managed, and monitored to meet these environmental outcomes, including:

- management actions, performance targets, monitoring methodology and review criteria
- responsibility and timing for implementation of actions.

Please note, in all cases, targets and criteria should be specific and measurable.

Please also consider the Department's Environmental Management Plan Guidelines (https://www.dcceew.gov.au/sites/default/files/documents/environmental-management-plan-guidelines.pdf).

The referral documentation provided a plan for the creation of new habitat for the Growling Grass Frog, we ask this is updated with regards to this request and relevant policies.

6.1 Offset Strategy

6.1.1 a description of the offset site(s) including location, size, condition, and environmental values

The first-party offset site (offset site) is in the eastern portion of the property at 78-88 Groves Road, Armstrong Creek and will comprise approximately 8.2 hectares. All offset sites within the property are proposed to be managed for offset and conservation purposes.

Patches of Coastal Saltmarsh were observed along the northern boundary of the proposed offset site. The vegetation was in low-moderate condition and predominantly comprised Beaded Glasswort *Salicornia quinqueflora ssp. quinqueflora* in the ground layer, as well as specimens of Australian Salt-grass *Distichlis distichophylla*, Rounded Noon-flower *Disphyma crassifolium* subsp*. clavellatum* and Austral Seablite *Suaeda australis.*

Much of the low-quality terrestrial dispersal habitat contains of a high cover (>80%) of exotic grass and herb species, planted vegetation and weeds. The study area is a disturbed area, dominated by environmental weeds and noxious weeds, as defined under the CaLP Act, including Artichoke Thistle, Spear Thistle *Cirsium vulgare* and African Boxthorn.

The offset site has been chosen as it meets 133.86% - 181.52% of the direct offset requirements generated by the vegetation removal at the impact site, and as such, offers considerably less risk in terms of management of the Growling Grass Frog population, and results in a demonstrable benefit in accordance with the Commonwealth's Environmental Offset Policy (DSEWPaC 2012a).

The existing Growling Grass Frog population, and those from adjacent areas of habitat (Sparrovale and Baenches Wetlands) were confirmed through past records and surveys undertaken following the *Survey Guidelines for Australia's Threatened Amphibians* (DSEWPaC 2011). The connectivity of the first-party offset site to established populations will be a key asset as it will encourage Growling Grass Frog colonisation from these areas.

Approximately 1.9 hectares of Growling Grass Frog habitat is proposed to be retained within the proposed offset site as part of the proposed action and includes low-quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock. Some exposed rock and debris in retained habitat may provide basking and overwintering opportunities for the species.

6.1.2 *a description of the habitat to be created or improved (aligned with type of habitat impacted)*

The offset site will result in the protection and management of 8.2 hectares of Growling Grass Frog habitat. This will include the creation of one large (1 hectare) and one smaller (0.5 hectare) wetland waterbody. The habitat design will broadly conform to the *Growling Grass Frog habitat design standards* (DELWP 2017). Beyond the aquatic habitat, a further 6.7 hectares of terrestrial dispersal habitat will also be protected, thereby ensuring connectivity between the constructed wetland habitat and the existing nearby wetlands (Baenches and Sparrovale Wetlands) where Growling Grass Frog are known to occur. Rock mattresses will cover a minimum of 20% of the bank area to provide refuge, basking and overwintering resources around the wetland margin, with additional logs and ground debris also to be provided for shelter and refuge.

A Landscape Masterplan prepared by a qualified wetland revegetation specialist and the Project Zoologist will provide a detailed account of all habitat improvement works within the No-Go-Areas. There will be ongoing management of threatening processes such as weed and pest animal control, and there will be no introduction of predatory species to created habitat.

Landscape plantings undertaken as part of the proposed works will be conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs. The *Growling Grass Frog Habitat Design Standards* (DELWP 2017) has been reviewed to provide a list of suitable species to be used when establishing vegetation within the Growling Grass Frog habitat (Appendix 7). Trees and/or large shrubs will not be planted within 20 metres of the banks of Growling Grass Frog wetlands to avoid shading out wetlands and providing vantage points for predatory birds.

6.1.3 *details of on-going threats to the protected matter at the offset site and how they will be managed*

Potential threatening processes for Growling Grass Frog resulting from the proposed residential development come from two main sources: impacts from construction activities (including removal of known habitat), and impacts resulting from the construction of a potential barrier to movement between habitat within the study area and potential habitat in Sparrovale wetlands and drainage lines to the north.

Table 10 outlines the key threats to Growling Grass Frog, as identified in the National Recovery Plan for the species (Clemann and Gillespie 2012), and addresses the management action that will be applied to the offset site to mitigate each threat.

Table 10. Mitigation measures applied to address key threats to Growling Grass Frog identified by the National Recovery Plan (Clemann and Gillespie 2012)

Key threats to Growling Grass Frog (Clemann and Gillespie 2012)	Mitigation measure
Loss and degradation of habitat	A Weed Management Plan was prepared to identify potential threats associated with pest plant species that may impact environmental values within the offset area. The Weed Management Plan provides appropriate management actions to address weed infestations and vertebrate pest species, to ensure environmental values within the offset site are maintained and enhanced (Appendix 6). Noise from building and other works relating to the residential development will comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works may not emit excessive or offensive noise. Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species.

Key threats to Growling Grass Frog (Clemann and Gillespie 2012)	Mitigation measure
	There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution. The following procedure will be undertaken to prevent erosion and sedimentation: • Installation and routine maintenance of sediment and erosion controls in key areas; • Installation of rock banks, boulders and logs to stabilise soils in affected areas; and, • Increase maintenance and monitoring operations in affected areas until problem areas are improved. Sediment controls will be implemented during and post-construction of the residential development to prevent damage to the offset site. These controls are detailed in the CEMP (Appendix 4) and include installation of sediment retention structures, such as silt fencing, to divert flow and prevent run-off from accessing waterways,
Barriers to movement	The placement of walking and/or bicycle paths and trails will be prohibited within the 'no impact' buffer zone within the existing Growling Grass Frog habitat and proposed constructed habitat to minimise human disturbance in these areas. Construction activities must be restricted in known habitat areas to minimise human and vehicular disturbance during the residential development phase. An exclusion zone will be implemented around the constructed wetlands prior to commencement of construction to protect the Growling Grass Frog habitat on site. The offset site is not adjacent to any busy roads or other significant barriers to nearby habitat (e.g. Sparrovale and Baenches wetlands).
Disease	Human activities and movements can exacerbate the risk of disease spread, and as such hygiene protocols for vehicles, equipment, footwear, handling, holding and transporting of frogs and tadpoles are paramount. Hygiene protocols will be implemented throughout the construction works. The Hygiene Protocol (Murray *et.al*. 2011) will be used to guide best practice Chytrid management.
Predation	The entire offset area will be appropriately fenced to exclude public access and avoid unrestrained access into the offset site by dogs and their owners. Geelong City Council imposes a cat curfew between sunrise to sunset, with domestic cats required to be contained indoors. This will reduce the likelihood of predation of frogs during periods when they are most active. Red Fox is likely to move through the study area. The species is known to hunt and eat adult members of the bell frog species complex. Feral Animal Control measures will be implemented over the life of the Growling Grass Frog Offset Management Plan both throughout the duration of residential development works and for the life of the OMP, as required to reduce the population size of foxes. Following this period, arrangements with relevant organisations (for example, Greater Geelong City Council, DEECA) will be undertaken to manage the sites thereafter. Feral cats are also likely to move through the study area and predate on Growling Grass Frog, but are not declared an established pest and cannot be controlled on private land. Throughout the duration of the Growling Grass Frog Offset Management Plan, feral cats will be trapped and surrendered to local Council. In the event that predatory fish are introduced to the wetlands (i.e. through routine flood events, dispersal of fish eggs by birds or artificially), the provision and maintenance of dense submerged and floating aquatic vegetation can increase Growling Grass Frog recruitment and survival rates by providing a greater amount of submerged cover for eggs and tadpoles. If Eastern Gambusia is observed within the constructed waterbodies, the protocols will be implemented that may include draining the wetland outside of the Growling Grass Frog active season (i.e. spring and summer) to remove this species from the wetland system.

Key threats to Growling Grass Frog (Clemann and Gillespie 2012)	Mitigation measure
Chemicals and Herbicide	All stormwater flow and discharge from the surrounding area will be directed away from the site or treated before entering the site to ensure that there is no negative impact to water quality or that external contaminants are inadvertently introduced to the constructed wetlands. The following procedure will be undertaken as required over the life of the Growling Grass Frog Offset Management Plan in the event of chemical influx following flood events: • Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc.; • Chemical treatments (for rectifying acidity or alkalinity); and, • Inspection of all drainage points leading to the waterbody for chemical spills, leaks, and rectify where necessary. Following this period, arrangements with relevant organisations (for example, Greater Geelong City Council, DEECA) will be undertaken to manage the sites thereafter.

6.1.4 a comparison of the environmental values as compared to the impact site

The following shows the environmental values currently present at the offset site as compared to the proposed impact site (Table 11).

Table 11. Comparison of Environmental Values between Offset Site and Impact Site

Ecological Values	Offset Site	Impact Site
Vegetation and overall condition	The offset site is 8.21 hectares and located within the eastern extent of 78-88 Groves Road. The condition of native vegetation is comparable to the impact site. Patches of Coastal Saltmarsh (EVC 9) were recorded along the northern boundary and were of low-moderate quality. The remaining area is comprised of farming paddocks comprising pasture grasses, scattered weeds and weed patches (particularly African Boxthorn and Bathurst burr).	The impact site is 33.28 hectares and is located in the centre and western portion of 78-88 Groves Road. Several patches of native vegetation present, as well as three scattered native trees and scattered occurrences of Tangled Lignum *Duma florulenta*. Native vegetation in the study area is representative of two EVCs: • Coastal Saltmarsh (EVC 9); and, • Brackish Wetland (EVC 656). The remainder of the study area comprised introduced and planted vegetation, present as pasture grass, native and non-native trees, noxious herbaceous and woody weeds and ornamental gardens.
Growling Grass Frog habitat	There are no waterbodies currently contained within this area, with the site predominantly comprising low-quality terrestrial dispersal habitat (i.e. pasture grass).	There are two effluent ponds situated in the centre of the site (which provide habitat for Growling Grass Frog) and one (dry) dam. Low-quality terrestrial dispersal habitat is also present. The proposed action will have a direct impact on 16.502 hectares of Growling Grass Frog habitat. This includes impacts to: • 0.216 hectares of high-quality aquatic foraging and potential breeding habitat (Effluent Pond 1); • 0.576 hectares of low-quality aquatic foraging habitat (Effluent Pond 2); and,

Ecological Values	Offset Site	Impact Site
		• 15.710 hectares of low-quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock.

6.1.5 justification of how the offset package meets the EPBC Act Environmental Offsets Policy.

To determine the suitability of offsets for the proposed residential development 78-88 Groves Road, Armstrong Creek, the guidelines for offsetting outlined in DSEWPaC (2012a) were taken into consideration which define environmental offsets as: "*measures that compensate for the residual adverse impacts of an action on the environment*". The aim of offsets is to provide environmental benefits to compensate the impacts of an action after avoidance and mitigations measures have been applied (DSEWPaC 2012b).

Habitat creation within the offset area will provide additional breeding, dispersal and foraging habitat for Growling Grass Frog, and areas identified for habitat creation have the primary aim of ensuring there is an overall improvement or 'net gain' for the species (i.e. provision of high quality breeding habitat) (Figure 3).

To compensate for the residual impacts to Growling Grass Frog as a result of the proposed residential development the following will be undertaken within the offset area:

- The construction of two wetlands to provide breeding, dispersal and foraging habitat for Growling Grass Frog (1.5 hectares of aquatic habitat in total). The design of wetlands will incorporate breeding and foraging habitat specifically designed and managed for the Growling Grass Frog;
- Terrestrial habitat (6.7 hectares) within the offset site will be enhanced through the provision of supplementary habitat (e.g. the provision of refuge and shelter resources such as rocks, logs and other ground debris) and ongoing weed control to eradicate pest species;
- Habitat augmentation of existing terrestrial habitat as detailed in the Offset Management Plan, and proposed Landscape Masterplan to be developed by a qualified wetland revegetation specialist and the Project Zoologist;
- The siting of the offset site will ensure connectivity between nearby wetlands where Growling Grass Frog are known to occur, thereby encouraging colonisation of the constructed wetlands;
- Distance between wetlands within the offset site will be ≤ 200 metre;
- The provision of a suitably designed frog exclusion fence to function as a barrier for frogs accessing paved areas;
- Emphasis on Balog Channel (initially), groundwater, rainwater and recycled water (post-completion of residential development) as a water source. If groundwater is found to be unsuitable water quality, then Balog Channel water will be used to supplement rainwater and recycled water (post-completion of residential development);
- Design parameters and vegetation requirements for breeding wetlands;
- Mechanisms for removing any predatory fish; and,
- Ongoing commitment to habitat management requirements.

The creation of dedicated Growling Grass Frog waterbodies and the improvement of terrestrial habitat within the offset area will compensate for potential impacts to the species (i.e. loss of aquatic habitat, and low-quality terrestrial habitat) as these dedicated areas will support key habitat features required by the species, and will be constructed at strategic locations (i.e. in proximity to known Growling Grass Frog populations in Sparrovale Wetland and Baenches Wetland) to ensure that dispersal opportunities throughout the local area (within and between the site) is maintained. In addition, habitat improvements directly surrounding the wetland (i.e. rock banks) will provide high quality refuge and overwintering resources for the species. The offset site will be secured initially via a Section 173 on-title agreement and subsequently via a TfN covenant, thereby protecting the offset area from the surrounding residential land uses and ensuring permanent protection from change in use of the offset site. The security agreement will act as a mechanism to ensure required conservation actions are undertaken, as detailed in the Offset Management Plan (Appendix 1). In order to reduce the potential for delay, a Section 173 on-title agreement is proposed at first before transitioning to a TfN covenant. The offset site will be managed in accordance with a suitable management regime.

With respect to the calculation of offsets for the project the Commonwealth Offsets Assessment Guide (excel spreadsheet) was used to calculate the overall gains associated with the creation of waterbodies and terrestrial habitat improvements and to demonstrate what is proposed will compensate for the proposed impacts to Growling Grass Frog associated with the project (Appendix 7). Based on the proposed habitat creation and improvement, the minimum direct offset for the project will be achieved on all aspects of the habitat construction and enhancement. The remaining indirect offset obligations are proposed to be met via research project funding or related initiative, to be determined.

6.2 Offset Management Plan

6.2.1 the specific environmental outcomes to be achieved, including specific environmental characteristics for habitat creation, improvement, and connectivity

Environmental outcomes to be achieved

While a total of 16.502 hectares of Growling Grass Frog habitat (comprising one high-quality waterbody, one low-quality waterbody, and low-quality terrestrial habitat) will be removed as part of residential development, the provision of two constructed wetland waterbodies and the improvement of suitable terrestrial habitat adequately offsets the removal of habitat for the species.

This is based on the following factors:

- Low quality terrestrial habitat (mostly containing pasture grass and high weed coverage) which is not considered limiting habitat or habitat the species would use on a regular basis (that is, when not located near important habitats such as the high quality waterbody where the species has been detected).
- Two waterbodies will be created to provide foraging, dispersal and breeding habitat, and to improve habitat connectivity and frog dispersal within the offset site as well as between the offset site and the nearby wetlands (i.e. Sparrovale and Baenches Wetlands).
- Appropriate mitigation measures including staff inductions, pre-clearance surveys and contingency measures will be undertaken to prevent direct impacts to the species during construction or the removal of habitats.

- In accordance with the detailed Growling Grass Frog Offset Management Plan that has been prepared for the project, the margins of the created wetlands will also be enhanced with the provision of additional refuge sites (i.e. rock banks). Logs and other ground debris will also be provided within the terrestrial habitat for shelter/ refuge.

Overall, a net benefit to the species is anticipated following the construction of habitat and the removal of existing Growling Grass Frog habitat, particularly given the detailed mitigation measures during construction and management and monitoring activities (as outlined in the Offset Management Plan; Appendix 1, 4).

Habitat creation, improvement and connectivity

The existing Growling Grass Frog terrestrial habitat within the offset site will be enhanced, and new aquatic habitat created, such that conditions are improved for Growling Grass Frog refuge, foraging and breeding purposes. This will include:

- Construction of two new wetlands (0.5 hectare and 1 hectare in size);
- Protection of 6.7 hectares of terrestrial dispersal habitat;
- Supplementary habitat installation (i.e. logs, rock banks);
- An exclusion zone will be installed around the constructed wetlands to protect the Growling Grass Frog habitat on-site;
- Preparation of a Landscape Masterplan by a qualified wetland revegetation specialist and the Project Zoologist, and submission to DEECA for approval. The Landscape Masterplan provides a detailed account of all habitat construction and enhancement works;
- Weed and pest animal control and,
- Supplementary aquatic vegetation planting.

According to Heard and Scroggie (2009) Growling Grass Frog populations that inhabit permanent wetlands with high aquatic vegetation cover, and close to other populations, have a higher probability of persistence, and were more likely to be recolonised should extinction of the species in the wetland occur (i.e. a classic meta-population structure). As outlined in Heard *et.al.* (2010), urban infrastructure / development presents a significant barrier to Growling Grass Frog dispersal, limiting or preventing the species from moving across the landscape within and between suitable breeding habitat. This can compromise the long-term viability of the species in an urban context where there is a disruption of the meta-population dynamics. Therefore suitable, well-connected, terrestrial and aquatic habitat (i.e. wetlands located within 500 metres of each other) needs to be available across the landscape to allow ongoing exchange of frogs and for populations to remain viable in the future. Considering the habitat requirements and population dynamics of the species, the offset site is designed appropriately to facilitate an ongoing connection between the created wetlands and existing habitat in Sparrovale and Baenches Wetland (i.e. there are no barriers to dispersal between constructed and existing wetlands). The siting of the offset site ensures that the proposed subdivision will not create a barrier to the movement of the species, and will promote colonisation of the newly constructed wetlands.

The primary function of the constructed wetlands is to provide additional breeding habitat, and to improve habitat connectivity and frog dispersal within the property and to existing populations in the adjacent wetlands. By attracting frogs into the study area from the core dispersal habitat in Sparrovale and Baenches

Wetland, genetic mixing and diversity of the population will be boosted, thereby leading to a more viable population in the future. The following habitat features will be incorporated within the proposed offset site:

- The construction of two dedicated Growling Grass Frog wetlands which will be designed to improve habitat connectivity within and adjacent to the study area (i.e. Sparrovale and Baenches Wetlands);
- Wetlands will be hydrologically independent from nearby wetlands and drainage lines to limit exposure to predatory fish such as Eastern Gambusia. Should the species be introduced into the constructed environment, the wetland will be drained (via a pump) outside the Growling Grass Frog active season (i.e. spring and summer) and will be re-filled using the water delivery system once the wetlands have completely dried and after it is assessed that Eastern Gambusia (or other predatory fish) are likely no longer present;
- Water will be sourced using Balog Channel water initially (filtered for Eastern Gambusia using silt fencing) and supplementary groundwater (if required) and rainwater. Following completion of the residential development, the ongoing water supply for the constructed wetlands will be groundwater using a solar-powered pump, recycled water and rainwater;
- Rock beaching will be installed on the margins of each constructed wetland to provide basking, sheltering and overwintering resources (covering at least 20% of the banks); and,
- Any landscape plantings that are undertaken as part of the proposed works will be conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs (Appendix 7). The Growling Grass Frog Habitat Design Standards (DELWP 2017) will be reviewed to provide a list of suitable species to be used when establishing vegetation within the Growling Grass Frog habitat. The cover of trees and shrubs will be low to avoid shading the wetlands or providing vantage points for predatory birds.

The ongoing maintenance of wetlands, particularly the maintenance of aquatic vegetation diversity and structure and terrestrial habitats will be essential to ensure these habitat types become and remain suitable for the species. Once established, wetlands are expected to be primarily self-sustaining. Maintenance of created habitats will be implemented every six months for the first two years during the residential development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat. This will include the following measures:

- Increase planting density by planting additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody), as required;
- Provision of additional refuge sites such as rocks, logs and dense low-lying vegetation if it is considered during site monitoring that the area of shelter is insufficient;
- Routine maintenance of grassed areas surrounding the waterbodies;
- Wetlands will be kept free of predatory fish, such as Eastern Gambusia. The ongoing monitoring program will identify invaded wetlands and subsequently instruct managers that draining is required;
- Where possible, weeds will be controlled by hand or with the use of implements. Alternatively, a frog sensitive herbicide (non-residual herbicide) will be selectively used. The use of other herbicides or pesticides within, or in proximity to wetlands, wetlands/waterways, shelter sites and likely dispersal areas will be prohibited;

- Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from wetlands/waterways. The removal of rubbish is particularly important over the first few years during pond and wetland establishment; and,
- Where relevant gross pollutant traps and/or sediment filters will be checked every 6 months and cleaned when required, particularly after heavy rain or storm events.

The quality of the terrestrial habitat in the areas proposed to be impacted as part of the residential subdivision is equivalent to much of the low quality and disturbed habitat in the surrounding area. Frogs may occasionally use these areas during dispersal events (i.e. warm, wet conditions). However, given the degraded and highly modified condition of these areas, they are not considered to provide limiting habitat for the species. Consequently, the construction of the wetlands in the offset site along with additional habitat enrichment measures, will provides a significant increase in the quality of the habitat within the study area, as well as a net increase in the available aquatic breeding habitat for the species.

6.2.2 details on how the offset will be secured, managed, and monitored to meet these environmental outcomes

Securing the site

The 8.2 hectares of Growling Grass Frog habitat within the offset site will be protected on-title initially via a Section 173 agreement before securing the site via a Trust for Nature Covenant. Following the 10-year active management period, the landowner will continue to manage the offset site as specified in the Offset Management Plan (Ecology and Heritage Partners 2023)

Funding for undertaking security, management and monitoring actions prescribed in the OMP (Ecology and Heritage Partners 2023) has been agreed to by between the landowner.

Any proposed uses or development of the offset site which conflict with the landowner's commitments are not permitted under the OMP. The sensitivities of the offset site must be considered with all management actions and all contractors entering the offset site need to be made aware of its ecological values.

Management

All management actions are detailed in the OMP (Ecology and Heritage Partners 2023a), and an overview provided below (Table 12).

Table 12. Management actions within the offset area (detailed in OMP; Ecology and Heritage Partners 2023)

Management Action	Description
Proposed habitat creation Creation of dedicated Growling Grass Frog Wetlands	Creation of two wetland waterbodies (1.5 hectare in total) and protection of 6.7 hectares of terrestrial habitat. Wetlands will be 'clustered' to facilitate dispersal within the site and to adjacent habitat (Sparrovale Wetland to the north and Baenches Wetland to the south). A Landscape Masterplan will be prepared to provide a detailed account of all habitat construction and enhancement works Rock mattresses covering minimum 20% of bank area. Weed and pest animal control.
Habitat maintenance	Consult an experienced zoologist for maintenance issues that could impact the species and/ or associated habitat.

Management Action	Description
	Undertake routine monitoring to investigate success of aquatic and terrestrial plant establishment and weed densities. Replace failed plantings. Control weeds invading terrestrial habitat by hand or spot-treatment methods with frog-sensitive herbicide. Monitor the level or public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs). Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary.
Fencing and access	Temporary frog exclusion fencing will be installed around the effluent treatment ponds and constructed wetlands prior to the commencement of construction to provide a physical barrier between the residential development area habitat to be removed and/or created habitat. Safety fencing will be installed around the entire constructed wetland area to exclude public access to the habitat, prior to the completion of the residential development.
Migration Period	Growling Grass Frog's will be allowed to migrate from existing habitat (effluent ponds) and colonise the newly constructed wetland habitat. This is proposed to occur over one breeding season, following completion of the constructed wetland habitat (Table 7; Appendix 1).
Management of Wetland Hydroperiod	The newly constructed wetlands will be hydrologically independent from nearby wetlands and drainage lines (which aims to limit exposure to Eastern Gambusia). The system will use Balog Channel water initially, filtered for Eastern Gambusia, and then groundwater and local recycled water as the project develops to manage water levels in the constructed wetlands. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Once filled and residential development is completed, a combination of groundwater and recycled water will become the primary water source for the constructed wetlands. Recycled water will be sourced from Barwon Water recycled water reserve. The recycled water sourced for the site will be prioritised for use in the wetlands only, as there are no other uses envisioned for this water source as part of the proposed action. The recycled water tank will be fitted with a multi parameter to identify if water quality parameters and nutrient levels are unsuitable for the species (i.e. salinity, pH, turbidity, dissolved oxygen, temperature, nitrate and phosphate). Growling Grass Frog have been found to inhabit wetlands with salinity levels over 5mS/cm. Warmer water temperatures (up to 27°C) minimise the risk of chytrid fungus infection, and tadpole hatching occurs in water between 24 to 27°C. Elevated nitrate and phosphate concentrations are known to have an impact on the survivability of Growling Grass Frog, and it is thought that the species requires waterbodies containing lower levels of nitrates and phosphates. The approximate salinity limit for the species is 5000 µS/cm. The holding tank will not be released into the constructed wetlands if salinity levels within the tank exceed 50000 µS/cm or temperatures fall below 18°C or above 27°C (or above 24°C during tadpole hatching periods). Additionally, dissolved oxygen should be maintained within an acceptable range for aquatic biota, and water should have low turbidity (<40NTU's), be still, maintain acidity between pH 6.0-8.0 and have low nitrogen (<1.0 mg/L) and phosphorous (<1.0mg/L) levels. In the event the water is not up to these standards, it will not be deployed in the waterbodies. More adequately treated recycled water will be sourced and used instead. The ongoing persistence of the resident Growling Grass Frog population within the study area will be achieved through the monitoring of wetland hydroperiods, and through the establishment and ongoing management of fringing and aquatic vegetation within constructed wetlands. Water levels will be assessed monthly over the species breeding season (October to March). Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction of the Growling Grass Frog

Management Action	Description
	wetland habitat, where water levels will not be allowed to fall below 0.5 metres. This monitoring will continue over the life of the Growling Grass Frog Offset Management Plan, but the frequency of the water level monitoring will be reviewed after the initial two-year period and a decision will be made regarding ongoing water level monitoring requirements based on results of the first two years (e.g. if the water delivery system is not maintaining stable water levels at the required depth).Water will be release from the water delivery systems if levels fall below 0.5 metres within the constructed wetlands during the species active breeding season (Spring and Summer) and will be regularly filled in order to retain water over the entire breeding season. Wetlands will be drained (i.e. via a pump) and allowed to completely dry out should Eastern Gambusia be detected and/or if the water quality within the proposed wetlands is not suitable for breeding by the species. Wetlands will only be drained outside of the Growling Grass Frog active season and will be re-filled using the water delivery system once evidence of predatory fish is no longer detected. Although absence of predatory fish cannot be confirmed, a high probability of absence can be inferred if the species is not detected during dip net surveys undertaken during consecutive water quality monitoring checks. The cause of Eastern Gambusia introduction will be investigated and the water delivery system repaired (if necessary).
Contaminants	Measures will be implemented to minimise the risk for chemical spill and hard rubbish dumping and respond to breaches if they occur. The risk of introducing chytrid will be managed by thorough cleaning and disinfection of all footwear and equipment before entering and exiting the site. A new pair of disposable latex gloves will be used between each frog and tadpole, and a separate bag used for each individual.
Pest Animals	**Cats and dogs**: It is understood that a cat curfew is currently enforced in the City of Greater Geelong with domestic cats required to be indoors from sunset to sunrise, which will minimise the risk to frogs. The entire constructed wetland habitat and surrounding 50-metre terrestrial buffer will be appropriately fenced to exclude public access and avoid unrestrained access into the offset site by dogs and their owners. **Eastern Gambusia**: Provide greater coverage of submerged coverage for GGF eggs and tadpoles. Potential draining of wetland outside GGF active season **Red Fox**: Remove dens and engage qualified and licenced trapper/shooter. **Feral cats**: Feral cats are not declared an established pest on private land in Victoria, and as such, feral cats cannot be controlled within the study area. If a feral cat is observed within the property more than once, it will be trapped and taken to the local Council where it will be humanely destroyed. It is the responsibility of the proponent to engage a licenced trapper to complete this work.
Weed Control	Weed Management will be undertaken in accordance with an approved Weed Management Plan (Appendix 6).
Noise and Lighting	Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species. Noise from building and other works relating to the residential development will comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works may not emit excessive or offensive noise. Works can only be carried out on any land between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays and public holidays. Sources of artificial light from the residential development will be directed away from existing habitat, constructed wetland and migration corridor. Shields will be used to reduce lateral light spill, and the use of high intensity lights in white or blue range (<50nm wavelength) will be avoided.

Monitoring and Reporting

The Offset Management Plan requires the landowner to submit a report annually to TfN and DCCEEW for each year of the ten years of the Offset Management Plan, and every year following for the life of the project's approval under the EPBC Act. The reports will include a review of past management works against the performance targets and objectives contained within the OMP. Future management priorities will also be detailed in these reports.

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the landowner is to document the justification and the substituted actions that will be undertaken in order to compensate and ensure the required outcomes are achieved.

All records/evidence of management actions must be maintained and be submitted to DCCEEW upon request.

An overview of the monitoring requirements is described below and full details are in Section 5.7 in the OMP (Ecology and Heritage Partners 2023):

Growling Grass Frog population monitoring

Population monitoring will be undertaken annually during the residential development and annually for the entire 10-year management period.

Each monitoring event will comprise diurnal and nocturnal surveys and will include the following (as a minimum);

Diurnal Surveys

The following will be undertaken as part of the diurnal surveys:

- Habitat assessment (type/cover of vegetation and refugia; water quality; disturbance, litter, erosion).
- Active searching for frogs (in and 20-metres around the waterbody, including aquatic and terrestrial vegetation, rocks, logs and other refugia).
- Dip netting for tadpoles and predatory fish.

Nocturnal Surveys

The following will be undertaken in accordance with Survey Guidelines for Australia's Threatened Amphibians (DSEWPaC 2011) as part of the nocturnal surveys:

- At least four nights of surveys (two early in active season when calling and mobility is high, and two later in the season when tadpoles and metamorphs greatest).
- Early in the active season, surveys will be at least 120 minutes (call-playback and active searching aquatic and terrestrial vegetation, rocks, logs and other refuge for frogs in and 20-metres around the waterbody).
- During the latter part of the active season, the 120-minute survey will involve dip netting for tadpoles and metamorphs, and active searching for metamorphs and sub-adults as detailed above.

All surveys will be conducted in weather conditions considered optimal for detection (i.e. warm and humid, overnight temperature not less than 14°C, preferably post rain) and when the species is known to be active elsewhere (reference sites).

Tadpole surveys

- Surveys will be undertaken annually for the first five years post-development, and conducted every second year, at minimum, following the fifth year. Commercially-available, collapsible bait-traps constructed of nylon netting will be baited with fluorescent glow sticks, and then set at the completion of each spotlight survey, in an effort to capture tadpoles at predetermined locations. At least two traps will be set at each wetland for a minimum of two nights over the breeding period of Growling Grass Frog. Traps will be suspended (use of floats) so that at least part of the trap emerges above water-level, allowing tadpoles to breathe.
- Traps will be retrieved the following morning and checked for tadpoles and predatory fish. All tadpoles caught will be identified to species level, counted and released. Alternatively, dip nets will be used to sample for tadpoles at, or in the vicinity of sites where calling males are identified.

Photo point monitoring

The landowner will establish three permanent photo-points across the offset site. Photographs taken from these points will be representative of the vegetation and objectives of the OMP (e.g. areas of high threat weed invasion). Photographs will be taken during the annual monitoring period annually and clearly labelled. This will allow for a visual assessment of potential threats (e.g. weed species, pest animal activity, biomass levels) to be assessed annually with reference to a baseline.

Habitat monitoring

Monitoring of created habitats (including vegetation monitoring and pest plant monitoring) will be undertaken every six months for the first two years during the residential development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat, then every two years until year 10.

Water quality monitoring

Water quality monitoring sites will be established within the constructed waterbodies immediately following the completion of the constructed wetlands. Water quality sampling will adhere to the EPA's reference document: S*ampling and analysis of waters, wastewaters, soils and wastes* (EPA 2009), and will be compared to the State Environment Protection Policy (SEPP) Water for Victoria objectives (EPA 2018). Sampling will be conducted every four months for two years post-construction to determine whether water quality has returned/ remained at baseline conditions. The frequency of the water quality monitoring will be reviewed after the initial two-year period and a decision will be made on whether ongoing water chemistry monitoring is required.

7 OTHER APPROVALS AND CONDITIONS

If updated from the information provided in the referral, provide any other requirements for approval or conditions that apply, or that you reasonably believe are likely to apply, to the proposed action.

This must include:

(a) a description of any approval obtained or required to be obtained from a State or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply to the proposed action

(b) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.

7.1 Response

The only known approval is approval from Council for planning permit for residential development of the site, including approvals from referral authorities (known include PowerCor, Downer, DEECA).

The monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action are unconfirmed at this stage as planning permit application still undergoing assessment.

8 SOCIAL AND ECONOMIC MATTERS

If updated from the information provided in the referral, address the economic and social impacts (both positive and negative) of the proposed action. This may include:

a) details of any public consultation activities undertaken, and their outcomes

b) projected costs and benefits of the proposed action, e.g. employment opportunities expected to be generated by the project (including construction and operational phases). This must include the basis for their estimation through cost/benefit analysis or similar studies

c) employment opportunities expected to be generated by the project at each phase of the proposed action

d) benefits to the local and wider community as a result of the proposed action.

Economic and social impacts should be considered at the local, regional, and national level.

8.1 Response

8.1.1 Public Consultation Activities

An approved Cultural Heritage Management Plan (CHMP) was previously undertaken in 2021 on this site (Unearthed Heritage 2021). The CHMP will not be made publicly available due to cultural sensitivities). The Registered Aboriginal Party (RAP) for the activity area is the Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC).

The notice of intent was provided to the Registered Aboriginal Party on 26 November 2020, and they elected to evaluate the Cultural Heritage Management Plan on 27 November 2020. Field methods and management conditions were discussed with the Registered Aboriginal Party during meetings and during field investigations for standard and complex assessment (Unearthed Heritage 2021). Will not be made publicly available due to cultural sensitivities).

The Registered Aboriginal Party was consulted as part of the Cultural Heritage Management Plan for the activity. Site officers representing the Registered Aboriginal Party were involved in the original field survey of the activity area on 22 October 2018 as part of CHMP15842.

Further public consultation was undertaken as part of the Sparrovale-Ngubitj yoorree Wetlands. The adopted Sparrovale-Ngubitj yoorree Wetlands Masterplan included public engagement that, in part, covered the proposed actions within the study area.

No further public consultation has been undertaken for the proposed action.

8.1.2 Projected costs and benefits

The Growling Grass Frog proposed constructed habitat and landscaping at is estimated to cost approximately $2.4m. However, this excludes professional fees associated with its design and construction, which is expected to cost approximately $250,000. The design and construction of constructed habitat will generate employment opportunities through the engagement of civil contractors and landscape contractors for its construction on-site, but will also create employment for the landscape architects, civil engineers, stormwater consultants and environmental consultants that are engaged to design the constructed wetland.

Total construction costs and professional fees for the wider residential development (excluding the constructed Growling Grass Frog habitat) are estimated at approximately $22.0m. Note that statutory fees and land holdings costs expected to total an additional $6.8m.

It is expected that over 30 full-time equivalent (FTE) jobs will be created from a civil works perspective, and 15 FTE from a landscaping perspective. Additional economic benefits will include the provision of housing for 200 lots, and depending if they move to the area from another part of Melbourne, may potentially bring additional benefits to the local region in terms of job creation, spending, etc.

8.1.3 Benefits to the wider community

The constructed wetlands will be specifically designed and managed to create high-quality habitat for Growling Grass Frog, providing resources for dispersal, foraging, breeding and overwintering. This will support the growth of the population at a local, regional and national level, thereby assisting in the recovery of a nationally listed Vulnerable species.

Further to the employment opportunities that will be created for local businesses and specialist contractors (as detailed above, Section 8.1.2), the delivery of the proposed Growling Grass Frog constructed habitat will support the objectives of the Sparrovale Wetland Master Plan. The vision statement for the wetland is:

"A diverse and sustainable wetland and waterway wildlife reserve to enjoy nature, history and improve community well-being"

The 500-ha nature reserve contains a combination of natural and constructed wetlands that promote high biodiversity of flora and fauna species, and ensure their protection into the future. The creation of new high-quality waterbodies at the offset site will strongly align with this purpose by providing additional habitat and facilitating connectivity for native fauna between the wetlands. As a result, the site will serve as an environmentally attractive location for locals and visitors alike, promoting tourism in the region. The presence of a threatened species (i.e. Growling Grass Frog) can also lend a perceived importance and value to the constructed wetlands, thereby promoting a feeling of pride and custodianship among locals. It provides an opportunity to foster community interest in local biodiversity, including via a Wetland Interpretation Centre proposed as part of the residential development.

9 ENVIRONMENTAL RECORD OF PROPONENT

If updated from the information provided in the referral, provide details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:

a) the person proposing to take the action

b) for an action for which a person has applied for a permit, the person making the application.

Please provide an update with regards to the status of the corporate environmental policy, and confirm there is still no history of incompliance related to environmental management.

9.1 Response

AC Manager Pty Ltd (the corporation proposing to take the action) has not been subject to any known prosecution for environmental breaches. No executives of AC Manager Pty Ltd have been a party to any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

At this stage, AC Manager Pty Ltd does not have any corporate environmental policies or frameworks at the residential development entity or group entity level, however they are intending to prepare a corporate environmental policy sometime in the FY22/23 financial year.

10 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

The preliminary documentation package must provide a description of the proposed action in relation to the principles of ecologically sustainable development and the objects and requirements of the EPBC Act:

a) the long-term and short-term economic, environmental, social, and equitable considerations

b) the precautionary principle which states that a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation where there are threats of serious or irreversible environmental damage

c) the principle of inter-generational equity which states that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations

d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making

e) improved valuation, pricing and incentive mechanisms should be promoted.

10.1 Response

The National Strategy for Ecologically Sustainable Development (1992) sets out the policy framework for the Australian Government to make decisions and take actions to pursue ecologically sustainable development (ESD). The National Strategy requires government departments to develop institutional arrangements to ensure that the principles and objectives of ESD are delivered and sets out the following core objectives for achieving ESD:

- To enhance individual and community well-being by following a path of economic development that safeguards the welfare of future generations.
- To provide for equity within and between generations.
- To protect biological diversity and maintain essential ecological processes and life-support systems.

The design and construction of constructed habitat will generate employment opportunities through the engagement of civil contractors and landscape contractors for its construction on-site, but will also create employment for the landscape architects, civil engineers, stormwater consultants and environmental consultants that are engaged to design the constructed wetland.

It is expected that over 30 FTE will be created from a civil works perspective, and 15 FTE from a landscaping perspective. Additional economic benefits will include the provision of housing for 200 lots, and depending if they move to the area from another part of Melbourne, may potentially bring additional economic benefits to the local region in terms of job creation, spending, etc.

The natural landscape of this site also provides a distinct opportunity to deliver something different for the area and provide opportunities to foster community interest in local biodiversity, including via a Wetland Interpretation Centre proposed as part of the residential development.

The proposed residential development will see the creation of Growling Grass Frog habitat to support a breeding population of Growling Grass Frog and the creation of a terrestrial habitat corridor to enable greater dispersal and foraging opportunities for the species.

11 CONCLUSION

The Preliminary Documentation must provide an overall conclusion as to the environmental acceptability of the proposal, including discussion on compliance with the principles of Ecologically Sustainable Development (ESD) and the objects and requirements of the EPBC Act.

You may wish to include a statement as to whether or not the controlled action should be approved and may recommend conditions pertaining to an approval. This should include justification for undertaking the proposed action in the manner proposed. The measures proposed or required by way of offset for any unavoidable impacts on MNES and the relative degree of compensation, should be restated here.

11.1 Response

The proposed residential subdivision will result in a direct impact on one matter of National Environmental Significance, Growling Grass Frog. A total of 16.502 hectares of habitat for Growling Grass Frog, comprising one low-quality waterbody, one high-quality waterbody, and 6.7 hectares of low-quality terrestrial habitat, mostly comprised of improved pasture is proposed to be removed. The terrestrial habitat may be used on occasion during dispersal events (i.e. warm, wet conditions), but is unlikely to provide important or limiting habitat for the species.

While existing Growling Grass Frog habitat within the study area will be impacted by the residential development, the loss of these areas will be mitigated through the creation of two high-quality waterbodies catered towards the habitat requirements of the species. In addition to providing resources for foraging, dispersal and breeding, the created wetlands will facilitate connectivity within the site (i.e. between the two wetlands) and to neighbouring habitat in the Sparrovale and Baenches Wetlands. The connectivity will allow the frogs to naturally colonise the newly constructed wetlands. Terrestrial habitat surrounding the constructed waterbodies will be protected and augmented through the provision of rock banks, logs and other ground debris which will provide shelter and overwintering resources. In addition, ongoing management of threatening processes such as weed and pest animal control will be undertaken.

As a result of these efforts, the proposed residential development plan adequately offsets the removal of habitat for the species. Further, it will result in a net increase in the extent of high-quality aquatic habitat, protection and augmentation of existing terrestrial habitat, provision of new resources (e.g. rock banks), and increased connectivity at a local scale, thereby promoting the persistence and recovery of the species.

Proposed conditions

AC Manager Pty Ltd intends to meet the offset obligations generated by the proposed removal of 16.502 hectares of Growling Grass Frog habitat at a first party offset site located at 78-88 Groves Road, Armstrong. This proposed offset site will offset 8.2 hectares of Growling Grass Frog habitat. The proposed offset site will be protected and managed in perpetuity.

The project should be approved subject to conditions, including the proposed security and management of the proposed offset site, along with regular reporting and auditing requirements to ensure the management commitments outlined in the Growling Grass Frog Offset Management Plan (Ecology and Heritage Partners 2023a) are undertaken, and that the Growling Grass Frog population persists within the proposed offset site.

12 INFORMATION SOURCES

The preliminary documentation must state for the information provided, the following:

a) the source and currency (date) of the information

b) how the reliability of the information was tested

c) the uncertainties (if any) in the information

d) the guidelines, plans and/or policies considered

12.1 Response

Information used in this report was appraised and assessed for quality, research rigour and relevance to the topic. Academic research, grey literature and policy documents were reviewed in preparation of this Preliminary Documentation, with research conducted prior to 2000 only considered on the basis that it is a seminal source or provides necessary background.

Relevant studies were identified using a range of methods, including:

- academic journal databases in the herpetology, biodiversity conservation, zoology, and aquatic biology fields;
- general internet searching of online policy communities and information clearinghouses (including government departments); and,
- follow up of bibliographic references in found studies.

The following guidelines, plans and policies were considered (see also 12.1.1):

- National Recovery Plan for the Southern Bell Frog Litoria Raniformis (2012);
- Growling Grass Frog Habitat Design Standards (2017);
- Flora and Fauna Guarantee Act 1988 Threatened List (2022);
- Threat Abatement Plan: Infection of amphibians with chytrid fungus resulting in chytridiomycosis (2006);
- Significant impact guidelines for the vulnerable growling grass frog (Litoria raniformis). Nationally threatened species and ecological communities EPBC Act policy statement 3.14 (2009);
- Environmental Management Plan Guidelines (2004);
- Biodiversity Precinct Structure Planning Kit (2010);
- Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (2012);
- Offsets Assessment Guide: For use in determining offsets under the Environment Protection and Biodiversity Conservation Act 1999 (2012);
- Offset Management Plan for 78-88 Groves Road, Armstrong Creek, Victoria (2023);
- Civil construction building and demolition guide. Publication 1834. (2020);
- Construction Techniques for Sediment Pollution Control. (1991);

- Legislative Noise Framework. (2021);
- City of Greater Greater Geelong Building works – Local Law Procedure Manual (2014);
- Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes (2010);
- Urban Stormwater: Best Practice Environmental Management Guidelines (1999); and,
- Aboriginal Cultural Heritage Management Plan: Subdivision of 76.88 Groves Road, Armstrong Creek, Victoria (2021).

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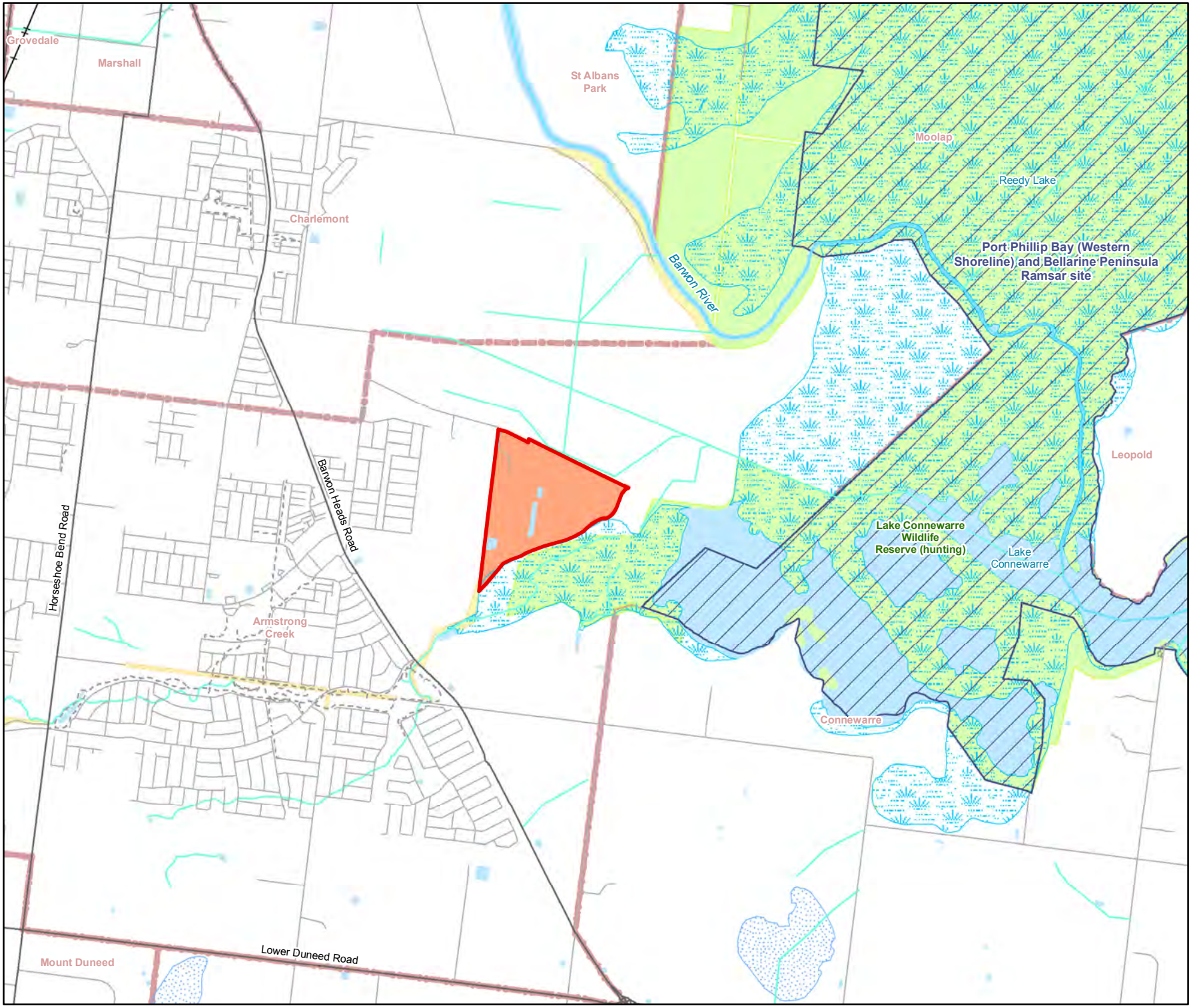
FIGURES



Legend

- Study Area
- Railway
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Ramsar wetland
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 250 500

Metres

Map Scale: 1:30,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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Legend

- Study Area
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Existing dams
- Survey sites
- Growling Grass Frog foraging habitat
- Growling Grass Frog foraging habitat impact area

Figure 2

Proposed development plan

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 75 150

Metres

Map Scale: 1:5,200 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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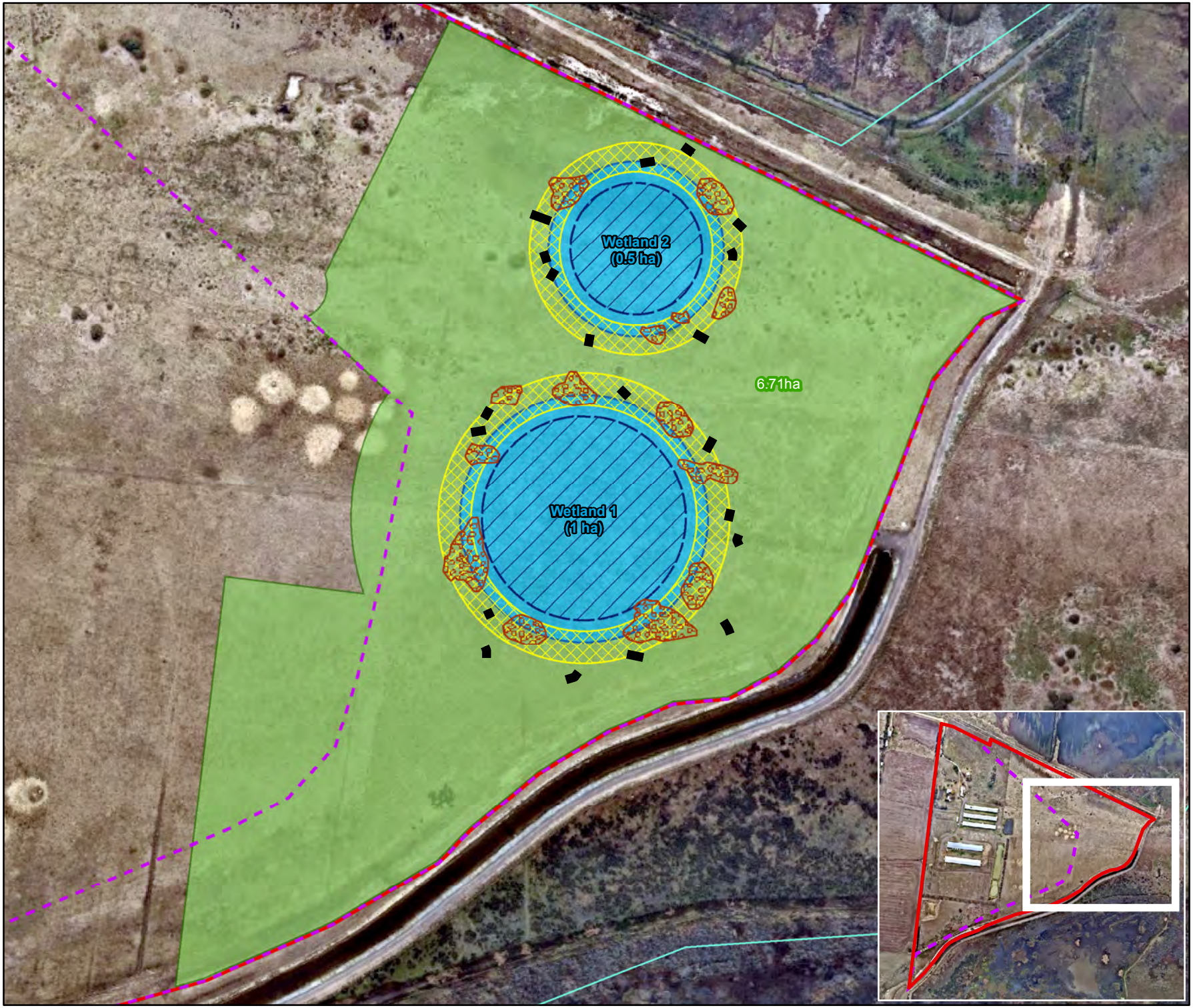
16303_Fig02_DevPlan_OMP 10/10/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- ESO2 extent
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Deep water submergent vegetation zone (>1.5m)
- Emergent vegetation zone
- Rock beds
- Logs and woody debris

Figure 3

Conservation Management Plan for Growling Grass Frog

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 30 60

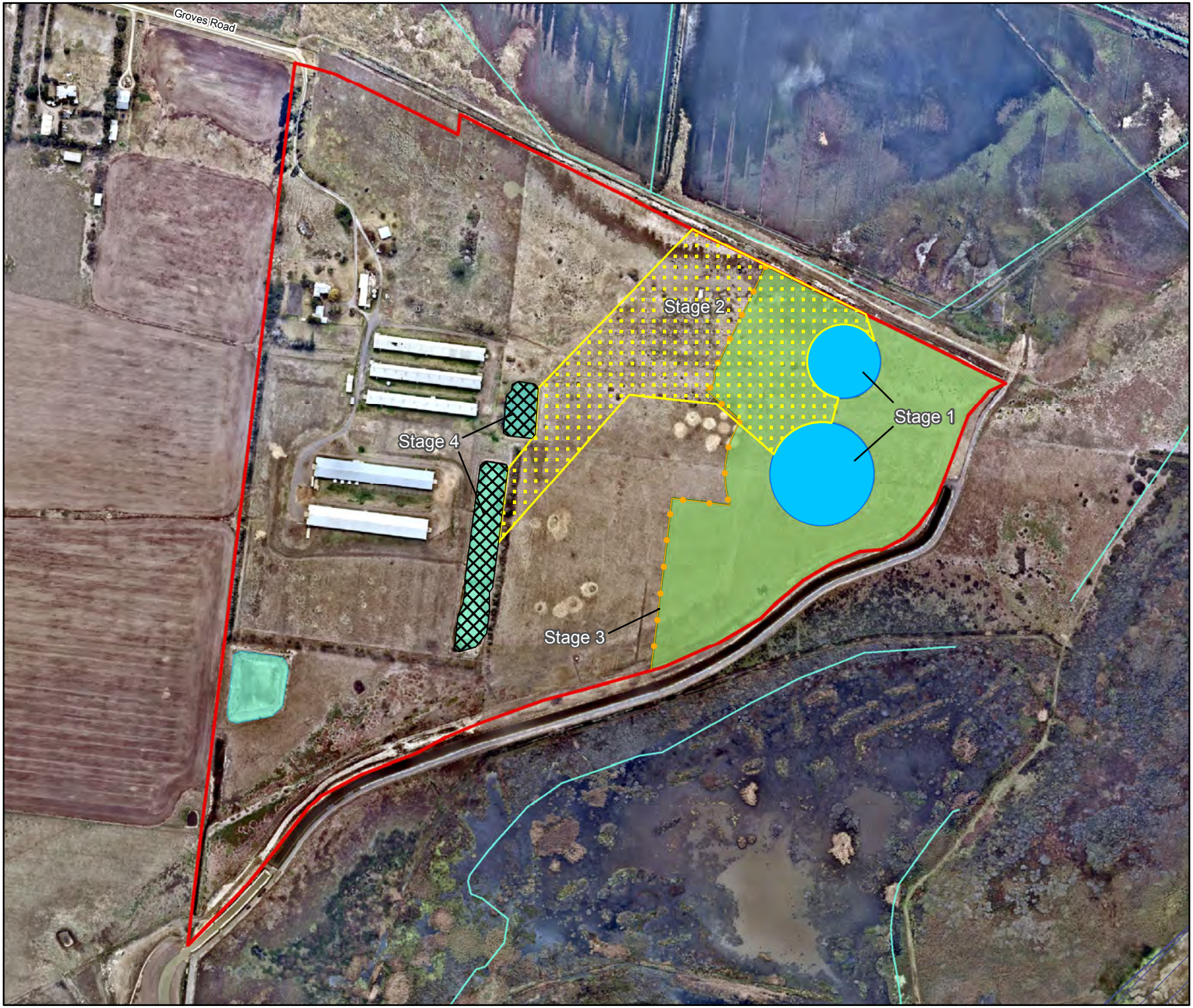
Metres

Map Scale: 1:2,300 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig03_CMP_OMP 11/10/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- Proposed Constructed Terrestrial Habitat Offset Area
- Existing dams

Stages

- 1. Waterbodies constructed (Autumn)
- 2. GGF migration period (Spring/ Summer)
- 3. Installation of frog exclusion, dog exclusion, safety and sediment fencing
- 4. Removals of dams following successful GGF migration

Figure 4

Constructed Wetlands Staging and Frog Migration

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 75 150

Metres

Map Scale: 1:5,500 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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16303_Fig04_Migration_OMP 9/11/2023 melsley

Aerial source: Nearmap 2022

APPENDICES

APPENDIX 1 – OFFSET MANAGEMENT PLAN

Final Report

Offset Management Plan: Residential Development at 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357).

Prepared for

AC Manager Pty Ltd

January 2024

Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road, Ascot Vale VIC 3032 **GEELONG:** 230 Latrobe Terrace, Geelong West Vic 3218
BRISBANE: Level 22, 127 Creek Street, Brisbane QLD 4000 **ADELAIDE**: 22 Greenhill Road, Wayville SA 5034
CANBERRA: PO Box 6067, O'Connor ACT 2602 **SYDNEY:** Level 5, 616 Harris Street, Ultimo, NSW, 2007
www.ehpartners.com.au | (03) 9377 0100

ecology & heritage partners

www.ehpartners.com.au

DOCUMENT CONTROL

Assessment	EPBC 2022/09357: Offset Management Plan
Address	78-88 Groves Road, Armstrong Creek, Victoria
Project number	16303
Project manager	Alex Wilkinson (Consultant Zoologist)
Other EHP staff	Sarah Hill (Field Ecologist)
Report reviewer	Aaron Organ (Director / Principal Ecologist)
Mapping	Dr Monique Elsley (GIS Coordinator)
File name	16303_EHP_OMP_78-88GrovesRd_ArmstrongCreek_Final_08012024
Client	AC Manager Pty Ltd
Bioregion	Otway Plain and Victorian Volcanic Plain
CMA	Corangamite
Council	City of Greater Geelong

Report versions	Comments	Comments updated by	Date submitted
Draft	-	-	16/06/2023
Draft v2	DCCEEW (Timothy Budden)	AW/SH	13/10/2023
Final	DCCEEW (Timothy Budden)	AW	09/11/2023
Final v2	DEECA	AW/SH	21/12/2023
Final v3	DCCEEW (Timothy Budden)	AW	8/01/2024

Ecology and Heritage Partners acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

GLOSSARY

Acronym	Description
CaLP	*Catchment and Land Protection Act 1994*
CMA	Catchment Management Authority
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEECA	Department of Energy, Environment and Climate Action
DELWP	(former) Victorian Department of Environment, Land, Water and Planning
DEWHA	(former) Commonwealth Department of Environment, Water, Heritage and the Arts
DSEWPaC	(former) Commonwealth Department of Sustainability, Environment, Water Population and Communities.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988*
GGF	Growling Grass Frog
NES	National Environmental Significance
OMP	Offset Management Plan
PD	Preliminary Documentation
TfN	Trust for Nature

CONTENTS

1 DECLARATION OF ACCURACY

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Management Plan (EPBC 2022/09357): Offset Management Plan: 78-88 Groves Road, Armstrong Creek, Victoria) is complete, current and correct.
2. I am duly authorised to sign this declaration on behalf of the approval holder.
3. I am aware that:
    a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.
    b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.
    c. The above offences are punishable on conviction by imprisonment, a fine or both.

_____

Signed

_____

Full name (please print)

_____

Organisation (please print)

_____

Date

2 EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was engaged by AC Manager Pty Ltd to prepare an Offset Management Plan (OMP) to compensate for impacts associated with the proposed residential development located at 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357).

The intention of this OMP is to detail the offset strategy to mitigate the loss of 16.502 hectares of Growling Grass Frog habitat at the development site, by outlining management actions for the creation and protection of 8.2 hectares of Growling Grass Frog habitat at a first party offset site. The OMP has been written in consultation with the landowner of the offset site and is intended to be implemented according to the management and monitoring actions outlined within this document.

Proposed Offset Site

The first-party offset site (offset site) is in the eastern portion of the property at 78-88 Groves Road, Armstrong Creek and will comprise approximately 8.2 hectares (Figure 2). The offset site within the property is proposed to be managed for offset and conservation purposes.

The 8.2 hectares of Growling Grass Frog habitat outlined in this OMP will be protected on-title initially via a Section 173 agreement before securing the site via a Trust for Nature Covenant for the area covered by this OMP. The management actions specified within the covenant are proposed to reflect those specified within this OMP specific to Growling Grass Frog. The offset site has been chosen as it meets 133.86% - 181.52% of the direct offset requirements generated by the vegetation removal at the impact site, and as such, offers considerably less risk in terms of management of the Growling Grass Frog population, and results in a demonstrable benefit in accordance with the Commonwealth's Environmental Offset Policy (DSEWPaC 2012a). The site's existing Growling Grass Frog population, and those from adjacent areas of habitat (Sparrovale and Baenches wetlands) were confirmed through targeted surveys undertaken following the Survey Guidelines for Australia's Threatened Amphibians (Ecology and Heritage Partners 2021a; DSEWPaC 2011). The first-party offset site is proposed to encourage Growling Grass Frog colonisation from these existing populations.

Management Actions

The offset site will be managed for the purposes of conservation and will involve creation and protection of Growling Grass Frog habitat, through the construction of high-quality aquatic and terrestrial habitat consistent with the Growling Grass Frog Habitat Design Standards (DELWP 2017), control of pest animals and environmental weeds and general maintenance of the character and quality of the habitat. An adaptive management approach will be adopted to allow flexibility to respond appropriately and effectively to uncertainties involved in ecological processes. This will ensure that management objectives are being met while allowing for altered circumstances to be included in the management of the offset site.

Any proposed changes to the management actions for the offset site contrary to those specified within this plan must be approved by Commonwealth Department of Climate Change, Energy, the Environment and Water, prior to implementation. Any proposed uses or development of the offset site which conflict with the commitments outlined within this document are not permitted.

3 INTRODUCTION

3.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by AC Manager Pty Ltd to prepare an Offset Management Plan (OMP) to compensate for impacts associated with the proposed residential development located at 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357).

In November 2022, a referral for the action was submitted for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2022/09357). On 23 December 2022, the proposed action was declared a "Controlled Action" and will be assessed under Preliminary Documentation, which requires the proponent to prepare and implement an Offset Management Plan to compensate for the removal of 16.502 hectares of Growling Grass Frog *Litoria raniformis* habitat. Growling Grass Frog are listed as Vulnerable under the EPBC Act.

3.1.1 Impact Site

The impact site comprises the land located at 78-88 Groves Road, Armstrong Creek, as well as a 40 metre long section of Groves Road extending west from the property and is approximately 85 kilometres south-west of Melbourne's CBD (Figure 1). The impact site covers approximately 41.48 hectares and is bound by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and private property to the west. Importantly, Baenschs Wetland (which is adjacent to the Armstrong Creek Water Frontage) forms part of a large wetland complex, part of which is protected under the EPBC Act as the *Port Phillip Bay (western shoreline) and Bellarine* Ramsar Site. Sparrovale Wetland also drains into the large wetland complex via the Barwon River.

The impact site is currently used for agriculture and farming, with a residence, outbuildings, and five broiler sheds on site. Two effluent treatment ponds exist in the centre of the site, and a dam is located in the south-west corner. It is generally flat, with no ridges or crests within or immediately adjacent to the site. The study area is covered by the Armstrong Creek East NVPP, as part of the Armstrong Creek East Precinct Structure Plan (SMEC 2010). The impact site is located across two bioregions: the Otway Plain and Victorian Volcanic Plain as defined by the Department of Energy, Environment and Climate Action (DEECA) NatureKit Map (DEECA 2023). It is situated within the Corangamite Catchment Management Authority (CMA) and the City of Greater Geelong Council municipality.

3.1.2 Proposed Action

The site has been acquired for the subdivision and development of the land for residential purposes.

The study area is proposed to be subject to future residential development, with a section of Groves Road road reserve proposed to be raised in order to provide access to the future 78-88 Groves Road development. The development is proposed to be undertaken over one phase. The proposed development is planned to include 200 residential lots.

3.2 Objectives

The proposed action at the impact site will have a direct impact on 16.502 hectares of Growling Grass Frog habitat, with a further 1.89 hectares proposed for retention. The objectives of this OMP are to offset the loss of the Growling Grass Frog habitat.

The intention of this OMP is to detail the ongoing management actions required to protect approximately 8.2 hectares of Growling Grass Frog habitat proposed to be constructed on site as a first party offset site, in order to offset the proposed impacts.

The OMP is both strategic and focused on management actions and performance measures (quantitative amounts indicated, where appropriate) in order to address management issues and key threats across the offset site.

4 OFFSET SUITABILITY

This section provides details on the site impacts and assesses the suitability of the proposed constructed habitat. The Preliminary Documentation provides further detail (Ecology and Heritage Partners 2023a). The existing conditions on site and the proposed constructed habitat are shown in this report (Figure 2 and 3).

4.1 Impact Site

The impact site details are provided below (Table 1). A detailed description of ecological values within the study area is provided in the associated flora and fauna assessment report (Ecology and Heritage Partners 2023b).

Table 1. Impact Site Details

Clearing Site Details	
Landowner of impact site	AC Manager Pty Ltd
Location and address of clearing site	78-88 Groves Road, Armstrong Creek, Victoria
Local Government Area	City of Greater Geelong
Catchment Management Authority	Corangamite Catchment Management Authority
Responsible Authority	City of Greater Geelong
Applicant	AC Manager Pty Ltd

4.1.1 Vegetation

Several patches of native vegetation, three scattered native trees and scattered occurrences of Tangled Lignum *Duma florulenta* were recorded within the study area as part of the site assessment. The remainder of the study area comprised introduced and planted vegetation, present as pasture grass, native and non-native trees, noxious herbaceous and woody weeds and ornamental gardens.

Native vegetation in the study area is representative of two EVCs: Coastal Saltmarsh (EVC 9) and Brackish Wetland (EVC 656). The presence of these EVCs is broadly consistent with the modelled extant (2005) native vegetation mapping (DEECA 2023), with the exception of the presence of Brackish Wetland (EVC 656).

Patches of Coastal Saltmarsh were observed along the northern and southern boundaries of the study area, fringing the south-western artificial dam and within the road reserve of Groves Road (Figure 2). The vegetation was in low-moderate condition and predominantly comprised Beaded Glasswort *Salicornia quinqueflora* subsp. *quinqueflora* in the ground layer, as well as specimens of Australian Salt-grass *Distichlis distichophylla*, Rounded Noon-flower *Disphyma crassifolium* ssp. *clavellatum* and Austral Seablite *Suaeda australis*. The occasional Berry Saltbush *Atriplex semibaccata* and Chaffy Saw-sedge *Gahnia filum* were also present in the ground layer.

One patch of Brackish Wetland was present along a drainage line within the south-western section of the study area (Figure 2). The vegetation was in moderate condition and predominantly comprised a mixture of inundated Salt Club-sedge *Bolboschoenus caldwellii* and Sea Rush *Juncus kraussii* subsp. *australiensis*.

Occurrences of Beaded Glasswort, Australian Salt-grass and Austral Seablite formed the surrounding vegetation with the occasional Chaffy Saw-sedge and Coastal Tussock grass *Poa poiformis* also present.

Areas not supporting native vegetation had a high cover (>90%) of exotic grass species. Noxious weeds, as defined under the Catchment and Land Protection (CaLP) Act, were prevalent throughout the study area, with Artichoke Thistle *Cynara cardunculus*, Spear Thistle *Cirsium vulgare* and African Boxthorn *Lycium ferocissimum* dominating the ground layer throughout the northern areas. Bathurst Burr *Xanthium spinosum* and Variegated Thistle *Silybum marianum* were also present in patches of moderate density. African Boxthorn is also a Weed of National Significance (WoNS).

4.1.2 Significant Species

Two Growling Grass Frog individuals were recorded at the impacts site in an effluent pond during targeted surveys (Ecology and Heritage Partners 2021a). Effluent Pond 1 contained high-quality Growling Grass Frog aquatic foraging habitat. While no tadpoles were recorded during targeted surveys, Effluent Pond 1 had the potential for breeding habitat. Extensive areas of submerged vegetation provided high quality habitat for tadpoles, and floating vegetation provided suitable habitat for calling males. In addition, Effluent Pond 2 likely provided low-quality aquatic foraging habitat between other areas of suitable habitat within the immediate locality (i.e. Baenches Wetland, Sparrovale Wetlands). Overall, the impact site supported a small wetland that contained two individuals that are part of a viable population within the broader Baenches Wetland and Sparrovale Wetland.

4.1.3 Summary of Impacts

Effluent Pond 1, 2 and surrounding foraging habitat is proposed to be directly impacted by construction works, including access, road construction, grading of land and construction of residences. Both ponds are proposed to be removed as part of the proposed action. This includes the proposed removal all aquatic (including breeding) Growling Grass Frog habitat in the study area, while a portion of terrestrial habitat is also proposed to be removed. Given the removal of an aquatic habitat corridor (i.e. removal of Effluent Pond 1 and 2) there has the potential for a significant impact to the species due to the proposed action.

In summary, the following direct impacts to Growling Grass Frog habitat in the impact site are proposed. A total of 16.502 hectares of habitat, comprising:

- 0.216 hectares of high-quality aquatic foraging and potential breeding habitat (Effluent Pond 1);
- 0.576 hectares of low-quality aquatic foraging habitat (Effluent Pond 2); and
- 15.710 hectares of low-quality terrestrial dispersal habitat comprised mostly of improved pasture in a paddock.

Potential indirect impacts associated with the proposed development includes changes in the hydrology of the constructed wetlands, the deterioration of water quality, the introduction and spread of chytrid fungus, human access, spreads of weeds, and noise and lighting impacts. The prevention and/or management of these indirect impacts is outlined in the Preliminary Documentation (Ecology and Heritage Partners 2023a).

No impacts to other Matters of National Environmental Significance (NES) are expected due to the proposed action.

4.2 Offset Site

4.2.1 Description of the First-party Offset Site

The first-party offset site (offset site) is in the eastern portion of the property at 78-88 Groves Road, Armstrong Creek and will comprise 8.2 hectares. The offset area within the property are proposed to be managed for offset and conservation purposes.

The 8.2 hectares of Growling Grass Frog habitat outlined in this OMP will be protected on-title initially via a Section 173 agreement before securing the site via a Trust for Nature Covenant for the area covered by this OMP. The management actions specified within the covenant are proposed to reflect those specified within this OMP specific to Growling Grass Frog. The offset site has been chosen as it meets 133.86% - 181.52% of the direct offset requirements generated by the vegetation removal at the impact site, and as such, offers considerably less risk in terms of management of the Growling Grass Frog population, and results in a demonstrable benefit in accordance with the Commonwealth's Environmental Offset Policy (DSEWPaC 2012a). The site's existing Growling Grass Frog population, and those from adjacent areas of habitat (Sparrovale and Baenches wetlands) were confirmed through surveys undertaken following the Survey Guidelines for Australia's Threatened Amphibians (DSEWPaC 2011). The first-party offset site is proposed to encourage Growling Grass Frog colonisation from these existing populations.

4.2.2 Ecological Condition

Native vegetation in the study area is representative of two EVCs: Coastal Saltmarsh (EVC 9). The presence of this EVCs is broadly consistent with the modelled extant (2005) native vegetation mapping (DEECA 2023), with the exception of the presence of Brackish Wetland (EVC 656).

The patch of Coastal Saltmarsh was observed along the northern boundaries of the proposed offset site. The vegetation was in low-moderate condition and predominantly comprised Beaded Glasswort in the ground layer, as well as specimens of Australian Salt-grass, Rounded Noon-flower and Austral Seablite.

Approximately 1.9 hectares of Growling Grass Frog habitat is currently present within the offset area, it is proposed to be retained and enhanced as part of the proposed action. This habitat includes some low-quality terrestrial dispersal habitat comprised of Coastal Saltmarsh (EVC 9) and improved pasture in a paddock. Some exposed rock and debris in retained habitat may provide basking and overwintering opportunities for the species.

4.3 Offset Strategy

The following section summarises offset requirements for the impacts site and indicates how Commonwealth offset requirements will be met.

The quantity and location of offsets identified to compensate for losses associated with Matters of NES is summaries below (Table 2).

Table 2. Offsets associated with Matters of NES

Matter of NES	Losses	Offset Target	Location
Growling Grass Frog habitat	16.502 hectares	*In-situ* 8.21 hectares	78-88 Groves Road, Armstrong Creek, Victoria

4.3.1 Environment Protection and Biodiversity Conservation Act 1999 Offsets Policy

The EPBC Act offset calculator was also employed when considering overall offset targets (Appendix 2). The assumptions used to populate the EPBC Act offset calculator for the site are presented below (Table 3).

***In-situ* Growling Grass Frog offset site**

Based on the EPBC Act offset calculator (DSEWPaC 2012a), the protection and management of 8.2 hectares of Growling Grass Frog habitat within the proposed offset site as an offset mitigates 133.86% - 181.52% of the impact of the removal of 16.502 hectares of Growling Grass Frog habitat (Table 3) (Appendix 2). As such, 133.86% - 181.52% of the offset requirements will be met through direct offsets which is in accordance with the Commonwealth environmental offset policy (DSEWPaC 2012b).

Table 3. EPBC Act Offset Calculator (Growling Grass Frog)

Offset Criteria	Response
Impact Site	
Impact Location	78-88 Groves Road, Armstrong Creek
Habitat to be removed	16.502 hectares of Growling Grass Frog habitat
Habitat quality	15.71 hectares of terrestrial dispersal habitat in total assigned a starting quality of 1/10. 0.58 hectares of aquatic habitat in total assigned a starting quality of 3/10 0.22 hectares of potential breeding aquatic habitat assigned a starting quality of 5/10. <u>Terrestrial dispersal habitat</u> *Site condition:* 0/3, the Growling Grass Frog habitat to be removed is of low quality. Terrestrial dispersal habitat within the entire property is uniformly low-quality and predominantly consists of pasture grass and areas of bare ground subject to regular pugging due to the presence of stock. The site is frequently grazed by heavy stock and contains several sheds and outbuildings for farming operations. The northern section of the site contains areas of native vegetation representative of Coastal Saltmarsh, however this native vegetation will be retained. Much of the foraging and dispersal habitat contains of a high cover (>80%) of exotic grass and herb species, planted vegetation and weeds. The study area is a disturbed area, dominated by environmental weeds such as such as Toowoomba Canary-grass *Phalaris aquatica*, Ribwort *Plantago lanceolata*, Couch *Cynodon dactylon* var. *dactylon* and Kikuyu *Cenchrus clandestinus*. Noxious weeds, as defined under the CaLP Act, were prevalent throughout these areas, with Artichoke Thistle *Cynara cardunculus*, Spear Thistle *Cirsium vulgare* and African Boxthorn *Lycium ferocissimum* dominating the ground layer throughout the northern areas. Bathurst Burr *Xanthium spinosum* and Variegated Thistle *Silybum marianum* were also present in patches of moderate density. African Boxthorn is also a Weed of National Significance (WoNS).

Offset Criteria	Response
	Site context: 1/3, The site is located adjacent to several small-scale farming operations, with this land proposed for residential subdivision over the coming years. The site is approximately 1 kilometre south of the Sparrovale wetland site which contains a known population of Growling Grass Frog, while the species is also known to occur in proximity (within approximately 100m) to the study area in the south in nearby Baenches Wetland (Shannon LeBel pers comms). The study area currently provides some opportunities for Growling Grass Frog dispersal through vegetated corridors, despite its highly modified nature. *Species stocking rate:* 0/4, While the overall site contains a confirmed two individuals, no individuals were recorded using the terrestrial dispersal habitat. The species was detected on one occasion within one of the three effluent ponds during targeted surveys three surveys nights between 18 – 29 November 2021 (Ecology and Heritage Partners 2021a). While potential breeding habitat is present in these waterbodies, no evidence of breeding was recorded (e.g. tadpoles). Specifically, individuals utilising aquatic habitat within the site are highly unlikely to occupy the low-quality terrestrial habitat for any purpose other than direct movement between areas of aquatic habitat within and adjacent to the site. This view is informed by the absence of most requisite Growling Grass Frog habitat characteristics from the terrestrial habitat (i.e. minimal protective cover, large areas of pugging and bare ground, etc.) and the presence of higher quality terrestrial habitat in adjacent areas (i.e. Sparrovale and Baenches Wetlands)(Ecology and Heritage Partners 2023c). Higher relative quality aquatic and terrestrial habitat for Growling Grass Frog is present in areas adjacent to the study area, including in Sparrovale and Baenches Wetlands. These areas contain large ephemeral and permanent waterbodies as well as terrestrial areas, all of which is currently managed for weed reduction, habitat improvement and restoration of floristic diversity and structural complexity, among other actions (CoGG 2020). Further, aquatic and terrestrial habitat are considered functionally separate as each habitat type is typically utilised differently by the species (e.g. time of year, functional purpose). For example, it holds true for Growling Grass Frog habitat generally, that aquatic habitat is used by the species almost exclusively during the breeding season, and only for basking, calling and potentially breeding purposes (Cogger 2000). Conversely, terrestrial habitat is used primarily for dispersal during the breeding season, and potentially for occasional foraging and protective habitat, while it may also be used as a refuge in the overwintering period during torpor (Cogger 2000; NSW DEC 2005). Finally, in relation to the site, there are little to no habitat characteristics shared by both the aquatic and terrestrial habitat areas present. The species stocking rate for terrestrial dispersal habitat is derived from the extent to which the species is likely to occupy terrestrial habitat and the results of the targeted surveys in terrestrial habitat. Given the low-quality of the terrestrial habitat present (i.e. presence of pugging, high weed coverage, large distance between waterbodies, etc.) and presence of higher quality and relative undisturbed terrestrial habitat in adjacent areas (i.e. Sparrovale and Baenches Wetlands), Growling Grass Frog individuals are highly unlikely to regularly use or dwell in this habitat. Further, no individuals were recorded using terrestrial dispersal habitat at any stage during targeted surveys. In this context, and in the absence of a local population (breeding or otherwise), a total stocking rate score of 0 for terrestrial habitat is appropriate. <u>Aquatic habitat (effluent pond 2)</u> *Site condition:* 1/3, the aquatic Growling Grass Frog habitat to be removed is of low-moderate quality. The waterbody is surrounded by Rushes and Sedges, with a low percentage of emergent and floating vegetation also present. The water was deep and turbid. A number of rocks were observed along the banks, which would provide areas of refuge for the Growling Grass Frog. However, the site was heavily pugged due to the use of the site as a watering hole for a large herd of cattle. *Site context:* 1/3, The site is located approximately 1 kilometre south of the Sparrovale wetland site which contains a known population of Growling Grass Frog, while the species is also known to occur to the south of the study area in Baenches Wetland. The study area currently provides

Offset Criteria	Response
	some opportunities for Growling Grass Frog dispersal through vegetated corridors, despite its highly modified nature. *Species stocking rate:* 2/4, The overall site contains a confirmed two individuals. The species was detected on one occasion at one of the three effluent ponds during targeted surveys three surveys nights between 18 – 29 November 2021 (Ecology and Heritage Partners 2021a). While potential breeding habitat is present in these waterbodies, no evidence of breeding was recorded (e.g. tadpoles). Given the survey effort, evidence of a Growling Grass Frog breeding population would be expected to be recorded on at least one of the survey nights (i.e. multiple observations of multiple animals, or identifiable breeding activity to give an indication of abundance in order to justify a higher category of stocking rate. In the absence of a local population (breeding or otherwise), the highly degraded quality of effluent pond 2 aquatic habitat is also considered to inhibit the total stocking rate. <u>Potential breeding aquatic habitat (effluent pond 1)</u> *Site condition:* 3/3, the aquatic Growling Grass Frog habitat to be removed is of moderate-high quality. The area was fenced off from cattle and was significantly less disturbed than other aquatic habitat at the site. The entire edge of the pond was fringed by Rushes *Juncus* spp. and Sedges *Carex* spp., while small patches of planted vegetation also occurred near the water's edge. The water was relatively deep and turbid with some floating vegetation and red algal blooms present on the surface. *Site context:* 1/3, The site is located approximately 1 kilometre south of the Sparrovale wetland site which contains a known population of Growling Grass Frog, while the species is also known to occur to the south of the study area in Baenches Wetland. The study area currently provides some opportunities for Growling Grass Frog dispersal through aquatic habitat and vegetated corridors. *Species stocking rate:* 2/4, The site contains a confirmed two individuals. The species was detected on one occasion at Effluent Pond 1 during targeted surveys three surveys nights between 18 – 29 November 2021 (Ecology and Heritage Partners 2021a). While potential breeding habitat is present in these waterbodies, no evidence of breeding was recorded (e.g. tadpoles). Given the survey effort, evidence of a Growling Grass Frog breeding population would be expected to be recorded on at least one of the survey nights (i.e. multiple observations of multiple animals, or identifiable breeding activity to give an indication of abundance in order to justify a higher category of stocking rate.
Offset Site	
Offset location	78-88 Groves Road, Armstrong Creek
Risk-related time horizon	20 years. The land will be managed in perpetuity for conservation purposes for Growling Grass Frog.
Time until ecological benefit	10 years. The existing habitat condition is expected to be improved over the 10-year active management schedule detailed in the Offset Management Plan.
Start area and quality of offset site	1.9 hectares in total, assigned a starting quality of 1/10. *Site condition:* 0/3, The offset site comprises 1.2 hectares of uniformly low-quality potential terrestrial dispersal habitat. Terrestrial dispersal habitat predominantly consists of pasture grass and areas of bare ground subject to regular pugging due to the presence of stock. The site is frequently grazed by heavy stock and contains several sheds and outbuildings for farming operations. A small patch of Coastal Saltmarsh (EVC 9) is also present. The remaining 7 hectares on site comprises a high cover (>80%) of exotic grass and herb species, planted vegetation and weeds. The study area is a disturbed area, dominated by environmental weeds such as such as Toowoomba Canary-grass *Phalaris aquatica*, Ribwort *Plantago lanceolata*, Couch *Cynodon dactylon* var. *dactylon* and Kikuyu *Cenchrus clandestinus*. Noxious weeds, as defined under the CaLP Act, were prevalent throughout these areas, with Artichoke Thistle

Offset Criteria	Response
	Cynara cardunculus, Spear Thistle *Cirsium vulgare* and African Boxthorn *Lycium ferocissimum* dominating the ground layer throughout the northern areas. Bathurst Burr *Xanthium spinosum* and Variegated Thistle *Silybum marianum* were also present in patches of moderate density. African Boxthorn is also a Weed of National Significance (WoNS). *Site Context:* 1/3, The site is located adjacent to several small-scale farming operations, with this land proposed for residential subdivision over the coming years. The site is approximately 1 kilometre south of the Sparrovale wetland site which contains a known population of Growling Grass Frog, while the species is also known to occur in proximity (within approximately 100m) to the study area in the south in nearby Baenches Wetland (Shannon LeBel pers comms). These wetlands form part of a wider complex of wetlands, part of which is Ramsar listed. The study area currently provides some opportunities for Growling Grass Frog dispersal through vegetated corridors, despite its highly modified nature. *Species stocking rate:* 0/4, While the overall site contains a confirmed two individuals (>200 metres west of the offset area), no individuals were recorded using the terrestrial dispersal habitat in the offset area. The species was detected on one occasion at one of the three effluent ponds during targeted surveys three surveys nights between 18 – 29 November 2021 (Ecology and Heritage Partners 2021a). While potential breeding habitat is present in these waterbodies, no evidence of breeding was recorded (e.g. tadpoles). Specifically, individuals utilising aquatic habitat within the site are highly unlikely to occupy the low-quality terrestrial habitat for any purpose other than direct movement between areas of aquatic habitat within and adjacent to the site. This view is informed by the absence of most requisite Growling Grass Frog habitat characteristics from the terrestrial habitat (i.e. minimal protective cover, large areas of pugging and bare ground, etc.) and the presence of higher quality terrestrial habitat in adjacent areas (i.e. Sparrovale and Baenches Wetlands)(Ecology and Heritage Partners 2023c). Higher relative quality aquatic and terrestrial habitat for Growling Grass Frog is present in areas adjacent to the study area, including in Sparrovale and Baenches Wetlands. These areas contain large ephemeral and permanent waterbodies as well as terrestrial areas, all of which is currently managed for weed reduction, habitat improvement and restoration of floristic diversity and structural complexity, among other actions (CoGG 2020). Further, aquatic and terrestrial habitat are considered functionally separate as each habitat type is typically utilised differently by the species (e.g. time of year, functional purpose). For example, it holds true for Growling Grass Frog habitat generally, that aquatic habitat is used by the species almost exclusively during the breeding season, and only for basking, calling and potentially breeding purposes (Cogger 2000). Conversely, terrestrial habitat is used primarily for dispersal during the breeding season, and potentially for occasional foraging and protective habitat, while it may also be used as a refuge in the overwintering period during torpor (Cogger 2000; NSW DEC 2005). Finally, in relation to the site, there are little to no habitat characteristics shared by both the aquatic and terrestrial habitat areas present. The species stocking rate for terrestrial dispersal habitat is derived from the extent to which the species is likely to occupy terrestrial habitat and the results of the targeted surveys in terrestrial habitat. Given the low-quality of the terrestrial habitat present (i.e. presence of pugging, high weed coverage, large distance between waterbodies, etc.) and presence of higher quality and relative undisturbed terrestrial habitat in adjacent areas (i.e. Sparrovale and Baenches Wetlands), Growling Grass Frog individuals are highly unlikely to regularly use or dwell in this habitat. Further, no individuals were recorded using terrestrial dispersal habitat at any stage during targeted surveys. In this context, and in the absence of a local population (breeding or otherwise), a total stocking rate score of 0 for terrestrial habitat is appropriate.
Risk of loss without offset	0%. An Environmental Significance Overlay (ESO) currently covers much of the proposed offset site. Risk of loss by human causes is low.

Offset Criteria	Response
	A protective covenant provides legal protection, averting this risk of habitat being degraded, depleted or the population within the site being lost.
Future quality without offset	1/10. Without protection as an offset site there is uncertainty about the future condition of the land. Without management as an offset, the site will remain low-quality potential terrestrial dispersal habitat, with the potential for reduction in quality over time due to continuing weed encroachment and the presence of introduced predators and large herbivores.
Risk of loss with offset	0%. There is a 0% chance that the Growling Grass Frog habitat will be lost with the offset being protected and managed in accordance with the OMP placed on-title. Further, the availability of Growling Grass Frog habitat adjacent to the offset site consolidates habitat within the property.
Future quality with offset	Terrestrial habitat 5/10. There is a high level of confidence that the future quality of the Growling Grass Frog Offset will increase through the active implementation of various actions outlined in the OMP. There is a high likelihood that the management actions provided in the OMP will lead to an increase in the species' habitat quality, site occupancy and population size. Terrestrial habitat will be improved through several management actions, including the placement of woody debris and planting of native vegetation structured to provide suitable protective habitat for the species. Protective habitat will be essential for creating refuges from predators for Growling Grass Frog as individuals disperse between constructed waterbodies and existing Baenches and Sparrovale wetlands. Terrestrial habitat will remain free of noxious weeds as outlined in Section 5.6.9, while basking opportunities will be provided in the form of exposed rock. This represents a significant improvement on current conditions, which currently provide very few refuge and basking opportunities for the species. Due to the commitment of the landowner and investment in the active management of the site these factors provide a high level of confidence that the future quality of the offset will increase (i.e. a score of six is realistic). Aquatic habitat 6/10. The effects of drought (e.g. drying out of breeding wetlands) within the offset site is a potential risk to the future habitat quality at the site. The potential impacts of drought on the quality of proposed aquatic habitat is dependent upon the duration of the drought event. The likelihood is considered moderate with an event causing potential significant detrimental impact upon both the Growling Grass Frog population and habitat. The effects of drought will be mitigated through the multifaceted water delivery system (e.g. Balog Channel water (filtered through silt fencing to exclude Eastern Gambusia), groundwater, rainwater, and recycled water). Further risks associated with the presence of pests and predators (i.e. Eastern Gambusia) within the offset site will be managed to minimise the risk of loss. Due to the commitment of the landowner and investment in the active management of the site these factors provide a high level of confidence that the future quality of the offset will increase (i.e. a score of eight is realistic). The offset site is to be secured and managed for conservation purposes in perpetuity, with implementation of a management plan incorporating weed control, predator and large herbivore control and regular monitoring, aiming to enhance native biodiversity.

Offset Criteria	Response
	Site condition: 2/3, Construction of two wetlands containing high-quality potential breeding habitat for the species will significantly increase the likelihood for the presence of a breeding population. Starting level of weeds present at the site are high with several high threat weeds identified in high abundance. Targeted control measures proposed within this OMP will manage both woody and herbaceous weeds through hand pulling and spot-spraying (Section 5.6.9). Targeted control of introduced predators including Eastern Gambusia, Feral Cats and Red Fox will reduce the threat of predation for the species. *Site Context:* 2/3, The overall context of the site is likely to improve if an offset is established. Adjacent areas contain established habitat for Growling Grass Frog. The site will significantly improve connectivity and potentially increase the size of the breeding population in the wider area. *Species stocking rate:* 2/4, Construction of two wetlands containing high-quality potential breeding habitat for the species will significantly increase the likelihood for the presence of a breeding population. A population of >15 is anticipated within 2 years of the first breeding season. Targeted control of introduced predators including Eastern Gambusia, Feral Cats and Red Fox will reduce the threat of predation for the species. Removal of heavy stock reduces the impact of pugging and soil compaction required to sustain suitable terrestrial dispersal habitat for a healthy population of Growling Grass Frog. Ongoing monitoring will be undertaken for the Growling Grass Frog population within the site during years 1, 2, 3, 4, 5 and 10 of the OMP (Section 5.7.1). The construction of high-quality terrestrial and aquatic habitat through the implementation of the OMP will be the primary measure implemented to improve the species stocking rate.
Confidence in result	80%. Confidence in applied scores is relatively high due to careful consideration of the offset site, existing condition and relatively low threat from external impacts. The site will initially be protected via Section 173 agreement and ultimately a Trust for Nature Covenant under the *Victorian Conservation Trust Act 1972* within 1-2 years of project approval. Trust for Nature and DCCEEW undertake reviews for all offset sites to ensure the landowner agreements address the management commitments on the plan.
% of impact offset off-site	133.86% - 181.52%

5 OFFSET IMPLEMENTATION

This section outlines the management actions necessary to implement this OMP and construct and enhance Growling Grass Frog habitat on site. This OMP details management activities over a ten-year period from the completion of construction at Groves Road following the completion of the Growling Grass Frog constructed habitat. This OMP aims to create and enhance Growling Grass Frog habitat through on ground actions, and must meet the targets outlined in this OMP.

5.1 Management Objectives and Strategy

The offset site will be managed for the purposes of conservation and will involve physical protection of the Growling Grass Frog habitat, the control of pest animals and environmental weeds, and general maintenance of the character and quality of the habitat.

The offset site will be protected initially via a Section 173 agreement with the intention to ultimately secure the site via a Trust for Nature Covenant. Security, management and monitoring responsibilities are summarised below (Table 4).

This OMP requires the landowner to manage the offset site in accordance with the requirements detailed herein. This OMP relates solely to the 8.2 hectares of Growling Grass Frog habitat proposed for construction (Figure 1), and includes actions related to the ongoing monitoring and management of this habitat.

Table 4. Security and Management Responsibility

Offset Security and Management Responsibility	
Who is liable/responsible for meeting offset requirements?	AC Manager Pty Ltd
Type of security mechanism	Section 173 initiated with Council upon project approval. Trust for Nature Covenant within 1-2 years of project approval
Agreement or Planning Permit Number (ID)	TBC
Date 10-year offset management to commence	Upon completion of the constructed habitat and commencement of residential construction
Date for targets and performance indicators within this management plan to be met	Ten years following commencement of OMP, or otherwise as specified within this plan (whichever occurs first)
Management of site following 10-year anniversary of this plan	Maintain habitat values at, or above, conditions achieved upon 10-year anniversary
Offset site management responsibility (i.e. Landowner, Authority Name)	Landowner
Offset Monitoring Responsibility (i.e. Responsible Authority)	Landowner, DEECA, DCCEEW and TfN

5.2 Growling Grass Frog

This OMP has been formulated to address the species threats outlined within the National Recovery Plan for the species (Clemann and Gillespie 2012):

- Loss and degradation of habitat, including due to expanding urban and industrial development, especially throughout Melbourne's urban growth area. Draining and degradation of coastal wetlands is a major threat;
- Barriers to movement created by human-induced changes to landscapes such as fences, roads and unsuitable habitat (e.g., industrial and urban estates);
- Disease such as chytridiomycosis is highly likely to have played a key role in losses of this species;
- Predation by Eastern Gambusia *Gambusia Holbrook* is a known high-risk factor for eggs and tadpoles; and,
- Herbicide has been implicated in the decline of at least some populations of the species.

5.2.1 Threats specific to Growling Grass Frog

Potential threatening processes for Growling Grass Frog resulting from the proposed development come from two main sources: impacts from construction activities (including removal of known habitat), and impacts resulting from the construction of a potential barrier to movement between habitat within the study area and potential habitat in Sparrovale wetlands and drainage lines to the north.

There are a number of key threats to Growling Grass Frog, as identified in the National Recovery Plan for the species (Table 5)(Clemann and Gillespie 2012) and addresses the management action that will be applied to the offset site to mitigate each threat. Further details regarding each mitigation measure are provided in this report (Section 5.6), including a table of recommended management actions for each year (Section 5.8).

Table 5. Mitigation measures applied to address key threats to Growling Grass Frog identified by the National Recovery Plan (Clemann and Gillespie 2012)

Key threats to Growling Grass Frog (Clemann and Gillespie 2012)	Mitigation measure
Loss and degradation of habitat	A Weed Management Plan will be prepared to identify potential threats associated with pest plant species, that may impact environmental values within the study area. The Weed Management Plan will provide appropriate management actions to address weed infestations and vertebrate pest species, to ensure environmental values within the offset site are maintained and enhanced. Noise from building and other works relating to the development will comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works may not emit excessive or offensive noise. Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species. There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution.

Key threats to Growling Grass Frog (Clemann and Gillespie 2012)	Mitigation measure
	The following procedure will be undertaken to prevent erosion and sedimentation: • Installation and routine maintenance of sediment and erosion controls in key areas; • Installation of rock banks, boulders and logs to stabilise soils in affected areas; and, • Increase maintenance and monitoring operations in affected areas until problem areas are improved.
Barriers to movement	The placement of walking and/or bicycle paths and trails will be prohibited within the 'no impact' buffer zone within the existing Growling Grass Frog and proposed constructed habitat to minimise human disturbance in these areas. Construction activities must also be restricted in known habitat areas to minimise human and vehicular disturbance during the development study area. An exclusion zone will be implemented around the constructed wetlands to protect the core Growling Grass Frog habitat on site. The offset site is not adjacent to any busy roads or other significant barriers to nearby habitat (e.g. Sparrovale and Baenches wetlands).
Disease	Human activities and movements can exacerbate the risk of disease spread, and as such hygiene protocols for vehicles, equipment, footwear, handling, holding and transporting of frogs and tadpoles are paramount. hygiene protocols will be implemented throughout the construction works. The Hygiene Protocol (Murray et.al. 2011) will be used to guide best practice Chytrid management. Further detail is provided in Section 5.6.7.
Predation	The entire constructed wetland habitat and surrounding 50 metre terrestrial buffer will be appropriately fenced to exclude public access and avoid unrestrained access into the offset area by dogs and their owners. Red Fox is likely to move through the study area. The species is known to hunt and eat adult members of the bell frog species complex. Feral Animal Control measures will be considered for development in the study area to reduce the population size of foxes. In areas that are subject to routine flooding, where the incursion of fish is unavoidable, the provision and maintenance of dense submerged and floating aquatic vegetation can increase Growling Grass Frog recruitment and survival rates by providing a greater amount of submerged cover for eggs and tadpoles. If Eastern Gambusia is observed within the constructed waterbodies, the protocols will be implemented that may include draining the wetland outside of the Growling Grass Frog active season (i.e. Spring and Summer) to remove this species from the wetland system.
Chemicals and Herbicide	All stormwater flow and discharge from the surrounding area will be directed away from the site to ensure that there is no negative impact to water quality or that external contaminants are inadvertently introduced to the constructed wetlands. The following procedure will be undertaken in the event of chemical influx following flood events: • Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc.; • Chemical treatments (for rectifying acidity or alkalinity); and, • Inspection of all drainage points leading to the waterbody for chemical spills, leaks, and rectify where necessary.

5.2.2 *Alignment of the proposed constructed habitat with the Growling Grass Frog Habitat Design Standards (DELWP 2017)*

The degree to which proposed constructed habitat in the proposed offset area meets the *Growling Grass Frog Habitat Design Standards* is provided below (Table 6).

Table 6. Adherence to Growling Grass Frog Habitat Design Standards (DELWP 2017)

Masterplan habitat standards	Constructed Habitat	Comments
Wetland clusters (nodes)		
Clusters contain at least 10 off-stream wetlands (including existing wetlands)	No	There is insufficient space for 10 off-stream wetlands. However the two constructed wetlands are proposed to link larger clusters of wetlands in neighbouring Baenches and Sparrovale Wetlands.
Wetlands less than 200-300 m apart	Yes	-
75% of wetlands should have a permanent hydroperiod (particularly Sept to Feb)	Yes	-
Variety of wetland types within a cluster	Yes	-
50% of wetlands to be 'anti-chytrid' (high rock cover, warm shallows, moderate salinity)	Likely	The aim is to achieve this standard, however will be a function of ongoing management.
All wetlands offline (i.e. except during 'exceptional' floods)	Yes	-
Wetland size and morphology		
Area of most created wetlands must be at least 0.3 ha; where space is limited, wetlands to be at least 0.15 ha (in all cases submergent zone must be at least 0.1 ha)	Yes	-
At least one wetland should be large (>0.7 ha)	Yes	-
All wetlands must have a deep water zone (maintained at greater than 1.5 m deep) of at least 50% of surface area	Yes	-
Emergent vegetation zone of 30-40%, and should include a littoral zone with fluctuating water levels	Yes	-
Incorporate a variety of slopes in banks	Yes	-
Wetlands lined (e.g. clay liner) to prevent leakage, with soil over the liner	Yes	-
Hydroperiod		

Masterplan habitat standards	Constructed Habitat	Comments
75% of wetlands in a cluster to have a permanent hydroperiod; all wetlands should hold water between Sept. to Feb.	Likely	Wetlands likely to have a permanent hydroperiod due to reliable water source (i.e. Balog Channel water (filtered through silt fencing to exclude Eastern Gambusia), groundwater, rainwater and recycled water from the residential development). Monitoring to ensure water levels do not drop below 0.5 metres.
Created wetlands designed to be able to be dried out (drained)	Yes	-
Thermal properties		
Wetlands to incorporate an extensive shallow, permanently inundated zone	Yes	-
Wetlands incorporate rock piles around at least 20% of margin, extending into water	Yes	-
'Anti-chytrid' wetlands to have c. 50% rock cover	Yes	-
Aquatic vegetation		
Planting density to establish c. 50% submergent/floating cover within 2-3 years	Likely	Intention is meet this standard but depends on performance over period.
Diverse vegetation established, in line with Growling Grass Frog planting species list	Yes	-
Water quality		
pH between 6.0 and 8.5	Likely	Intention is meet this standard but depends on performance over period.
Salinity up to c. 5.0 mS/cm	Likely	Intention is meet this standard but depends on performance over period.
Turbidity <40	Likely	Intention is meet this standard but depends on performance over period.
Terrestrial habitat		
A minimum 50 m buffer of wetlands from development (i.e. roads/buildings)	Yes	-
Shared use paths and minor infrastructure (e.g. passive recreation) must not be constructed closer than 30 m from wetland	Yes	-
c. 50% of area within 10 m of wetlands to be low grassy vegetation to 10 cm height; ≤20% cover of tussock-forming graminoids	Yes	-
Rock piles established around wetlands	Yes	-
No mulch within 50 m of a wetland	Yes	-
No trees or shrubs within 10 m; < 10% cover of trees/shrubs within 100 m of wetlands	Yes	-

Masterplan habitat standards	Constructed Habitat	Comments
The area between 10 m and 100 m should primarily have an open structure (e.g. short mown grass) with scattered denser plantings of tussock-forming vegetation	Yes (although some buffer <100m wide)	-
Other		
Inclusion of a fish exclusion filter between Growling Grass Frog wetlands and water source(s)	Yes	-
Groundwater is generally the preferred water source	Yes	However, wetlands will also use rainwater and local recycled water as supplementary water sources.

5.3 Compliance with Offset Principles

The 'Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy' (DSEWPaC 2012a) outlines a set of principles that a proposed offset must meet in order to be assessed under the referral process. These principles are detailed in Section 7 of the Preliminary Documentation (Ecology and Heritage Partners 2023a), along with how the proposed first-party offset site meets these requirements.

5.4 Offset Targets

The EPBC Act offsets policy (DSEWPaC 2012a) provides the details of the offsetting approach for Matters of NES; this includes an Offset Assessment Guide and offset calculator.

The Offset Assessment Guide offset calculator has been completed to determine the area of offset required to adequately compensate for the removal of the Growling Grass Frog habitat at the development site. The Offset Assessment Guide offset calculator is provided in Appendix 2, and a justification for the scores given in Section 4.3.

5.5 Ongoing Land-use Commitments

At the end of the 10-year management period, the offset site will be required to be managed in perpetuity by the landowner. After the 10-year management period, the management plan may be updated with the knowledge gained over the 10-year management period by the landowner, to ensure the Growling Grass Frog habitat can be best maintained.

Ongoing management actions after the 10-year management period are likely to be limited to:

- Standard ongoing vegetation management practices, including:
- Regular mowing of grassy areas (Section 5.2).
- Controlling significant weeds (Section 5.6.9).
- Replacing inappropriate plants, and dead or dying plants (Section 5.6.2).

Infrequent management only of wetlands where required, such as:

- Water level management in the constructed wetlands (Section 5.6.6).
- Water quality monitoring and management (Section 5.7.4).
- Controlling invasive fish in constructed wetlands, most likely after major flood events (i.e. 1 in 10-year floods when banks are overtopped) (Section 5.6.8).

5.6 Management Actions

Implementation of this OMP is the overall responsibility of the landowners. However, direct management responsibility may be delegated to a designated site manager and/or managing ecologist with annual reports submitted to TfN, DCCEEW and AC Manager Pty Ltd.

Management actions detailed in this OMP will commence from the date the Section 173 agreement or Trust for Nature Covenant is registered on-title. A breakdown of management actions required over the mandatory 10-year active management period is provided in this report (Section 5.8). Following the 10-year active management period, the landowner will continue to manage the offset site as specified in this plan (Section 5.5).

Funding for undertaking security, management and monitoring actions prescribed in this OMP has been agreed between the landowner and will ultimately be held by Trust for Nature.

Any proposed uses or development of the offset site which conflict with the landowner's commitments are not permitted under this plan. The sensitivities of the offset site must be considered with all management actions and all contractors entering the offset site need to be made aware of its ecological values.

The management and monitoring actions detailed in this OMP have been developed in accordance with the following legislations and/or policies:

- *Environment Protection and Biodiversity Conservation) Act 1999;*
- *Flora and Fauna Guarantee Act 1988* (FFG Act)*;*
- *Catchment and Land Protection Act 1994* (CaLP Act)*;*
- Commonwealth's Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DoEE 2016); and,
- National Recovery Plan for the Southern Bell Frog *Litoria raniformis* (Clemann and Gillespie 2012).

This OMP addresses demonstrated threats by including management actions aimed at reducing their likelihood, and establishing habitat corridors and connectivity between potentially fragmented populations of the species.

5.6.1 Proposed Habitat Creation

Growling Grass Frog habitat creation will be achieved through the provision of the following:

- The creation of one large and one smaller wetland waterbodies (Figure 3);

- The preparation of a Landscape Masterplan by a qualified wetland revegetation specialist and the project zoologist. The Landscape Masterplan provides a detailed account of all habitat improvement works within the No-Go-Area;
- Include rock mattresses, covering minimum 20% of the bank area, as refuge and overwintering sites around the wetland margin (Figure 3); and
- Weed and pest animal control.

No-Go areas will be established in existing Growling Grass Frog habitat prior to its removal and created habitat prior to, during and post-created habitat construction. All habitat improvement works within the No-Go-Area will be undertaken by a qualified and experienced wetland revegetation specialist / contractor in accordance with the provisions of this OMP and an approved Landscape Masterplan. There will be ongoing management of threatening processes such as weed and pest animal control, and there will be no introduction of predatory species to created habitat.

Offset areas will include the provision of terrestrial habitat (rock, logs and other ground debris) and aquatic habitat (aquatic vegetation). Habitat creation within and directly surrounding the wetland will also provide direct connection of suitable habitat between constructed wetland habitat, Baenches wetland and Sparrovale wetland.

As indigenous flora provides valuable habitat for indigenous fauna, any landscape plantings that are undertaken as part of the proposed works will be conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs. The *Growling Grass Frog Habitat Design Standards* has been reviewed to provide a list of suitable species to be used when establishing vegetation within the Growling Grass Frog habitat (DELWP 2017). Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out ponds, thus potentially rendering them unsuitable for the species and providing vantage points for predatory birds.

Creation of Dedicated Growling Grass Frog Wetlands

The clustering of waterbodies is an important factor in allowing Growling Grass Frog to move between waterbodies when water conditions change, and it has been shown that the likelihood of frogs occupying a particular waterbody is largely dependent upon the distance to a nearby occupied site (Hamer and Organ 2006). A development plan and Landscape Masterplan will be prepared as part of the planning permit application for the proposed development, and these plans include the provision of a series of two permanent wetlands on the eastern boundary of the study area. Habitat creation will involve the construction of Growling Grass Frog wetlands covering a total area of approximately one hectare near a focal population so that new populations can colonise and persist in these areas. Emphasis has been placed on the quality of the habitat within the corridor, which extends approximately 220 meters from the northern boundary to the southern boundary (Figure 3).

The creation of the dedicated wetlands will provide breeding and dispersal opportunities for the species, thus ensuring future dispersal connectivity for the known population through the study area between Sparrovale wetland to the north and Baenches wetland to the south of the site. The habitat design will broadly conform with the *Growling Grass Frog habitat design standards* (DELWP 2017).

The dedicated Growling Grass Frog breeding wetlands identified in Figure 3 must be:

- Designed to permanently contain water utilising Balog Channel water (filtered through silt fencing to exclude Eastern Gambusia), groundwater, rainwater and recycled water from the residential development (once completed);
- Supplied with the best feasible water quality consistent with the Growling Grass Frog Habitat Design Standards (DELWP 2017);
- Able to sustain appropriate vegetation to provide habitat (see below);
- Will be clay-lined to retain water with a loamy or sand-substrate topsoil;
- Include rock mattresses, covering minimum 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins (Plate 1, Figure 3);
- Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out wetlands, thus potentially rendering them unsuitable for the species;
- Designed, constructed and managed so that they predominantly comprise open water low water turbidity, be still, and have low nitrate, phosphate, and salinity levels; and,
- Be able to be drained via an effective and straightforward drainage mechanism (if constraints such as topography allow). Water will be pumped out using a 150 millimetre diesel pump across approximately two days..

A typical arrangement of a Growling Grass Frog wetland is provided below (Plate 1). All Growling Grass Frog wetlands will contain appropriate water levels (i.e. some wetlands with permanent water and others with variable water levels) and be constructed between 1.5 metres and 4 metres (ideally) in depth. The maximum depth will vary between wetlands depending upon the local topography constraints.

A water balance (including inflows, outflows, evaporation etc.) must be undertaken for each Growling Grass Frog wetland to determine the required depth of the open water area. The water balance will be based on historical rainfall simulation modelling over a 10-year period (i.e. 2010-2020). The minimum operating depth must be 1.5 metres over 50% of the total wetland surface area.

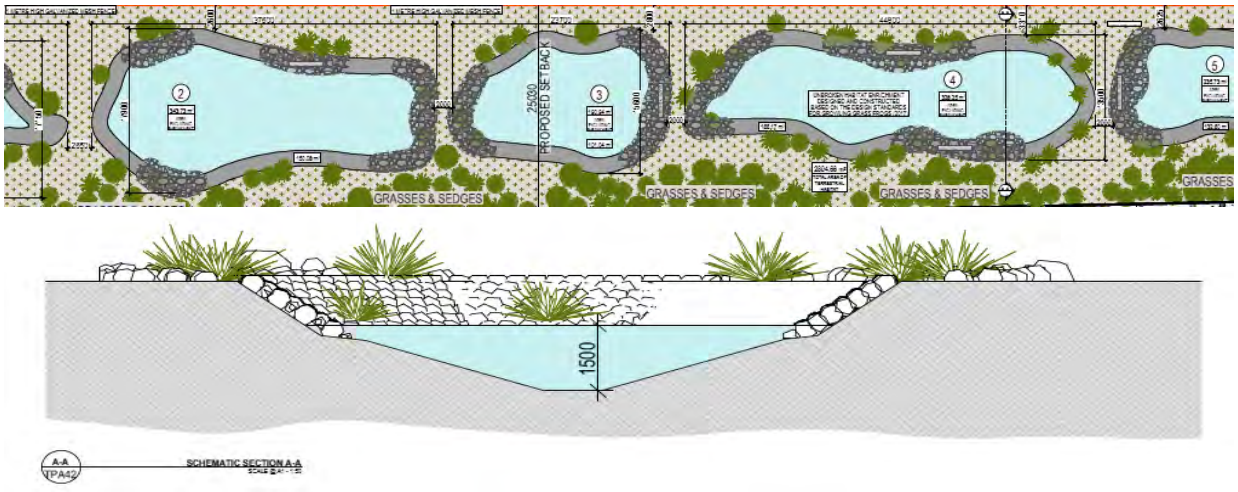

Plate 1. Example of a typical Growling Grass Frog wetland arrangement, including rocky areas located between and around the perimeter of a wetland extending into the aquatic habitat

Growling Grass Frog wetlands are required to support an extensive cover of aquatic and semi-aquatic vegetation, specifically to cater for an extant breeding population of Growling Grass Frog and to ensure that there is sufficient nutrient uptake to enhance water quality in wetlands. To achieve these habitat requirements, in each Growling Grass Frog wetland there will be three distinct zones (as shown in Plate 2):

- Zone 1: Littoral/ Ephemeral Wetland Zone: This zone incorporates the terrestrial planting area. Here the aim is to establish a moderate percentage cover of vegetation with bare ground areas for frog refuge occupying the margins of the wetland. The margins will remain dry for extended periods, whilst the littoral/ephemeral zone will be subject to periodic inundation, and therefore must support plants able to tolerate wet conditions. A study by Heard *et al.* (2008) recorded most frogs perching on bare soil, rocks and leaf litter near the water's edge, with few occupying terrestrial vegetation stands. Their results indicated a preference for a low structural diversity in the vertical plane of terrestrial microhabitats. This zone will be created to incorporate the following structural features based on known sites where the species occurs:
    - A minimum width of five metres of ephemeral wetland zone will be created;
    - A minimum topsoil depth of 150 mm within all wetland planting areas;
    - The planting area will contain floristically diverse and structurally similar vegetation planted at a nominal density of six individuals per square metre with the provision for areas of bare ground between plantings;
    - Plant species will reflect the Wet Verge Sedgeland Ecological Vegetation Class (EVC 932) and include, where appropriate, native vegetation including Common Spike-sedge (in low densities to prevent spreading), rushes *Juncus* spp and Tussock Grasses *Poa* spp. High density planting is not encouraged as Growling Grass Frog seek refuge under rocks and timber debris;
    - A selection of large concave (300-1,500 mm diameter) and small (3-5 boulders/m^2) rocks, extending at least one metre into the entry zone;

  - Rock mattresses, covering approximately 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins; and,
  - Rock piles and large woody debris around the outer wetland margins and dense areas of rocks and logs along the banks, extending down a minimum of five metres from the water's edge. Exposed rocks retain heat more readily and are beneficial to frogs compared to cooler shaded sections (i.e. Growling Grass Frog is known to use rocks for thermoregulation). Woody debris provide additional refugia and attract invertebrate prey. The location and spacing of refugia will vary to optimise microhabitat diversity.

- Zone 2: Entry Zone - This zone incorporates part of the aquatic planting area and refers to the edge of the wetland where frogs can enter the water. The zone will be subject to frequent drying and will require plant species capable of tolerating fluctuating water levels. The following structural features will be incorporated:
  - A profile length of at least one metre;
  - A shallow 1:8 grade slope containing a variety of rocks and logs from the bank, with rocks down to at least one metre below the freeboard water level; and,
  - The shallow marsh planting area will extend from 0-0.25 metres below the water level. Terrestrial and aquatic species will be planted at a density of six plants per square metre;
- Zone 3: Embankment - This zone incorporates part of the aquatic planting area and will provide a variety of aquatic vegetation, i.e. emergent (low density), submergent and floating plants (higher densities), for potential frog courtship, egg-laying, metamorphling/ tadpole cover and territorial displays. Typical aquatic vegetation will include Water Ribbon *Triglochin procerum*, Water Plantain *Alisma platago-aquatica*, and submerged or floating aquatic vegetation including Floating Pondweed *Potamogeton tricarinatus*, Nardoo *Marsilea drummondii*, and White Purslane *Neobassia proceriflora* (refer Attachment C). Heard *et al*. (2008) observed many Growling Grass Frog in or on mats of submergent and floating vegetation in post-breeding months. The study demonstrated that occupied microhabitats characterised by a high cover of floating vegetation over still, deep water, were more frequently occupied than high emergent or fringing cover, or high woody stem density. This zone will be created to incorporate the following structural features:
  - A profile length of at least five metres;
  - A 1:2.5 grade slope abruptly steepening (variable grade) in the final approach to the adjacent deep-water zone;
  - A deep marsh planting area extending from 0.25-0.5 metres below the water level;
  - Plantings at a nominal six individuals per square metre for semi-aquatic plants (emergent species) and three individuals per square metre for aquatic species to a depth of 0.5 metres; and,
  - Within 1-3 years the zone will support at least 40% submergent, 20% floating, and 30% emergent vegetation.

Recommended species for wetland planting known to be present in Growling Grass Frog habitats are provided in the Growling Grass Frog Habitat Design Standards (DELWP 2017). Newly vegetated wetlands are particularly

vulnerable to damage caused by species of waterfowl, from foraging, roosting and nesting. Accordingly, any newly planted vegetation will be protected by appropriate netting, to allow vegetation to establish and provide suitable habitat for Growling Grass Frog.

The wetland revegetation specialist must consider the following additional issues when developing the Landscape Masterplan:

- Timing of works - works will be undertaken between April and August inclusively and ideally planting should occur in late winter/ early spring, providing there is adequate rainfall;
- All works must be subject to disease control in accordance with the measures contained in Section 5.6.7 and the *Hygiene Protocols for the Control of Diseases in Australian Frogs* (Murray *et.al*. 2011); and,
- Protective netting will be installed, where required, to prevent damage to aquatic plants by waterfowl.

The following species must not be introduced into the offset area or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation;

  - Narrowleaf Cumbungi *Typha domingensis*
  - Broadleaf Cumbungi *Typha orientalis*
  - Lesser Reed-mace *Typha latifolia*
  - Common Reed *Phragmites australis*
  - Tall Spike-rush *Eleocharis sphacelata*

If these species are observed within the offset area during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

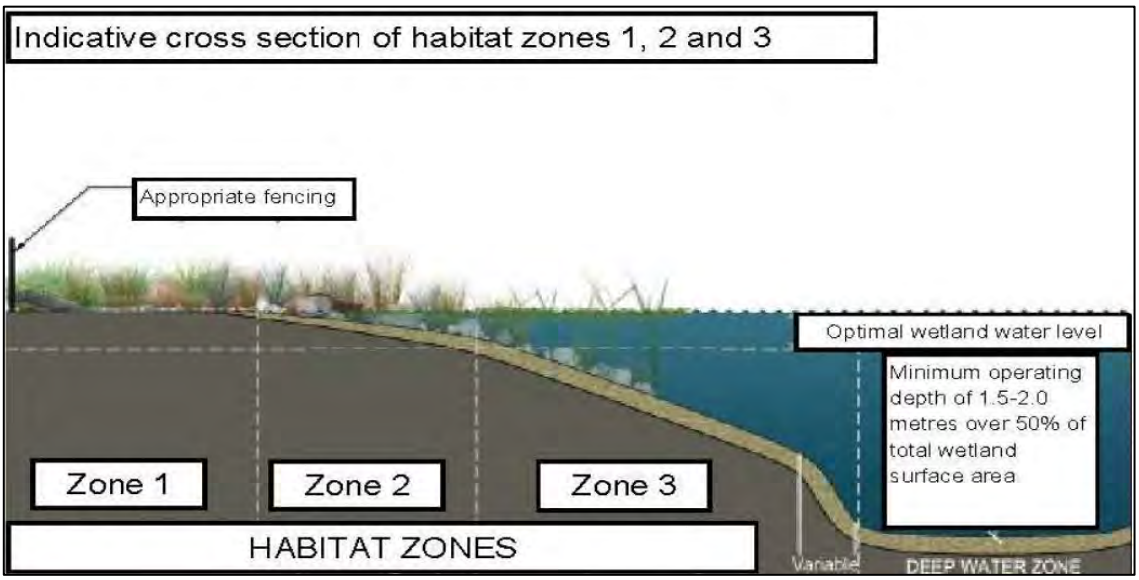

Plate 2. Growling Grass Frog wetland habitat zones

Terrestrial Habitat

The following standards must be applied to created terrestrial habitat areas, as per the Growling Grass Frog Habitat Design Standards (DELWP 2017):

- A minimum 50 metre buffer from development must surround each wetland, in which major infrastructure such as roads, car parks, and buildings should be avoided (unless the wetland is constructed closer than 50 metres to the conservation area boundary because of space constraints);
- Shared use paths, other minor infrastructure for passive recreation and stormwater assets must not be constructed closer than 30 metres from the normal water level of a breeding wetland;
- Approximately 50% of the area within 10 metres of the wetland's normal water level must designed to be maintained as low, grassy vegetation up to 10 centimetres in height;
- Where tussock-forming grasses and sedges are used in the zone that is within 10 metres of normal water level, planting density should allow for no greater than 20% cover when mature;
- Mulch must not be used within 50 metres of a wetland;
- Shrubs must not be planted within 10 metres of the wetland's normal water level;
- Rock piles at least one metre deep must be constructed adjacent to the wetland margin using a variety of rock sizes between 10 centimetres and one metre in diameter;
- Where possible, the area between 10 metres and up to 100 metres (where space is available) from the wetland should be designed to be maintained primarily as short, mown grass with an open structure (for example 20% cover);
- Tree cover within 100 metres of a wetland should not exceed 10%;
- Shrub cover within 100 metres of a wetland should not exceed 10%;

- A patchy arrangement of denser plantings of tussock-forming species is encouraged to maintain some potential terrestrial shelter sites;
- Low, grassy vegetation areas do not need to be native vegetation (mown pasture grasses and even lawn are acceptable); and,
- Invasive plant species must not be used anywhere within the terrestrial habitat zone.

5.6.2 Habitat Maintenance

Maintenance of the constructed wetlands habitat area is to be undertaken as is identified through monitoring, with particular focus on the maintenance of aquatic vegetation diversity and structure, and terrestrial habitats. Once habitat improvement works are complete, it is considered that the constructed waterbodies will primarily be self-sustaining and not require significant interventionist management, including the regulation of water levels.

Overall habitat conditions for Growling Grass Frog will be maintained within the site through the identification of issues during the monitoring program and through the implementation of suitable rectification measures. A summary of general maintenance requirements include:

- Regularly consult an experienced zoologist for maintenance issues that could impact on the Growling Grass Frog population and associated habitat;
- Undertake routine monitoring to investigate the success of aquatic and terrestrial plant establishment and weed densities;
- Replace any failed plantings;
- Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides;
- Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary; and,
- Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage).

5.6.3 Habitat Connectivity Surrounding the Study Area

Aside from providing crucial habitat for Growling Grass Frog and other locally common frog species, the constructed wetlands within the study area will provide an important source of connectivity between suitable habitat to the south of the study area (i.e. Baenches Wetland) and the newly created Sparrovale Wetlands.

Wetlands that are created within a suitable distance of known Growling Grass Frog populations are likely to be colonised by the species, provided they contain the necessary habitat characteristics such as suitable size, patches of emergent and submerged vegetation, have good water quality, provide a diversity of wetland habitats and are not disconnected from the existing populations by significant barriers. In addition, having a variety of wetlands/ waterbodies in the local area with varying characteristics will provide greater opportunities for the persistence and dispersal of Growling Grass Frog populations (i.e. some with permanent water for habitat connectivity, and others with an ephemeral water level to increase the likelihood that they are free of predatory fish [e.g. Eastern Gambusia]).

Through the design, construction and establishment of aquatic vegetation in local wetlands (where possible), and ongoing maintenance and management, there is a significant opportunity to increase the overall quality of Growling Grass Frog habitat in and surrounding the study area. This will contribute to the long-term viability (population processes) of local populations.

5.6.4 Fencing and Access

Temporary frog exclusion fencing will be re-instated around the effluent treatment ponds and/or constructed wetlands prior to the commencement of construction to provide a physical barrier between the development area habitat to be removed and/or created habitat. An example of suitable frog exclusion fencing is shown in Plate 3. The following controls apply to the installation of sediment/ frog exclusion fencing:

- Fencing must be constructed of a cloth or plastic material and only appropriate fencing material that withstands variable weather conditions over long periods of time must be used;
- Fencing must be installed at least one metre high, with an additional 0.2 metres buried below-ground. An additional 0.2 metres at the top of the fence must be bent/ angled over at less than 90 degrees to the vertical on the frog habitat side (not the excluded habitat side) to prevent frogs from climbing or hopping over the fence;
- Refugia for shelter must be placed at least one metre away from the fence and any vegetation within one metre of the fence must not exceed 0.5 metres to prevent frogs from escaping (i.e. low-growing grasses will be planted).
- Fences must be taut without creases or folds;
- Fence posts must be installed on the outer fencing side (i.e. excluded habitat side) and fastened with nails or similar, and lie flush with fencing material to prevent frogs from climbing up posts and escaping over the fence; and,
- Regular inspection of the fencing is required to ensure its effectiveness, including:
    - Inspections of fencing between May and August, prior to Growling Grass Frog breeding season and the repair or replacement of any damaged or ineffective material;
    - Maintenance of vegetation within one metre of fencing at less than 0.5 metres high; and,
    - Removal of any litter or other debris caught in fencing which could assist frogs to climb over.

Plate 3. Example of suitable frog exclusion fencing (fence posts must be on the outside and not within the Offset Area)

Safety Fencing

Prior to the completion of the development, the entire constructed wetland area will be appropriately fenced to exclude public access to the habitat.

Integration of safety fencing and frog fencing will also be considered, as a single fence which achieves the purposes of safety, unauthorised access prevention, and a barrier for preventing frogs accessing paved areas is achievable and preferable in terms of functionality, aesthetics and maintenance.

Performance Indicators

The following performance indicators are required as part of fencing:

- Access to the offset site is appropriately controlled, incidents of unauthorised access are reported to Victoria Police and noted in the corresponding annual management and monitoring report;
- Posts around the perimeter of the offset site are established for monitoring and management purposes; and,
- All fencing activities and repairs are effectively documented.

Adaptive Management

- Adaptive management should be undertaken over the management of the offset site, including reviewing the need to implement new fencing if persistent incident of unauthorised access occurs.
- Install additional signage around areas that areas of the site subject to regular unauthorised access.

5.6.5 Migration Period

Growling Grass Frog's will be allowed to migrate from existing habitat (effluent ponds) and colonise the newly constructed wetland habitat. This is proposed to occur over one breeding season, following completion of the constructed wetland habitat. Growling Grass Frog individuals are predicted to migrate along surrounding foraging habitat situated east of the effluent ponds, which extends to the proposed constructed wetland (Ecology and Heritage Partners 2023d).

No construction will occur in proximity to the likely migration path between the effluent pond (existing habitat) and constructed wetland (created habitat) or in identified Growling Grass Frog habitat on-site (terrestrial or aquatic). The created wetland habitat will be constructed before impacts occur and then there will be a breeding season 'frog migration' period, which is intended to allow Growling Grass Frogs to colonise newly created wetlands from the existing areas of Growling Grass Frog habitat (Table 7).

Impacted Growling Grass Frog habitat (i.e. Effluent Pond 1 and 2) will only be removed once all Growling Grass Frog individuals are confirmed to have migrated to constructed wetlands or elsewhere. This will be confirmed via targeted surveys for the species at the impacted wetlands following the migration period. In the event that Growling Grass Frog individuals do not migrate to constructed wetlands and are detected at impacted wetlands during targeted surveys, Growling Grass Frog individuals will be relocated via a salvage and relocation process conducted by a qualified zoologist suitably experienced in frog capture and release.

Table 7. Timeline of Growling Grass Frog migration period

Stage	April '24	May '24	June '24	July '24	Aug '24	Sept '24	Oct '24	Nov '24	Dec '24	Jan '25	Feb '25	Mar '25	April '25
Construction of GGF wetlands													
GGF migration period													
Installation of frog exclusion fencing													
Removal of dams													
Commence residential development													

5.6.6 Management of Wetland Hydroperiod

The newly constructed wetlands will be hydrologically independent from nearby wetlands and drainage lines (which aims to limit exposure to Eastern Gambusia) and will be located to facilitate connections with other Growling Grass Frog populations in the area. In order to maintain permanent wetlands, a water delivery system will be constructed to maintain water levels in the wetlands. The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Adult Eastern Gambusia grow to approximately 6-10 centimetres in length and their live born young are a minimum 6 millimetres long and 1 millimetre wide. While Eastern Gambusia is likely present within the Balog Channel, the sediment filter silt fence is suitable for excluding all individuals from the constructed wetlands (Plate 4). The silt fence will have an approximate porosity of 0.22 millimetres, with an estimated 10 x 10 metre square area, 500 millimetre above ground, allowing an approximate discharge capacity of 300l/s (200ML per day). The base is proposed to include 200 millimetres of compacted class four crushed rock, while the silt fence will be buried 100 millimetres beneath crushed rock to prevent fish exiting under the fence.

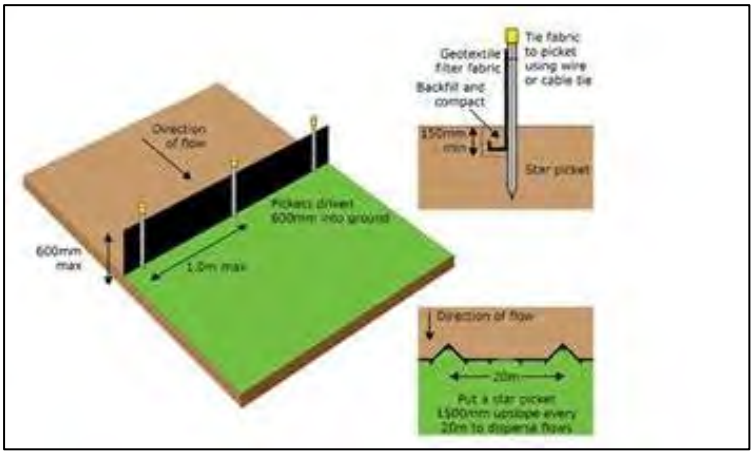

Plate 4. Silt fence example installation (EPA 2004)

Groundwater, rainwater and recycled water (post-residential construction) will then be used to maintain water levels in the wetlands, including during periods of low rainfall (e.g. drought). If groundwater is found to be unsuitable water quality, then Balog Channel water will be used to supplement rainwater and recycled water (post-completion of residential development). The specifics of the groundwater water delivery system are to be finalised but are likely to utilise a self-sustaining solar-powered groundwater pump system. The specifics of the water delivery system are to be finalised.

The ongoing persistence of the resident Growling Grass Frog population within the study area will be achieved through the monitoring of wetland hydroperiods, and through the establishment and ongoing management of fringing and aquatic vegetation within constructed wetlands. Water levels will be assessed checked monthly over the species breeding season (October to March).

Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction. This monitoring will continue over the life of the Growling Grass Frog Offset Management Plan, but the frequency of the water level monitoring will be reviewed after the initial two-year period and a decision will be made regarding ongoing water level monitoring requirements based on results of the first two years (e.g. if the water delivery system is not maintaining stable water levels at the required depth).

Water will be released from the water delivery system if levels fall below 0.5 metres within the constructed wetlands during the species active breeding season (Spring and Summer) and will be regularly filled in order to retain water over the entire breeding season. Wetlands will be drained (i.e. via a pump) and allowed to completely dry out should Eastern Gambusia be detected and/or if the water quality within the proposed wetlands is not suitable for breeding by the species. Wetlands will only be drained outside of the Growling Grass Frog active season (i.e. Spring and Summer) and will be re-filled using the water delivery system once the wetlands have completely dried and after it is confirmed that Eastern Gambusia (or other predatory fish) is not present.

Based on previous studies, fluctuating water levels and flooding are known to stimulate breeding in Southern Bell Frogs in the semi-arid region of Western NSW (Wassens 2005).

Primary Water Source

The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Adult Eastern Gambusia grow to approximately 6-10 centimetres in length and their live born young are a minimum 6 millimetres long and 1 millimetre wide. While Eastern Gambusia is likely present within the Balog Channel, the sediment filter is suitable for excluding all individuals from the constructed wetlands.

Groundwater and rainwater will be the primary ongoing water source for the constructed wetlands, while recycled water will be drawn on as a supplementary water source if required. Groundwater supply will be self-sustaining, using a solar-powered groundwater pump. The pipe will be capped, and a perforated section of pipe will be submerged in the waterbody at the end of the pipe to avoid any frogs or tadpoles being injured by pumping activities.

Groundwater will be supplemented by rainwater and local recycled water (post-residential construction) to ensure sufficient water availability and ensure water quality metrics are met, as per the Growling Grass Frog Habitat Design Standards (DELWP 2017). The recycled water tank will be fitted with a multi parameter to identify if water quality parameters and nutrient levels are unsuitable for the species (i.e. salinity, pH, turbidity, dissolved oxygen, temperature, nitrate and phosphate). Growling Grass Frog have been found to inhabit wetlands with salinity levels over 5mS/cm. Warmer water temperatures (up to 27°C) minimise the risk of chytrid fungus infection, and tadpole hatching occurs in water between 24 to 27°C. Elevated nitrate and phosphate concentrations are known to have an impact on the survivability of Growling Grass Frog, and it is thought that the species requires waterbodies containing lower levels of nitrates and phosphates. The approximate salinity limit for the species is 5000 µS/cm. The holding tank will not be released into the constructed wetlands if salinity levels within the tank exceed 50000 µS/cm or temperatures fall below 18°C or above 27°C (or above 24°C during tadpole hatching periods). Additionally, dissolved oxygen should be maintained within an acceptable range for aquatic biota, and water should have low turbidity (<40NTU's), be still, maintain acidity between pH 6.0-8.0 and have low nitrogen (<1.0 mg/L) and phosphorous (<1.0mg/L) levels.

5.6.7 Contaminants

Chemical spill / hard rubbish dumping

- Chemical and fuel storage area to be established as far from Growling Grass Frog habitat as practical.
- Equipment to be regularly serviced and inspected daily.
- Personnel to undergo adequate training in equipment usage.
- Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc.
- Inspection of all drainage points leading to the water bodies for chemical spills, leaks, and rectify where necessary.

- Once-off intensive hard litter removal (and if required between normal maintenance schedules).

Several 'Spill Response Kits' will be maintained on site in areas where chemicals are stored and in construction areas. Appropriate training will be provided on how to use the kits if a spillage occurs on site.

Chytrid Management

- All footwear and equipment (e.g. nets, buckets, callipers, headlamps, waders), will be thoroughly cleaned and disinfected before entering and exiting the constructed wetland, and between sites including between the site of salvage and No-Go-Areas.
- Any equipment used to handle frogs and tadpoles will be cleaned and disinfected between each use.
- The tyres of all vehicles will be cleaned and disinfected before entering and exiting the construction area of the proposed wetlands habitat (if required).
- The tyres/tread and other parts of machinery and plant (e.g. the excavator bucket; pumps) involved in the habitat construction and associated activities, will be cleaned and disinfected before entering the construction area of the proposed wetlands habitat.
- A new pair of disposable latex gloves will be used between each frog and tadpole. Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up.
- Frogs will be placed into new and clean plastic sample bags, with a 'one bag– one frog' policy. Bags will not, under any circumstances, be reused.
- Disinfection methods will follow the procedures outlined in the Hygiene Protocol.
- Follow handling guidelines for salvage and relocation outlined in the Conservation Management Plan (Ecology and Heritage Partners 2023d).

5.6.8 Pest Animals

Objectives

The objective of pest animal management is to control pest animals (e.g. fish, cats, foxes, deer) within the offset site, as required, to minimise negative impacts to Growling Grass Frog populations. The *Catchment and Land Protection Act 1994* lists rabbits and foxes as established pest animals and requires that all landowners take reasonable steps to prevent the spread of, and as far as possible eradicate, established pest animals on their land.

Dogs and Cats

Unrestrained dogs *Canis vulpes* and Cats *Felis catus* have the potential to roam into Growling Grass Frog wetlands within the Precinct. Cats in particular are known to predate upon dispersing or sheltering frogs. Predation of native wildlife by Cats is a threatening process under Schedule 3 of the FFG Act. Surrounding residential development is likely to introduce unrestrained cats that may also hunt and kill Growling Grass Frog. It is understood that a Cat curfew is currently enforced in the City of Greater Geelong with domestic cats required to be indoors from sunset to sunrise, which will minimise the risk to frogs.

The entire constructed wetland habitat and surrounding 50 metre terrestrial buffer will be appropriately fenced to exclude public access and avoid unrestrained access into the offset area by dogs and their owners.

Eastern Gambusia

The introduced Eastern Gambusia has been identified as a possible factor in the decline of species in the "bell frog species complex", which includes Growling Grass Frog (Mahony 1999; White and Pyke 1996; Hamer *et al*. 2002) because it eats the eggs and tadpoles of these species (Morgan and Buttermer 1996). This species may reduce the potential of a site to support breeding populations, although the extent of predation depends on aquatic vegetation and habitat complexity, and waterbody permanency (Hamer et al. 2002). Predation by Eastern Gambusia on tadpoles of Growling Grass Frog may be a significant threat to the species.

In areas that are subject to routine flooding, where the incursion of fish is unavoidable, the provision and maintenance of dense submerged and floating aquatic vegetation can increase Growling Grass Frog recruitment and survival rates by providing a greater amount of submerged cover for eggs and tadpoles. While it is preferred that all waterbodies be kept fish-free, in an urban setting the introduction of fish through routine flood events, dispersal of fish eggs by birds or artificial introduction by residents, is likely. However, if Eastern Gambusia is observed within the constructed waterbodies, the protocols outlined in Section 5.8 will be implemented that may include draining the wetland outside of the Growling Grass Frog active season (i.e. Spring and Summer) to remove this species from the wetland system.

Red Fox

Red Fox is likely to move through the study area. The species is known to hunt and eat adult members of the bell frog species complex. Feral Animal Control measures will be considered for development in the study area to reduce the population size of foxes.

Pest animals will be controlled as detailed in Table 7.

Table 8. Pest animals to be controlled - species, method and timing

Common name	Method	Timing
Eastern Gambusia	Provide greater coverage of submerged coverage for GGF eggs and tadpoles. Potential draining of wetland outside GGF active season	Ongoing
Cats	Engage qualified and licenced trapper/shooter.	Ongoing
Foxes	Remove dens. Engage qualified and licenced trapper/shooter. Investigate the use of Canid Pest-ejectors on site.	Ongoing
New and emerging pest animals	Monitor and control	Ongoing

Actions

The following actions are required associated with pest animal management:

- Monitor site for evidence of increased incidence of pest animal; and
- Control and seek to locally eliminate pest animals using appropriate control techniques, including poison baits, trapping/shooting.

Performance Indicators

The following performance measures are required as part of pest animal management:

- Any fox dens are controlled immediately following detection;
- Reduction in the abundance of pest animals, as evidenced by reduced number of target pest animals (i.e. cats, foxes and deer) recorded during Growling Grass Frog monitoring programs; and
- All monitoring and management activities are effectively documented.

Adaptive Management

- If pest animal management fails to achieve a reduction, or effectively control cat, fox or Eastern Gambusia numbers, a review of the current procedures and management measures will be undertaken;
- If impacts to Growling Grass Frog populations are attributable to an increase in pest animals activities, a review of the current procedures and management measures will be undertaken;
- Review performance of pest animal contractor;
- Increase active monitoring of pest animal activity; and,
- Incorporate addition control measures (i.e. spotlighting and shooting).

5.6.9 Weed Control

Objectives

The objective of weed control within the offset site is to improve the existing quality of the Growling Grass Frog habitat by reducing/minimising future invasion by exotic flora. Increased weed encroachment into areas of indigenous or planted terrestrial and aquatic vegetation in wetland complexes may occur due to runoff from development. Weeds may also be transported via construction equipment and machinery, and people/animals entering the Precinct. 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 /or foraging site.

Consequently, a Weed Management Plan may need to be prepared to identify potential threats associated with pest plant species, that may impact environmental values within the study area. The Weed Management Plan should provide appropriate management actions to address weed infestations and vertebrate pest species, to ensure environmental values within the study area are maintained and enhanced.

The control of pest plants within dedicated Growling Grass Frog habitat is a major requirement for management, as habitat within the site is under continual pressure from the invasion of introduced grasses and weeds (e.g. Artichoke Thistle *Cynara cardunculus* and African Boxthorn *Lycium ferocissimum*). Excessive weed growth can smother and reduce the quality of frog habitat for breeding and foraging. In order to control and/or eradicate these weed species, several on-going techniques can be used including physical removal, brush cutting and herbicide application. Herbicide must only be applied to weeds by using the spot-spraying technique, in order to prevent off-target issues.

It is important to ensure that any weed control works using herbicides are both targeted (i.e. spot spraying) and undertaken at the right time of the year, as this can also reduce the requirement for future weed control activities.

Actions

The following controls apply to all on-site weed control works:

- Weed management must be undertaken throughout all open space areas, with particular attention given to vegetated areas which are not subject to routine maintenance;
- Any weed control works must be completed in a manner that minimises soil disturbance;
- Herbicide use must be minimised to avoid adverse effects on frogs and invertebrates;
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- Where herbicides are used, selective application is preferable to broad area application;
- Non-residual herbicides must not be used; and,
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen.

The following species must not be introduced into constructed habitat or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation:

- Narrowleaf Cumbungi *Typha domingensis*
- Broadleaf Cumbungi *Typha orientalis*
- Lesser Reed-mace *Typha latifolia*
- Common Reed Phragmites australis
- Tall Spike-rush *Eleocharis sphacelate*

If these species are observed within constructed habitat during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

Weed control works must be monitored regularly to assess their effectiveness and follow-up / evaluation works must be completed (Section 5.7). With any weed control works it is important to establish a cover of native species as soon as possible to occupy the newly vacated environment. While native species will naturally re-colonise such areas, so will exotic species if weed seed is present in soil.

Performance Indicators

The following performance indicators are required as part of weed control:

- Eliminate all high threat weeds (<1% cover);
- Maintain absence of woody weeds across the sites (<1% cover);
- Where herbicide application is employed, waterway sensitive products and non-residual herbicides are to be employed;
- No off-target damage to indigenous plants; and,
- No new or high threat weeds establishing within the offset site.

Adaptive Management

Respond to the annual monitoring report and associated recommendations;

- If objectives and performance indicators are not being met:
- Increase frequency of control activities; and
- Raise any significant issues with TfN as soon as they arise.

5.6.10 Noise and Lighting

Objectives

Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species. Noise from building and other works relating to the development will comply with the

Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works may not emit excessive or offensive noise. Works can only be carried out on any land between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays and public holidays.

Growling Grass Frog are a predominantly nocturnal species. Artificial light pollution may increase the risk of predation of Growling Grass Frog by foxes and Cats and may also disrupt mating activities of the species. As such, sources of artificial light from the surrounding development will be directed away from the existing and proposed constructed habitat. There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution. Overall, there are likely to be no significant impacts related to noise and light pollution associated with the project.

Actions

- Construction activities will comply with the Greater Geelong City Council Building works – Local Law requirements (Greater Geelong City Council 2014);
- Building or other works that may produce noise can only be carried out between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays, and public holidays;
- Sources of artificial light from the surrounding development will be directed away from the existing habitat, constructed wetland and migration corridor;
- No additional lighting directed towards the existing habitat or constructed wetlands;
- Shields will be placed on lights to reduce lateral light spill;
- If necessary embedded lights will be used on walkways adjacent to the constructed wetland habitat; and,
- Use of high intensity lights in white or blue range (<50 nm wavelengths) will be avoided.

5.6.11 Timing of the Management Actions

The proposed constructed wetland habitat will be constructed prior to, and possibly during the commencement of the development to allow frogs to naturally colonise the wetlands during the species active season. In the immediate vicinity of the existing and proposed constructed wetland habitat, the new habitat corridor will be constructed first to minimise development impacts to Growling Grass Frog. Development will then follow. The planned sequence is:

1. Pre-construction phase – commencement of the constructed wetland habitat;
2. Migration phase – completion of the constructed wetland habitat; migration of Growling Grass Frog from existing habitat (effluent pond) into constructed wetland; removal of existing habitat (effluent pond); construction may commence in areas outside the immediate vicinity of the existing and proposed constructed wetland habitat and migration path (Table 7);
3. Construction phase – construction of remaining residential development likely over several stages;
4. Post-construction phase – maintenance and monitoring.

Development of the Growling Grass Frog constructed wetland habitat will occur during the pre-construction phase. Following completion of the constructed wetland habitat, and for one breeding season, no construction will occur in the likely migration path between the effluent pond (existing habitat) and constructed wetland (created habitat). The created habitat will be constructed first and then there will be a breeding season 'frog migration' period, which should allow Growling Grass Frogs to colonise newly created wetlands from the existing areas of Growling Grass Frog habitat. In areas that fall outside this migration path, the construction phase may commence prior to or during the pre-construction period, but the order in which they will be developed is yet to be finalised.

Once completed and colonised, permanent frog exclusion fencing will be installed along the perimeter of the constructed wetland to prevent frogs accessing development areas (Figure 3).

The control of pest animals such as foxes will be undertaken in accordance with local government laws and relevant legislation. Given the threat posed by feral predators such as Red Fox, an assessment of feral predators in the movement corridor will be completed prior to the commencement of construction, and if evidence of these species are found, appropriate control measure will be implemented immediately to reduce the potential threat posed by predatory pests.

5.6.12 Growling Grass Frog Population Targets and Contingency

Contingency management actions will be activated if unacceptable monitoring cycle/s occurs (Table 9). If, at the end of the annual surveys, the results indicate a trigger event in the Growling Grass Frog population or significant degradation of Growling Grass Frog habitat, the OMP will be re-evaluated and adapted accordingly, and adaptive management actions will be undertaken.

Some management actions that may be required to be undertaken by the proponent or council include:

- Installation of additional refuge sites if considered necessary;
- Clean out wetlands to remove silt or other debris, or to rectify chemical imbalances;
- Minimise and control erosion or active sources of sedimentation;
- The implementation of water quality improvement measures which could include supplementary vegetation planting or installation of additional rock beach or screen areas;
- Control or eradication of pest animal species throughout the constructed wetland area;
- Maintain permanent signage within and throughout the constructed wetland area adjacent to pathways, to identify dogs to be on leash throughout the area, and no fishing or introduction of fish into wetlands.

Contingency management actions provided above will be implemented if a population trigger event occurs (Table 9) and informed by all monitoring results, including population, habitat and water quality. The trigger events were developed with reference to the EPBC Act triggers endorsed for Growling Grass Frog populations at other offset sites and sites containing a significant population (Ecology and Heritage Partners 2023d). There are currently no guidelines for determining unacceptable population change and total. Local extinction risk is more commonly measured by the probability of occupied wetlands declining below a threshold, however given

only two wetlands are proposed for construction, population levels are considered a more appropriate indicator (DELWP 2017).

Table 9. Growling Grass Frog population triggers for contingency management actions

Type	Trigger
Action	Failure of Growling Grass Frog to colonise the wetland site. In the event that <3 individuals are recorded across the entire offset site for each of the first two years.
Action	Failure of Growling Grass Frog to achieve a viable population at the wetland site. In the event that <8 individuals are recorded across the entire offset site on both the third and fourth breeding seasons following commencement of the OMP.
Action	An annual decline of ≥10% in any three successive years in the number of individuals recorded during annual surveys across the entire offset site.
Action	A cumulative decline of >25% in annual average number of individuals recorded across the entire offset site during annual surveys over any successive two or three-year period. This action is not triggered if the >25% decline occurs over one-year as seasonal variation is common and does not necessarily indicate a critical issue.

5.6.13 Monitoring and Reporting

This Offset Management Plan requires the landowner to submit a report annually to TfN and DCCEEW for each year of the ten years of this Offset Management Plan, and every year following for the life of the project's approval under the EPBC Act. The reports will include a review of past management works against the performance targets and objectives contained within this OMP. Future management priorities will also be detailed in these reports.

The Landowner will establish three permanent photo-points in the Growling Grass Frog offset site. Photographs taken from these points will be representative of the vegetation and objectives of the OMP (e.g. areas of high threat weed invasion). Photographs will be taken in during annual monitoring surveys each year and be clearly labelled. Each photo will be taken from as near to the same point each year and will use the same direction, trajectory and camera settings as is practicable.

Photographs and Annual Reports are to be submitted to TfN at least two months prior to the anniversary date of the execution of the agreement to allow time for compliance to be assessed before the anniversary date.

The Annual Report addresses progress against the commitments set out in this agreement. Annual Reports must provide enough detail in the form of written comments and supporting evidence that TfN can easily determine the completion of/progress against the commitments for each zone.

A template for annual reporting will be provided by TfN upon registration of the covenant on title. Information to be provided in the reporting form includes:

- A copy of the Management Action Table from the OMP with information on which actions have been completed for year/s of this reporting period;

- A description of the specific monitoring results from surveys undertaken (i.e. Growling Grass Frog surveys);
- Success of weed and pest animal control work;
- Successful management tools (i.e. techniques used to control weed species, protection of new plants, monitoring technique, etc.);
- Any problems or issues experienced (i.e. new infestation of weed species, etc.); and,
- Provide photographs showing evidence of works.

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the landowner is to document the justification and the actions that will be action/s will be undertaken to implement the requirement.

All records/evidence of management actions must be maintained and be submitted to TfN and/or DCCEEW upon request, and any proposed changes to management must be submitted to TfN and/or DCCEEW prior to the changes being undertaken.

5.7 Monitoring and Reporting

Ongoing monitoring is required to determine whether Growling Grass Frog population/s and Growling Grass Frog habitat quality persist and remain viable over time and to ensure that management actions improve habitat.

Appropriate survey and monitoring methods for Growling Grass Frog is an important component to effectively conserve the species (Heard *et al.* 2010). Methods based on research and commensurate with the objective (e.g. determining wetland occupation versus population size versus reproductive success) are required to adequately identify the impact of an action, along with the most appropriate management actions and the effectiveness of such actions (Heard *et al.* 2010). Such surveys will be conducted to assess the impact of the development and/or monitor the suitability of a site's management regime, or to monitor the species status throughout a region (which may also relate to regional scale management strategies etc.).

Site monitoring must include:

- Population monitoring annually during the development and for the first 5 years following the completion of construction of the Growling Grass Frog wetlands;
- Monitoring of created habitats undertaken every six months for the first two years during the development, annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat, and conducted every second year, at minimum, from the fifth year to the tenth year; and,
- Water quality monitoring at two sites within the constructed wetland prior to the commencement construction immediately following the completion of the constructed wetlands.

Further details on the monitoring actions is outlined below.

5.7.1 Growling Grass Frog population monitoring (Years 1-5, 6, 8 and 10)

Population monitoring will be undertaken annually during the development and annually for the entire 10-year management period.

Each monitoring event will comprise diurnal and nocturnal surveys and will include the following (as a minimum). If, at the end of the annual monitoring the results indicate a decline in the Growling Grass Frog population or degradation of Growling Grass Frog habitat, the OMP will be re-evaluated and adapted accordingly.

Diurnal Surveys

The following will be undertaken as part of the diurnal surveys:

- Habitat assessment (type/cover of vegetation and refugia; water quality; disturbance, litter, erosion).
- Active searching for frogs (in and 20-metres around the waterbody, including aquatic and terrestrial vegetation, rocks, logs and other refugia).
- Dip netting for tadpoles and predatory fish.

Nocturnal Surveys

The following will be undertaken in accordance with Survey Guidelines for Australia's Threatened Amphibians (DSEWPaC 2011) as part of the nocturnal surveys:

- At least four nights of surveys (two early in active season when calling and mobility is high, and two later in the season when tadpoles and metamorphs greatest).
- Early in the active season, surveys will be at least 120 minutes (call-playback and active searching aquatic and terrestrial vegetation, rocks, logs and other refuge for frogs in and 20-metres around the waterbody).
- During the latter part of the active season, the 120-minute survey will involve dip netting for tadpoles and metamorphs, and active searching for metamorphs and sub-adults as detailed above.

All surveys will be conducted in weather conditions considered optimal for detection (i.e. warm and humid, overnight temperature not less than 14°C, preferably post rain) and when the species is known to be active elsewhere (reference sites).

Tadpole surveys

- Surveys will be undertaken annually for the first five years post-development, and conducted every second year, at minimum, following the fifth year. Commercially-available, collapsible bait-traps constructed of nylon netting will be baited with fluorescent glow sticks, and then set at the completion of each spotlight survey, in an effort to capture tadpoles at predetermined locations. At least two traps will be set at each wetland for a minimum of two nights over the breeding period of Growling Grass Frog. Traps will be suspended (use of floats) so that at least part of the trap emerges above water-level, allowing tadpoles to breathe.

Traps will be retrieved the following morning and checked for tadpoles and predatory fish. All tadpoles caught will be identified to species level, counted and released. Alternatively, dip nets will be used to sample for tadpoles at, or in the vicinity of sites where calling males are identified.

5.7.2 Photo point monitoring

The landowner undertakes to establish three permanent photo-points across the offset site (Figure 1). Photographs taken from these points will be representative of the vegetation and objectives of the OMP (e.g. areas of high threat weed invasion). Photographs will be taken during the annual monitoring period annually and clearly labelled. Each photo will be taken from as near to the same point each year and will use the same direction, trajectory and camera settings as is practicable.

Annual monitoring must be undertaken by the landowner (or an appointed entity on behalf of the landowner), and must include an assessment of:

- Photographs taken at established photo-points;
- The extent, severity, trend and presence of current weed species and any new and emerging weed species.
- The extent, severity, trend and presence of pest animal activity;
- Biomass levels, visually assessed across the site;

- Evidence of unpermitted human/stock access; and,
- Any new threats.

The annual monitoring must be undertaken for each year of the ten years of this Offset Management Plan.

5.7.3 Habitat Monitoring

Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat. After the fifth year, monitoring frequency will be conducted every second year, at minimum, with the frequency of monitoring to be determined based on the results of the first five years.

Several site-specific habitat variables will be assessed during the monitoring period, including:

- Wetland depth, flow, permanency and a visual assessment of water quality;
- Availability and suitability of shelter and over-wintering sites;
- Vegetation diversity, structure, composition and percentage of cover;
- Presence of introduced fish, particularly Eastern Gambusia and Goldfish; and,
- Presence of pollutants, rubbish and other threatening processes.

Vegetation Monitoring

- Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas. After the fifth year, monitoring frequency will be determined based on the results of the first five years, with monitoring occurring every second year at minimum.
- Monitoring of vegetation will be conducted in autumn and spring.
- Replace any failed plantings.
- Increase planting density by planting additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody); as required.
- Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides.
- Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from wetlands/waterways.
- Identify and remove barriers to frog dispersal.
- Where relevant gross pollutant traps and/or sediment filters will be checked and, if necessary, subsequently cleaned, particularly after heavy rain or storm events.

As required, based on conditions:

- Increasing the intensity of feral animal controls.
- Additional refuge sites such as rocks, logs and dense low-lying vegetation will be added if it is considered, during site monitoring, that the area of shelter is insufficient.
- Routine maintenance of grassed areas within the reserve area around the periphery of the waterbodies.
- Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage).
- Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary.

Pest Plant Monitoring

- Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas. After the fifth year, monitoring frequency will be determined based on the results of the first five years, with monitoring occurring every second year at minimum.
- Where possible, weeds will be controlled by hand or with the use of implements.
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- When used in riparian areas, will be directly sponged or wicked onto weeds to minimise off target damage.
- Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March).
- Any weed control works must be completed in a manner that minimises soil disturbance.
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen.

The following species must not be introduced into the offset area or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation;

- Narrowleaf Cumbungi *Typha domingensis*
- Broadleaf Cumbungi *Typha orientalis*
- Lesser Reed-mace *Typha latifolia*
- Common Reed Phragmites australis
- Tall Spike-rush *Eleocharis sphacelate*

If these species are observed within the offset area during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist

must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

5.7.4 Water Quality Monitoring

Water quality monitoring sites will be established within the constructed waterbodies immediately following the completion of the constructed wetlands. Water quality sampling will adhere to the EPA's reference document: S*ampling and analysis of waters, wastewaters, soils and wastes* (EPA 2009). Water quality results will be compared to the GGF Habitat Design Standards water quality standards and the State Environment Protection Policy (SEPP) Water for Victoria objectives (EPA 2018; DELWP 2017).

A monitoring program has been designed to identify any potential reduction in water quality if conditions deteriorate from the water quality outlined in the GGF habitat design standards. Management actions will be implemented if chemical spills are detected or if there is a noticeable deterioration in water quality. Several 'Spill Response Kits' will be provided if an oil or fuel spill occurs, appropriate training will be provided on how to use the kits if a spillage occurs on site. If water quality results exceed trigger values (see below) and/or are outside SEPP objectives, a review of appropriate measures will be conducted and correction actions will be taken, if required, to ensure the water quality is suitable for Growling Grass Frog.

Weekly monitoring will be undertaken until the water quality conditions return to the GGF Habitat Design Standards water quality standards or within SEPP Waters of Victoria (WoV) objectives (EPA 2003).

During each monitoring event, the proponent will also undertake surveys in the neighbouring wetlands to determine prevailing conditions of Sparrovale and Baenschs Wetlands, primarily relating to water quality and Growling Grass Frog wetland occupancy.

Site Specific Trigger Values

Trigger values will be established and based on immediate post-construction water quality within the created waterbodies. The triggers will be assessed against predominantly against the GGF Habitat Design Standard water quality standards (DELWP 2017). The following trigger values will be used:

- If turbidity is >20% than 40.0 (upper target value);
- If nitrogen is >1.0 mg/L;
- If phosphorous is >0.1 mg/L;
- If electrical conductivity is >1% above 5.0 mS/cm (target value c. <5.0 mS/cm);
- If dissolved oxygen concentration is <1% of the background condition recorded in adjacent wetlands known to contain a population of GGF (Sparrovale / Baenches);
- If pH ±0.5pH unit from targeted range (target range between 6.0 – 8.5pH); and,
- All other water quality parameters (including any nutrients or heavy metals) have not substantially exceeded the GGF Habitat Design Standard parameters (i.e. no statistically significant difference (alpha >0.05).

Sampling frequency

In order to demonstrate if water quality has returned/remained at target values, water quality monitoring will be conducted every four months for at least two years post-construction, and continue until the water source system stabilizes. For instance, the recycled water sources may vary in quantity and potentially quality until the entire site is developed.

The frequency of the water quality monitoring will be reviewed after the initial two-year period and a decision will be made on whether ongoing water chemistry monitoring is required.

5.7.5 Reporting

To demonstrate that the management measures are effective in meeting the environmental outcomes, this OMP requires the landowner to submit a report annually to TfN and DCCEEW for each year of the ten years of this Offset Management Plan.

Photographs and reports are to be submitted at least 2 months prior to the anniversary date of the execution of the agreement to allow time for compliance to be assessed before the anniversary date.

The report must address progress against the commitments set out in this agreement and any conditions of the EPBC Act referral (EPBC 2022/09357). Reports should provide enough detail in the form of written comments and supporting evidence that an assessor can easily determine the completion of/progress against the commitments for each zone.

Information to be provided in the progress report includes:

- Detailing actions completed during the reporting period;
- Results of habitat creation (i.e. wetlands and terrestrial habitat);
- Results of Growling Grass Frog population monitoring;
- Results of vegetation condition assessment (Habitat Hectare Assessment);
- A description of the specific monitoring results from ecological surveys undertaken;
- Results of weed and pest animal control work;
- Successful management tools (i.e. techniques used to control weed / pest species, monitoring technique, etc.);
- Any problems or issues experienced (i.e. new infestation of weed species, etc.);
- Any corrective actions and contingency measures where monitoring indicates that there has been a deterioration in the Growling Grass Frog habitat or population;
- Photographs showing evidence of works; and,
- Assessment of whether the site is on track to meet, or meets the conditions under the EPBC referral (EPBC 2022/09357), including an assessment against the EPBC offset gain calculator inputs

If any agreed management actions or commitments are incomplete or have not been undertaken in the times specified, the landowner is to document the justification and the substituted actions that will be undertaken in order to compensate and ensure the required outcomes are achieved.

All records/evidence of management actions must be maintained and be submitted to DCCEEW upon request.

5.7.6 Offset Management Plan Review

The protection and management of the nominated offset area is for perpetuity. The OMP will be reviewed by a suitably qualified Ecologist, in consultation with the Landowner, five years from the date of approval. The focus of the review will be to determine its effectiveness in managing the Growling Grass Frog habitat.

The 5-year review of the OMP will be submitted to TfN and DCCEEW for approval prior to any recommendations regarding management of the offset site being implemented.

5.8 Management Actions Table

Management actions proposed to compensate for the loss of native vegetation and habitat under Commonwealth legislation at the offset site are presented in Table 10. The actions constitute the minimum management requirements for the offset site over the mandatory 10-year management period and are appropriate for the management of Growling Grass Frog habitat.

Table 10. Schedule of Management Actions

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
1 and ongoing	**1. Creation of Dedicated Growling Grass Frog Wetlands.** The creation of dedicated Growling Grass Frog waterbodies within the proposed wetlands will provide additional breeding and foraging habitat for the species and improve habitat connectivity and frog dispersal.	Following establishment of no-go zone and exclusion fencing	The created wetland habitat will be constructed prior to and during development to allow frogs to naturally colonise the wetlands during the species active season. Design feature of constructed wetlands: Wetlands will be designed to permanently contain water and will be filled from The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Groundwater, rainwater and recycled water (post-residential construction) will then be used to maintain water levels in the wetlands, including during periods of low rainfall (e.g. drought). The specifics of the groundwater water delivery system are to be finalised but are likely to utilise a self-sustaining solar-powered groundwater pump system. Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction. Supplied with the best feasible water quality consistent with the Growling Grass Frog Habitat Design Standards. Able to sustain appropriate vegetation to provide habitat (see below). Will be clay-lined to retain water with a loamy or sand-substrate topsoil. Include rock mattresses, covering minimum 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins (Plate 1, Figure 1). Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out wetlands, thus potentially rendering them unsuitable for the species. Designed, constructed and managed so that they predominantly comprise open water, low water turbidity, be still, and have low nitrate, phosphate, and salinity levels.	5.6.1
1 and ongoing	**2. Salvage and Relocation** The salvage and relocation of Growling Grass Frog individuals from within the offset area prior to habitat creation	Both immediately prior to and during the development works, as required	Salvage and relocation (if required) will be undertaken as follows: The salvage and relocation of Growling Grass Frog individuals from within the proposed constructed wetland habitat area may need to be undertaken prior to habitat construction activities.	Growling Grass Frog Conservation Management Plan (Ecology and Heritage Partners 2023d)

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			Salvage and relocation procedures may be initiated to reduce the occurrence of death, injury or displacement of individuals. All areas where rock beaching is to be incorporated must be identified using clearly visible timber stakes and/or bunting prior to works being carried out. The area will be searched by a suitably qualified zoologist and appropriate salvage and relocation protocols initiated. If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors are required to temporarily halt works in that area, contact a zoologist and follow procedures outlined in the Conservation Management Plan (Ecology and Heritage Partners 2023d).	
1 and ongoing	**3. Migration of Growling Grass Frog from effluent pond (existing habitat) into constructed wetland**	Prior to and during construction	The habitat corridor will be constructed prior to commencement of construction in the adjacent residential development area to allow frogs to naturally migrate from the effluent pond (existing habitat) and colonise the constructed wetlands during the species active season (Table 7).	5.6.5
1 and ongoing	**4. Removal of Effluent Ponds (possible salvage and relocation)** The removal of Effluent Pond 1 where Growling Grass Frog was recorded	Prior to and during construction	Removal of effluent ponds will occur following completion of constructed wetland habitat and after one Growling Grass Frog breeding season, to allow migration of Growling Grass Frog individuals from the effluent ponds into constructed habitat. The following steps will be undertaken during removal of effluent ponds: 1. Pre-clearance searches and salvage; 2. De-watering of effluent ponds; 3. Removal of terrestrial habitat; 4. Filling of ponds. Salvage and relocation (if required) will be undertaken as follows: 1. The salvage and relocation of Growling Grass Frog individuals from Effluent Pond 1 and 2 will be undertaken prior to their removal. 2. Salvage and relocation procedures may be initiated to reduce the occurrence of death, injury or displacement of individuals.	5.6.5 5.6.11

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			3. The area will be searched by a suitably qualified zoologist and appropriate salvage and relocation protocols initiated. 4. If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors are required to temporarily halt works in that area, contact a zoologist and follow procedures outlined in the Conservation Management Plan (Ecology and Heritage Partners 2023d).	
1 and ongoing	**5. Staged development.** Development of the Groves Road site will be undertaken over multiple stages to protect existing habitat until the dispersal corridor has been constructed.	Throughout construction	Development of the site will be staged as follows: 1. The created wetland habitat will be constructed prior to commencement of residential construction in the adjacent development area to allow frogs to naturally colonise the wetlands during the species active season. 2. Frog Exclusion fencing will be installed along the border of the constructed wetland habitat with the development area once frog colonisation has occurred. Fencing will be installed prior to the commencement of residential construction in areas adjacent to the constructed wetland to prevent Growling Grass Frog from entering the residential development area during and after residential construction. Impacted Growling Grass Frog habitat (i.e. Effluent Pond 1 and 2) will only be removed once all Growling Grass Frog individuals are confirmed to have migrated to constructed wetlands or elsewhere. This will be confirmed via targeted surveys for the species at the impacted wetlands following the migration period. 3. Temporary frog fencing in all areas will be decommissioned once permanent frog exclusion fencing and all construction activities within the constructed wetland habitat have been completed.	5.6.1 5.6.4 5.6.5 5.6.11
1 and ongoing	**6. Establish no-go zones and temporary exclusion fencing.** Protect existing habitat (prior to its removal) and subsequently the habitat corridor and no-go areas during construction.	Prior to commencement of construction	Temporary frog exclusion fencing and signage will be installed around the outer perimeter of the constructed wetland habitat area prior to the commencement of construction (see Figure 3).	5.6.4 5.6.11
		Prior to and during construction of the habitat corridor / frog migration	Fencing will be installed along the entire boundary of the development areas during construction during construction of created wetland habitat and the Growling Grass Frog migration from effluent pond. This is to prevent Growling Grass Frog from entering the development area during and after construction.	

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
		Following completion of permanent exclusion fencing	Temporary frog fencing in all areas will be decommissioned once and all construction activities, Growling Grass Frog migration, and permanent frog exclusion fencing within the constructed wetland habitat have been completed.	
		Monthly	Fencing and "no-go" zones inspected monthly for damage or evidence of dumping/activity.	
		As required	All no-go zones and sensitive habitat areas for Growling Grass Frog clearly signed and discussed during on site inductions.	
1 and ongoing	**7. Revegetation and constructed wetland and habitat creation in the Offset Area.** New constructed wetland habitat and the terrestrial habitat will be created through the provision of appropriate revegetation and habitat enhancement.	During stage 1 in wetland habitat. Following earthworks and landscaping of wetlands within constructed terrestrial habitat	The creation of constructed Growling Grass Frog wetland habitat will include the provision of terrestrial habitat (rock, logs and other ground debris) and aquatic habitat (supplementary aquatic vegetation). Habitat creation and enhancements activities associated within constructed wetland habitat will commence prior to, or during the first stage of the development. 1. To achieve these habitat requirements, in each Growling Grass Frog wetland there will be three distinct zones (as shown in Plate 2). 2. Timing of works - works will be undertaken between April and August inclusively and ideally planting should occur in late winter/ early spring, providing there is adequate rainfall. 3. All works must be subject to disease control in accordance with the measures contained in section 5.6.7 and the Hygiene Protocols for the Control of Diseases in Australian Frogs (Murray *et.al*. 2011). 4. Protective netting will be installed, where required, to prevent damage to aquatic plants by waterfowl. 5. Trees and/or large shrubs must not be planted within 20 meters of the banks of Growling Grass Frog wetlands. 6. A minimum topsoil depth of 150 mm within all wetland planting areas. 7. The planting area will contain floristically diverse and structurally similar vegetation, planted at a nominal density of six individuals per square metre with the provision for areas of bare ground between plantings.	5.6.1 5.6.2 5.6.7

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			8. Recommended species for wetland planting known to be present in Growling Grass Frog habitats are provided in the Growling Grass Frog Habitat Design Standards (DELWP 2017). The following species must not be introduced into constructed habitat or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation; • Narrowleaf Cumbungi *Typha domingensis* • Broadleaf Cumbungi *Typha orientalis* • Lesser Reed-mace *Typha latifolia* • Common Reed *Phragmites australis* • Tall Spike-rush *Eleocharis sphacelata*	
1 and ongoing	**8. Chemical/petroleum spill and hard rubbish dumping.** Protect existing and constructed Growling Grass Frog habitat from contamination.	Both immediately prior to and during the development works, as required	1. Chemical and fuel storage area to be established as far from Growling Grass Frog habitat as practical. 2. Equipment to be regularly serviced and inspected daily. 3. Personnel to undergo adequate training in equipment usage. 4. Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc. 5. Inspection of all drainage points leading to the water bodies for chemical spills, leaks, and rectify where necessary. 6. Once-off intensive hard litter removal (and if required between normal maintenance schedules). 7. Several 'Spill Response Kits' will be maintained on site in areas where chemicals are stored and in construction areas. Appropriate training will be provided on how to use the kits if a spillage occurs on site.	5.6.7 5.7 Growling Grass Frog Conservation Management Plan (Ecology and Heritage Partners 2023d)
1 and ongoing	**9. Chytrid management.**	During habitat construction, management of	1. All footwear and equipment (e.g. nets, buckets, callipers, headlamps, waders), will be thoroughly cleaned and disinfected before entering and exiting the constructed wetland, and between sites including between the site of salvage and No-Go-Areas.	5.6.7 5.6.11

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	Chytrid fungus is a major threat to amphibian populations in Australia. Hygiene Protocol will be used to guide best practice Chytrid management.	the offset area, throughout construction and post-construction (when residential development and offsite site maintenance occurs for both GGF Wetlands and the 6.7ha terrestrial dispersal habitat).	2. Any equipment used to handle frogs and tadpoles will be cleaned and disinfected between each use. 3. The tyres of all vehicles will be cleaned and disinfected before entering and exiting the construction area of the proposed wetlands habitat (if required). 4. The tyres/tread and other parts of machinery and plant (e.g. the excavator bucket; pumps) involved in the habitat construction and associated activities, will be cleaned and disinfected before entering the construction area of the proposed wetlands habitat. 5. A new pair of disposable latex gloves will be used between each frog and tadpole. Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up. 6. Frogs will be placed into new and clean plastic sample bags, with a 'one bag– one frog' policy. Bags will not, under any circumstances, be reused. 7. Disinfection methods will follow the procedures outlined in the Hygiene Protocol.	Growling Grass Frog Conservation Management Plan (Ecology and Heritage Partners 2023d)
		During salvage and relocation.	Follow handling guidelines for salvage and relocation (see Conservation Management Plan – Ecology and Heritage Partners 2023d).	
		Ongoing	Sterilise footwear before entering offset area.	
1 and ongoing	**10. Manage artificial lighting and noise.** Artificial light and noise will be kept to a minimum to reduce impacts to Growling Grass Frogs.	During construction activities	1. Construction activities will comply with the Greater Geelong City Council Building works – Local Law requirements (Greater Geelong City Council 2014). 2. Building or other works that may produce noise can only be carried out between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays, and public holidays. 3. Sources of artificial light from the surrounding development will be directed away from the existing habitat, constructed wetland and migration corridor.	5.6.10
		Design and installation phase	1. No additional lighting directed towards the existing habitat or constructed wetlands. 2. Shields will be placed on lights to reduce lateral light spill. 3. If necessary embedded lights will be used on walkways adjacent to the constructed wetland habitat. 4. Use of high intensity lights in white or blue range (<50 nm wavelengths) will be avoided.	

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
1 and ongoing	**11. Monitor and control pest fauna species.** If Eastern Gambusia is observed within constructed wetland habitat, protocols outlined in Section 5.6.8 will be implemented. Feral Animal Control measures will be implemented in the study area to reduce the population size of foxes.	Both immediately prior to and during the development works, as required	1. Assessment of feral predators within the offset area prior to the commencement of construction. 2. If evidence of foxes is found, appropriate control measure to be implemented immediately. 3. Destroying any dens discovered on site.	5.6.8 5.7.1 5.6.13 5.6.6
		During wetland habitat construction	1. The newly constructed wetlands will be hydrologically independent from Sparrovale and Baenches wetlands. 2. The wetlands will contain a drainage outlet at the lowest point of the waterbody for removing some or all water from the system.	
		Monitor fish in autumn and September.	1. Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat. After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum. 2. Wetlands will be drained (i.e. via a pump) and allowed to completely dry out should Eastern Gambusia be detected. 3. Wetlands will only be drained outside of the Growling Grass Frog active season (i.e. not to be drained in Spring and Summer). 4. Wetlands will be re-filled naturally once the wetlands have completely dried and after it is confirmed that Eastern Gambusia (or other predatory fish) is not present.	
		Opportunistic and ongoing	Destroy any fox dens found on site.	
1 and ongoing	**12. Monitor and managed vegetation in habitat corridor.** Once constructed, habitat in the offset area will need to be maintained through ongoing revegetation or slashing.	Twice annually (autumn and spring) in years 1 and 2. Annually for the first five years following the	1. Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat. After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum. 2. Monitoring of vegetation will be conducted in autumn and spring. 3. Replace any failed plantings.	5.7.1 5.7.2 5.6.9 5.7.3 5.6.8

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
		completion of construction.	4. Increase planting density by planting additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody); as required. 5. Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides. 6. Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from wetlands/waterways. 7. Identify and remove barriers to frog dispersal. 8. Where relevant gross pollutant traps and/or sediment filters will be checked and, if necessary, subsequently cleaned, particularly after heavy rain or storm events.	
		As required, based on conditions.	1. Increasing the intensity of feral animal controls. 2. Additional refuge sites such as rocks, logs and dense low-lying vegetation will be added if it is considered, during site monitoring, that the area of shelter is insufficient. 3. Routine maintenance of grassed areas within the reserve area around the periphery of the waterbodies. 4. Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage). 5. Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary.	
1 and ongoing	**13. Pest plant monitoring and control.** It is important to ensure that any weed control works using herbicides are both targeted (i.e. spot spraying) and undertaken at the right time of the year. Where possible, weeds will be controlled by hand or with the use of implements.	Monitoring quarterly for two years, then biannually.	Monitoring of created habitats will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas. After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum.	5.6.9 5.7.2 5.7.3
		Ongoing pest plant controls as required	1. Where possible, weeds will be controlled by hand or with the use of implements. 2. Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;	

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			3. When used in riparian areas, will be directly sponged or wicked onto weeds to minimise off target damage. 4. Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March). 5. Any weed control works must be completed in a manner that minimises soil disturbance. 6. Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen. The following species must not be introduced into the offset area or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation; • Narrowleaf Cumbungi *Typha domingensis* • Broadleaf Cumbungi *Typha orientalis* • Lesser Reed-mace *Typha latifolia* • Common Reed Phragmites australis • Tall Spike-rush *Eleocharis sphacelate* If these species are observed within the offset area during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.	
1 and ongoing	**14. Water quality monitoring.** A monitoring program has been designed to identify any potential reduction in water quality if conditions deteriorate from the baseline (pre-	Both immediately prior to and during the development works, as required	1. A water quality monitoring site will be established at two sites within the constructed wetland prior to the commencement construction immediately following the completion of the constructed wetlands. 2. Trigger values will be established and based on pre-construction water quality within the constructed wetland. Given that there is no long-term water quality data for the constructed wetland the following trigger values will be used: • If turbidity is >20% than 40.0 (upper target value);	5.7.4

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	construction) water quality conditions.		• If nitrogen is >1.0 mg/L; • If phosphorous is >0.1 mg/L; • If electrical conductivity is >1% above 5.0 mS/cm (target value c. <5.0 mS/cm); • If dissolved oxygen concentration is <1% of the background condition recorded in adjacent wetlands known to contain a population of GGF (Sparrovale / Baenches); • If pH ±0.5pH unit from targeted range (target range between 6.0 – 8.5pH); and, • All other water quality parameters (including any nutrients or heavy metals) have not substantially exceeded the GGF Habitat Design Standard parameters (i.e. no statistically significant difference (alpha >0.05). 3. Water quality monitoring will be conducted on a monthly basis as soon as approvals are granted, prior to commencement of construction, to establish any relevant background conditions. 4. Weekly monitoring will be undertaken until the water quality conditions return to target values or within SEPP Waters of Victoria (WoV) objectives (EPA 2003).	
1 and ongoing	**15. Growling Grass Frog Population Monitoring** Surveys will be conducted to assess the impact of the development and/or monitor the suitability of a site's management regime.	Annually during the development and for the first 5 years following the completion of construction, and conducted every second year, at minimum, from the fifth year.	Each monitoring event will comprise diurnal and nocturnal surveys. 1. At least 4 nights of surveys will be conducted; at least two in the early part of the active season (to collect data when calling and mobility is high) and two later in the season (when reproductive output is greatest i.e. tadpoles, metamorphs). 2. Tadpole surveys will be undertaken annually for the first five years post-development, and conducted every second year, at minimum, from the fifth year. 3. Monitoring of created habitats will be undertaken every six months for the first two years during the development, and annually for the entire 10-year management period. Contingency management actions provided above will be implemented if a population trigger event occurs (Table 8) and informed by all monitoring results, including population, habitat and water quality. The trigger events were developed with reference to the EPBC Act triggers endorsed for Growling Grass Frog populations at other offset sites and sites containing a significant population (Ecology and Heritage Partners 2023d). There are currently no guidelines for determining unacceptable population change and total. Local	5.7.1 5.6.13

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			extinction risk is more commonly measured by the probability of occupied wetlands declining below a threshold, however given only two wetlands are proposed for construction, population levels are considered a more appropriate indicator (DELWP 2017). If, after implementation of contingency management actions, monitoring results indicates a continued decline in the Growling Grass Frog population or degradation of Growling Grass Frog habitat, the OMP will be re-evaluated and adapted accordingly.	
2 and ongoing	**16. Management of Constructed Wetland Hydroperiod** Water levels will be checked monthly over the species breeding season (October to March).	Following completion of construction of wetland and ongoing	Design features and active management to be implemented: 1. Balog Channel water will be the initial water source for the constructed wetlands. Groundwater and rainwater will be the primary ongoing water source for the constructed wetlands, with recycled water providing a supplementary water source. 2. The wetlands will contain a drainage outlet at the lowest point of the waterbody for removing some or all water from the system. 3. Water levels will be checked monthly over the species breeding season (October to March). 4. Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction.	5.6.6 5.7.2
2 and ongoing	**17. Management of Wetland Hydroperiod** Water levels will be actively checked monthly over the species breeding season (October to March).	Following completion of construction of wetland and ongoing	Design features and active management to be implemented: 1. Water quality and levels within the constructed wetland will be regularly monitored as part of the monitoring program outlined in the Section 5.7.4. 2. A depth gauge will be installed in the constructed wetland.	5.6.6 5.7.2
1 to 10	**18. Annual Monitoring Reporting and Review.** A summary of the results of all monitoring procedures, habitat creation (i.e. wetlands) and any	Annual reporting as required	1. The annual audit will outline the progress of the OMP implementation and identify any key issues and management responses. 2. Management actions may need to be amended or updated if new information becomes available, or if management actions are considered inappropriate or inadequate for the long-term persistence of Growling Grass Frog within the site.	5.7.5 5.6.13

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	maintenance activities will be provided to DCCEEW on an annual basis throughout the 10-year implementation of the OMP.		3. New information may become available through ongoing monitoring procedures or following review of ongoing reporting submitted to DCCEEW. Recommendations based on this information will be provided to the responsible land manager. 4. In addition to revisions triggered by adaptive management, additional changes to this OMP may be required following the EPBC Act assessment and approval process. Any proposed amendments or deviations to the actions and requirements of this OMP must be approved by DCCEEW, and the plan must be updated with any approved changes.	

6 CONTINGENCY RESPONSE AND CORRECTIVE ACTIONS

The landholder will use an Adaptive Management Approach to allow the flexibility to respond appropriately and effectively to the uncertainties involved in ecological processes. This will ensure that management objectives are being met while allowing for altered circumstances to be included in the management of the site.

If after Year 5 of management, the actions detailed in this OMP are not leading to the ongoing maintenance and improvement of the Growling Grass Frog habitat, a review will be undertaken, and a new management plan prepared for the remaining five years of management.

Any proposed changes to the management contrary to that specified within this plan must be approved by DCCEEW and TfN, prior to implementation. Any proposed uses or development of the site which conflict with the landowners' commitments or maintenance/improvement of the habitats for Matters of NES are not permitted under this plan.

The landholder will use an Adaptive Management Approach to allow the flexibility to respond appropriately and effectively to the uncertainties involved in ecological processes. This will ensure that management objectives are being met while allowing for altered circumstances to be included in the management of the site.

Alternative management measures, as part of an adaptive management approach, may be implemented if:

- The management outcomes outlined within Section 5.6 are unable to be met based on methods outlined within this plan;
- A new management technique has been identified which is considered to be more effective in meeting the objectives of this OMP, and relevant recovery plans, threat abatement plans, conservation advices and does not increase risk of impacts to Growling Grass Frog communities. A review of the benefits and risks of the proposed management technique must be prepared and submitted to DCCEEW and Landowner / TfN; and,
- The proposed management technique has been approved by DCCEEW and TfN.

Where management outcomes outlined within Section 5.6 have not been met during any monitoring event (Section 5.7) corrective actions must be identified upon submission of the monitoring report.

Where an adaptive management approach has been implemented, the success, or failure, of the approach must be outlined within subsequent monitoring reports. The monitoring report must make recommendations on whether the approach should be continued, or whether subsequent alternative management is recommended.

In the event of a significant detrimental impact within the offset area and/or failing of the Offset Management Plan, the landowner will promptly notify Trust for Nature, the Approval Holder and DCCEEW, and in consultation with these parties:

- Develop responsive management plan to address impacts; and,

- Update the OMP and/or review implementation period (i.e. extend if required to address impacts)

6.1 Managing Uncertainty

An assessment of potential risks associate with the objectives of this plan are outlined within Table 11. All risks are considered manageable and actions within subsequent sections of this OMP address relevant risks.

7 RISK ASSESSMENT

An assessment of potential risks associated with the objectives of this plan are outlined within Table 11. Risk assessment and management definitions are provided in Appendix 1. All risks are considered manageable and actions within subsequent sections of this OMP address relevant risks.

L = Likelihood, **C** = Consequence, **RR** = Residual Risk

Table 11. Risk assessment and management table for specific offset site

Management objective/desired outcome	Event or circumstance	Relevant management actions/measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions	Notes
			L	C	RR			
To legally secure approved offset properties for conservation.	Failure to legally secure approved offset site	Engage with expert offset brokers	Unlikely	Moderate	Low	n/a	Engage a consultant	Low risk: the site is currently in the process of being secured with an on-title agreement (Section 173).
	Legislative reform prejudices proposed tenure arrangements for offset properties.	Monitor DCCEEW, DEECA, LGAs and other legislative bodies on developments to offsets	Rare	High	Low	Newsletters, expert liaison, press releases and direct contact.	Adjust offset calculations accordingly.	
To achieve performance targets and completion criteria for all MNES	Landowner-proponent agreements fail to adequately address management commitments in the offset plan	Engage an expert to manage this process. Ensure all impacts are suitably offset.	Unlikely	High	Medium	Quality assurance and monitoring	Revise on-title and/or proponent agreements.	The site will be protected through an on-title Section 173 agreement initially and ultimately through a Trust for Nature Covenant. Trust for Nature and DCCEEW undertake a review of OMP.
	Adjacent/regional landowner's land management practices fail to	Liaise with adjacent landholders. Ensure understanding of offset objectives	Unlikely	High	Medium	Adjacent land practices begin to negatively	Take steps to halt negative impacts. Follow up with	The adjacent land parcels are within the same broader property boundary, with much of the adjacent land also currently protected. Based on the current

Management objective/desired outcome	Event or circumstance	Relevant management actions/measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions	Notes
			L	C	RR			
	support attainment of offset outcomes.					impact offset site.	stakeholder discussions	land management practices in the region and it is unlikely that any foreseeable land management practices within the vicinity will impact the offset site.
To achieve performance targets and completion criteria for all MNES	Insufficient funds provided by proponent to implement the plan.	Ensure reputable land holder to implement plan.	Unlikely	High	Medium	Monitoring and/or annual reporting	Review plan for cost efficiencies.	The offset funds provided by the proponent will ultimately be deposited in a trust account with Trust for Nature. Annual payments over ten years will be reliant on annual reports being provided each year by the land holder and successful implementation of the annual management actions within this OMP. The offset funds will be administered using Trust for Nature trust fund which will guarantee that funds are available for the first ten years of management, which will include the most extensive habitat improvement works required.
	Stochastic events (wildfire/drought/flood) prejudice attainment of interim performance targets and/or completion criteria for MNES.	Plan for scheduling delays.	Possible	High	Medium	Monitoring and/or annual reporting	Apply adaptive management to ensure the objectives of the OMP are not compromised.	-

Management objective/desired outcome	Event or circumstance	Relevant management actions/measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions	Notes
			L	C	RR			
To achieve performance targets and completion criteria for all MNES	Approved development on/near project/offset prejudicing plan outcomes	Ensure proper stakeholder engagement to prevent poor outcomes.	Unlikely	High	Medium	Advertisement of planning scheme amendments/planning permit applications	Objection to proposed development/liaise with proponent to ensure the proposed development does not compromise the objectives of the OMP.	The OMP addresses risks associated with the proposed adjacent development. Further development is highly unlikely to occur nearby due to the presence of sensitive sites (Sparrovale and Baenches Wetlands) and is within a semi-rural landscape. As such, there is a low likelihood of further development within adjacent properties. The ecological values within the offset site do not rely on habitat values within adjacent land.
To improve the quality of Growling Grass Frog habitat present on the site	Drought	Apply adaptive management to ensure the site is not over-grazed during a post-fire recovery period.	Likely	Moderate	Medium	Drought Event	Apply adaptive management to ensure the site is not over-grazed during a post-fire recovery period.	Filtered Balog Channel water will be the initial water source for the constructed wetlands, while groundwater and rainwater will be the primary ongoing water source. A supplementary water source is recycled water.
	Wildfire		Likely	Moderate	Medium	Wildfire Event		
	Uncontrolled grazing	Maintain fences and install temporary fencing, if required (Section 5.6.4)	Unlikely	Moderate	Low	Continual monitoring	Repair permanent fences, and/or install temporary exclusion fences.	No livestock grazing activities are planned to occur within the offset site.

Management objective/desired outcome	Event or circumstance	Relevant management actions/measures	Residual risk			Trigger detection and monitoring activity/ies	Feasible/effective corrective actions	Notes
			L	C	RR			
	Loss of biodiversity due to competition with weeds (see Section 5.5.4.3 for performance indicators)	Spot spraying of weeds (Section 5.6.9) Annual monitoring to adapt future control works and targets (Section 5.7)	Likely	Moderate	Possible	Annual monitoring	Undertake weed control activities (Section 5.6.9)	The Offset Management Plan includes actions to reduce weed cover, improving the ecological condition of the site over the ten-year period.
	Loss of biodiversity due to pest animal activity (see Section 5.7.1 for performance indicators)	Deer, cats foxes and fox dens are controlled	Likely	Moderate	Possible	Annual monitoring	Undertake pest control activities (Section 5.6.8)	The Offset Management Plan includes actions to reduce pest animal activity, thereby reducing risk of habitat degradation or predation by introduced species. As a result, the population of Growling Grass Frog is likely to increase and ecological condition of Growling Grass Frog habitat within the site improved.

8 EMERGENCY CONTACTS AND PROCEDURES

Should any environmental emergency occur on-site that poses a risk to the objectives of this OMP, the relevant contacts (Table 12) must be notified as soon as possible, and no later than 12 hours following the event. At a minimum, DCCEEW, TfN and the landholder must be notified; CFA and Victoria Police should be notified if assistance is required from these emergency services (e.g. control of wildfire). Emergency services must be advised of the on-site protections to avoid inadvertent damage to ecological values (e.g. creation of graded earthen fire breaks within the site, which unless absolutely necessary, must be avoided).

Table 12. Emergency contacts

Contact	Role	Telephone
Country Fire Authority (CFA)	Bushfire emergency	000
Victoria Police	Various (e.g. unauthorised access)	000
DCCEEW	Offset Monitoring Responsibility	1800 803 772
TfN	Offset Monitoring Responsibility	(03) 8631 5888
	Landholder	

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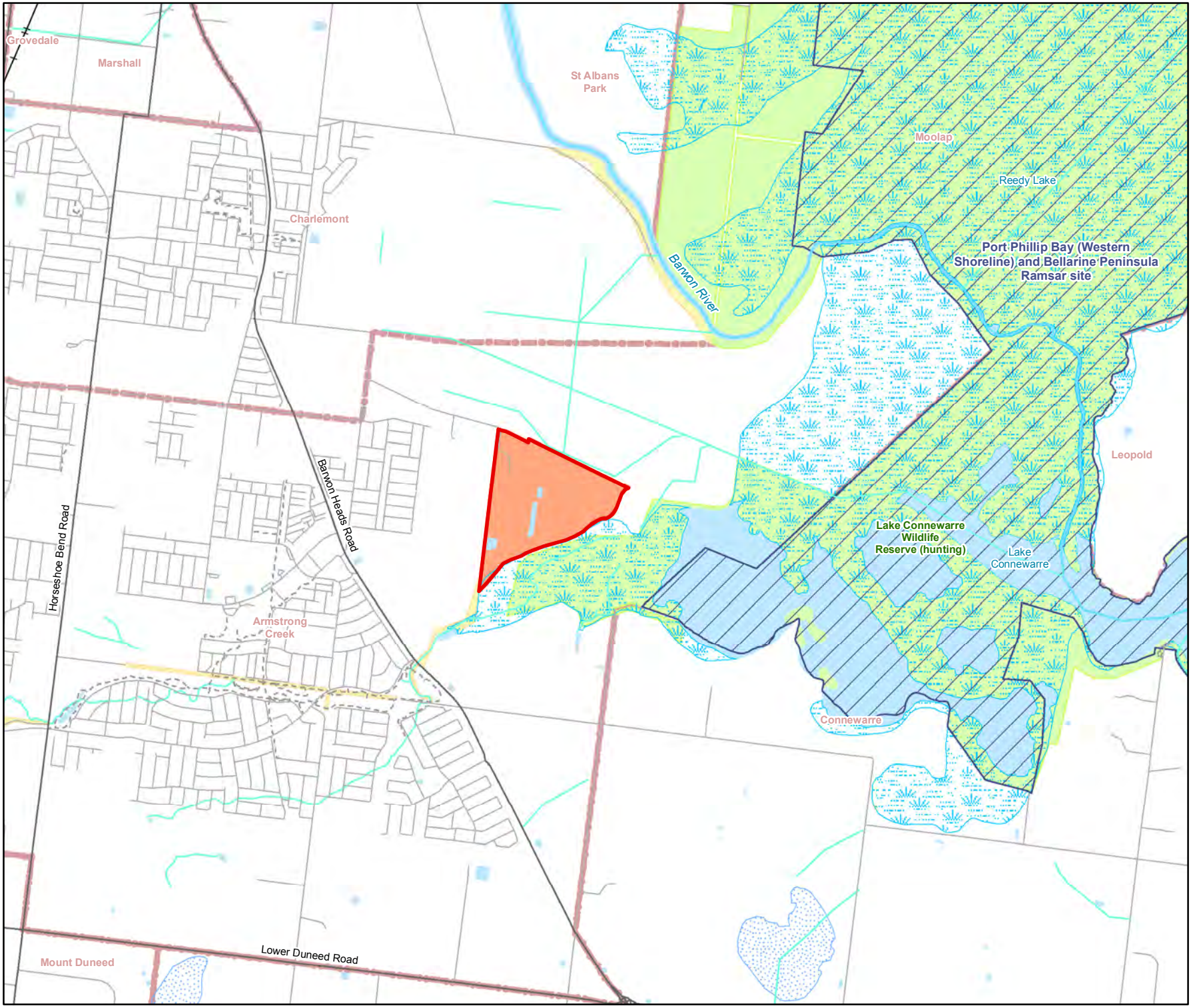
FIGURES



Legend

- Study Area
- Railway
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Ramsar wetland
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 250 500

Metres

Map Scale: 1:30,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

Legend

- Study Area
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Existing dams
- Survey sites
- Growling Grass Frog foraging habitat
- Growling Grass Frog foraging habitat impact area

Figure 2

Proposed development plan

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 75 150

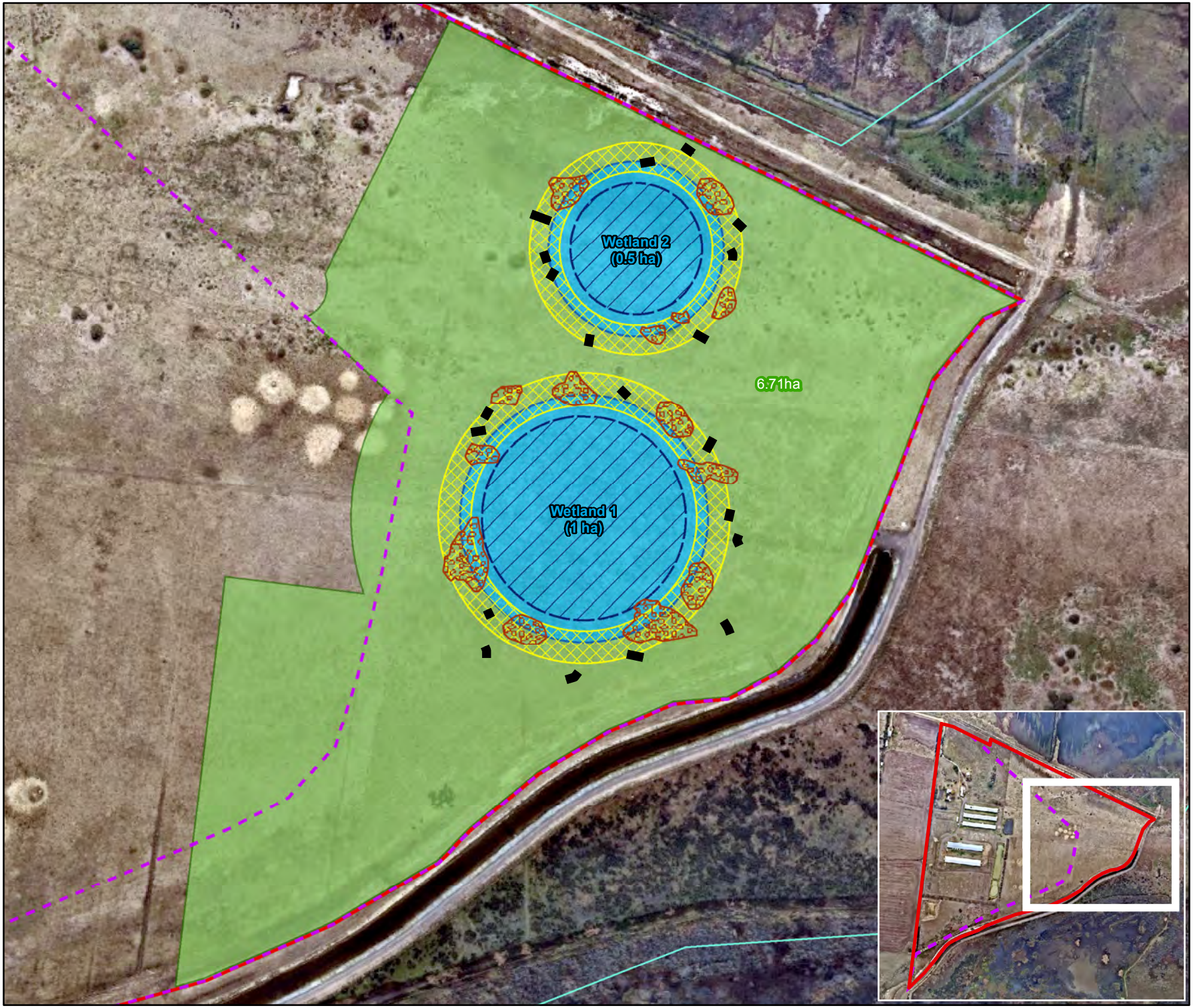
Metres

Map Scale: 1:5,200 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_DevPlan_OMP 10/10/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- ESO2 extent
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Deep water submergent vegetation zone (>1.5m)
- Emergent vegetation zone
- Rock beds
- Logs and woody debris

Figure 3

Conservation Management Plan for Growling Grass Frog

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 30 60

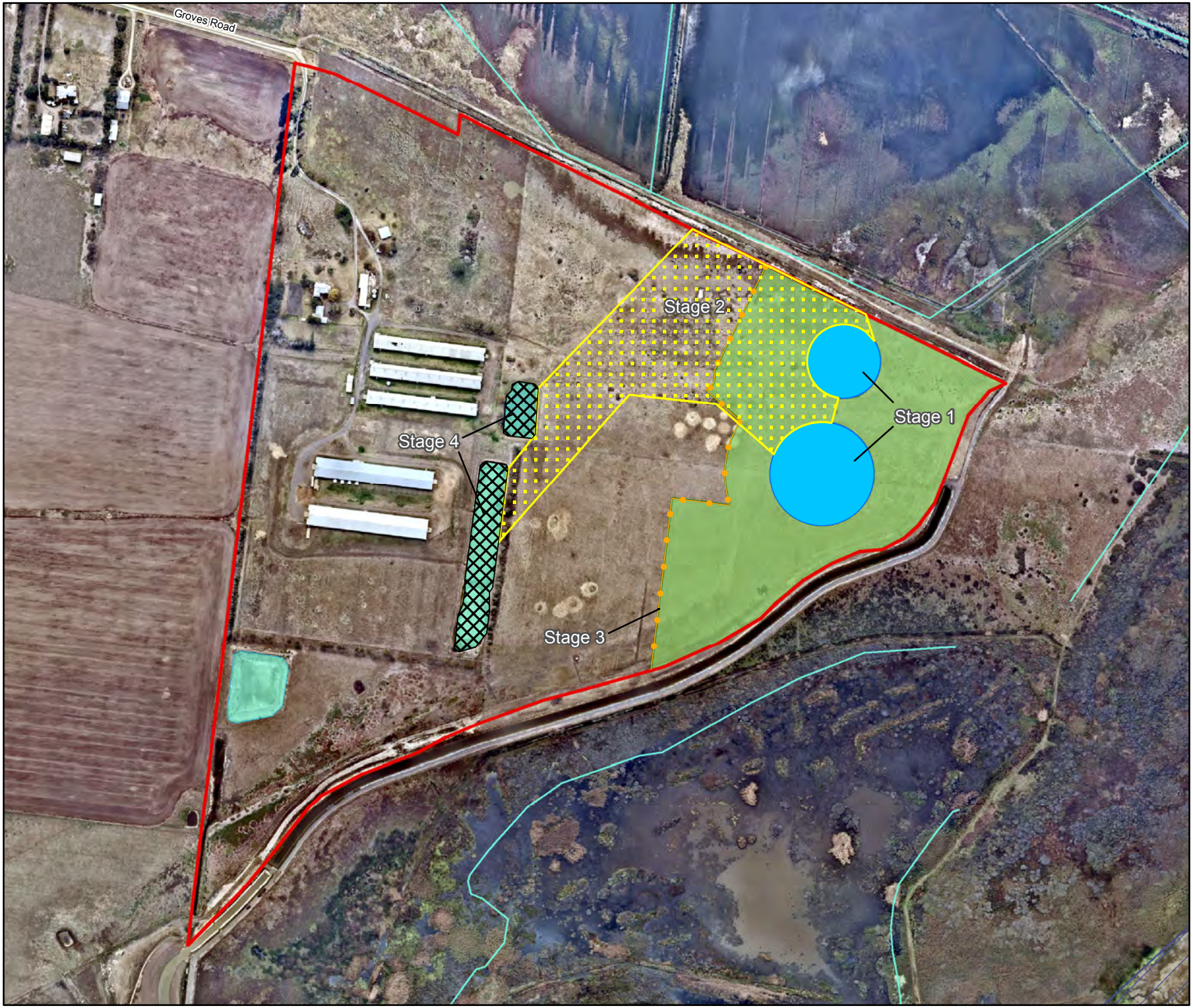
Metres

Map Scale: 1:2,300 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig03_CMP_OMP 11/10/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- Proposed Constructed Terrestrial Habitat Offset Area
- Existing dams

Stages

- 1. Waterbodies constructed (Autumn)
- 2. GGF migration period (Spring/ Summer)
- 3. Installation of frog exclusion, dog exclusion, safety and sediment fencing
- 4. Removals of dams following successful GGF migration

Figure 4

Constructed Wetlands Staging and Frog Migration

Offset Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 75 150

Metres

Map Scale: 1:5,500 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig04_Migration_OMP 9/11/2023 melsley

Aerial source: Nearmap 2022

APPENDIX 1 - RISK ASSESSMENT AND MANAGEMENT DEFINITIONS

Risk framework

Likelihood	Consequence: Minor	Moderate	High	Major	Critical
Highly Likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

Likelihood and consequence

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances
Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.

Moderate	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major	The plan's objectives are unlikely to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical	The plan's objectives are unable to be achieved, with no evidenced mitigation strategies.

APPENDIX 2 - EPBC OFFSET CALCULATOR

Offset calculator for effluent pond 1 aquatic habitat

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	0.216 ha of GGF potential breeding aquatic habitat	Area	0.22	Hectares	Biodiversity assessment
			Quality	6	Scale 0-10	
			Total quantum of impact	0.13	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat tree (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	0.13	Adjusted hectares	First party aquatic habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	0.6	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	0.24	181.52%	Yes	Ecological assessment
									Future area without offset (adjusted hectares)	0.6	Future area with offset (adjusted hectares)	0.6								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	6	5.00	80%	4.00	3.92				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			

Offset calculator for effluent pond 2 aquatic habitat

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	0.58 ha of GGF foraging aquatic habitat	Area	0.58	Hectares	Biodiversity assessment
			Quality	4	Scale 0-10	
			Total quantum of impact	0.23	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat tre (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	0.23	Adjusted hectares	First party aquatic habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	0.9	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	0.35	153.16%	Yes	Ecological assessment
									Future area without offset (adjusted hectares)	0.9	Future area with offset (adjusted hectares)	0.9								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	6	5.00	80%	4.00	3.92				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			

Offset calculator for dispersal habitat areas

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	15.71 hectares of low quality dispersal GGF habitat	Area	15.7	Hectares	Biodiversity assessment
			Quality	1	Scale 0-10	
			Total quantum of impact	1.57	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat tree (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	1.57	Adjusted hectares	First party dispersal habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	6.7	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	2.10	133.86%	Yes	Ecological assessment
									Future area without offset (adjusted hectares)	6.7	Future area with offset (adjusted hectares)	6.7								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	5	4.00	80%	3.20	3.14				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			

APPENDIX 2 - STORMWATER MANAGEMENT STRATEGY

78-88 Groves Road, Armstrong Creek

Stormwater Management Strategy

30th November 2022

Report by: **Stormy Water Solutions Consulting Pty Ltd**

E: michael.mag@stormywater.com.au

M: 0401 861 301

www.stormywater.com.au

Document Verification

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Client	03/10/2022	V2	MM	VM

Note that for the purposes of this report, Stormy Water Solutions (**SWS**) consists of two business entities being:

- Stormy Water Solutions (ABN 95 656 703 998) – Valerie Mag (Principal), and
- Stormy Water Solutions Consulting Pty Ltd (ABN 57 650 394 899) – Michael Mag (Director and Senior Hydrologic Engineer)

Accreditation

Michael Mag

- Bachelor of Engineering – Civil (Honours) 2016
- Bachelor of Science – Applied Mathematics 2016
- Master of Advanced Civil Engineering (Water) 2020
- Registered Professional Engineer – Civil (Victoria), BLA Registration No: PE0005386

Valerie Mag

- Bachelor of Engineering (Honours) 1989
- Master of Engineering Science 1993
- Registered Professional Engineer – Civil (Victoria): BLA Registration No: PE0005130
- Registered Professional Engineer (Civil and Environmental Engineering), National Engineering Register (Engineers Australia).

Disclaimer

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Contents

1 Introduction

Stormy Water Solutions Consulting Pty Ltd (**SWS**) has been engaged by JD AC Nom Pty Ltd (**Jinding**) to develop a stormwater management strategy (**SWMS**) for 78-88 Groves Road, Armstrong Creek (the **Subject Site**) as shown in Figure 1.

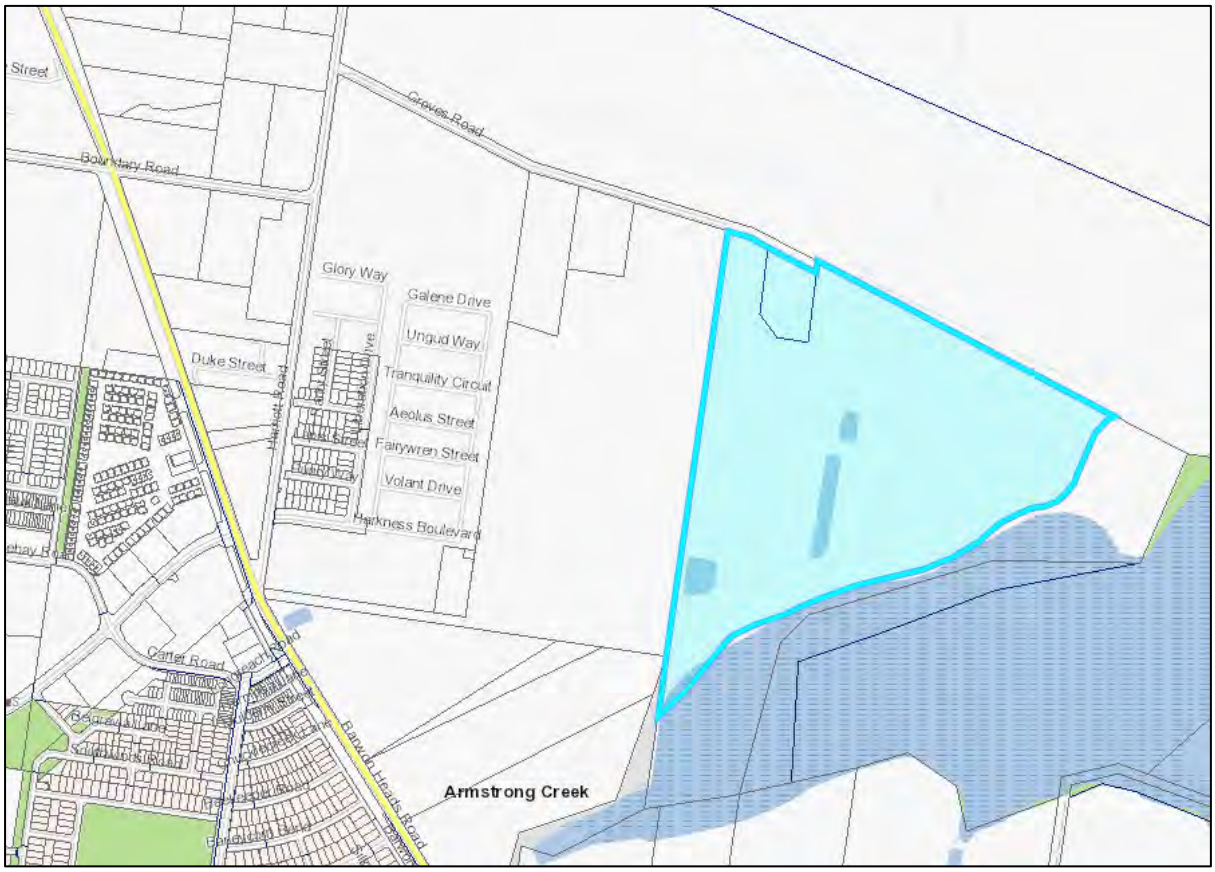

Figure 1 **Locality, with the Subject Site highlighted blue.**
Source: DELWP MapshareVic, accessed 19/10/21.

The Subject Site is located within the May 2010 Armstrong Creek East Precinct Structure Plan (the **ACEPSP**) region. Figure 2 shows an extract of the ACEPSP's Plan 18, with the Subject Site highlighted. The Subject Site is also defined as Property 2 of the ACEPSP.

The Subject Site is at the eastern edge of the ACEPSP region and is bounded:

- To the north by the Sparrovale Wetlands;
- To the south and east by the Balog Channel; and
- To the west by future ACEPSP development.

This report details the proposed SWMS for the Subject Site (i.e. Concept designs of key drainage infrastructure). It also details the constraints, design development and modelling undertaken to show that discharging the Subject Site into the Balog Channel, rather than constructing the ACEPSP wetlands on the property to the west, is a suitable SWMS outcome for the Subject Site.

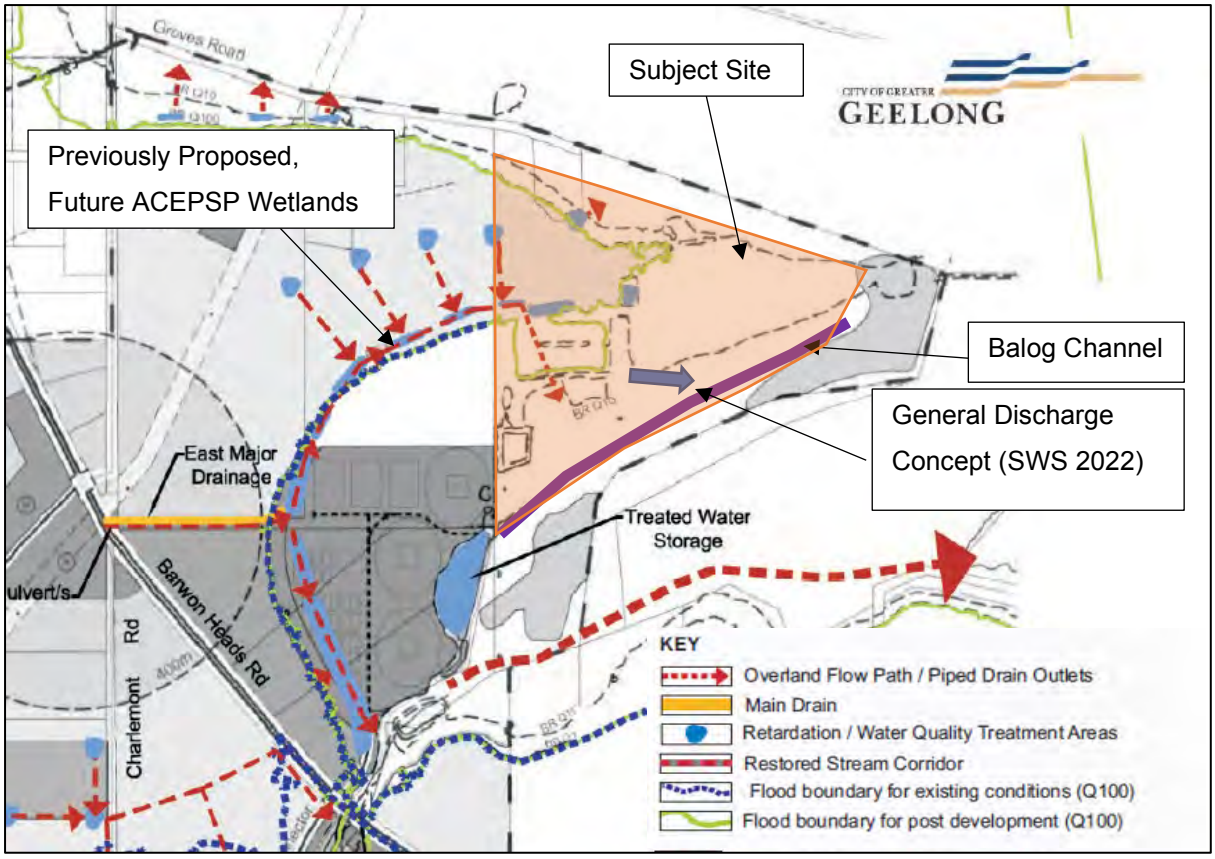

Figure 2 **Extract of Plan 18 of the ACEPSP with the Subject Site highlighted orange. Note: There is an error in the overland ACEPSP Plan 18 flow path directions as discussed in Section 2.3.**

2 Assumptions and Constraints

2.1 Site Development Layout

The general site development layout assumed within this SWMS is provided within Figure 3.

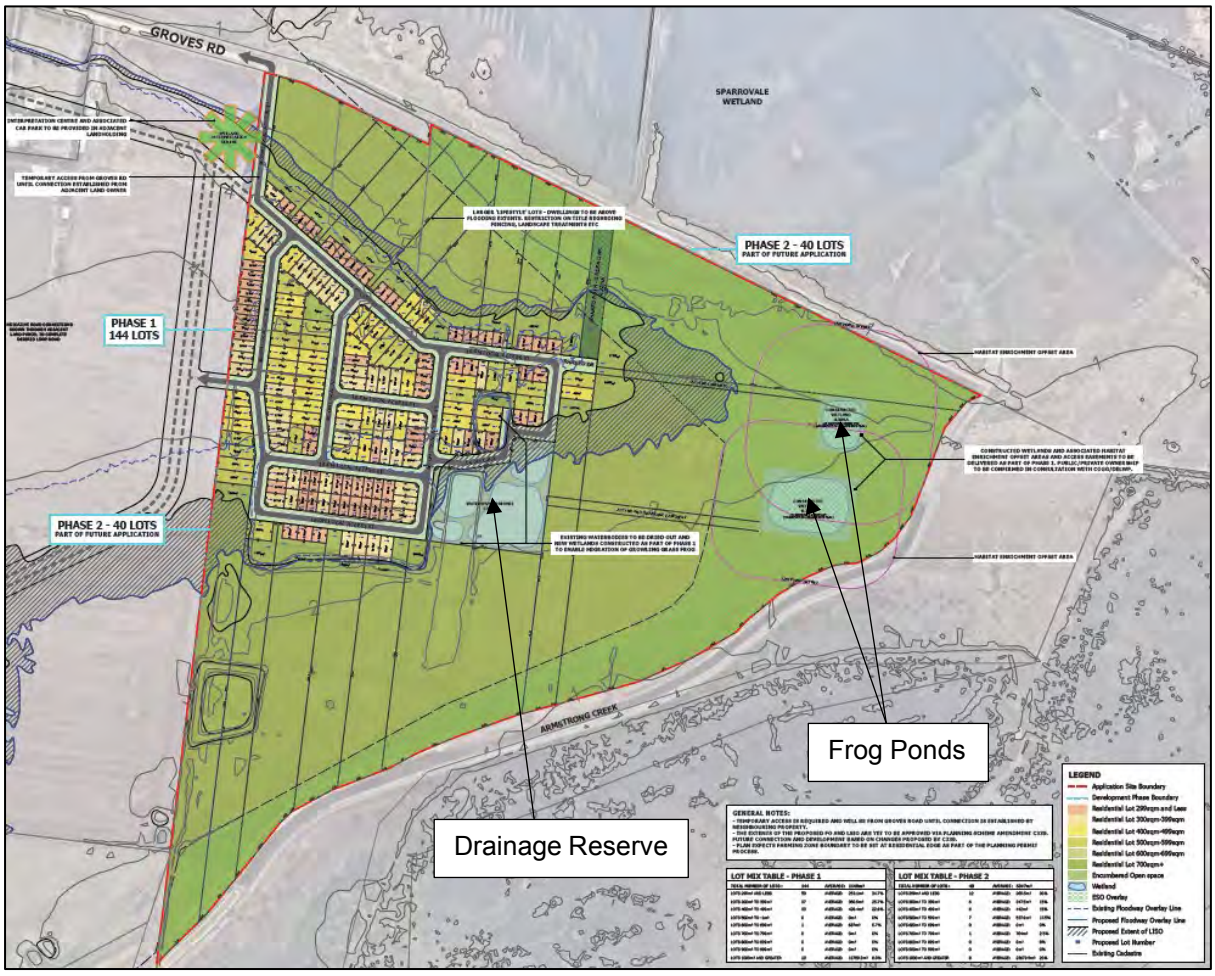

Figure 3 Site development layout assumed. Subject to change. Source: The Development Proposal

Based on the layout, and utilising the Melbourne Water Corporation (**MWC**) "MUSIC Guidelines - Input parameters and modelling approaches for MUSIC users in Melbourne Water's service area" (Melbourne Water 2018), SWS has assumed that the post-development overall fraction impervious ($\mathbf{F_{imp}}$) of the Subject Site to be:

- 0.75 for the residential development; and
- 0.10 for the larger 'fringe' lots.

The Subject Site development layout is subject to change. However, provided the general F_{imp} assumption remains valid, the design response presented within this SWMS should also remain valid.

2.2 Information Sources

The formulation of this SWMS has had regard to information from the following sources relating to designs and/or current works in the catchments/sites surrounding the Subject Site. Information obtained from each source below is described in more detail in subsequent sections of this report as required.

- A site visit conducted by SWS on the 24/08/2021;
- Publicly available cadastral and land use information from: https://mapshare.vic.gov.au/mapsharevic/
- Feature and level survey provided by the client;
- 2012 LiDAR information;
- "Armstrong Creek East Precinct Structure Plan, May 2010, City of Greater Geelong" (the **ACEPSP**)
- "Armstrong Creek Horseshoe Bend Precinct Structure Plan, September 2014, City of Greater Geelong" (the **HSBPSP**);
- "Armstrong Creek East Precinct, Update of Integrated Stormwater Management Strategy, V3-Draft, 14/10/2010, Neil M Craigie Pty Ltd" (the **2010 ACEPSP SWMS**);
- "Anchoridge, Balog Channel, City of Greater Geelong, Drawing Set, Rev A, 21/9/2018, SMEC" (the **Balog Channel Design Drawings**).
- The findings of the 2019 Lower Barwon Flood Study completed by Water Technology for the Corangamite Catchment Management Authority as they relate to the Subject Site (the **2019 Lower Barwon Flood Study**);
- "*Panel Report, Greater Geelong Planning Scheme Amendment C394ggee Land Subject to Inundation Overlay – Coastal Inundation and Hazard, 3/04/2020, Planning Panels Victoria*" (the **2020 C394ggee Report**);
- "*64-74 Groves Road, Armstrong Creek, VCAT Reference P1605/2020, 26 July 2021, Andrew McCowan, Water Technology, 21010303_R01v01*" (the **Water Technology VCAT Evidence**);
- "*Final Report, Growling Grass Frog Litoria raniformis Conservation Management Plan for the Proposed Development at 78-88 Groves Road, Armstrong Creek, Victoria, V03, 16 September 2022, Ecology and Heritage Partners Pty Ltd*" (the **GGF Conservation Management Plan**);
- The memorandum from Terence Kelly of Water Technology to Mitch Graham of GPR Consulting regarding 88 Groves Road, Armstrong Creek, ref 23010126-: Version 2, 25/11/22 (the **Water Technology Groves Road Memo**);
- The drawing "Overall Urban Design Layout Plan, 78-88 Groves Road, Armstrong Creek, Mdplan, 23/11/2022" (the **Development Proposal**).

2.3 The 2010 ACEPSP SWMS

An extract of the ACEPSP's drainage network proposals is provided in Figure 2.

The Water Technology VCAT Evidence highlights that there is an error in the ACEPSP's drainage plan, with the Subject Site's drainage (as per the ACEPSP) due to be directed to the southwest (see Figure 4), along the future linear wetland extension, not to the east (away from this channel) as shown in Figure

2. As detailed in Figure 4, the ACEPSP recommends that the site should be discharging to the extension of the linear wetland in a southwest direction, which will then be discharged to the Hospital Swamp.

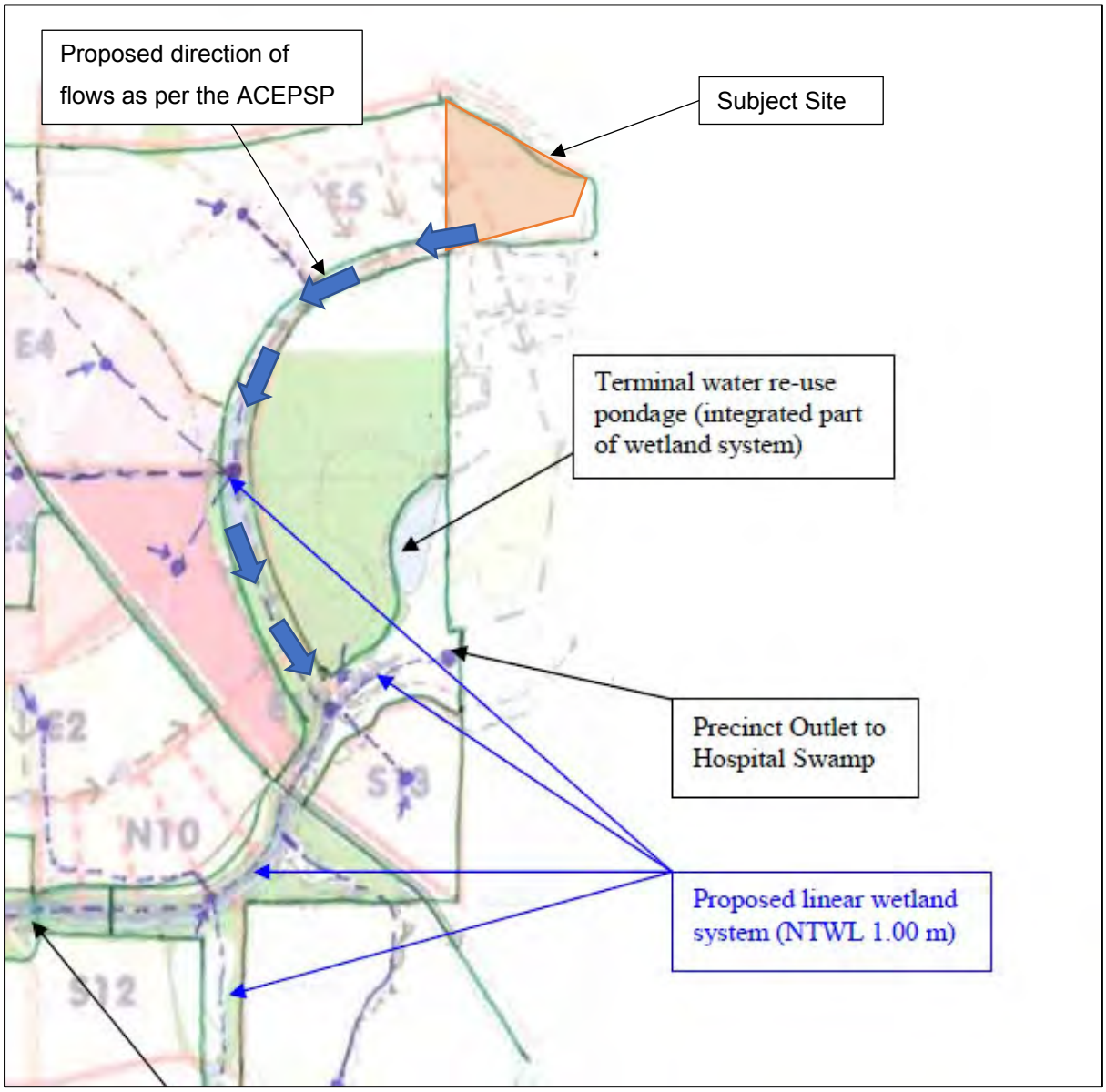

Figure 4 Extract of the 2010 ACEPSP SWMS with "correct" PSP flow paths shown in blue.

The relevant objectives of the ACEPSP relating to drainage and floodplain management (p 46 of the ACEPSP) are:

a) *to ensure appropriate floodplain management in ACEP and beyond;*
b) *to protect and/or enhance downstream environments including recognised social, environmental and economic values, by managing appropriately the quality and quantity of stormwater runoff;*
c) *to integrate appropriately stormwater systems into the natural and built environments whilst optimising the potential uses of drainage corridors;*
d) *to reduce the annual average volumes of stormwater runoff from developed catchments by a minimum of 30 per cent;*

e) *to ensure the peak stormwater discharge from developed catchments is not greater than peak discharges from the same catchment subject to existing conditions; and*

f) *to avoid impervious surfaces and piped drainage systems that are directly connected to waterways.*

The 2010 ACEPSP SWMS shows that the above objectives are met via the system of interconnected wetlands and linear pool systems as part of the ACEPSP before discharge into the Hospital Swamp.

Thus, if following the ACEPSP, the Subject Site's discharge would be via an online 'half-moon' shaped wetland to the west through 64-74 Groves Road, Armstrong Creek as shown in Figure 4.

However, this proposal would involve constructing significant downstream works on 64-74 Groves Road, Armstrong Creek. The Client has advised this is not preferred. Rather, it is proposed within this SWMS to discharge the Subject Site to the (already constructed) Balog Channel (via a frog pond), located south-east of the Subject Site.

2.4 The Balog Channel

The Balog channel is not mentioned in the 2010 ACEPSP SWMS or the ACEPSP. The Balog Channel (also referred to as the Southern Deviation Channel) has been constructed along the southern and eastern boundary of the Subject Site as detailed in Figure 5.

From the Water Technology VCAT Evidence and informal discussions with Neil M Craigie Pty Ltd, SWS's understanding of the Balog channel is that it has been constructed to divert Summer/Autumn stormwater flows north towards the Sparrovale Wetlands, and away from the Hospital Swamp. In this way, the Sparrovale Wetlands can receive additional inflows during dry periods.

The Balog Channel Design Drawings show that it is an approximately 1,000 m long channel with a normal water level (**NWL**) of 1.00 m AHD.

The channel connects via a gate valve and pipe at its northern end into the Sparrovale wetlands (see Figure 6). It is not known whether (or when) this gate valve is open or shut as it was unable to be accessed during the site visit.

Thus, if the Subject Site were to discharge into the Balog Channel, the flows from frequent rainfall events could potentially flow to directly to either the Sparrovale wetlands or to Hospital Swamp, depending on the gate valve arrangements.

This SWMS assumes that most local flood and low flow events will occur during the wetter times of the year. As such, the modelling in this report assumes most flows from the Subject Site discharging to the Balog Channel will be conveyed to Hospital Swamp (with all the other ACEPSP catchments) and not north to the Sparrovale wetlands.

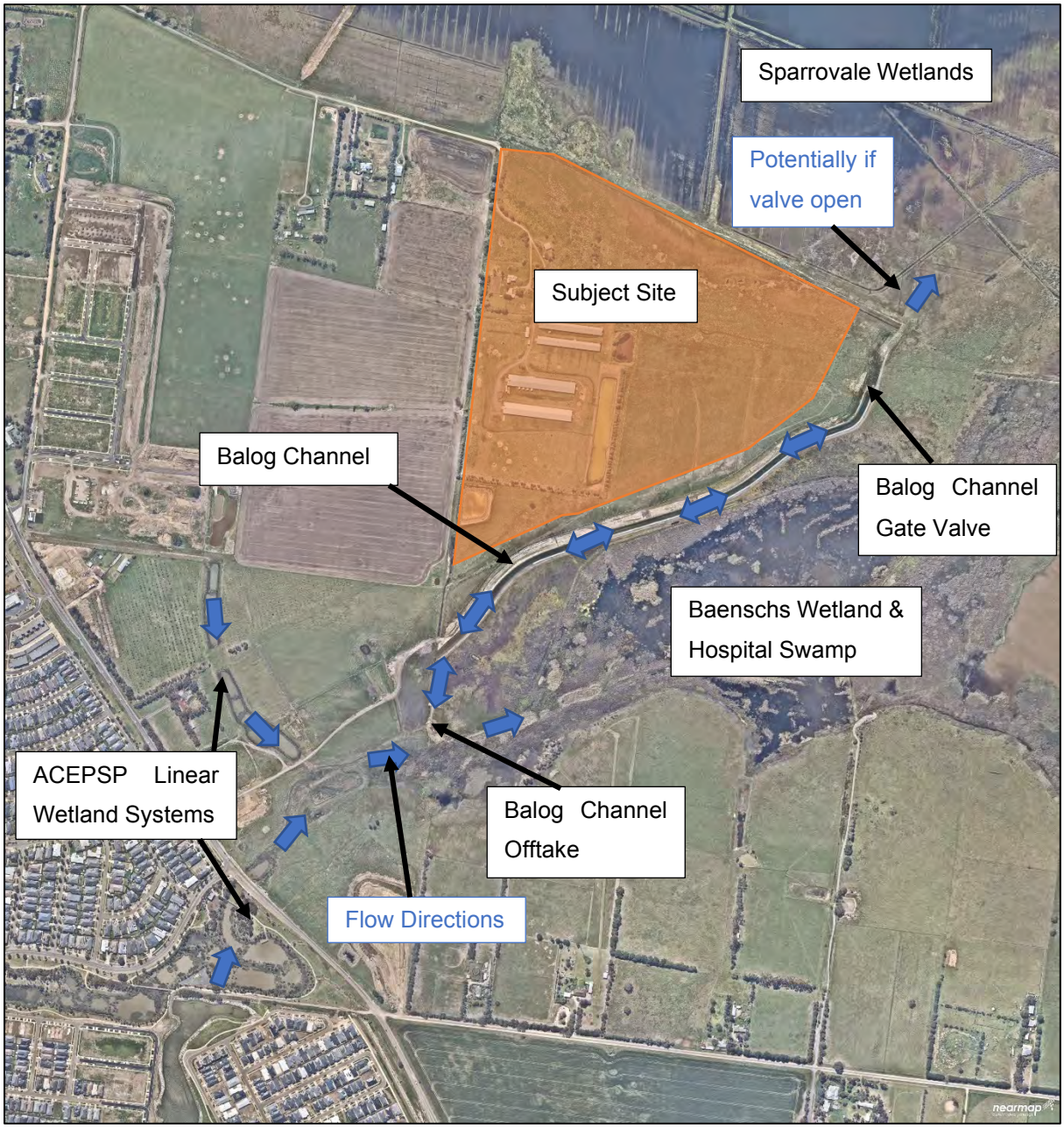

Figure 5 **Balog Channel Function. Image background: Nearmap 06/10/2021.**

Figure 6 Balog Channel Gate Valve. Source: GGF Conservation Management Plan

2.5 Growling Grass Frog Considerations

Litoria raniformis, the growling grass frog (**GGF**), may be present within the Subject Site. As such, a GGF Conservation Management Plan has been developed and provided by the Client. The GGF Conservation Management Plan proposes two new GGF habitat wetlands be provided as part of the Subject Sites development. Of these two habitats, one larger habitat wetland (to be fed via outflows from the proposed stormwater treatment wetland) and one smaller habitat wetland (not to be fed via outflows from the proposed stormwater treatment wetland) are to be provided.

Given this, the concept design of the stormwater treatment wetland developed herein will set a NWL for each system that will enable the assets to drain into the Balog Channel under gravity.

2.6 Local Design Objectives

Given the proposal to discharge directly into the Balog Channel (via a frog pond), the following design objectives / targets for the Subject Site are proposed to be met within this SWMS:

Obj-1 Provide BPEMG stormwater treatment prior to discharge into the Frog ponds and then the Balog Channel.

Obj-2 Show no increase on the local flood flows up to and including the 1% AEP event discharging into the Hospital Swamp due to the Subject Site development.

Obj-3 Ensure all Subject Site development fill levels are a minimum of 600 mm above the applicable 1% Annual Exceedance Probability (**AEP**) flood level in the Barwon River at this location. This requirement should be confirmed with the Corangamite Catchment Management Authority (**CCMA**).

2.7 Regional Flooding

The extent of the regional flooding which affects the Subject Site has been obtained from the 2019 Lower Barwon Flood Study and the CCMA's online 'flood portal' (accessed 29/09/2022).

This study specifies that the Subject Site is affected by 1% (**AEP**) riverine flooding from the Barwon River to a variable level of between 2.55 and 2.66 m AHD (say 2.70 m AHD) with a velocity between 0 and 0.79 m/s. A map of the expended 1% AEP inundation, relative to the development proposal, is provided in Figure 7.

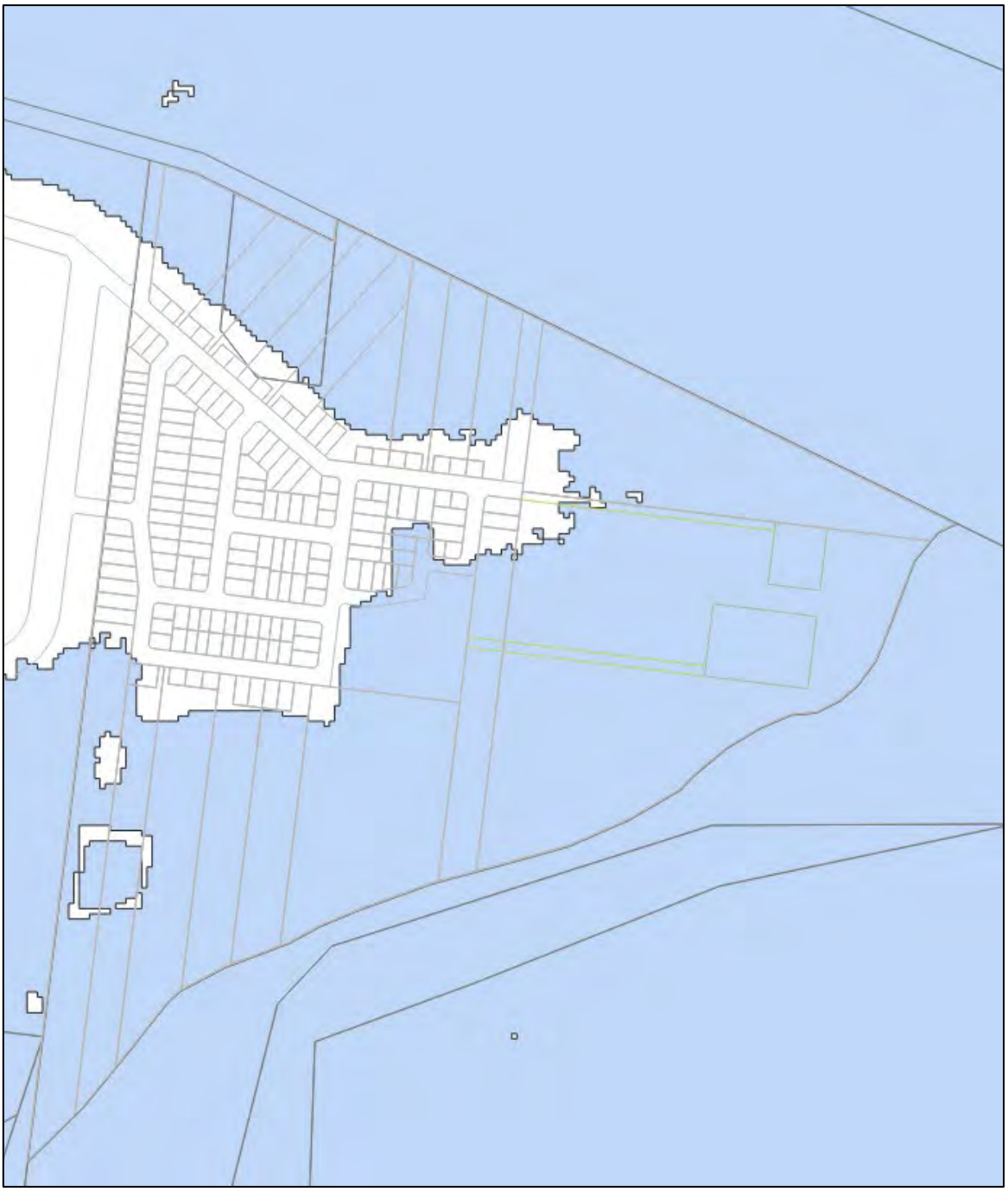

Figure 7 **Overlaid 1% AEP 2019 Lower Barwon Flood Study Extent on the site development proposal. Layout subject to change.**

The low velocity, and the Subject Site's location within the floodplain indicate that the Subject Site is located on the fringe of the Barwon River floodplain.

In line with the Guidelines for Development in Flood Affected Areas (DELWP 2019) (the **Floodplain Development Guidelines**) the following principles are adopted in this SWMS:

- Development (including earthworks) should not divert floodwaters to the detriment of any adjoining property;
- Development (including earthworks) should not increase the flood velocity on any adjoining property;
- Development (including earthworks) should not increase flood levels on any adjoining properties; and
- Earthworks and buildings should not result in a detrimental loss of flood storage.

It is assumed that the regional flood impacts of the Subject Site development will be suitably managed provided the future minimum fill levels within the Subject Site residential lots are set at a minimum level of 3.30 m AHD (600 mm freeboard above the 1% AEP level).

At this stage it is assumed that any minor fringe filling (associated with providing adequate flood protection to proposed lots) that may be required will be insignificant compared with the total flood storage provided within the Barwon River flood plain downstream of Barwon Heads Road.

2.8 Interim Access Provisions

Ultimately, the ACEPSP will provide flood free access to the Subject Site via new roads within 64-74 Groves Road.

However, without having an access through 64-74 Groves Road, the only logical interim/temporary access point for access to the Subject Site is via Groves Road.

Currently, in a 1% AEP flood event, the Water Technology Groves Road Memo specifies that the 1% AEP flood level estimate along much of Groves Road is approximately 2.62 m AHD. The current crest of Groves Road varies between 1.40 and 1.60 m AHD. Thus, the current 1% AEP inundation would be to a depth of at least 1.0 to 1.2 m in the 1% AEP event.

The Floodplain Development Guidelines state "*Development should not be allowed on properties where the depth and flow of floodwaters would be hazardous to people or vehicles entering and leaving the properties*". With inundation to a depth of 1.0 to 1.2 m in the 1% AEP event, Groves Road in its current conditions would be hazardous.

The Water Technology Groves Road Memo shows that raising Groves Road to 2.92 m AHD (the 1% AEP flood level estimate plus 300 mm of freeboard) to provide access into the Subject Site does not adversely impact the floodplain and/or its function as shown in Figure 8. That is, it as per the Water Technology Groves Road Memo:

- *"Solely raising Groves Road to ensure access to the Site does not appear to produce adverse impacts off-site.*
- *The raised road preserves safe access in events up to and greater than the 1% AEP.*
- *There is benefit to maintaining the existing culverts under Groves Road if work proceed, both to allow local runoff to drain from the site and to balance water levels either side of the road.*
- *Raising ground levels for sections of impacted lots along the north-western limit of development does not have any impact to the 1% AEP event as the building footprints are outside of the extent."*

As such, this SWMS assumes that access from Groves Road into the Subject Site can be provided via raising of Groves Road.

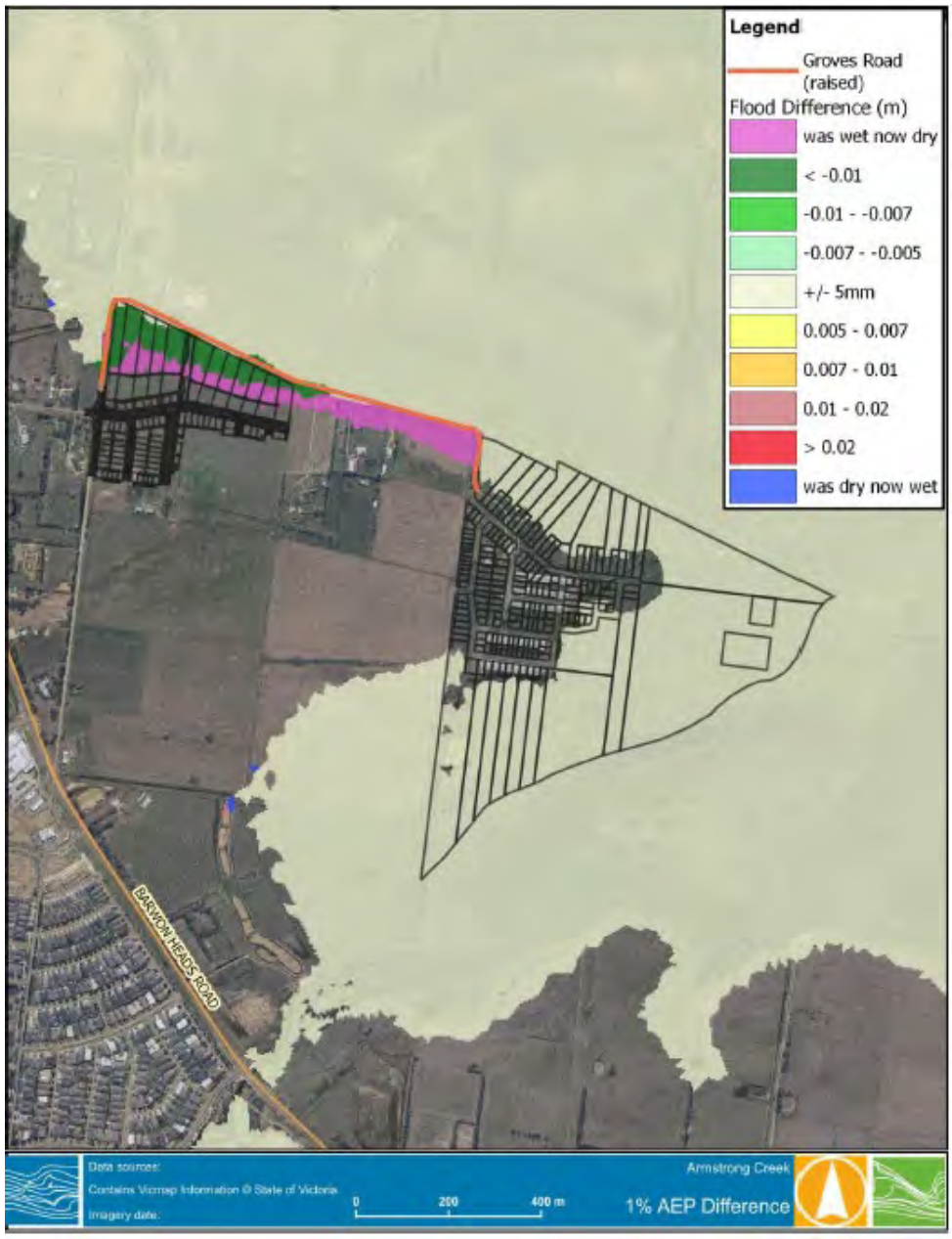

Figure 8 **1% AEP Afflux plot from the Water Technology Groves Road Memo showing that raising Groves Road for access does not adversely impact floodplain.**

2.9 Overlays, Ecology and Heritage

Figure 9 shows that the Subject Site is covered by two overlays, a floodway overlay (**FO**) (as discussed in Section 2.6) and a Environmental Significance Overlay (**ESO2**).

It is not expected that either of these overlays will affect the proposals of this SWMS other than the FO implications as discussed in Section 2.6 and the GGF considerations (Section 2.5).

The ACEPSP plan 18 (Biodiversity and Habitat Zones) is reproduced in Figure 10 showing that the Subject Site may be affected by a habitat zone (HZ3). Again, it is assume that this zone will not affect the proposals of this SWMS other than the GGF considerations (Section 2.5).

Figure 9 **Planning Overlays Affecting the Subject Site.**
Source: https://mapshare.vic.gov.au/vicplan/, accessed 25/08/21.

Figure 10 Extract of Plan 18 of the ACEPSP

2.10 General Mean Annual Runoff Volume Implications

In June 2021, the Environment Protection Authority Victoria (**EPA Vic**) released updated 'urban stormwater management guidance' (EPA Vic 2021) (referred to as the **updated guidance** herein). The updated guidance is clear that it does not impose compliance obligations. Rather, the updated guidance provides quantitative performance objectives for urban stormwater which set an objective that should be aimed to be met as far as 'reasonably practicable'.

For the Subject Site (rainfall band 500-600 mm/yr based on long term averages from the nearby gauges 087184 and 087135), the updated guidance provides the following performance objective (in addition to those required under the BPEMG):

- Reduce the mean annual runoff volume (**MARV**) generated from post-development impervious areas by:
    a. 29% using harvesting (i.e. re-use) and evapotranspiration; and
    b. 7% using infiltration

It is assumed that the extensive design development within the HSBPSP and ACEPSP already meet the MARV targets as far a reasonably practicable at a catchment scale due to the utilisation of the downstream Sparrovale wetlands. Thus, no additional measures (other than lot scale re-use) will be proposed within this SWMS.

2.11 Climate Change Implications

It is understood from the 2020 C394ggee Report that 800 mm of sea level rise is expected by 2100 (relative to 1990 levels).

2.11.1 Normal Operation

The main potential climate change implications in normal operation are any potential impact on the design NWL within the Balog Channel from either the Sparrovale wetland or the Hospital Swamp.

It is understood (from informal discussions with Neil M Craigie Pty Ltd) that in normal operation a levee between the Sparrovale wetland, and Lake Connewarre, isolates the Sparrovale wetland from downstream tidal influences, both now an into the future. As such, future high tide levels are not expected to influence the assumption of a 1.0 m AHD NWL in the Sparrovale wetland if the Subject Site is discharging to this asset.

From the 2010 ACEPSP SWMS it is understood that the control of the ACEPSP system into the Hospital swamp is proposed to be an informal riffle control at 1.0 m AHD and then a series of weirs up to 2.20 m AHD. This arrangement, combined with expected dissipation of tidal surge affects at this point in the Barwon River estuary (due to the constricted river opening at Barwon Heads) is expected to retain the 1.0 m AHD NWL assumption if the sea level was to rise by 800 mm. However, this assumption should be confirmed with Water Technology, the CCMA or the CoGG as design development continues.

2.11.2 Flood and Tidal Surge Impacts

The Water Technology VCAT Evidence states:

> "*That 0.0m AHD corresponds approximately to current mean sea, level. Further, the 1% annual exceedance probability (AEP) storm tide elevation in Bass Strait in the vicinity of Barwon Heads is approximately 1.8m AHD under current conditions and is expected to increase to about 2.7m AHD by 2100.*"

It is SWS's understanding through conversations with Water Technology that the 2019 Lower Barwon Flood Study found that the impacts of sea level rise on 1% AEP flood levels and extents upstream of Lake Connewarre are minimal. It is understood that riverine flooding dictates the flood levels upstream of Lake Connewarre, not tidal surges.

Thus, given the Subjects Site's location upstream of Lake Connewarre, it is assumed that the impacts of climate change (both in rainfall increase and sea level rise) on the 1% AEP level estimate are suitably captured within the 2.70 m AHD level utilised (as per Section 2.6).

This assumption should be confirmed as the design development proceeds. Notwithstanding the above, the setting lot fill levels at 3.30 m AHD is expected to provide adequate protection due to tidal surge impacts in the future.

3 SWMS Proposal

The SWMS proposals for the Subject Site are as per drawings 2180/SWMS/1-2 (Appendix A).

3.1 Stormwater Treatment and Drainage Reserve Allocation

No drainage works on the adjoining 64-74 Groves Road are proposed as part of this SWMS.

Rather than provide a 'half-moon' shaped wetland through 64-74 Groves Road as per the ACEPSP, to service the Subject Site, it is proposed to provide:

- A stormwater treatment wetland (NWL = 1.65 m AHD, TED = 2.00 m AHD), connecting into
- A trapezoidal channel (Grade = 1V:550H), connecting into
- A GGF habitat pond (NWL = 1.10 m AHD), connecting into
- The Balog Channel (NWL = 1.00 m AHD, to be proven).

Appendix C.2 and C.3 detail the sizing of the proposed sediment basin and wetland within the drainage reserve.

The total system is able to achieve BPEMG for the approximate 11.50 ha of residential development within the Subject Site as shown in Table 1 when discharging from the wetland.

Table 1 Stormwater Pollutant Removal from the Proposed System.

Pollutant	Total Catchment Load	Pollutants Removed	Residual Load	Treatment Train Effectiveness
	kg/yr	kg/yr	kg/yr	%
Total Suspended Solids	7,770	6,370	1,400	82.0%
Total Phosphorus	15.7	11.3	4.4	72.2%
Total Nitrogen	110	59	51	53.5%
Gross Pollutants	1,680	1,680	0	100.0%

The proposed stormwater treatment system, with a 4 m wide maintenance path and suitable sediment dewatering area, is proposed to be contained within a 12,350 m^2 drainage reserve as shown in 2180/SWMS/2.

The stormwater treatment assets have been specified with a normal water level (**NWL**) of 1.65 m AHD to ensure a free draining outfall into frog pond (NWL = 1.10 m AHD) and then into the Balog Channel (NWL = 1.00 m AHD). All stormwater treatment assets are predominantly in cut below their top of extended detention (**TED**) level of 2.00 m AHD.

Lot scale stormwater capture and reuse for toilet and laundry uses is also encouraged on all lots.

3.2 Local Retardation

No local retardation is proposed for the Subject Site. Appendix B details the regional scale hydrological modelling which assess the peak flows at the ACEPSP's outfall, with and without development of the Subject Site. The timing of the Subject Site's discharge to the ACEPSP's outfall (fast) compared to the peak flow discharges from the larger ACEPSP catchment (much slower) result in negligible increases

in the catchment scale flood flow estimates from the ACEPSP region when the Subject Site is developed. As such, no site scale flood retardation is required, or proposed as part of this SWMS.

3.3 Regional Flood Influences

3.3.1 Required Fill Levels

As shown in drawing 2180/SWMS/1, all residential lots which are proposed to be filled a level of 3.30 m AHD. A fill level of 3.30 m AHD is greater than 600 mm above the applicable 1% AEP flood level estimate from the 2019 Lower Barwon Flood Study and hence conservative.

Note that additional filling may be required in some areas to drain the residential development within the Subject Site towards the sediment basin (see Section 3.4 below).

3.3.2 Flood Storage

It is expected that to fill the residential developments lots to the 1% AEP flood level plus freeboard estimate of 3.30 m AHD, that there will be a loss of approximately 1,000 m^3 of floodplain storage.

The proposed stormwater treatment wetland provides approximately an additional 1,000 m^3 of floodplain storage.

Thus, there is expected to be no net loss of floodplain storage due to the development.

Notwithstanding, given the Subject Sites location within the floodplain, any minor loss, compared to the volume of water within the wider Barwon River floodplain, is not expected to cause any detrimental impacts.

3.4 Site Drainage and Fill

Subject Site piped drainage infrastructure will be designed with a (local) 20% AEP capacity at a later design stage. General pipe alignments are expected to follow the arrows shown in 2180/SWMS/1.

However, it is expected that in order to direct the pipe and overland flow path system back to the sediment basin SB1, an additional 1.0 to 1.5 m of fill may be required in areas of the Subject Site (outside of the 1% AEP flood extent region).

4 Concluding Remarks and Further Work Required

The SWMS presented in within this report and the developed drawing set (Appendix A) shows 78 - 88 Groves Road can seamlessly integrate into the existing assets and development proposals for the ACEPSP, without performing works on the adjacent 64-74 Groves Road property.

Subject Site piped drainage infrastructure will be designed with a (local) 20% AEP capacity at a later design stage.

Lot fill requirements will ensure that appropriate freeboard provisions from the 1% AEP level are met for all new lots, with fill levels set at 600 mm above the applicable 1% AEP flood level in the Barwon River.

It is recommended that Council provide in principle support to the designs presented within the SWMS.

It is also recommended that this report be provided to the Corangamite Catchment Management Authority for comment.

The following further work is recommended to further develop the design:

- Full service proving be completed;
- The GGF habitat ponds be further designed, with the NWL's specified in this report;
- A civil functional layout plan be prepared detailing pipe locations, road over land flow paths (to generally outfall at Sediment Basin SB1) and applicable site fill levels to direct flow to this point;
- Confirmation of the 2100 climate change implications detailed in Section 2.1 is required;
- A landscape plan be developed for the drainage reserve; and
- Functional and detailed design be competed encompassing the proposals within this SWMS.

4.1 Timing

The SWMS proposals herein assumes the development of the Subject prior to works on the adjacent 64-74 Groves Road, Armstrong Creek.

However, if works on 64-74 Groves Road, Armstrong Creek occur prior to the development of the Subject Site, it is recommended that that the stormwater treatment wetland proposals herein not be developed further. In this instance, following the PSP proposals for the Subject Site (Figure 2) is the logical way of draining the land. Following the PSP proposals will avoid the need for (and cost of) the additional stormwater treatment wetland proposed herein.

5 References

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Nearmap 2021. *Areal imagery for locations and dates shown on Figures where applicable*.

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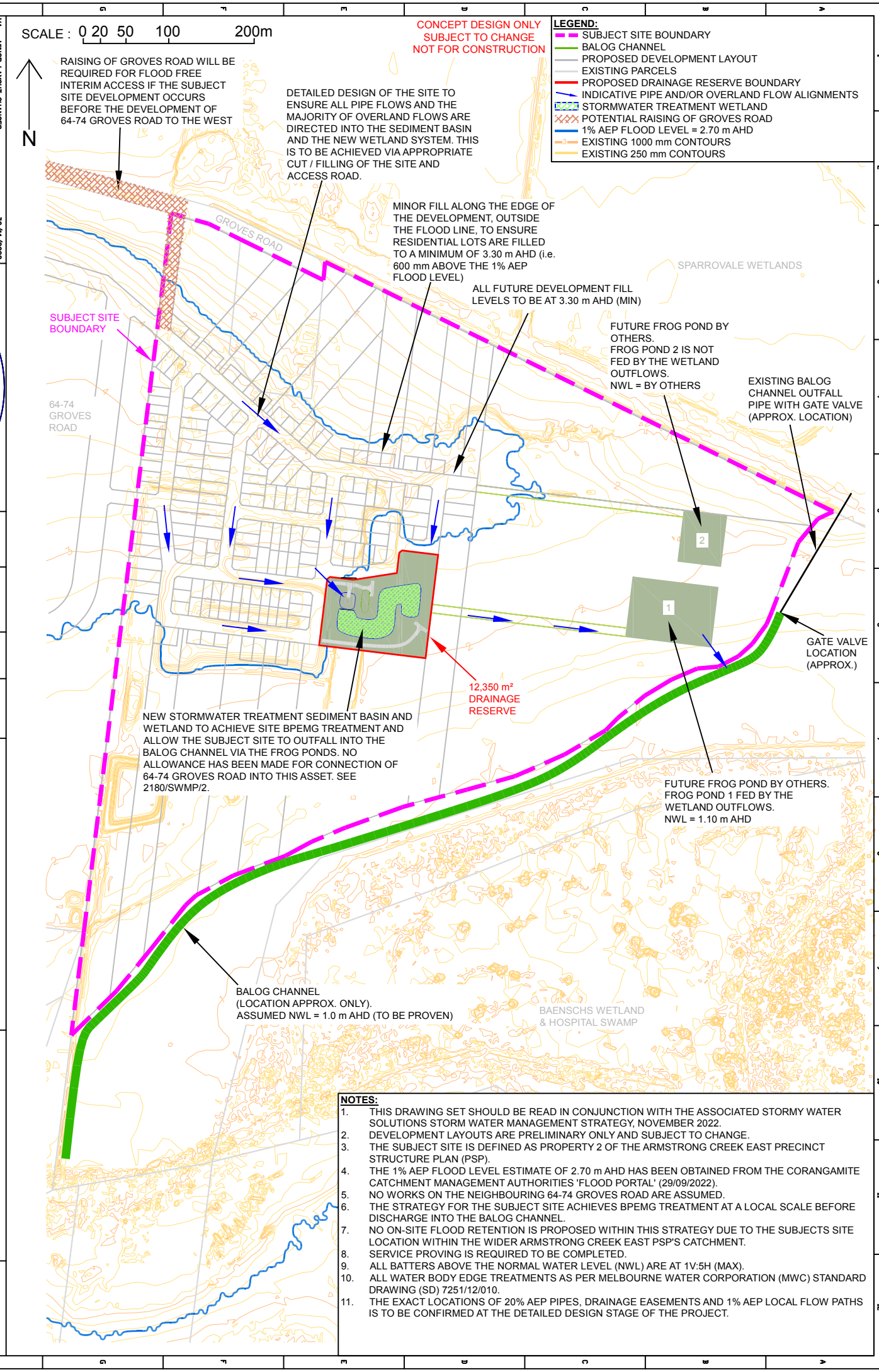
6 Abbreviations, Descriptions and Definitions

The following table lists some common abbreviations and drainage system descriptions and their definitions which may be referred to in this report.

Abbreviation / Descriptions	Definition
AHD - Australian Height Datum	Common base for all survey levels in Australia. Height in metres above mean sea level.
ARI - Average Recurrence Interval.	The average length of time in years between two floods of a given size or larger. A 100 Year ARI event has a 1 in 100 chances of occurring in any one year.
AEP – Annual Exceedance Probability	The chance of a storm (flow) of that magnitude (or larger) occurring in a given year. $\boldsymbol{AEP = 1 - e^{(\frac{-1}{ARI})}}$. i.e. 18.13% AEP = 5 Year ARI
BPEMG	Best Practice Environmental Management Guidelines. See CSIRO (1999)
DSS or DS	Development Services Scheme (DSS) or Drainage Scheme (DS) is a master plan developed my MWC for drainage within a catchment area.
EY – Exceedances per year	The amount of times a storm (flow) of that magnitude is expected to be exceeded per year. i.e. 4 EY = 3 Month ARI
Hectare (ha)	10,000 square metres
HECRAS	A hydraulic software package that enables the calculations of flood levels and velocities along a waterway given a specified flow.
Kilometre (km)	1000 metres
m^3/s -cubic metre/second	Unit of discharge usually referring to a design flood flow along a stormwater conveyance system
Megalitre (ML) (1000 cubic metres)	1,000,000 litres = 1000 cubic metres. Often a unit of water body (e.g. pond) size
MUSIC	Hydrologic computer program used to calculate stormwater pollutant generation in a catchment and the amount of treatment which can be attributed to the WSUD elements placed in that catchment
MWC / MW	Melbourne Water Corporation
Retarding basin	A flood storage dam which is normally empty. May contain a lake or wetland in its base
NWL - Normal Water Level	Water level of a wetland or pond defined by the lowest invert level of the outlet structure
NSL – Natural Surface Level	The surface level of the natural (existing) surface before works.
RORB	Hydrologic computer program used to calculate the design flood flow (in m^3/s) along a stormwater conveyance system (e.g. waterway)
Sedimentation basin (Sediment pond)	A pond that is used to remove coarse sediments from inflowing water mainly by settlement processes.
Swale	A small shallow drainage line designed to convey stormwater discharge. A complementary function to the flood conveyance task is its WSUD role (where the vegetation in the base acts as a treatment swale).
TED	The top level of water stored for treatment within a wetland before bypass occurs
TSS	Total Suspended Solids – a term for a particular stormwater pollutant parameter
TP	Total Phosphorus – a term for a particular stormwater pollutant parameter
TN	Total Nitrogen – a term for a particular stormwater pollutant parameter
WSUD - Water Sensitive Urban Design	Term used to describe the design of drainage systems used to: ○ Convey stormwater safely ○ Retain stormwater pollutants ○ Enhance local ecology ○ Enhance the local landscape and social amenity of built areas
Wetland	WSUD element which is used to collect TSS, TP and TN. Usually incorporated at normal water level (NWL) below which the system is designed as shallow marsh, marsh, deep marsh and open water areas.

Appendix A SWMS Drawings



NOTES:

1. THIS DRAWING SET SHOULD BE READ IN CONJUNCTION WITH THE ASSOCIATED STORMY WATER SOLUTIONS STORM WATER MANAGEMENT STRATEGY, NOVEMBER 2022.
2. DEVELOPMENT LAYOUTS ARE PRELIMINARY ONLY AND SUBJECT TO CHANGE.
3. THE SUBJECT SITE IS DEFINED AS PROPERTY 2 OF THE ARMSTRONG CREEK EAST PRECINCT STRUCTURE PLAN (PSP).
4. THE 1% AEP FLOOD LEVEL ESTIMATE OF 2.70 m AHD HAS BEEN OBTAINED FROM THE CORANGAMITE CATCHMENT MANAGEMENT AUTHORITIES 'FLOOD PORTAL' (29/09/2022).
5. NO WORKS ON THE NEIGHBOURING 64-74 GROVES ROAD ARE ASSUMED.
6. THE STRATEGY FOR THE SUBJECT SITE ACHIEVES BPEMG TREATMENT AT A LOCAL SCALE BEFORE DISCHARGE INTO THE BALOG CHANNEL.
7. NO ON-SITE FLOOD RETENTION IS PROPOSED WITHIN THIS STRATEGY DUE TO THE SUBJECTS SITE LOCATION WITHIN THE WIDER ARMSTRONG CREEK EAST PSP'S CATCHMENT.
8. SERVICE PROVING IS REQUIRED TO BE COMPLETED.
9. ALL BATTERS ABOVE THE NORMAL WATER LEVEL (NWL) ARE AT 1V:5H (MAX).
10. ALL WATER BODY EDGE TREATMENTS AS PER MELBOURNE WATER CORPORATION (MWC) STANDARD DRAWING (SD) 7251/12/010.
11. THE EXACT LOCATIONS OF 20% AEP PIPES, DRAINAGE EASEMENTS AND 1% AEP LOCAL FLOW PATHS IS TO BE CONFIRMED AT THE DETAILED DESIGN STAGE OF THE PROJECT.

REVISION	DATE
V1 – INITIAL ISSUE	4/11/2021
V2 – REVISED DEVELOPMENT LAYOUT	3/10/2022
V3 – MINOR CLIENT COMMENTS	6/10/2022
V4 – MINOR LAYOUT CHANGES	30/11/2022

DESIGNED	Michael Mag	
CHECKED	Valerie Mag	
AUTHORISED BY		
PROJECTION MGA94/Z55		

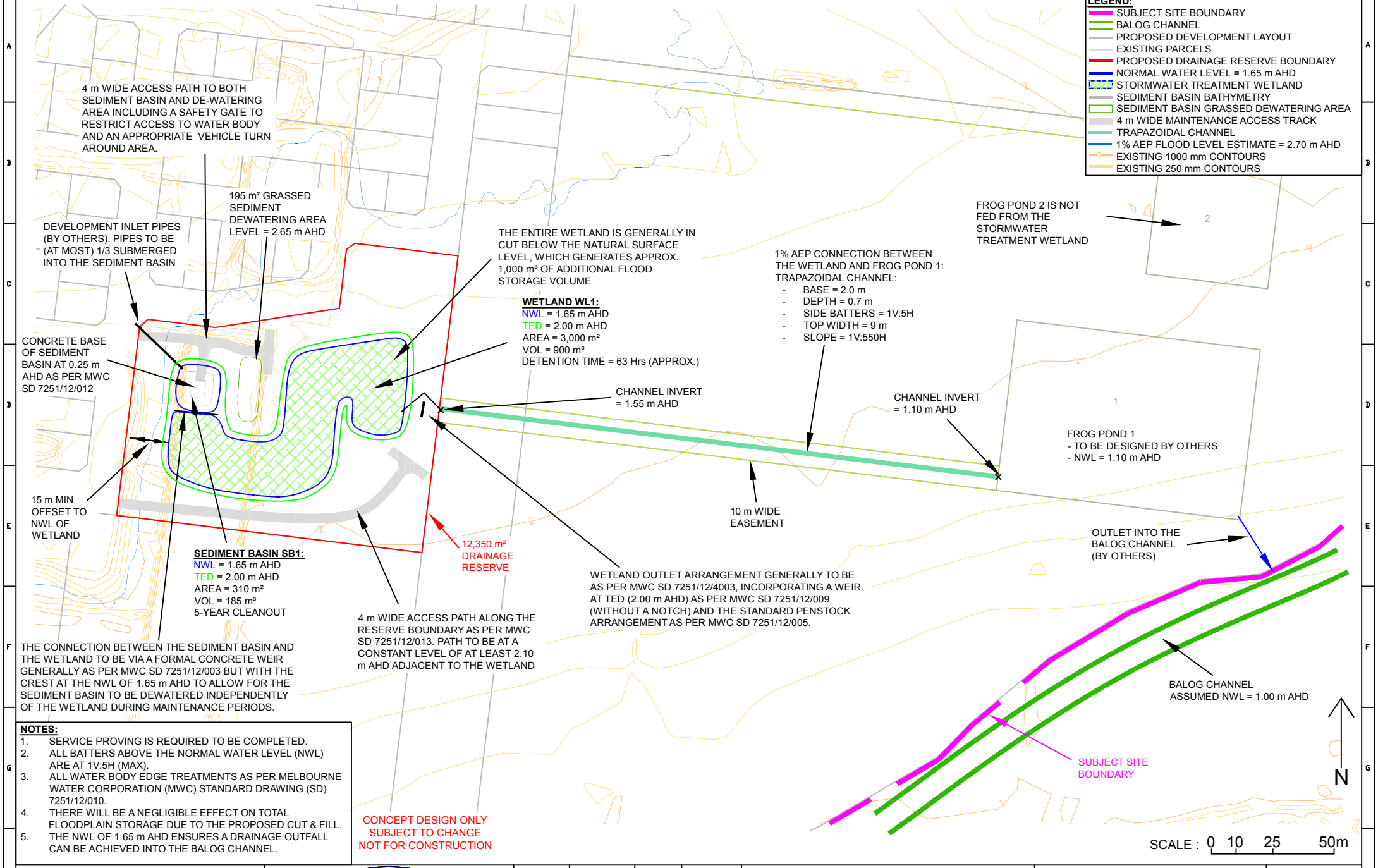
STORMY WATER SOLUTIONS CONSULTING PTY LTD
Website: www.stormywater.com.au
E: michael.mag@stormywater.com.au M: +61 401 861 301
ABN: 57 650 394 899 ACN: 650 394 899

78-88 GROVES ROAD

STORMWATER MANAGEMENT STRATEGY

OVERVIEW

SCALE:	AS SHOWN
SHEET	1 OF 2
DRAWING No.	2180/SWMS/1



NOTES:

1. SERVICE PROVING IS REQUIRED TO BE COMPLETED.
2. ALL BATTERS ABOVE THE NORMAL WATER LEVEL (NWL) ARE AT 1V:5H (MAX).
3. ALL WATER BODY EDGE TREATMENTS AS PER MELBOURNE WATER CORPORATION (MWC) STANDARD DRAWING (SD) 7251/12/010.
4. THERE WILL BE A NEGLIGIBLE EFFECT ON TOTAL FLOODPLAIN STORAGE DUE TO THE PROPOSED CUT & FILL.
5. THE NWL OF 1.65 m AHD ENSURES A DRAINAGE OUTFALL CAN BE ACHIEVED INTO THE BALOG CHANNEL.

REVISION	DATE
V4 – MINOR LAYOUT CHANGES	30/11/2022
V3 – MINOR CLIENT COMMENTS	6/10/2022
V2 – REVISED DEVELOPMENT LAYOUT	3/10/2022
V1 – INITIAL ISSUE	4/11/2021

Stormy Water Solutions

DESIGNED	Michael Mag		
CHECKED	Valerie Mag		
AUTHORISED BY		PROJECTION	MGA94/Z55

STORMY WATER SOLUTIONS CONSULTING PTY LTD
Website: www.stormywater.com.au
E: michael.mag@stormywater.com.au M: +61 401 861 301
ABN: 57 650 394 899 ACN: 650 394 899

78-88 GROVES ROAD
STORMWATER MANAGEMENT STRATEGY
TREATMENT ELEMENTS PLAN

SCALE:	AS SHOWN
SHEET	2 OF 2
DRAWING No.	2180/SWMS/2

Appendix B Regional Hydrological Modelling

Hydrological modelling has been completed using the RORB model (v6.45).

The RORB model which supports the ACEPSP, "AC_ugp_basins with ACEP and C301 developed with 3cell fish ladder Sep 2021.cat", has been provided by Neil M Craigie Pty Ltd. This model has been re-simulated with ARR 2019 inputs to obtain flow estimates for a range of AEP's downstream of the ACEPSP region.

The model has then been modified to reflect the Subject Site discharging directly into the Balog Channel as proposed within this SWMS.

B.1 Model Description

Figure B.1 details an extract of the ACEPSP catchment plan and the variation in approx. 11.5 ha of Subject Site catchment (including the surrounding roads) at an assumed F_{imp} of 0.75 into the Balog Channel.

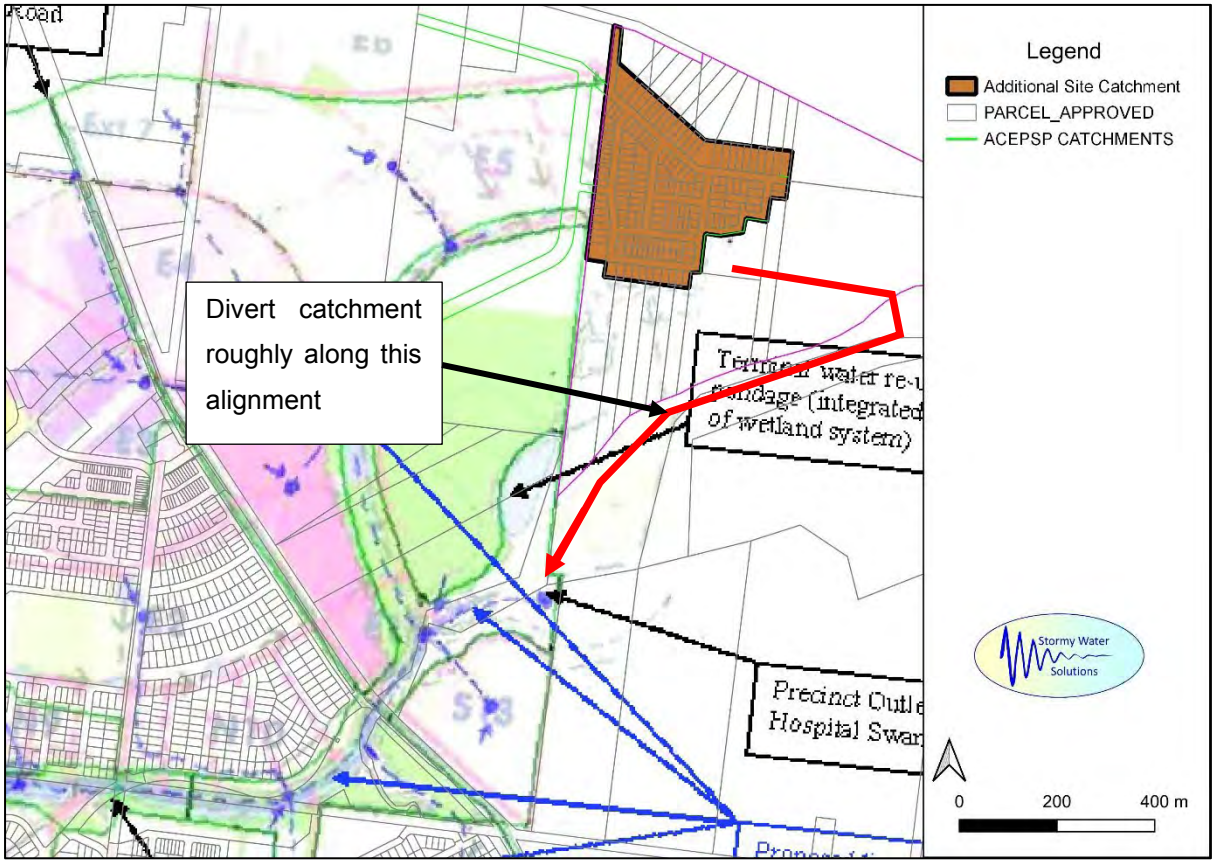


Figure B.1 RORB model Schematic. Background Source: 2010 ACEPSP SWMS, Figure 1

B.2 Model Parameters and Inputs

The ACEPSP RORB model was originally run with the following parameters:

K_c =11.52 K_c/d_{av} =2.15 m = 0.8 IL = 20 mm CL = 2.0 mm/hr.

These parameters have been adopted in the modelling undertaken. For the scenario where the Subject Site has been added, the K_c has been retained at 11.52 as there is a negligible change in the d_{av} value.

The model has been simulated with ARR 2019 inputs (IFD's, temporal patterns and areal reduction factors) for the location 38.238 S, 144.357 E (ARR 2019 datahub inputs obtained on the 20/10/21).

B.3 Model Results

Table B.1 summarises the results of the simulations for the total discharge from the ACEPSP catchment. There is either no (or a negligible increase) in flows from the catchment for all AEP's.

Thus, there are no detrimental downstream flood impacts if the Subject Site discharges directly to Balog Channel without retardation.

Table B.1 Total Flow Estimates from the Discharging from the ACEPSP Region

AEP (%)	ARI (Years)	ACEPSP ARR2019 Flow Estimate		ACEPSP With Modified Catchment ARR2019 Flow Estimate	
		Q (m^3/s)	Duration	Q (m^3/s)	Duration
63	1	1.1	24-hrs	1.1	24-hrs
39	2	3.3	24-hrs	3.3	24-hrs
18	5	7.7	24-hrs	7.7	24-hrs
10	10	11.3	18-hrs	11.4	18-hrs
5	20	15.4	18-hrs	15.4	18-hrs
2	50	22.3	24-hrs	22.3	24-hrs
1	100	27.1	24-hrs	27.2	24-hrs

Note: [1.] The absolute flow increases of the 1% AEP and 10% AEP are less than 0.1 m^3/s due to being rounded in the table above. This is deemed a negligible increase.

Appendix C Site Scale Design and Modelling

C.1 Hydrological Calculations

Given the relative size of the site's residential catchment (11.5 ha approx.), and that local retardation is not required for the Subject Site (see Appendix B), flow estimates required for sizing site scale assets have been obtained utilising the Probabilistic Rational Method as this concept design stage. The Probabilistic Rational Method is deemed by SWS the "simplest model, capable of the necessary calculations" in this instance and as such, it has been used herein as the "*the simplest model, capable of the necessary calculations should be favoured*" (for model choice) (ARR 2019, Book 9, Chapter 6.3.5).

Table C.1 below summaries the Probabilistic Rational Method calculations utilised to obtain site scale design flow estimates into the sediment basin and wetland.

Table C.1 Flow Estimates Entering the Sediment Basin

AEP	**1%**	**10%**	**20%**	**63%**
Catchment Area (ha)	11.5	11.5	11.5	11.5
C[1.]	0.75	0.65	0.60	0.50
T_C (min)[2,]	12	12	12	12
$I_{Tc,AEP}$ (mm/hr)[3.]	100.9	59.2	49.9	28.5
Q (m^3/s)	2.40	1.25	0.95	0.45

Notes: [1.] *C values for the 1% AEP and 20% AEP sourced from Table 10 of the IDM (LGIDA 2020)*

[2.] *T_c = 6 min + approximate travel time in pipes*

[3.] *IFD location (38.2375 S, 144.3875 E)*

C.2 Sediment Basin Sizing

A sediment basin is proposed to service the Subject Site development as designed in Table C.2 and C.3.

Table C.2 SB1 Sediment Basin Sizing Calculations

Asset Properties		
Asset ID =	SB1	
Normal Water Level = NWL =	1.65	m AHD
NWL Area = (A_{asset}) =	310	m^2
Pond Depth = (d_p) =	1.40	m
Extended Detention Depth = (d_e) =	0.35	m
Volume = (Vol_{TOT}) =	185	m^3
Sump Volume[1.] = (Vol_S) =	100	m^3
4EY Inflow[2.] = (Q_{4EY}) =	0.20	m^3/s
Assumed Hydraulic efficiency[3.] = λ =	0.26	
Upstream Catchment Area = (A_{Catch}) =	11.5	ha
Target Particle Settling Velocity[4.] = (V_s) =	0.011	m/s
Removal Efficiency		
d* = max (d_p, 1) =	1.4	
$\frac{d_e + d_p}{d_e + d^*} =$	1.0	
$\frac{V_s \times A_{asset}}{Q_{4EY}} =$	17.1	
$n = \frac{1}{1-\lambda} =$	1.35	
$Removal\ efficiency^{5.} = R = 1 - \left[1 + \frac{1}{n} \times \frac{V_s \times A_{asset}}{Q_{4EY}} \times \frac{d_e + d_p}{d_e + d^*}\right]^{-n} =$	**97.1%**	
Cleanout Frequency		
Sediment Load[6.] = (L_s) =	1.60	m^3/ha/year
$Cleanout\ Frequency = \frac{R \times (L_S + L_{GP}) \times A_{Catch}}{Vol_S} =$	**5.7**	**years**
Dewatering Area Required ((assuming 500 mm deep layout & 5-year cleanout frequency) =	**193**	**m^2**

Notes: *[1.] Sump volume taken as the volume below 350mm deep (i.e. below the safety bench).*

[2.] Q_{4EY} taken as 40% of the $Q_{63\%AEP}$ from the Rational Method.

[3.] Hydraulic efficiency estimated from Figure 4.3 of Melbourne Water 2005.

[4] Target particle size taken as 125 µm (as per criteria SP3 of Melbourne Water 2018c) with a settling velocity sourced from Table 4.1 of Melbourne Water 2005.

[5.] Methodology taken from Chapter 4.3.2 of Melbourne Water 2005.

[6.] Load estimate sourced from Willing and Partners 1992.

The Melbourne Water "Wetland Design Manual, Part A2: Deemed to Comply Criteria" (Melbourne Water 2020) criteria SP3 requires:

"*that velocity through the sediment pond during the peak 100 year ARI event is ≤ 0.5 m/s.*"

Note: SP3 states the 100-year ARI velocity should be calculated using TED, while the methodology in Part D of the Manual states the 10-year ARI level should be used. The TED level has been used going forward.

Table C.3 below shows how this condition is met for the sediment basin (SB1).

Table C.3 SB1 1% AEP Velocity Check

Step	Description	Label	Value	
1a	1% AEP Flow through Sediment Basin (FP3)[1.]	Q	2.40	m^3/s
2 (i)	NWL	NWL	1.65	m AHD
2 (ii)	10% AEP Level Estimation[1.]	FL	2.00	m AHD
3 (i)	Narrowest Width at NWL	W_{NWL}	15.0	m
3 (ii)	Narrowest Width at 10% AEP Level	$W_{10\%AEP}$	18.5	m
4	Flow Area = $\frac{W_{10\%AEP}-W_{NWL}}{2} \times (FL - NWL) =$	A	5.86	m^2
5	**Flow Velocity = $\frac{Q}{A}$ =**	**V**	**0.41**	**m/s**
Check	SP3 Requirement, V <		0.50	m/s
	Requirement Met?		**YES**	

Notes: [1.] *Estimated as TED*

C.3 Wetland Sizing

A MUSIC (v6.3) model has been formulated to confirm the required wetland size to achieve BPEMG for the 11.50 ha of residential development of the Subject Site.

The model has generally been formulated in line with the "MUSIC – Modelling Approach and Parameters, Design Note 3, City of Greater Geelong" (the **Geelong MUSIC Guidelines**).

The model schematic is shown in Figure C.1. The model has been simulated with 20-years of climate data and soil parameters as specified within the Geelong MUSIC Guidelines.

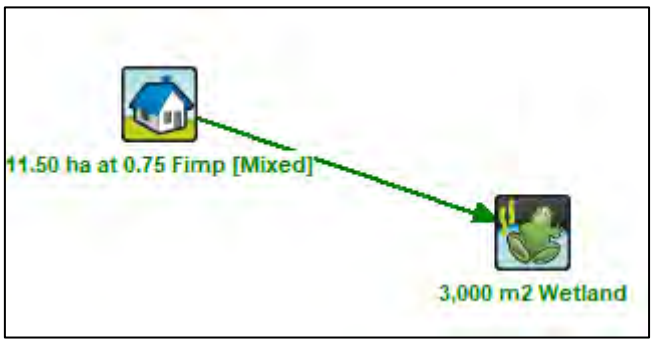


Figure C.1 MUSIC Model Schematic

The sediment basin proposed within Appendix C.2 has been modelled within the wetland node. The wetland node has properties as per Table C.4.

Table C.4 WL1 Design Properties

Asset Property	Value	Unit
Normal Water Level (NWL)	1.65	m AHD
Extended Detention Depth (ED)	350	mm
Top of Extended Detention (TED)	2.00	m AHD
Inlet Pond Volume	185	m^3
Wetland Area at NWL	3,000	m^2
Permanent Pool Volume below NWL [1.]	900	m^3
Approximate Detention Time [2.]	63	hrs
Infiltration Rate [3.]	0	mm/hr

Notes: [1.] *Taken as 30% of NWL*

[2.] *approx. 60-hours is required to meet MWC constructed wetland design manual criteria for plant health at later design stages.*

[3.] *conservatively assumed to be 0 mm/hr. However, if it is found that the in-situ soil is suitable for infiltration this is encouraged and will improve the treatment performance.*

Table C.5 shows that the wetland can meet all applicable velocity design requirements with a width of 10 m.

Table C.5 WL1 Minimum Width, Wetland Design Manual Velocity Calculations

Step	Description	Label	Value	Unit
1b (i)	4EY flow through macrophyte zone[1.]	Q_{4EY}	0.20	m^3/s
1b (iii)	1% AEP flow through macrophyte zone	$Q_{1\%AEP}$	2.40	m^3/s
6 (i)	NWL	NWL	1.65	m AHD
6 (ii)	TED	TED	2.00	m AHD
6 (iii)	10% AEP Level Estimation[2.]	FL	2.10	m AHD
7 (i)	Narrowest Width at NWL	W_{NWL}	10.0	m
7 (ii)	Narrowest Width at TED	W_{TED}	13.5	m
7 (iii)	Narrowest Width at 10% AEP Level	$W_{10\%AEP}$	14.5	m
8 (i)	Flow Area 4EY = $\frac{W_{TED}-W_{NWL}}{2} \times (TED - NWL) =$	A_{4EY}	4.1	m^2
8 (ii)	1% AEP Flow Area = = $\frac{W_{10\%AEP}-W_{NWL}}{2} \times (FL - NWL) =$	$A_{1\%AEP}$	5.5	m^2
9	4 EY Flow Velocity = =$\frac{Q_{4EY}}{A_{4EY}}$ =	V_{4EY}	0.05	m/s
Check	MZ9 Requirement, V_{4EY} <		0.05	m/s
	Is Width Suitable		YES	
10	1%AEP Flow Velocity = Q/A =	$V_{1\%AEP}$	0.44	m/s
Check	MZ9 Requirement, $V_{1\%AEP}$ <		0.50	m/s
	Is Width Suitable		YES	

Notes: [1.] *4EY flow estimate calculated as 40% of the 1EY flow estimate.*

[2.] *Estimated.*

Table C.6 details the results of the MUSIC modelling showing that the proposed assets can achieve BPEMG stormwater treatment.

Table C.6 Stormwater Pollutant Removal from the Proposed System.

Pollutant	Total Catchment Load	Pollutants Removed	Residual Load	Treatment Train Effectiveness
	kg/yr	kg/yr	kg/yr	%
Total Suspended Solids	7,770	6,370	1,400	82.0%
Total Phosphorus	15.7	11.3	4.4	72.2%
Total Nitrogen	110	59	51	53.5%
Gross Pollutants	1,680	1,680	0	100.0%

C.4 Fill Implications and Overland Flow

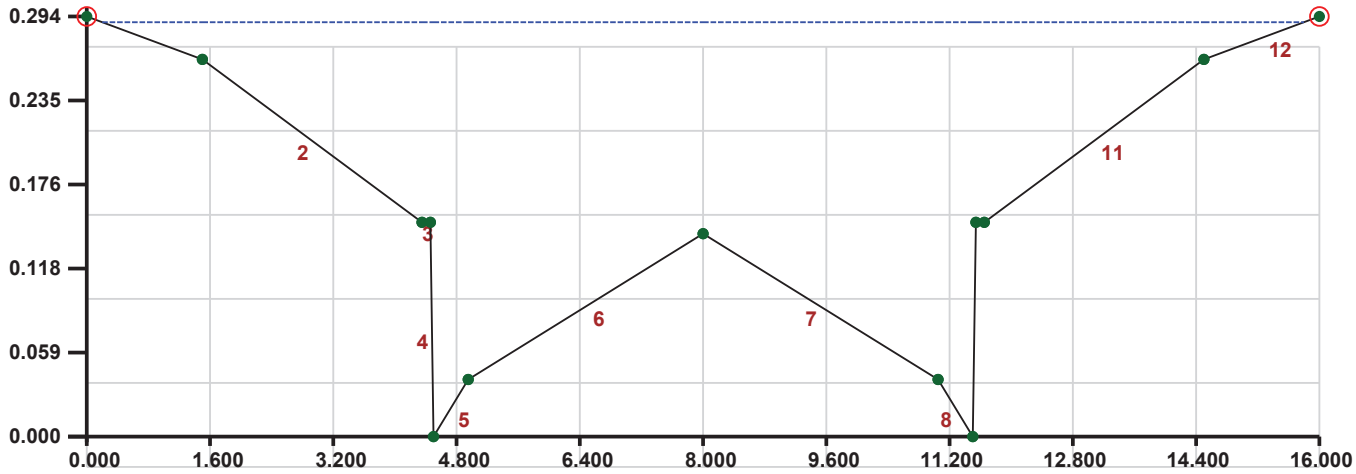
Detailed sizing of pits and pipes within the development is to be completed at the detailed design stage design stage. However, SWS has completed a preliminary check and found that, in order to direct all development inflows into the sediment basin, approximately 1 m of extra fill may be required in excess of the fill to 3.30 m AHD which is required for flood protection. This extra fill is expected to be governed by the road grade, not the pipe cover (assuming the pipes can discharge into the sediment basin at 1/3 depth).

At this concept stage of the design process, it is required to show that the flows within the road reserves can be conveyed in a low risk manner.

The attachment below utilises PC-Convey to assess the roads 1% AEP gap flow. At the inlet to the sediment basin, a 16 m wide road reserve (conservatively at a minimum grade of 1V:300H), can convey the 1% AEP gap flow estimate (1% AEP flow minus the 20% AEP flow = 2.40 – 0.95) of 1.45 m^3/s in a low risk manner. This satisfies the requirements of the DELWP “Guidelines for the development in flood affected areas” (DELWP 2019).

PROJECT: 2176_16m_PSP_Road_Reserve
Print-out date: 09/09/2021 - Time: 10:45
Data File: C:\Users\mmags\Desktop\2176_16m_Road_Reserve.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

Not specified
2176 16 m PSP Road Reserve

3. RESULTS: Water surface elevation = 0.290 m

High Flow Channel grade = 1 in 300, Main Channel / Low Flow Channel grade = 1 in 300.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.000	1.467	0.000	1.467
D(Max) = Max. Depth (m):	0.000	0.290	0.000	0.290
D(Ave) = Ave. Depth (m):	0.000	0.129	0.000	0.129
V = Ave. Velocity (m/s):	0.000	0.729	0.000	0.729
D(Max) x V (cumecs/m):	0.000	0.212	0.000	0.212
D(Ave) x V (cumecs/m):	0.000	0.094	0.000	0.094
Froude Number:	0.000	0.648	0.000	0.648
Area (m^2):	0.000	2.012	0.000	2.012
Wetted Perimeter (m):	0.000	15.843	0.000	15.843
Flow Width (m):	0.000	15.600	0.000	15.600
Hydraulic Radius (m):	0.000	0.127	0.000	0.127
Composite Manning's n:	0.000	0.020	0.000	0.020
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA:

	LEFT HAND POINT		RIGHT HAND POINT		
SEGMENT NO.	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	MANNING'S N
1	0.000	0.294	1.500	0.264	0.020
2	1.500	0.264	4.350	0.150	0.020
3	4.350	0.150	4.460	0.150	0.020
4	4.460	0.150	4.500	0.000	0.020
5	4.500	0.000	4.950	0.040	0.020
6	4.950	0.040	8.000	0.142	0.020
7	8.000	0.142	11.050	0.040	0.020
8	11.050	0.040	11.500	0.000	0.020
9	11.500	0.000	11.540	0.150	0.020
10	11.540	0.150	11.650	0.150	0.020
11	11.650	0.150	14.500	0.264	0.020
12	14.500	0.264	16.000	0.294	0.020

APPENDIX 3 – CONSTRUCTED WETLANDS DETAILED DESIGN

78-88 Groves Road Armstrong Creek
Frog Ponds

DRAWING INDEX	
REFERENCE	DRAWING No.
Locality Plan, Drawing Index & General Notes	0352-M3-01
Layout Plan	0352-M3-02
Typical Sections and Details	0352-M3-03
Pond 1 Weir Details	0352-M3-04
Pond 2 Weir Details	0352-M3-05
Drainage Longitudinal Section & Pit Schedule	0352-M3-06
Pit 2 Detail	0352-M3-07

GENERAL NOTES

1. The works shall be constructed in accordance with the current Infrastructure Design Manual (IDM) and the City of Greater Geelong requirements. Works to be carried out to the satisfaction of Council's supervising officer.
2. The contractor is responsible for safety of work on site in accordance with appropriate legislation. The contractor shall ensure that the site is maintained in a safe manner at all times.
3. The contractor shall:
   - 3.a. Comply with the requirements of the Occupational Health and Safety Act 2007.
   - 3.b. Notify Workcover of their intention to commence trenching operations where trenches are 1.5 metres or deeper.
   - 3.c. Ensure that the mine manager or his deputy as required by the Act is in attendance when trenching operations are in progress.
4. The contractor is to notify council and all service authorities seven (7) days prior to commencement of construction.
5. The location of existing services should be determined by the contractor prior to commencing any excavation by contacting all relevant service authorities. Any existing services shown on the drawings are offered as a guide only and are not guaranteed as correct.
6. Removal or retention of existing trees or vegetation must be in accordance with the approved tree removal plan.
7. No surplus trees, vegetation or other materials are to be burnt on site.
8. All levels are to Australian Height Datum (AHD). All coordinates are to Map Grid of Australia (MGA).
9. Any existing pavement or drainage works damaged during construction or the maintenance period to be reinstated to the satisfaction of the Council.
10. Upon the completion of construction, the whole site shall be cleaned up and graded over. All rubbish is to be removed and the site is to be left in a clean and tidy condition to the satisfaction of the superintendent.

EARTHWORKS NOTES

11. A site environmental management plan is to be approved by Council prior to works commencing. The requirements of the plan are to be maintained onsite for the duration of the works.
12. 100mm min depth of topsoil to be stripped over whole of works area and stockpiled. Upon completion of earthworks, topsoil to be spread over all disturbed areas to a depth of 200mm, unless noted otherwise.
13. All topsoil must comply with Melbourne Waters 'Specification for soils and landscaping of constructed Melbourne Water assets'.
14. All temporary grass seed mix must comply with Melbourne Waters 'Standard turf sowing mixes and rates for Melbourne Water Waterways Projects'.
15. Planting in proposed terrestrial habitats within the Offset Area will be undertaken according to the schedule set out in the Offset Management Plan (Section 5.6.1) in accordance with the Growling Grass Frog Habitat Design Standards (DELWP 2017). The revegetation species provided in Table A3.1, Table A3.2 and Table A3.3 of Appendix 3 in the Weed Management Plan may be consulted and applied in accordance with the Design Standards.
16. All filling to be carried out in 150mm layers and compacted to 95% of max. dry density. All filling to comply with AS 3798-2007, Section 8.2, Level 1. A fill report must be submitted from NATA registered soil testing laboratory.
17. All batters are to have erosion and weed control as per Melbourne Water standard drawing 7251/08/124 and must comply with Melbourne Waters 'Temporary erosion and weed matting - specification for constructed Melbourne Water assets'.
18. Upper bank batters shall be rounded, to avoid the appearance of uniform batter intersection lines.
19. Compacted clay liners are required below Normal Water Level (NWL). Refer geotechnical investigation for specification.

DRAINAGE NOTES

20. All stormwater pipes are to be Class 2 with rubber ringed joints unless noted otherwise.
21. A CCTV report must be provided on all drainage pipelines prior to practical completion of works.
22. No stormwater drainage pipes shall be subjected to construction traffic loading during construction unless the pipe strength characteristics have been computed and approved by the contractors engineer. Computations are to accord with AS3725-1989 Loads on Buried Pipes.
23. Concrete pipes damaged due to construction loads shall be repaired at the contractors cost.

ROCKWORK

24. Areas on which rock is to be placed shall be trimmed as required to provide a finished surface level of rock in accordance with the drawings. Any scours or hollows in the surface shall be stripped of organic matter and any unsuitable base material and then filled with compacted crushed rock
25. The general concept of rockwork construction is:
    - it should be made up of angular rock (either quarried or broken up field rock).
    - it must be made up of well sized, well graded, well embedded, well interlocked rock.
    - all voids must be sealed to provide stability and resistance to flow velocities and infiltrations/ undermining.
    - it should form an interlocking mass of rock in which the larger rocks in the mix are not free to move.
26. All rockwork shall be done to the satisfaction of the superintendent.
27. Toe rocks are situated at the base of a rock structure and edge rocks are located around the remaining perimeter. The function of toe and edge rocks is to hold the rock structure together and prevent flows from undermining the structure. With toe and edge rocks the following should be considered:
    - the size of the toe and edge rocks will depend on the site and hydraulic conditions. Edge rocks are generally smaller than toe rocks but are larger than lining rocks.
    - toe and edge rocks should be trenched into in-situ ground (minimum 150mm). Ground should be boxed-out to enable toe and edge rocks to be placed before filter layer and lining rocks.
    - toe/edge rocks should finish flush with surrounding ground.
    - toe/edge rocks to be a minimum nominal size of 750Ø.
28. Lining rock is the mass rock medium contained by the leading edge rock to armour/protect the given earth surface. With lining rocks the following should be considered:
    - a filter/embedment layer should be used underneath (refer note 20).
    - lining rocks should be well graded to form a tightly sealed rock layer which is free of voids and provides resistance to flow velocities and infiltration/undermining as per the general intent of rockwork mentioned in note 17. In sealing voids consideration should be given to using a smaller graded rock mix (ie. Also referred to as an infill mix). Depending on the size of the voids, a 0-150mm infill mix may be appropriate. Depending on rock availability and construction method adopted, sealing of the rockwork may occur as a pre-mix (ie. Infill mix is combined with larger lining rocks before placement), or by working the infill mix between the larger rocks as they are laid.
    - the size of the lining rock and thickness of the lining rock layer will depend on generally smaller edge rocks.
    - the contractor should use methods for handling and placement of lining rock that will avoid segregation of the rock sizes. Rocks shall be carefully placed and positioned, not dumped directly.
29. Filter/embedment layer provide protection to the underlying soil base from infiltration of flows and provide a suitable medium for the embedment of the overlaying rock. Granular filter/embedment layers are usually sufficient, however some sandy, dispersive soils may warrant the use of a geotextile filter layer in addition to the granular filter layer. Where a geotextile filter layer is used, special care needs to be exercised in the laying of the rockwork and consideration given to a thicker granular filter/embedment layer over the geotextile layer to prevent damage to the fabric. With granular filter/embedment layers the following should be considered:
    - layer thickness - should generally be 100mm or thicker - depends on type of underlying soil (ie. More or less dispersive), rock size, and hydraulic conditions.
    - use of graded rock - should generally be limited to 0-100mm graded rock. One size ballast rock is considered ineffective as it does not resist flow infiltration.

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23
B	Note 14 amended, 15 added and balance renumbered	GP	MG	10/11/23

Principal

Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Locality Plan, Drawing Index & General Notes

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

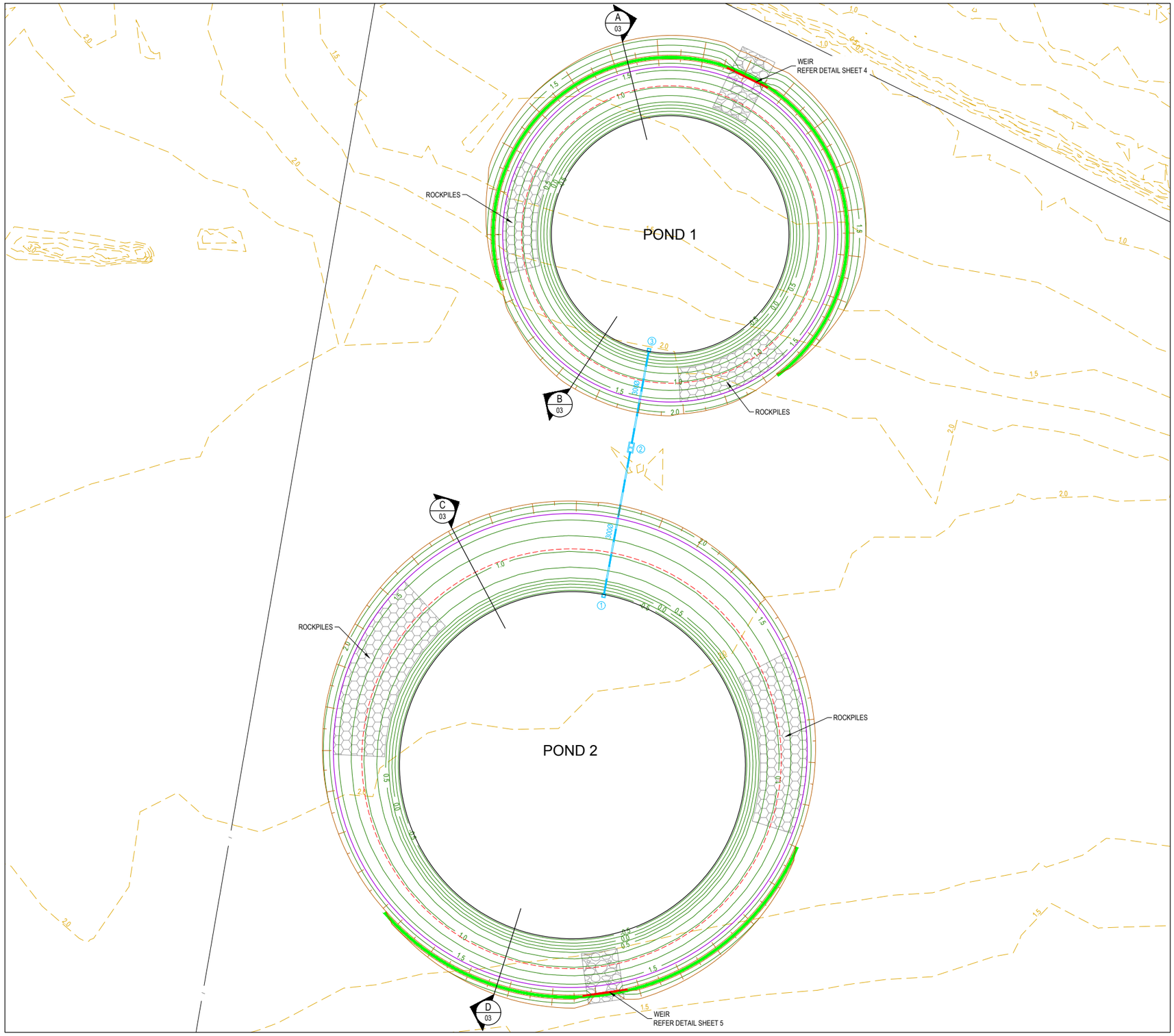
Scale @ A1: 1:10000

0 100 200 300 400 500

Drawing No. **0352-M3-01**

Sheet: 01 of 07

Rev: **B**



POND WATER LEVELS		
LEVEL	POND 1	POND 2
NORMAL WATER LEVEL	1.60	1.60
BASE LEVEL	-0.60	-0.60
TOTAL DEPTH	2.20	2.20
SUMMER DRAWDOWN LEVEL (95% LOWER)	1.04	1.04
SUMMER DRAWDOWN DEPTH (95% LOWER)	1.64	1.64

POND AREAS					
ZONE	DEPTH RANGE (m)	POND 1		POND 2	
		AREA (m2)	PERCENTAGE	AREA (m2)	PERCENTAGE
LITTORAL ZONE	0.00 - 0.56	1059	36.1%	2159	36.8%
PERMANENT SHALLOW ZONE	0.56 - 1.00	745		1521	
DEEP ZONE	>1.00	3196	63.9%	6320	63.2%
TOTAL		5000	100.0%	10000	100.0%

NOTE: FENCING
FENCING OF PONDS TO FORM PART OF LANDSCAPE WORKS.

WARNING
BEWARE OF UNDERGROUND SERVICES
The locations of underground services are approximate only and their exact position should be proven on site.
No guarantee is given that all existing services are shown.
Locate all underground services before commencement of works.
DIAL 1100 BEFORE YOU DIG
www.1100.com.au

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

Legend

Proposed Contour	1.5	Drainage Pipe & Pit	
Existing Contour	1.5	Weir	
Normal Water Level (NWL)		Weir Rockwork	
Summer Drawdown Level		Rockpiles	
Top / Toe of Batter		Embankment Key	

Principal

Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Layout Plan

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

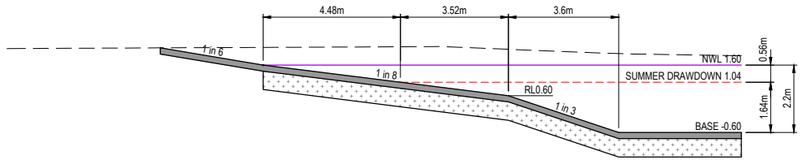
Scale @ A1: 1:500

0 5 10 15 20 25

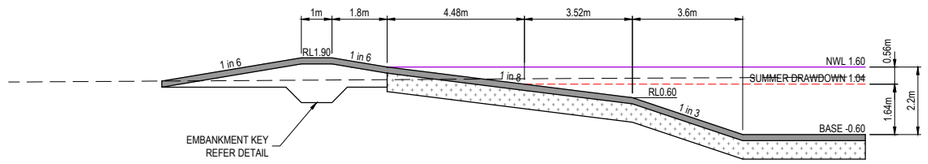
Drawing No. **0352-M3-02**

Sheet: 02 of 07

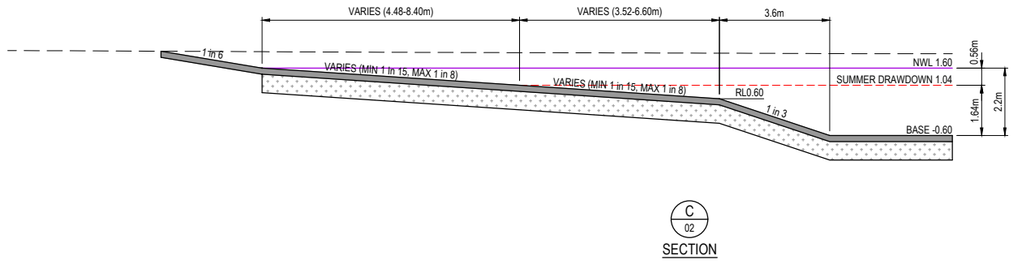
Rev: **A**



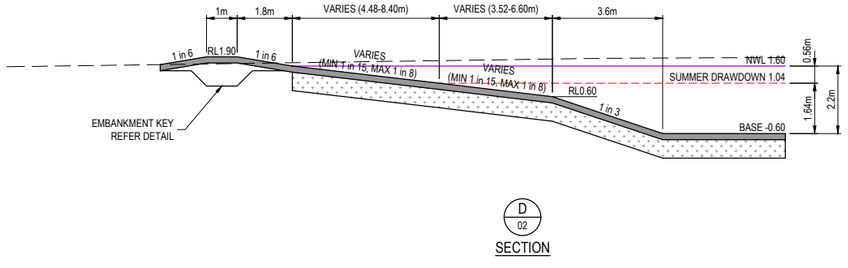
A/02
SECTION



B/02
SECTION



C/02
SECTION



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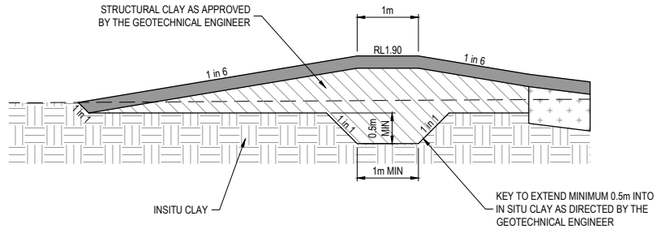
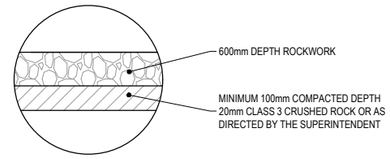
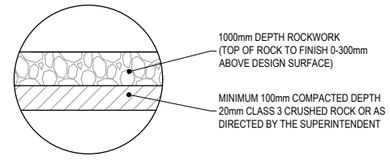


EMBANKMENT KEY DETAIL



WEIR ROCK WORK
(D_{50} = 300mm)



ROCK PILES
(D_{50} = 500mm)

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

Legend

Existing Surface	— — —	200mm Depth Topsoil	
Design Surface	———	Clay Liner	
Normal Water Level (NWL)	———		
Summer Drawdown Level	- - - -		

Principal

Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Typical Sections & Details

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

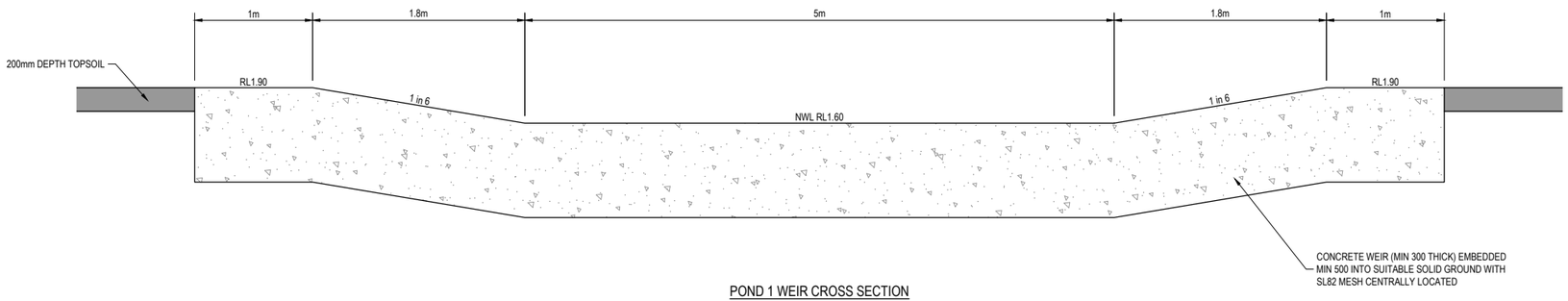
Scale @ A1: 1:100

0 1 2 3 4 5

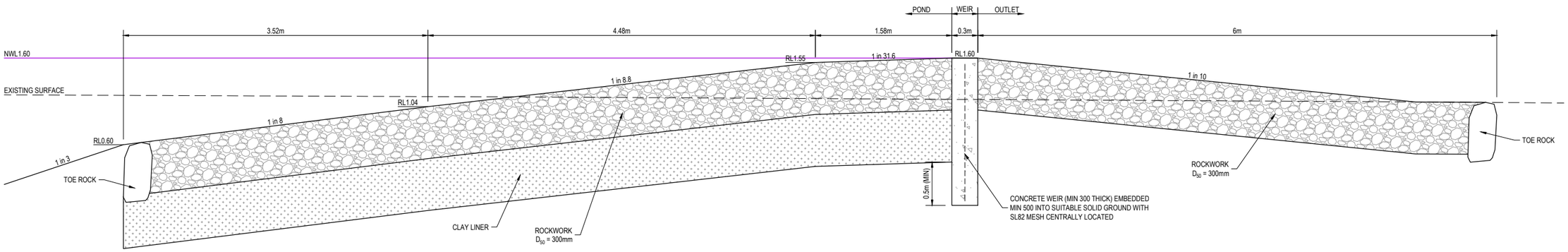
Drawing No. **0352-M3-03**

Sheet: 03 of 07

Rev: **A**



POND 1 WEIR CROSS SECTION



POND 1 WEIR LONG SECTION

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

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Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Pond 1 Weir Details

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

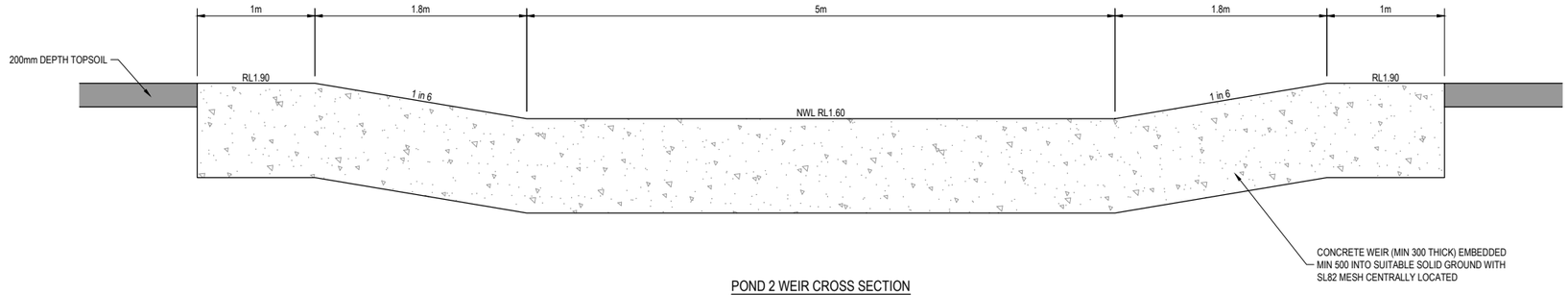
Scale @ A1: 1:25

0 0.25 0.5 0.75 1.0 1.25

Drawing No. **0352-M3-04**

Sheet: 04 of 07

Rev: **A**



POND 2 WEIR CROSS SECTION

POND 2 WEIR LONG SECTION

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

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Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Pond 2 Weir Details

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

Scale @ A1: 1:25

0 0.25 0.5 0.75 1.0 1.25

Drawing No. **0352-M3-05**

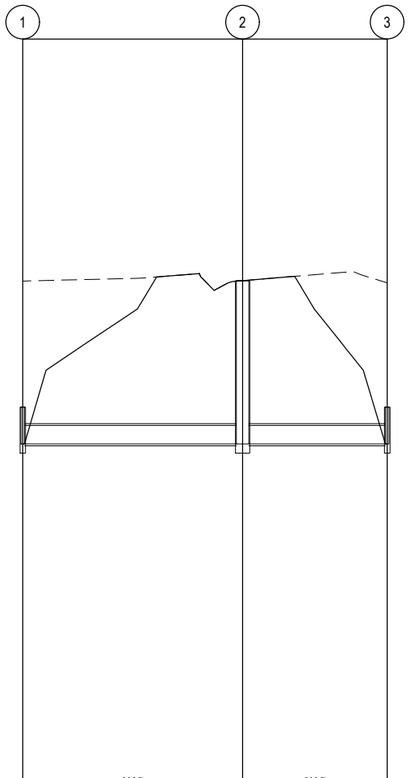
Sheet: 05 of 07

Rev: **A**

NOTE: DRAINAGE PIPES
ALL DRAINAGE PIPES TO BE CLASS 2 RCP WITH RUBBER RINGED JOINTS.

PIT SCHEDULE

PIT No.	TYPE	LOCATION		INTERNAL		INLET		OUTLET		COVER LEVEL	PIT DEPTH	STD DWG	REMARKS
		EASTING	NORTHING	WIDTH	LENGTH	DIA.	INV R.L.	DIA.	INV R.L.				
1	BALANCE PIPE SUBMERGED OFFTAKE PIT	271591.929	5765631.001	600	600	300	-0.600			0.000	0.600	MW 7251/12/035	PROVIDE 300X300 NOTCH IN PIT WALL AND WATER LEVEL GAUGE TO MW 7251/12/011
2	GRATED PIT	271598.429	5765666.268	900	2025	300	-0.600	300	-0.600	2.060	2.660	REFER DETAIL SHEET 7	
3	BALANCE PIPE SUBMERGED OFFTAKE PIT	271602.704	5765689.463	600	600			300	-0.600	0.000	0.600	MW 7251/12/035	PROVIDE 300X300 NOTCH IN PIT WALL AND WATER LEVEL GAUGE TO MW 7251/12/011



PIPE SIZE (mm)		300Ø	300Ø
PIPE CLASS		CLASS 2	CLASS 2
GRADE		FLAT	FLAT
DATUM RL		-7.0	
DEPTH TO INVERT	0.600 0.600	2.660	2.660 0.600
INVERT LEVEL	-0.600 -0.600	-0.600	-0.600 -0.600
FINISHED SURFACE LEVEL	0.000	2.060	0.000
EXISTING SURFACE LEVEL	2.054	2.061	2.026
CHAINAGE	0.000	35.861	59.447
(Reach Length)		(35.861)	(23.585)

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

Legend
- Existing Surface
- Design Surface
- Proposed Drain
- Crushed Rock Backfill
- Rock Beaching

Principal

Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Drainage Longitudinal Section & Pit Schedule

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

Scale @ A1: H1:500 V1:50

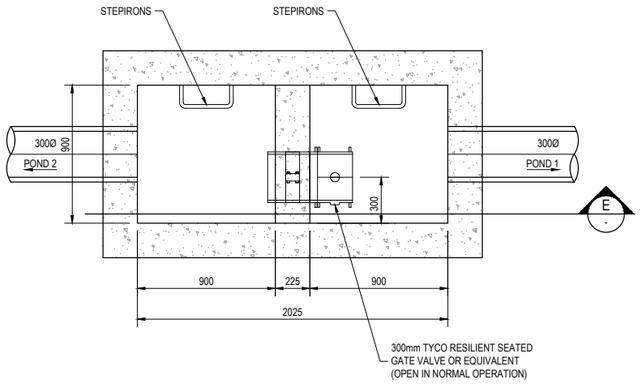
H 0 5 10 15 20 25

V 0 0.5 1 1.5 2 2.5

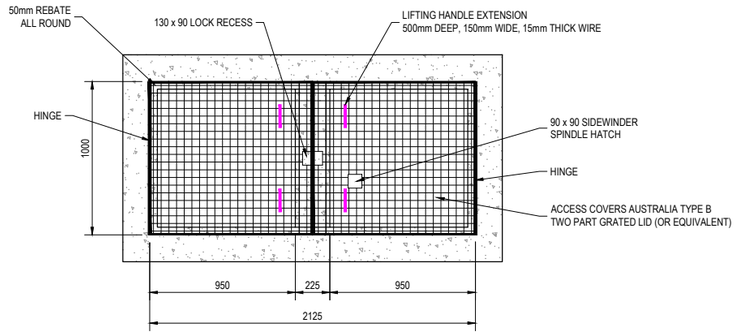
Drawing No. **0352-M3-06**

Sheet 06 of 07

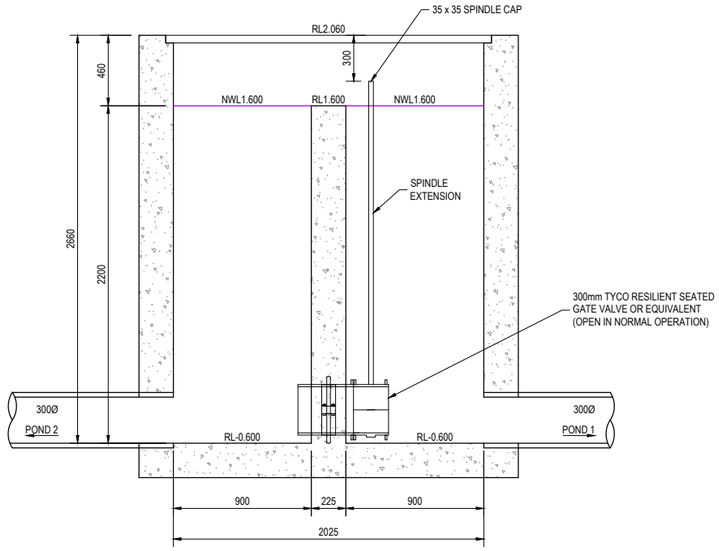
Rev **A**



PIT 2 PLAN



PIT 2 COVER PLAN



SECTION E

NOTES:
REFER TO STRUCTURAL PLANS FOR STRUCTURAL DETAILS.

Rev	Amendment	Des/Dft	App'd	Date
A	Initial Issue	GP	MG	12/10/23

Principal

Jinding Australia
Level 53, 525 Collins Street
Melbourne Vic 3000

GPR Consulting Pty Ltd
ABN 98 140 136 205
Suite 217, 202 Jells Road
Wheelers Hill Vic 3150
Telephone 0456 634 727

Council: City of Greater Geelong

Project: **78-88 Groves Road Frog Ponds**

Title: Pit 2 Detail

Scale @ A1: 1:20

0 0.2 0.4 0.6 0.8 1

Drawing No.: **0352-M3-07**

Designed: G.Pratt | Authorised: M.Graham

Drafted: G.Pratt | Date: October 2023

Sheet: 07 of 07

Rev: **A**

APPENDIX 4 – CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

ecology & heritage partners

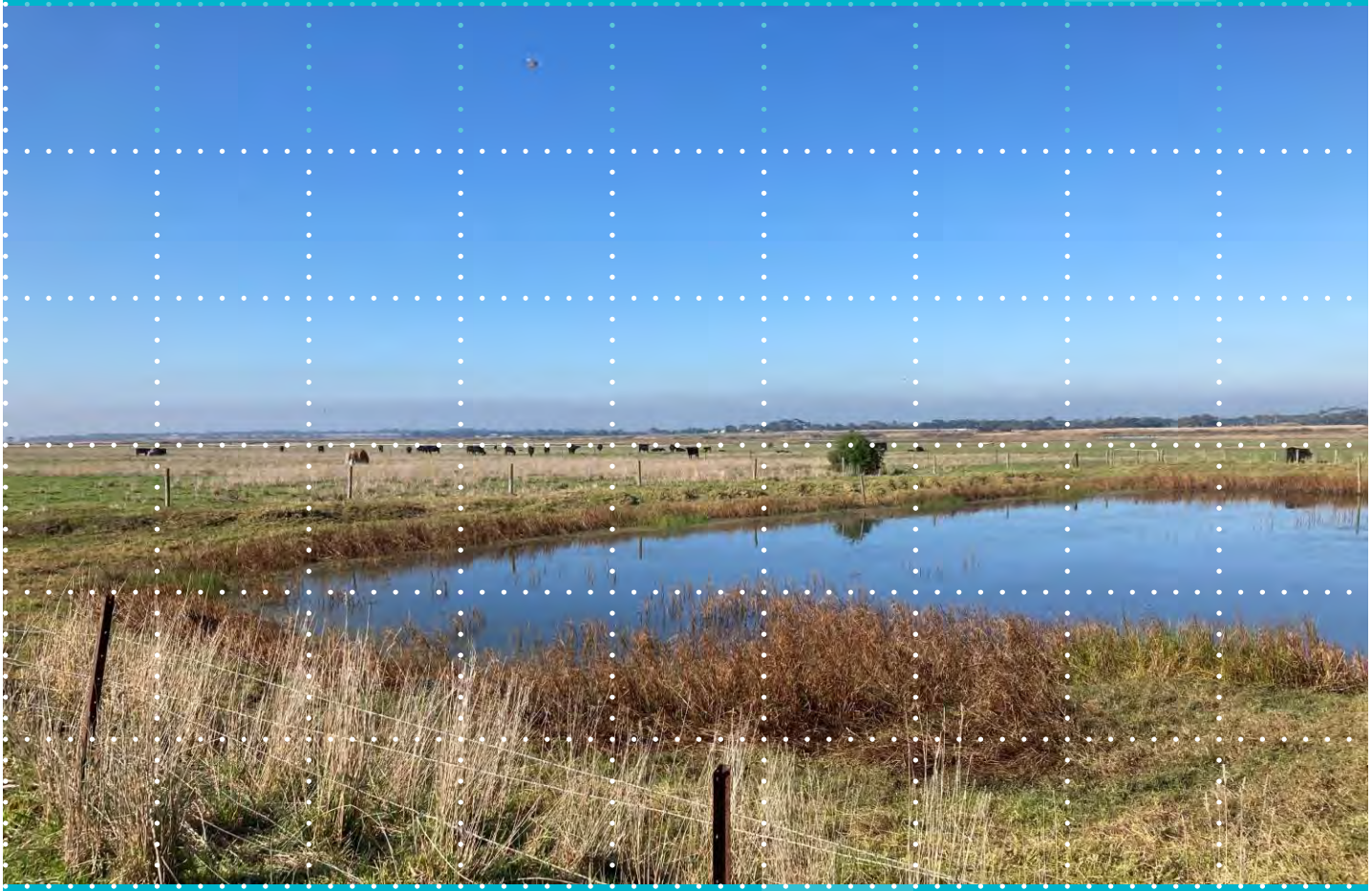
Final Report

Construction Environmental Management Plan: 78-88 Groves Road, Armstrong Creek, Victoria

Prepared for

AC Manager Pty Ltd

November 2023



Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road, Ascot Vale VIC 3032 **GEELONG:** 230 Latrobe Terrace, Geelong West VIC 3218
BRISBANE: Level 22, 127 Creek Street, Brisbane QLD 4000 **ADELAIDE**: 78 Edmund Avenue, Unley SA 5061
CANBERRA: 19-23 Moor Street, Turner ACT 2612 **SYDNEY:** Level 5, 616 Harris Street, Ultimo NSW 2007
www.ehpartners.com.au | 1300 839 325

DOCUMENT CONTROL

Assessment type	Construction Environmental Management Plan
Address	78-88 Groves Road, Armstrong Creek, Victoria
Project number	16303
Project manager	Alex Wilkinson (Senior Zoologist)
Report author	Sarah Hill (Zoologist)
Report reviewer	Alex Wilkinson (Senior Zoologist)
Mapping	Petra Sorensen (GIS Analyst)
File name	16303_EHP_CEMP_78-88GrovesRd_ArmstrongCreek_Final_09112023
Client	AC Manager Pty Ltd
Bioregion	Otway Plain and Victorian Volcanic Plain
Catchment Management Authority	Corangamite
Council	City of Greater Geelong

VERSION CONTROL

Report versions	Comments	Report updated by	Date submitted
Draft	Report issued to client for review	-	08/09/2023
Draft v2	AC Manager Pty Ltd	SH	11/10/2023
Final	DCCEEW	AW	09/11/2023

Ecology and Heritage Partners acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was commissioned by AC Manager Pty Ltd to prepare a Construction Environmental Management Plan (CEMP) for the property located at 78-88 Groves Road, Armstrong Creek, Victoria, as well as a 40-metre long section of Groves Road extending west from the property (the study area). The study area is covered by the Armstrong Creek East Native Vegetation Precinct Plan (NVPP) (SMEC 2010).

We understand that study area is proposed to be subject to future residential development, with a section of the road reserve along Groves Road proposed to be raised in order to provide access to the future 78-88 Groves Road development, and a planning application has been submitted to the City of Greater Geelong (i.e. Council).

A referral (EPBC 2022/09357) to the Commonwealth Minister of Climate Change, Energy, the Environment and Water (DCCEEW) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was submitted to determine potential impacts to matters of National Environmental Significance (NES). On 3 January 2023 it was determined that the proposed action is a controlled action under section 75 and section 87 of the EPBC Act. As such, Ecology and Heritage Partners prepared draft Preliminary Documentation (PD) and an Offset Management Plan (OMP) to address potential impacts, mitigation measures and potential offset strategies associated with two matters of NES (Growling Grass Frog *Litoria raniformis major*; and Spiny Peppercress *Lepidium aschersonii*). The CEMP has been prepared in response to a request for further information provided by Department of Energy, Environment and Climate Action (DEECA) on 14 July 2023, after reviewing the draft PD and OMP. This notes the proponent must prepare a management plan prior to the commencement of works. This CEMP is applicable to all stages of the proposed development.

This purpose of this CEMP is to provide a set of pre-construction, construction and post-construction management measures to mitigate potential impacts to native flora and fauna species that are, or are likely to be present, within and adjacent to the development footprint associated with the works. Native flora and fauna values were identified in an Ecological Assessment prepared by Ecology and Heritage Partners Pty Ltd (2023a). Information from the Ecological Assessment was used to determine the appropriate environmental construction management recommendations.

Once the CEMP has been endorsed by the Responsible Authority (DEECA) it must be implemented and complied with at all times to the satisfaction of the Responsible Authority unless with the further written approval of the Responsible Authority.

1.2 Objectives

The CEMP has the following objectives:

- Prescribe mitigation measures to ensure protection of native vegetation and minimise environmental impacts, specifically relating to construction;

- Provide guidance for on-going improvement, monitoring and management with respect to environmental sustainability; and,
- Establish responsibility, reporting and compliance guidelines to comply with environmental legislation.

1.3 Legislative and Policy Implications

The relevant environmental legislation and policies that were reviewed in preparation of this CEMP are:

1. *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (*Commonwealth*);
2. *Flora and Fauna Guarantee Act 1988* (FFG Act) (Victoria);
3. *Planning and Environment Act 1987* (Victoria);
    - Local Planning Schemes;
    - Victoria's Native Vegetation Permitted Clearing Regulations.
4. *Wildlife Act 1975* and Wildlife Regulations 2013 (Victoria); and
5. *Catchment and Land Protection Act 1994* (CaLP Act) (Victoria);

1.4 Study Area

The study area comprises the land located at 78-88 Groves Road, Armstrong Creek, as well as a 40-metre long section of Groves Road extending west from the property and is approximately 85 kilometres south-west of Melbourne's CBD (Figure 1). The study area covers approximately 41.48 hectares and is bound by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and private property to the west. Importantly, Baenschs Wetland (which is adjacent to the Armstrong Creek Water Frontage) forms part of a large wetland complex, part of which is protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), as the Port Phillip Bay (western shoreline) and Bellarine Ramsar Site. The Sparrovale Wetland also drains into this site via the Barwon River.

The study area is currently used for agriculture and farming, with a residence, outbuildings, and five broiler sheds on site. Two effluent treatment ponds exist in the centre of the site, and a dam is located in the south-west corner. It is generally flat, with no ridges or crests within or immediately adjacent to the site.

The study area is covered by the Armstrong Creek East NVPP, as part of the Armstrong Creek East Precinct Structure Plan (SMEC 2010).

According to the Department of Energy, Environment and Climate Action (DEECA) NatureKit Map (DEECA 2023a), the study area is located within both the Otway Plain and Victorian Volcanic Plain bioregion, Corangamite Catchment Management Authority (CMA) and the City of Greater Geelong Council municipality.

1.5 Assessment Qualifications and Limitations

This report has been written based on the quality and extent of the ecological values and habitat considered to be present or absent at the time of the Ecological Assessment undertaken by Ecology and Heritage Partners Pty Ltd (2023a).

2 SUMMARY OF ECOLOGICAL VALUES

2.1 Vegetation within the NVPP

There is no native vegetation within the study area that is designated for retention or removal in the Armstrong Creek East NVPP (SMEC 2010).

Two patches of Coastal Saltmarsh (Habitat Zones HZ2 and HZ3) immediately adjacent to the southern boundary of the study area are designated for retention in the NVPP (SMEC 2010). It is understood that the land covered by these habitat zones was once part of the property, but was publicly acquired in accordance with the PAO12.

2.2 Native Vegetation Removal

A planning permit from the Greater Geelong is required to remove 0.512 hectares of native vegetation along the proposed Groves Road alignment under Clause 52.17 of the Planning Scheme (Ecology and Heritage Partners 2023a). No permit under the ESO2 is required. In this instance, the application is required to be referred to DEECA is the Responsible Authority manages the Groves Road road reserve.

2.3 Vegetation Condition

Several patches of native vegetation, four scattered native trees and scattered occurrences of Tangled Lignum *Duma florulenta* were recorded within the study area as part of the site assessment. The remainder of the study area comprised introduced and planted vegetation, present as pasture grass, native and non-native trees, noxious herbaceous and woody weeds and ornamental gardens.

2.3.1 Patches of Native Vegetation

Native vegetation in the study area is representative of three EVCs: Coastal Saltmarsh (EVC 9), Plains Sedgy Wetland (EVC 647) and Brackish Wetland (EVC 656).

The modelled extant (2005) native vegetation mapping for the study area and surrounds indicated the presence of Coastal Alkaline Scrub (EVC 858) and Plains Grassland (EVC 132) and Plains Sedgy Wetland (EVC 647) within proximity. However, due to hydrological influences, and the composition and structure of the native vegetation present, Plains Grassland was not observed due to the absence of perennial tussock species typically associated with the vegetation type. And Coastal Alkaline Scrub was not present due to the absence of swales and dunes dominated by a scrub layer.

Instead, the broader site was dominated by saline tolerant herbs, scrub and graminoids indicative of a saltmarsh community. Coastal Saltmarsh (EVC 9) contains the species composition and saline influences most closely aligned with the vegetation observed.

The presence of these EVCs is broadly consistent with the modelled extant (2005) native vegetation mapping (DEECA 2023a), with the exception of the presence of Brackish Wetland (EVC 656).

The patches of native vegetation identified were predominantly exposed to halophytic and wetland influences which are inconsistent with those required to support Plains Grassland (EVC 132). The adjacent wetland, saltmarsh systems and poor drainage exacerbated by historical agricultural practices have likely driven the modification process, resulting in the vegetation observed during the field assessment.

Specific details relating to the observed EVCs are provided below.

Coastal Saltmarsh

Coastal Saltmarsh is generally characterised by distinct bands or zones of halophytic flora occurring immediately above marine and estuarine tidal flats. A range of life forms including herbs, low succulent shrubs, rushes and sedges are often present (DEECA 2023c).

Patches of Coastal Saltmarsh were observed along the northern and southern boundaries of the study area, fringing the south-western artificial dam and within and north of the road reserve of Groves Road (Plate 1; Plate 2; Figure 2). The vegetation was in low-moderate condition and predominantly comprised Beaded Glasswort *Sarcocornia quinqueflora ssp. quinqueflora* in the ground layer, scattered occurrences of Tangled Lignum *Duma florulenta,* as well as specimens of Austral Salt-grass *Distichlis distichophylla*, Rounded Noon-flower *Disphyma crassifolium* ssp. *clavellatum* and Austral Seablite *Suaeda australis* (Plates 1-4).

Plate 1. Low-moderate quality Coastal Saltmarsh along the study area's northern boundary (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 2. A fringing patch of Coastal Saltmarsh in the South-western artificial dam road (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 3. Coastal Saltmarsh north of Groves Road within Sparrovale Wetlands (Ecology and Heritage Partners Pty Ltd 18/04/2023).

Plate 4. Coastal Saltmarsh in background, with Couch-dominated grassland in the foreground adjacent to Groves Road (Ecology and Heritage Partners Pty Ltd 18/04/2023).

Brackish Wetland

Brackish Wetland is generally treeless, dominated by sedges and herbs indicative of saline conditions. Generally correlated with brackish lakes and poorly defined drainage lines, Brackish Wetland usually occurs in estuaries, shorelines and associated areas (DEECA 2023c).

One patch of Brackish Wetland was present along a drainage line within the south-western section of the study area (Figure 2). The vegetation was in moderate condition and predominantly comprised a mixture of inundated Salt Club-sedge *Bolboschoenus caldwellii* and Sea Rush *Juncus kraussii* ssp. *australiensis*. Occurrences of Beaded Glasswort, Austral Salt-grass and Austral Seablite formed the surrounding vegetation with the occasional Chaffy Saw-sedge and Coastal Tussock grass *Poa poiformis* also present (Plate 5; Plate 6).

Plate 5. Patch of sedge dominant Brackish Wetland within a drainage line along the south-western boundary (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 6. Fringing Austral Salt-grass (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plains Sedgy Wetland

Plains Sedgy Wetland occurs in seasonally wet depression. A range of aquatic herbs can be present, with low-moderate species richness, but higher towards drier margins (DEECA 2023c).

One patch of Plains Sedgy Wetland was present adjacent to an artificially constructed wetland within private property north of Groves Road (Figure 2) that was dominated by Common Spike-sedge *Eleocharis acuta* with occurrences of Rush *Juncus* sp., also present.

2.3.2 Scattered Trees and Trees in Patches

No Large Trees (LT) were identified during the field assessment. Three small-scattered River Red-gum *Eucalyptus camaldulensis* trees and one Melbourne Yellow-gum *Eucalyptus leucoxylon* subsp. *connata* were identified during the site assessment (Appendix 1; Figure 2).

2.3.3 Introduced and Planted Vegetation

Areas not supporting native vegetation had a high cover (>90%) of exotic grass species, many of which were direct-seeded for use as pasture. Scattered native grasses were generally absent from the study area.

Non-native areas were dominated by environmental weeds such as Toowoomba Canary-grass *Phalaris aquatica*, Ribwort *Plantago lanceolata*, Couch *Cynodon dactylon* var. *dactylon* and Kikuyu *Cenchrus clandestinus* (Plate 7).

Coastal Saltmarsh within Sparrovale Wetlands comprised a high cover of the environmental weeds Prostrate Knotweed *Polygonium aviculare* and Creeping Saltbush *Atriplex prostrata,* and scattered occurrences of Tall Wheat-grass *Lophopyrum ponticum*.

Noxious weeds, as defined under the CaLP Act, were prevalent throughout the study area, with Artichoke Thistle *Cynara cardunculus*, Spear Thistle *Cirsium vulgare* and African Boxthorn *Lycium ferocissimum* dominating the ground layer throughout the northern areas. Bathurst Burr *Xanthium spinosum* and Variegated

Thistle *Silybum marianum* were also present in patches of moderate density (Plate 8). African Boxthorn is also a Weed of National Significance (WoNS).

Planted non-native and native tree species were common throughout the study area. Ornamental gardens surrounded the residency and entrance driveway (Plate 9) with shelter belts bordering multiple fence lines within the study areas west. The Shelter belts were predominately Radiata Pine *Pinus radiata* or planted native and non-native Eucalyptus species (Plate 10; Figure 2).

Plate 7. Exotic pasture grass currently being grazed by cattle (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 8. Large patch of Artichoke Thistle and African Boxthorn within the study areas northern paddocks (Ecology and Heritage Partners Pty Ltd 3/06/2022).

2.4 Fauna Habitat

Most of the study area consisted of paddocks, which contained improved exotic pastures, likely to be used as a foraging resource by common generalist bird species that are tolerant of modified open areas. Fauna observed using this habitat included; Australian Magpie *Cracticus tibicen*, Common Blackbird *Turdus merula*, Little Raven *Corvus mellori*, Magpie-lark *Grallina cyanoleuca*, House Sparrow *Passer domesticus*, Willie Wagtail *Rhipidura leucophrys* and Red Fox *Vulpes vulpes*. Red Fox is a listed pest animal under the CaLP Act.

A population of the nationally significant Growling Grass Frog *Litoria raniformis* is known to occur within Baenches Wetland to the south of the study area (Shannon LeBel *pers. obs.*), and was also recorded within the northernmost farm dam located within the central part of the study area in December 2021. The results of the targeted Growling Grass Frog survey are provided in a separate report (Ecology and Heritage Partners 2021).

Plate 9. Planted ornamental gardens near the residency (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 10. Planted native Eucalyptus tree with tree guard (Ecology and Heritage Partners Pty Ltd 3/06/2022).

2.5 Presence of Significant Values

2.5.1 Flora

No nationally or State significant flora species have previously been recorded within the proposed development area according to the Armstrong Creek NVPP and the Victorian Biodiversity Atlas (SMEC 2010; DELWP 2022a), although there are nearby records of the nationally significant Spiny Peppercress.

There are several records of the State significant Melbourne Yellow Gum *Eucalyptus leucoxylon* subsp. *connata* (listed as Endangered under the FFG Act) and Giant Honey-myrtle *Melaleuca armillaris* subsp. *armillaris* (listed as Endangered under the FFG Act) previously recorded further north of the proposed development area, but these species are not present within the study area, nor will not be impacted by the proposed works.

Based on the modified condition of habitat present within the study area, aside from Spiny Peppercress, no additional significant flora were considered likely to occur. Despite targeted surveys being undertaken in all areas of potential habitat, no individuals of Spiny Peppercress were detected within the study area. The habitat within the site was low in quality, consisting predominately of exotic grass species (Plate 3), with grazing cattle were also present within the study area at the time of the survey. The southern portion of the study area also appears to have been subject to agricultural ground disturbance based on the onsite conditions, and historical aerial photography (Plates 4-5).

Outside of the patches of native vegetation detailed above (Section 2.3.1), the study area did not support the common native or exotic species typically associated with habitat where Spiny Peppercress are known to occur. The lack of suitable habitat and ongoing ground disturbance in the form of cattle grazing and pugging, combined with the efforts of the targeted survey indicate that the Spiny Peppercress is absent from the study area. As such, a significant impact to the Spiny Peppercress as part of the proposed development within the study area is considered highly unlikely.

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2.5.2 *Fauna*

Given the proximity to the nearby wetlands, there are many records of significant fauna - mostly waterbirds - within five kilometres of the study area (DELWP 2022a). The degraded condition of habitats within the majority of the study area and its close proximity to large areas of high-quality habitat makes it unlikely that these species would rely on habitat within the study area for foraging or breeding purposes. They may use the use the site opportunistically or fly over on their way to more suitable habitat.

The nationally-significant Growling Grass Frog Litoria raniformis (vulnerable under the EPBC Act) is known to occur to the south of the study area in Baenches Wetland (S. LeBel pers. obs.) and was confirmed to be present within a dam within the study area (Ecology and Heritage Partners 2021).

No other significant fauna were considered to rely on habitat within the study area for breeding or foraging purposes.

2.5.3 *Ecological Communities*

Seven nationally listed ecological communities are predicted to occur within 10 kilometres of the study area (DCCEEW 2022):

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community;
- Giant Kelp Marine Forests of South East Australia;
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain;
- Natural Damp Grassland of the Victorian Coastal Plains;
- Natural Temperate Grassland of the Victorian Volcanic Plain;
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains; and,
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Based on the modified condition of native vegetation within the study area, and the absence of key indicator species and community structural attributes, the study area is not considered to support any significant ecological communities.

3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

3.1 Overview

The summary of actions, timing, objectives, key responsible person/s and performance indicators for the protection of native vegetation and habitat are outlined in Section 3. Details and specifications for each management response and action are provided under the appropriate headings.

Construction managers will ensure they are familiar with the following documents:

- EPA 1991. Construction Techniques for Sediment Pollution Control. Published document prepared by the Victorian Environment Protection Authority, Melbourne, Victoria;
- EPA. 2004a. Temporary Environmental Protection Measures for Subdivisions Construction Sites. Published document prepared by the Victorian Environment Protection Authority (EPA).
- EPA 2004b. Doing it right on subdivisions: Publication 960. Published document prepared by the Victorian Environmental Protection Authority (EPA);
- EPA 2008a. Noise Control Guidelines: Publication 1254. Published document prepared by the Victorian Environmental Protection Authority (EPA);
- EPA 2008b. Noise from large residential subdivisions or urban development sites. Publication 1264. Published document prepared by the Victorian Environmental Protection Authority (EPA); and,
- EPA 2008c. Classification of Wastes: Publication 448.3. Published document prepared by the Victorian Environmental Protection Authority (EPA).
- EPA 2018. Liquid storage and handling guidelines. Published document prepared by the Victorian Environmental Protection Authority (EPA).
- EPA 2019. Guideline for stockpile management: Waste and waste derived products for recycling and reuse. Published document prepared by the South Australian Environmental Protection Authority (EPA).
- EPA 2020. Civil construction building and demolition guide. Publication 1834. Published document prepared by the Victorian Environmental Protection Authority (EPA), Melbourne, Victoria.

3.2 Plan Implementation

Details and specifications for this CEMP are provided under the appropriate headings below. It is envisaged that this document will be implemented in agreement between the City of Greater Geelong, DEECA and the relevant head contractor of each sub-contracting company. Other regulatory authorities (i.e. EPA) may also be involved in the compliance and monitoring aspects of this CEMP, as required.

Each element requiring management is discussed below and specific detail is provided where required. The management responses set out here are based on standard best-practice environmental protection measures.

It should be noted that it must always be ensured that all works are undertaken wholly within the boundaries of the study area.

3.3 Site Environmental Induction

During all stages of construction, all construction staff on the site (i.e. the area of construction) will be made aware of this CEMP and their responsibilities regarding environmental management. As such, all staff will attend an environmental site induction, which will inform contractors of the requirements of this CEMP. All main contractors undertaking construction works will be provided with a copy of the CEMP.

Following the induction, all persons working on site are required to sign the induction form and a log will be kept of all staff that have completed the environmental site induction. All construction personnel will hold appropriate competencies/qualifications for their intended role.

The induction will include the following:

- Information about the environmental values present within and surrounding the site;
- Plant and animal disease and pest plant and animal management protocols will be covered during the environmental site inductions;
- A site plan will be provided for viewing in order to become informed on environmental values;
- The legislative context of the development;
- The key objectives and measures outlined in the CEMP;
- The duty of care of all persons to: protect the environmental values within and surrounding the site; ensure that their actions are in accordance with the relevant environmental legislations and policies and the CEMP; report any faults, issues or actions with the potential (even remote) to impact upon the environment;
- The hierarchy of environmental responsibility and the lines of reporting;
- The reprimand and penalties for non-compliance;
- The requirement for all persons inducted to sign a log book of induction and,
- Location of legal disposal sites.

Toolbox meetings will be conducted regularly to maintain and improve awareness of Occupational Health and Safety (OH&S) and environmental issues. A wide range of topics are to be covered, with a focus on issues most relevant to current works.

3.3.1 Monitoring and Reporting

A log is to be kept of all staff that have completed the environmental site induction. All site changes that affect environmental protection, whether they are directly or indirectly a result of development will be logged at each toolbox meeting.

3.4 Native Vegetation Protection and Native Fauna Salvage and Management

Disturbance and removal of native vegetation has been kept to a minimum. Where practicable, vegetation will be rehabilitated at the cost of the developer to the satisfaction of the Responsible Authority.

No scattered trees or patches of native vegetation were identified within the study area in the Armstrong Creek East NVPP. Therefore, there are no permit or offset requirements associated with the removal of vegetation in the Armstrong Creek East NVPP within the study area. It is understood that a small portion of the ESO2 along the northern perimeter of the site will be incorporated into the residential subdivision, however, no development works will occur within these areas. Coastal Saltmarsh EVC is also present within the subdivided lots where there is overlap with the ESO2, but will not be impacted.

The southern half of Groves Road is located within the Armstrong Creek East PSP boundary, while the northern half is located outside the PSP boundary. Within the road reserve along Groves Road, a patch of Coastal Saltmarsh (EVC 9) is proposed to be impacted as part of the proposed works. The construction impact area is limited to 0.671 hectares of native vegetation within this patch (Figure 2).

It is not possible to avoid impacts to native vegetation within the road reserve along Groves Road due to the engineering and road safety standards required to facilitate acceptable access and egress into the study area. Impacts, including all construction buffers will be wholly confined to the road reserve boundary. No feasible opportunities exist to further avoid or minimise impacts on native vegetation without undermining the key objectives of the proposal. Vegetation proposed for removal has been assessed in accordance with the Guidelines (DELWP 2017) and Clause 52.16 and 52.17 of the Greater Geelong Planning Scheme.

A total of 16.502 hectares of Growling Grass Frog habitat is proposed to be directly impacted, including:

- 0.216 hectares of high quality aquatic dispersal, foraging and potential breeding habitat (Effluent Pond 1);
- 0.576 hectares of low quality aquatic dispersal and foraging habitat (Effluent Pond 2); and,
- 15.710 hectares of low quality terrestrial foraging and dispersal habitat comprised mostly of improved pasture in a paddock.

Approximately 1.9 hectares of Growling Grass Frog (GGF) habitat is proposed to be retained within the proposed offset site as part of the proposed action and includes terrestrial foraging and dispersal habitat comprised mostly of improved pasture in a paddock. Some exposed rock and debris in retained habitat may provide basking and overwintering opportunities for the species. The proposed action includes the creation of dedicated habitat for GGF, including a large wetland (1 hectare) and one smaller wetland (0.5 hectares), as well as terrestrial habitat (6.7 hectares) in a movement corridor that will be constructed to ensure ongoing connectivity to adjacent frog breeding habitat and dispersal corridors. As part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral wetlands) will be retained and enhanced. The improvement of retained terrestrial habitat (in conjunction with the creation of dedicated GGF waterbodies) will provide additional breeding and foraging habitat for the species, and improve habitat connectivity and frog dispersal within the property to allow for a future link for the study area between known GGF populations at Sparrovale and Baenches wetlands. Management actions regarding effluent pond and associated terrestrial habitat removal and GGF wetland construction will be outlined in the final GGF

Conservation Management Plan (GGFCMP) prepared by Ecology and Heritage Partners, for which AC Manager Pty Ltd is responsible for the overall implementation.

The primary purpose of retaining native vegetation is so that the site can continue to support local flora and fauna species, as well as cater for any fauna species that may, currently or in the future, use it for habitat and/or foraging. The retained vegetation will also act to buffer some of the edge effects that adjacent habitats may incur as a result of the subdivision.

The retention, protection and management requirements of these areas have been provided below and summarised in Table 1.

3.4.1 Pre-construction

- Vegetation to be retained in Figure 2 must be clearly marked and fenced off with vegetation / No-Go fencing, and readily identifiable on site in order to reduce the likelihood of areas scheduled for retention being disturbed;
- The implementation of all measures to protect native vegetation (such as fence construction), as well as any incident impacting on native vegetation must be logged in a logbook by the Head Contractor's Project Manager. The logbook must be made available for inspection by the Responsible Authority at all times;

The following measures relating to fencing and No-Go Zones will be implemented:

- Vegetation to be retained onsite that is in proximity to the construction area (within 20 metres) will be protected with vegetation protection fencing (e.g. para-webbing and hardwood stakes, or the equivalent) and will be known as a No-Go Zone (as shown in Figure 2) to avoid loss of vegetation cover, soil disturbance, compaction and weed infestation;
- No works are to take place within No-Go Zone and fences are not to be moved during the entire construction period and will not be removed until all works have been completed to the satisfaction of Responsible Authority;
- No machinery or construction equipment, waste, storage materials or unauthorised personnel are permitted within established No-Go Zones;
- Specific areas designated for vehicle re-fuelling and maintenance, dumping of waste and storage of materials and equipment will be located outside the No-Go Zones. In addition, no entry or exit pits for underground services are permitted within the No-Go Zones;
- Temporary signage will be installed along the perimeter of the No-Go Zone. All signage will be maintained until construction works are complete or until replaced by permanent fencing. Signage will be installed in order to:
    - Highlight the area as an ecologically sensitive area;
    - Prevent accidental entry by construction personnel; and,
    - Prevent vegetation trampling, rock disturbance and rubbish ingress by construction workers during the construction phase.

- Measures and protocols for protecting native vegetation will be covered during the environmental site inductions.
- Suitable signs will be predominantly displayed at the front of the site's access point/s. These signs will detail the following:
    - Hours of operation;
    - Designated delivery and unloading points with expected frequency is to be noted, where possible.
    - Liaison personnel and contact details to deal with public enquiries and Responsible Authority.
    - An outline of requests to occupy public footpaths or road, and anticipated disruptions to local services.
    - The materials which may be accepted; and,
    - A list of materials which are not to be brought on to site.

Removal of any habitat trees or shrubs (particularly hollow-bearing trees or trees/shrubs with nests) should be undertaken between February and September to avoid the breeding season for most fauna species. If any habitat trees or shrubs are proposed to be removed, this must be undertaken under the supervision of an appropriately qualified zoologist with current Management Authorisation to salvage and translocate any displaced fauna in accordance with *Wildlife Act 1975*.

Prior to and during removal of effluent ponds and surrounding terrestrial GGF habitat within the study area, pre-clearance searches for adults, metamorphs and tadpoles will be undertaken, including salvage and relocation if required. Salvage and relocation procedures may be initiated to reduce the occurrence of death, injury or displacement of individuals. Removal of effluent ponds will occur following completion of constructed wetland habitat and after one GGF breeding season, to allow migration of GGF individuals from the effluent ponds into constructed habitat. GGF populations and habitats will be monitored prior to, during and after the decommissioning works to ensure habitats remain suitable. Experienced zoologists will be involved throughout the implementation of the final GGFCMP (prepared by Ecology and Heritage Partners). If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors are required to temporarily halt works in that area, contact a zoologist and follow procedures outlined in Section 3.9.7 of the GGFCMP.

3.4.2 During Construction

- The project Head Contractor's Project Manager will undertake daily routine inspections of the temporary fencing and signage for the length of the project and will organise any required maintenance ensuring that it is carried out in a timely manner and to a satisfactory standard;
- Any accidental damage to the fencing or to the retained vegetation during construction will be reported to the Head Contractor's Project Manager immediately who will assess the extent of damages and report to Greater Geelong City Council. Corrective actions are to be first approved by Greater Geelong City Council and the Head Contractor's Project Manager will undertake the required

corrective actions and reporting. All incidents will be recorded in a logbook, with the logbook available for inspection at all times by the Responsible Authority;

- In the event that an animal is at risk from construction works, all activities that contributed to the risk of injury, mortality or stress to the animal will be stopped until the animal has been removed. Construction activities that are not likely to affect the animal can continue (as determined by the site supervisor). In some instances, the animal may move on voluntarily, however a licensed wildlife handler may be required where this does not occur, or in the event of fauna injury. Owing to OH&S and animal welfare considerations, encountered animals must only be handled by experienced and qualified personnel. Appropriate contacts include:
    - Wildlife Victoria: 1300 094 535
    - Any engaged wildlife handler must be licensed and comply with the standards for Animal Welfare Handling and Release provided below.

  Once the encountered animal has moved on voluntarily or been moved on by a qualified handler, the site supervisor will direct the continuation of work. Further, a report will be prepared by the qualified zoologist to document any fauna species impacts and or fauna species salvage operations, and submitted to the relevant authority.

- Vehicle and machine access, wash down and set down, and excavation material stockpiling will be limited to the areas specifically designated for these activities (Figure 2). These areas will be appropriated bunded and fenced off to avoid any run-off, sediment, pollutants etc. entering adjacent vegetation and habitats.

Landscape Plantings

- As indigenous flora species provide valuable habitat for indigenous fauna species, it is recommended that any landscape plantings that are undertaken as part of the proposed works are conducted using indigenous flora species sourced from a local provenance, rather than exotic deciduous trees and shrubs. Landscape planting may be conducted with reference to species plantings relevant to each EVC, with guidance from documents such as the former Department of Sustainability and Environment's 'Revegetation Planting Standards' (DSE 2006)(Appendix 1).
- The *Growling Grass Frog Habitat Design Standards* (DELWP 2017) have been reviewed to provide a list of suitable species to be used when establishing vegetation within Growling Grass Frog habitat (Table A1.4, Appendix 1).

Table 1. Summary of actions, timing, objectives, key responsible person/s and performance indicators for the protection of native vegetation and habitat.

Action	Timing	Key objective	Responsible person/s	Performance indicator
Environmental site inductions	Pre and during construction.	Ensure all persons are informed and aware of the 'no go zone' areas and restrictions, as well as designated parking, stockpiling and set down areas.	Head Contractor's Project Manager.	Record of inductions in log book.
Installation of fencing to protect retained vegetation	Pre-construction.	Ensure required 'no go zone' areas are achieved and there are no breaches in planning permit and offset approvals.	Head Contractor's Project Manager and Contractors.	No damage to retained vegetation or fencing, no breach of planning permit and offset approvals.
Routine inspections of fencing installed to protect retained vegetation and required maintenance carried out	Pre and during construction.	Avoid unintended damage to retained vegetation so that it can continue to support local flora and fauna.	Head Contractor's Project Manager, Contractors and Staff.	No damage to retained vegetation.
Reporting of any damage to fencing or retained vegetation	Pre and during construction.	Avoid unintended damage to retained vegetation so that it can continue to support local flora and fauna. All incidents logged.	All Managers, Contractors and Staff.	No damage to retained vegetation. All incidents logged. Logbook available for inspection by the responsible Authority.

3.4.3 Monitoring and Reporting

The implementation of all measures to protect native vegetation, as well as any incident impacting on flora and fauna species must be logged in a logbook by the Head Contractor's Project Manager. All salvage outcomes will be reported to the relevant authorities (i.e. DEECA, City of Greater Geelong). The logbook must always be made available for inspection by the Responsible Authority.

A report is also required to be prepared by the qualified zoologist to document any fauna species impacts and or fauna species salvage operations.

3.5 Plant Disease, Pest Plant and Invasive Fauna Management

Earthworks and construction associated with the development will involve the removal and transportation of plant material and soil, as well as the use of various machines, vehicles and equipment. This means that there is an innate risk of spreading plant and animal diseases and pest plants and invasive animals to and from the study area (and areas adjacent). Vegetation within and surrounding the study area contains environmental and noxious weeds. Native vegetation is under constant threat from further pest plant and animal encroachment. Preventing further spread of weeds and invasive fauna species is a priority for management of

the study area. Management and control of noxious and environmental weeds is outlined in the Weed Management Plan (Ecology and Heritage Partners 2023b).

3.5.1 Invasive Fauna Species

Given the level of disturbance associated with construction, it is unlikely that invasive fauna species will move into the construction site however it is important to ensure this does not happen. Measures to ensure invasive fauna species are not utilising the site are included in Section 3.5.4.

Mitigation measures to manage plant disease, pest plant and invasive fauna have been detailed below for each stage of construction.

Pre-construction

- Pest control contractors with demonstrated experience working in ecologically sensitive environment will be engaged to undertake pest plant control;
- All equipment and machinery are to be thoroughly cleaned and disinfected off site prior to commencing works.
- If invasive fauna species are found to be inhabiting the site, a qualified and experienced pest controller will be engaged to address the infestation;
- If European Rabbit *Oryctolagus cuniculus* or Red Fox *Vulpes Vulpes* warrens are identified within the site, they must be collapsed to ensure the invasive species to not take up residence.
- A wash down area will be established within the study area for periodic cleaning of excess soil and organic matter to avoid the spread of noxious weeds and soil pathogens (Figure 2). Contaminated water from the wash down area must not be discharged into drainage lines or flow into areas of environmental sensitivity, namely Sparrovale Wetland, Armstrong Creek and Baenschs Wetland. Sediment from the wash down area must be retained in wash down bays and prevented from spreading over the site. Sediment and wash down water must not leave the site until decontaminated at is successfully tested in accordance with background level conditions (as determined through background level sampling)(EPA 2022).
- Actions to limit the spread of diseases and pest plant species will follow best-practice protocols as detailed in the Summary of State and Territory Noxious Weeds Legislation, Weed Management Strategy, Weeds of National Significance (WONS) Strategies and Developing and Implementing a Weed Management Plan (DNRE 2002; CRC 2004; AWC 2008; DPI 2008). These protocols address the potential spread of weeds and plant disease.

During Construction

- All vehicles, equipment and machinery must be cleaned and disinfected offsite (i.e. before leaving the depot). Vehicles and machinery are to be checked thoroughly for contaminants prior to entering the site. Machinery, vehicles and equipment coming into the site are required to be cleaned of excess soil and organic matter by a high-pressure water or air spray jet and a washdown bay is to be established at the entrance. Only vehicles/equipment/machinery that can be certified as clean and disinfected can enter the site.

- Rumble strips will be installed at entry and exit points to reduce the spread of pest plants and disease (Figure 2).
- All machinery and vehicles not exiting the construction zone will be set down in a designated area each evening.
- Before exiting the construction zone, all machinery, vehicles, equipment and footwear will also be washed and disinfected at designated wash down bays by high pressure air or water spray jets (Figure 2).
- Imported soil (if required) will be certified as 'weed-free'.
- All waste will remain within the footprint of the site until such time as it can be taken to a legal disposal site.
- All efforts must be made to minimise waste and recycle all recyclable products; and,
- Should any waste spillage occur it must be cleared immediately and where applicable recycled, or sent to the appropriate, registered disposal site as stated in Section 3.12.

Post construction

- Any areas scheduled for rehabilitation or landscaping, are recommended to be restored with indigenous plant species. This is to minimise the potential for the spread or establishment of plant diseases and pest plants, and to ensure that non-indigenous plants, which could spread and establish into native vegetation, are not introduced to the local area.
- Planting must be done at an appropriate time to maximise survival of tubestock (e.g. autumn, winter), which may not coincide with completion of construction works.
- Any new landscaping within the site will use indigenous species.
- Ongoing pest plant control will be carried out by qualified pest plant control contractors. The pest plant control contractors and the Environmental Manger will continue to monitor the site to identify the establishment of new weeds and implement control actions accordingly.

3.5.2 Monitoring and Reporting

Vehicles and machinery are to be checked on a weekly basis to ensure they remain clean of excess soil and organic matter. Vehicles and machinery must be checked and cleaned on every entry and exit. A logbook will be maintained at the wash-down area. All machinery and vehicle wash-downs will be logged, including:

- Date;
- Time;
- The name of the person undertaking the washdown;
- Description (whether machinery, a vehicle or equipment);
- Identification (registration, serial number);
- Origin (where the machinery, vehicle, piece of equipment or personnel has come from);

- Destination (where the machinery, vehicle or equipment is going to);
- Sign off that a check (for attached soil, dust or weed propagules) has been undertaken; and
- Physical removal of soil and debris methods undertaken.

3.6 Erosion, Sedimentation and Water Quality

Construction activities (e.g. soil excavation) may increase the potential for erosion and sedimentation and can pose a significant hazard to water quality and associated fauna habitat. Sedimentation control is critical to protecting such fauna habitat. This includes adjacent Sparrovale and Baenschs wetlands, which are known to provide breeding, dispersal and refuge habitat for Growling Grass Frog populations. Detailed plans to mitigate potential impacts to the existing Growling Grass Frog population and associated habitats will be provided in the GGFCMP (prepared by Ecology and Heritage Partners), which outlines the proposed creation and monitoring of new habitat within the study area during pre-development, development, and post-development stages.

Pre-Construction and During Construction

Measures employed for dust suppression are effective as erosion and sedimentation controls. In addition to the measures outlined for dust suppression (Section 3.7), the following measures are appropriate to reduce erosion and sedimentation (EPA 2004a):

- Install sediment retention structures to divert flow away from exposed soils and prevent contaminated stormwater and/or sediment laden run-off from accessing waterways or stormwater drains. Such structures must include silt fences, straw bales, coir logs, rock or gravel sausages, catch drains, earth banks, slopes and batters and/or rock bunds (Plate 3; Plate 4). A wide range of sediment retention structures are described in detail in EPA (2004a).
- Ongoing sediment and erosion control: permanent stormwater protection through 'water-sensitive urban design' principles must be incorporated post-construction within the detailed design phase of the subdivision. Run off following significant rainfall events will be evaporated on site or directed into sediment traps and sump pits.
- All sediment control measures (fencing and sausage filters) will be inspected as part of the weekly environmental inspection, as well as after significant rainfall events, to ensure they are functioning properly.
- Any occurrences of sedimentation and erosion must be controlled immediately. Remediation of all areas where sedimentation and erosion have occurred must be undertaken within 24 hours.
- Extra sediment control equipment will be stockpiled on site for emergency repairs and exceptional weather events (1 in 5 year storm event).
- Once construction has been completed, remove sediment retention structures, if the structure is no longer required.

Maximum post spacing	Installation condition
2m	No support wire or backing mesh.
3m	Support weir attached along top of the fabric at 1m intervals. Wire mesh or PVC safety mesh backing.

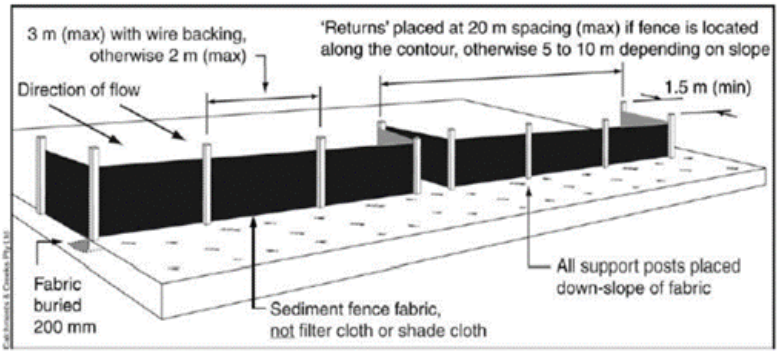

Plate 3. Typical silt fencing specifications

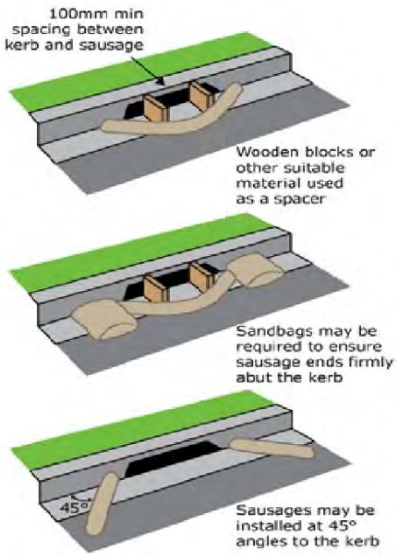

Plate 4. Typical geotextile fence and gravel sausages

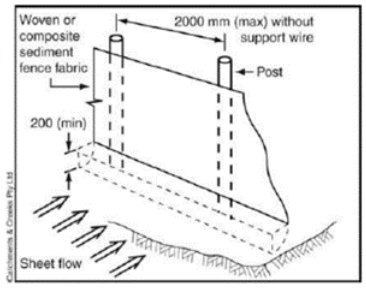

Plate 5. Typical installation of sediment fence without wire backing

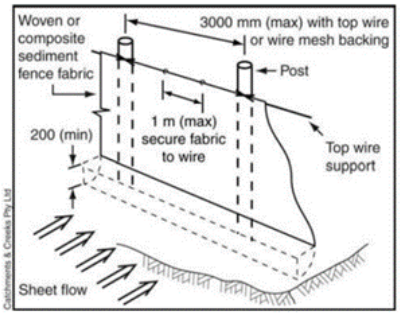

Plate 6. Typical installation of sediment fence with wire backing

3.6.1 Monitoring and Reporting

Sedimentation controls are to be checked on a weekly basis to ensure silt fencing and other sediment retention structures remain in place and are working effectively. The occurrence of rain will increase the likelihood that sedimentation and erosion will occur. When raining, sedimentation controls must be checked daily.

3.7 Dust

Dust is generated through exposure of dry soils and agitation through either construction activities (e.g. moving soils, vehicle and machinery movements) or by high wind speeds that enable soil particles to become airborne. Construction activities and exposure of topsoil is likely to increase dust levels, which can pose a hazard to air quality.

During Construction

The following measures will be implemented to reduce dust levels as a result of construction activities (EPA 2004a):

- Phase the work program to minimise land disturbance where possible throughout the construction period;
- Stabilise exposed soil (stabilisation matting, grassing, mulch, progressive revegetation, roughen surface of exposed soil);
- Watering exposed soil and access tracks. Water trucks must always be maintained on site and be available. Frequency of watering will be determined by weather conditions (e.g. above 30º Celsius, wind above 15 kilometres per hour).
- A 'Stop Work' order must be given if conditions are sufficient to suspend dust despite watering. Work may resume only when watering suppresses all dust;
- Vehicles to keep to paved roads wherever paved roads area available, and reduce traffic speeds to 20 kilometres an hour on access tracks; and,
- Protect soil stockpiles by applying the following measures:
    - Stabilise exposed stockpiles by seeding (or a treatment to provide a crusted surface) may be accepted by City of Greater Geelong. However other stabilisation methods including stabilisation matting, geotextile may be approved;
    - The City of Greater Geelong Environment Team must be consulted prior to chemical stabilisers being used;
    - Provision of silt fencing on the low side of each stockpile;
    - Silt fences must be reinforced with wire mesh or by placing star pickets every metre;
    - Silt fences must not be installed so that run-off can pass around them. Silt fences must be constructed along the contour, with the ends turned up slope to ensure that any build-up of run-off behind the fence cannot pass around it;
    - When installing silt fences ensure that they are trenched into the ground and appropriately backfilled and compacted;
    - Stockpiles must be no higher than five metres (EPA 2019);
    - Stockpiles must be below fencelines when within five metres of the site boundary;
    - Maximum 2:1 height to width ratio for soil stockpile; and,
- Dust suppression fencing is to be used in locations where there are exiting dwellings.

3.7.1 Monitoring and Reporting

Dust controls are to be checked on a weekly basis to ensure measures remain in place and are working effectively. Dust controls are to be checked daily when the temperature is above 30º Celsius and/or wind speed is above 15 kilometres per hour. Remediation must be undertaken within 24 hours of any incidents.

3.8 Mud

During periods of high rainfall the heavy clay soils can cause a safety and environmental hazard when actively used during construction activities (e.g. moving soils, vehicle and machinery movements).

During Construction

The following measures will be implemented to reduce damage to vehicle undercarriage, compaction to the soil, ground disturbance from wheel ruts and off-target damage to native vegetation:

- Phase the work program to minimise land disturbance where possible throughout the construction period;
- Stabilise saturated soil along high-use roads (e.g. stabilisation matting and temporary road base);
- Ensure roads have adequate drainage and it is working effectively;
- A 'Stop Work' order must be given if conditions are sufficient to cause bogging. Work must resume only when deemed safe; and,
- Vehicles to keep to paved roads wherever paved roads area available, and reduce traffic speeds to 20 kilometres an hour on access tracks.

3.8.1 Monitoring and Reporting

Mud management controls are to be checked on an as needed basis, particularly during high rainfall months, i.e. July to October, to ensure measures remain in place and are working effectively. Remediation must be undertaken within 24 hours of any incidents.

3.9 Vehicular Access and Transport of Materials

Management measures to minimise disturbance from the increase in local traffic and transport of materials have been detailed below.

Pre-Construction, During Construction and Post Construction

- Any vehicle depositing materials on site will be inspected by construction personnel (e.g. site supervisor) prior to being permitted to enter. This inspection will involve the identification of materials on board as well as the vehicle itself to ensure no unauthorised materials are entering the site.
- Where large loads (i.e. loads exceeding the height of the container) are entering and/or exiting the site, they will be covered (i.e. tarp) or bound (i.e. webbing straps) appropriately. This will avoid any debris littering surrounding areas or causing accidents/injuries;
- The movement of construction vehicles to and from the site must be regulated to ensure that no traffic hazards are created;
- Construction, trade and staff vehicles are to be parked and contained within a designated area within the site boundary and encouraged to incorporate a temporary turn-around bay for safe passage of all vehicles within the site boundary during construction;

- Any vehicles entering will follow the disease and pest plant management procedures, as identified in Section 3.5; and
- Notification must be provided for any request to occupy public footpaths or roads, and anticipated directions to local services.

3.9.1 Monitoring and Reporting

A log is to be maintained by the site supervisor of all vehicles and machinery permitted to enter the construction site. The logbook is to record the following:

- Date;
- Time;
- The name of the person responsible for the receival of materials;
- Supplier;
- Composition;
- Source;
- Destination; and
- A sign off that a declaration form or equivalent has been provided by the supplier to confirm that they are free of weed seeds and pathogens.

3.10 Chemical and Fuel Storage

Several mitigation measures will be implemented to avoid and minimise potential impacts from chemicals and fuels.

Pre-Construction and During Construction

To avoid the risk of contamination associated with fuels, lubricants and chemicals, the following measures will be implemented:

- Appropriate storage and refuelling points will be designated;
- Appropriate bunding and liners for chemical storage will be installed in line with *Liquid Storage and Handling Guidelines* (EPA 2018), prior to the chemicals/fuels entering the site;
- Fuel and chemicals must be stored according to the relevant MSDS;
- Fuel spill response plans will be prepared. A spill kit will be kept approximately 10 metres away from the fuel storage area so that it is accessible in the event of a spill, but safely out of the range of spills (EPA 2004a); and,
- Response to fuel spills must be immediate with remediation occurring within 24 hours. In the event of a fuel spill the Responsible Authority must be notified immediately upon completion of remediation.

Additionally, all fuel will be contained within the designated stockpiling area. This area will be surrounded by an air and watertight barrier to minimise risk should any spillage occur. The barrier will be at least 700

millimetres high and entirely sealed at ground level to safeguard against any leaks. The barrier will have capacity to hold double the volume stored in the onsite fuel storage tank.

3.11 Managing Operational Failure / Accidental Spill of Pollutants

Several mitigation measures will be implemented to avoid and minimise the occurrence and extent of pollutant spills or operational failure and the subsequent impacts to environmental values.

Pre-Construction and During Construction

These mitigation measures include the following:

- All fuel, waste, chemicals and other hazardous materials will be stored in a designated stockpiling area (Figure 2);
- All underground utilities will be clearly marked and therefore avoided during construction works;
- Spill kits will be placed and clearly marked throughout the construction site;
- Potential pollutants present on site and the protocols for storage, transportation, handling and disposal of pollutants, reporting procedures of risks, and emergency procedures in the event of a spill, will be covered during the environmental site inductions; and,
- If fauna have been, or may be, directly impacted by the spill, wildlife rescue and assistance will be organised.

3.11.1 Monitoring and Reporting

All spills will be reported by the site supervisor, including documentation identifying the cause of the spill, actions taken, the outcome and what actions are proposed to avoid a repeat spill.

3.12 Waste Management

Construction activities will involve the use of fuels, lubricants, chemicals, demolition and construction waste materials that pose a risk to soil, waterways and groundwater contamination.

Pre-Construction and During Construction

Measures used to manage waste include the following:

- A designated set down area for vehicle and equipment storage, vehicle refuelling and dumping of contaminated waste will be established prior to commencement of construction activities (Figure 2). The area must (EPA 2004a):
    - Be located away from drainage lines, stormwater inlets, waterways, areas of significant flora and fauna and other sensitive areas identified on site;
    - Be appropriately bunded to contain all contaminated water; and,
    - Be clearly signed for easy identification.
- A process is to be implemented to separate, re-use and recycle demolition material;

- All waste material will be contained (within suitable skips with netting/lids onsite) and cleaned on a weekly basis to ensure skips do not overflow and litter does not enter surrounding areas;
- Green bins must be appropriately bunded to avoid run-off and transmission of disease in the event of rain;
- Appropriate methods of disposal for wastes are dependent on the classification of the waste material and are detailed in Classification of Wastes (EPA 2008c);
- The construction contractor will be made aware of their responsibility to keep the construction zone clean during construction, which is to be outlined within a relevant site induction; and,
- All waste will be stored securely in designated sites within the footprint of the project until such time as it can be taken to a legal disposal site.

3.12.1 Monitoring and Reporting

All waste must be monitored on a weekly basis. A logbook will be maintained that records the time of monitoring and the occurrence, and response actions to any spills. Remediation of spills and contamination must be finalised within 24 hours of the occurrence. All incidents involving inadequate equipment storage or spillages will be reported immediately to the Responsible Authority and the management of waste material must be adjusted to ensure storage procedures are appropriate. Benchmarks for success are the continuing avoidance of all spills or contamination. Waste must be minimised at all times and all recyclable materials must be recycled.

3.13 Fire Management

The potential for a fire to start within a works area can be particularly high in bushland areas.

During Construction

The contractor will be made aware of the following safety procedures to minimise the risk of fire.

- All vehicles and machinery will be parked in designated parking areas;
- All staff will be made aware of the declared Fire Danger Period and days of Total Fire Ban;
- Weather conditions will be monitored during periods of high fire danger, such as days of Total Fire Ban;
- Adequate fire suppression equipment will be on site as per the requirements of Regulation 109 and 110 of the Country Fire Authority Regulations 2014 (State of Victoria 2014). The contractor's personnel will be made aware of the location and operation of this equipment; and,
- The Construction Supervisor will be supplied with the contact number for the local FRV unit:

  Belmont FRV Fire Station 64

  Address: 2-4 Reynolds Rd, Belmont VIC 3216

  FRV Headquarters phone: (03) 9662 2311

  Emergency phone: 000

3.13.1 Monitoring and Reporting

Establish a fire management plan and ensure that the site manager has the contact number for the local FRV unit.

3.14 Noise Management

Noise levels will be managed in accordance with the State Environment Protection Policy (Noise from large residential subdivisions or urban development sites) (EPA 2008a; EPA 2008b). Noise from building and other works relating to the development will also comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works must not emit excessive or offensive noise. Works can only be carried out on any land between the hours 7:00am and 6:00pm on weekdays, 9:00am and 6:00pm on Saturdays, Sundays and public holidays. Restricting noise created by building works will allow male Growling Grass Frogs to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species.

Pre-Construction and During Construction

The hours of operation for construction works must comply with the Noise Control Guidelines (EPA 2008) and Building works – Local Law requirements (Greater Geelong City Council 2014):

- Monday-Friday: 7am-6pm
- Saturdays: 9am-1pm
- Sunday: No work without approval of an Out of Hours Permit
- Public Holidays: No work without approval of an Out of Hours Permit

Noise level is not to exceed background noise during the hours of:

- 6-10pm Monday to Friday;
- 1-10pm Saturdays.

The following actions are recommended by the *Civil construction building and demolition guide* (EPA 2020) and will be implemented:

- Schedule activities to minimise noise impacts outside of business hours;
- Consult and inform residents and other people who may be affected by noise;
- Provide noise attenuation screens, where appropriate;
- Restrict areas where mobile plant can operate so that it is away from people who could be affected by noise;
- Noise must not be above background levels inside any adjacent residence between 10pm and 7am;
- Use quieter equipment or methods;
- Schedule deliveries to the site so that disruption to local amenity and traffic are minimised; and
- Minimise air vibrations.

The following actions are recommended by the *Noise Control Guidelines* (EPA 2008):

- Where work is conducted in a residential area or other noise-sensitive location, use the lowest-noise work practices and equipment that meet the requirements of the job.
- Site buildings, access roads and plant must be positioned such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures must be used. The site must be planned to minimise the need for reversing of vehicles.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, must be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Fit all pneumatic tools operated near a residential area with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Special assessment of vibration risks may be needed, such as for pile-driving or works structurally connected to sensitive premises.
- Noise from the site needs to comply with the requirements of the schedule, except for:
    - Unavoidable works; and,
    - Night period low-noise or managed-impact works approved by the local authority.

3.14.1 Monitoring and Reporting

Monitor noise levels to ensure levels do not become disruptive to local residents. This must include monitoring all vehicles to ensure they are fitted with appropriate, functioning mufflers/noise suppressors.

Should any noise complaints be received, City of Greater Geelong should be consulted and an appropriate response initiated within 24 hours.

Benchmarks for success are adhering to the hours specified above and receiving no complaints.

3.15 Light Pollution

Growling Grass Frog are a predominantly nocturnal species. Artificial light pollution may increase the risk of predation of Growling Grass Frog by foxes and Cats and may also disrupt mating activities of the species. As such, sources of artificial light from the surrounding development will be directed away from the existing and

proposed constructed habitat. There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution.

Pre-Construction, During Construction and Post Construction

Measures used to manage light pollution include the following:

- Sources of artificial light from the surrounding development will be directed away from the existing GGF habitat, constructed wetland and migration corridor.
- No additional lighting directed towards the existing habitat or constructed wetlands.
- Shields will be placed on lights to reduce lateral light spill.
- If necessary, embedded lights will be used on walkways adjacent to the constructed wetland habitat.
- Use of high intensity lights in white or blue range (<50 nm wavelengths) will be avoided.

3.15.1 Monitoring and Reporting

Artificial lighting controls are to be checked on a weekly basis to ensure artificial light from the surrounding development is not directed towards existing and proposed constructed GGF habitat. This must include monitoring all vehicle/machinery lighting, security lighting, street/walkway lighting and temporary construction site lighting to ensure all artificial lighting sources are directed away from existing habitat or constructed wetlands at all times, are fitted with appropriate shields to reduce lateral light spill, and do not use high intensity lighting in white or blue range (<50 nm wavelengths). Should compliance with any of these measures fail, remediation must be undertaken within 24 hours of any incidents.

3.16 Monitoring and Compliance

Monitoring throughout construction works is required to assess the success of management actions on the integrity of environmental values surrounding the site, and to implement change if required.

During Construction

A monitoring and compliance framework is provided below (Table 2). Weekly environmental inspections will be carried by a Site Manager (or representative) and completion of the environmental checklist provided in Table 3. Site managers are to sign and date each management action when it has been completed.

Table 2. Environmental Management Controls.

Risks and Potential Impacts	Management Action	Monitoring frequency	Relevant Section
Non-compliance with requirements under local and State environmental policies.	All contractors to attend an environmental site induction.	Pre-construction and ongoing for new contractors.	Section 3.2 and 3.3
Potential impacts to native vegetation that are to be retained.	Routine inspections of fencing installed to protect retained vegetation and required maintenance carried out. Reporting of any damage to fencing or retained vegetation.	Daily	Section 3.4
Unrestricted spread/removal of existing weeds from the site. **Introduction of new weeds into the site.**	Implement pest plant controls. Vehicles and machinery are to be checked on a upon entry and exit of the site to ensure they remain clean of excess soil and organic matter.	When entering or exiting the site	Section 3.5
Increased potential for erosion and sedimentation poses a risk to water quality.	Implement erosion and sedimentation controls. Controls are to be checked on a weekly basis (daily when raining) to ensure measures remain in place and are working effectively.	Weekly/daily.	Section 3.6
Increased dust levels pose a hazard to air quality.	Implement dust controls. Controls are to be checked on a weekly basis (daily basis when the temperature is above 30º Celsius and/or wind speed is above 15 kilometres per hour) to ensure measures remain in place and are working effectively.	Weekly/daily	Section 3.7
Construction activities causing environmental harm due to saturated soil conditions.	Implement controls and temporary track stabilisation measures to minimise harm when site becomes excessively muddy. Conditions to be monitored, 'Stop Work order to be issues if deemed unsafe.	Seasonally	Section 3.8
Construction activities, use of heavy machinery and excavation equipment causing noise pollution, impacting residents in the local area.	Implement noise management controls. Ensure construction complies with mandated EPA hours of operation.	Throughout duration of construction.	Sections 3.9 and 3.14
Construction activities will involve the use of fuels, lubricants, chemicals and construction waste materials that pose a risk to soil, waterways and groundwater contamination.	Implement waste management controls. Report all incidents immediately involving inadequate equipment storage or spillages and the management of waste material in order to adjust storage procedures accordingly.	Throughout duration of construction.	Sections 3.10, 3.11 and 3.12
The potential for a fire to start within a works area can be particularly high in rural and semi-rural areas. Activities such as driving and parking of vehicles in tall grass can result in fire.	Establish a fire management plan. The site manager must have the contact number for the local FRA unit.	Throughout duration of construction.	Section 3.13

Table 3. Weekly environmental management checklist.

Action #	Management Measure	Relevant Section	Compliance Actions Required?	Supervisor Name And Signature	Date
1	All new contractors attended an environmental site induction.	Section 3.3			
2	Compliance with native vegetation protection measures and fauna salvage controls	Section 3.4			
3	Compliance with plant disease, pest plant and invasive fauna management controls	Section 3.5			
4	Compliance with erosion and sedimentation controls.	Section 3.6			
5	Compliance with dust controls.	Section 3.7			
6	Compliance with mud controls	Section 3.8			
7	Compliance with vehicular access and transport of material controls	Section 3.9			
8	Compliance with chemical and fuel storage controls	Section 3.10			
9	Compliance operation failure and accidental spillage controls.	Section 3.11			
10	Compliance with waste management controls	Section 3.12			
11	Compliance with fire management controls	Section 3.13			
12	Compliance with noise management controls	Section 3.14			
13	Compliance with light pollution controls	Section 3.15			

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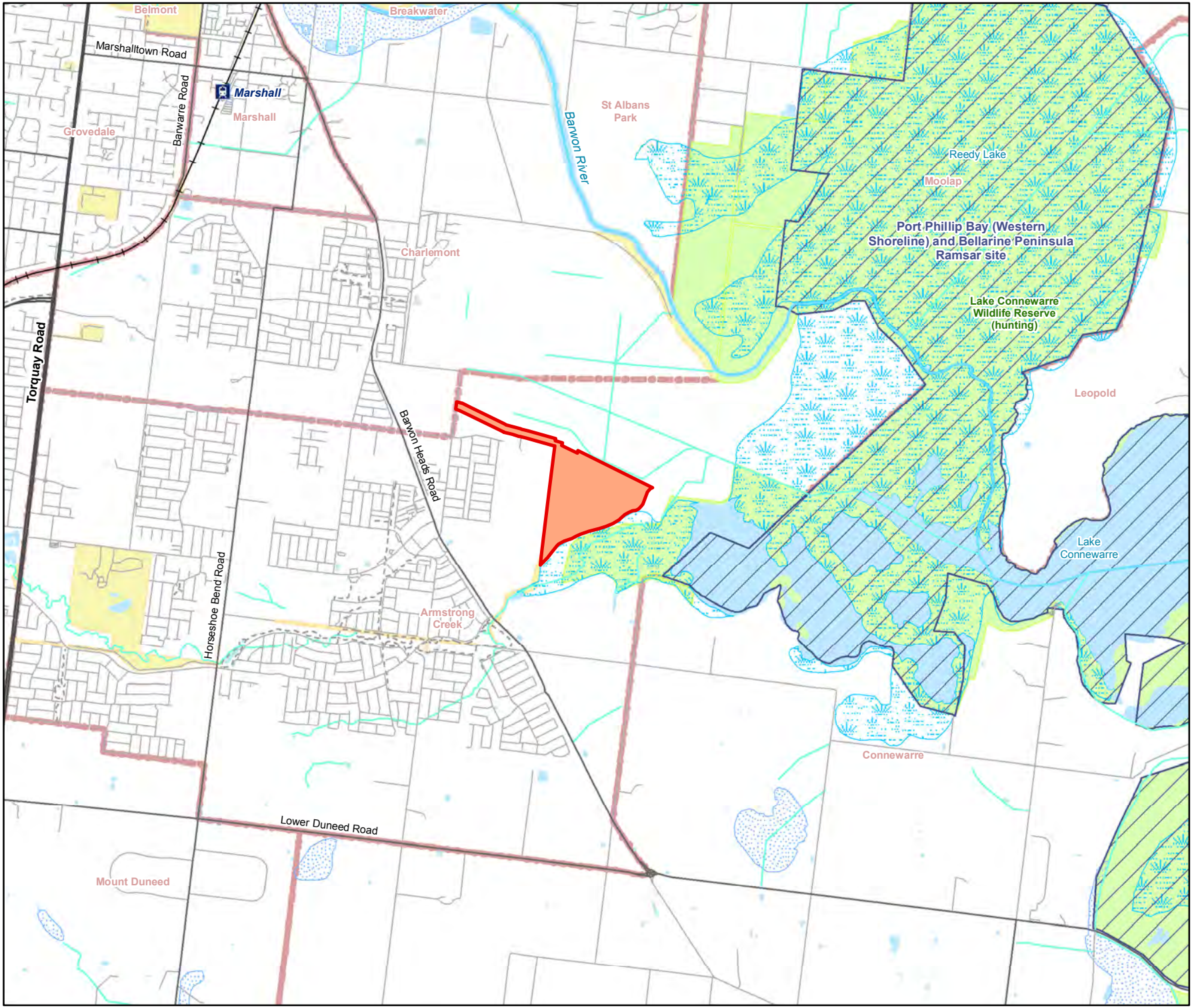
FIGURES



Legend

- Study Area
- Railway
- Major Road
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Ramsar wetland
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 500 1,000

Metres

Map Scale: 1:40,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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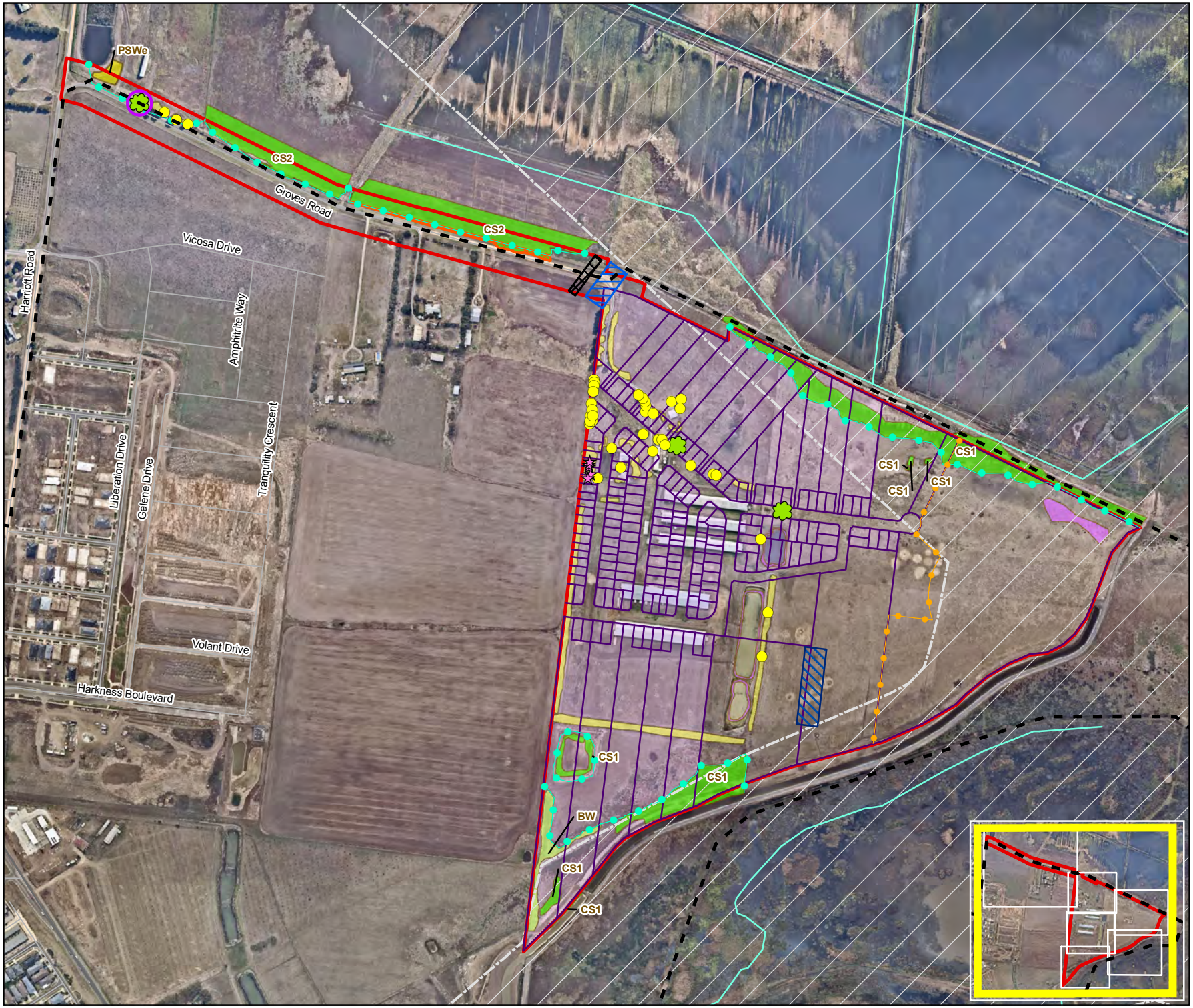

Legend

- Study Area
- Precinct boundary
- ESO
- Vehicle and machinery entry/exit point
- Indicative stockpile area
- Washdown bay and rumble strips
- Retained vegetation protection / No-Go fencing
- Frog exclusion, safety and sediment fencing
- Proposed lot boundaries
- Scattered Small Tree
- Planted tree
- Planted vegetation
- Scattered Tangled Lignum

FFG Act Listed Flora

- Fragrant saltbush
- Melbourne Yellow-gum

Ecological Vegetation Class

- Brackish Wetland (EVC 656)
- Plains Sedgy Wetland (EVC 647)
- Coastal Saltmarsh (EVC 9)
- Impacted vegetation (Clause 52.17)

Figure 2 Overview

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 100 200

Metres

Map Scale: 1:44,122 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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16303_Fig02_MgmtPlanOV 3/11/2023 dvaladares

Aerial source: Nearmap 2022

Legend

- Study Area
- Precinct boundary
- ESO
- Vehicle and machinery entry/exit point
- Washdown bay and rumble strips
- Retained vegetation protection / No-Go fencing
- Proposed lot boundaries
- Scattered Small Tree
- Planted tree
- Planted vegetation

FFG Act Listed Flora

- Fragrant saltbush
- Melbourne Yellow-gum

Ecological Vegetation Class

- Plains Sedgy Wetland (EVC 647)
- Coastal Saltmarsh (EVC 9)
- Impacted vegetation (Clause 52.17)

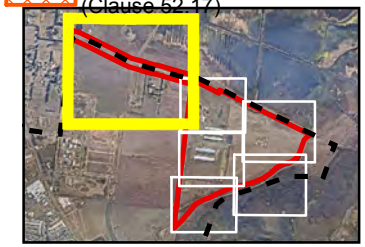

Figure 2a

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

0 50 100

Metres

Map Scale: 1:3,500 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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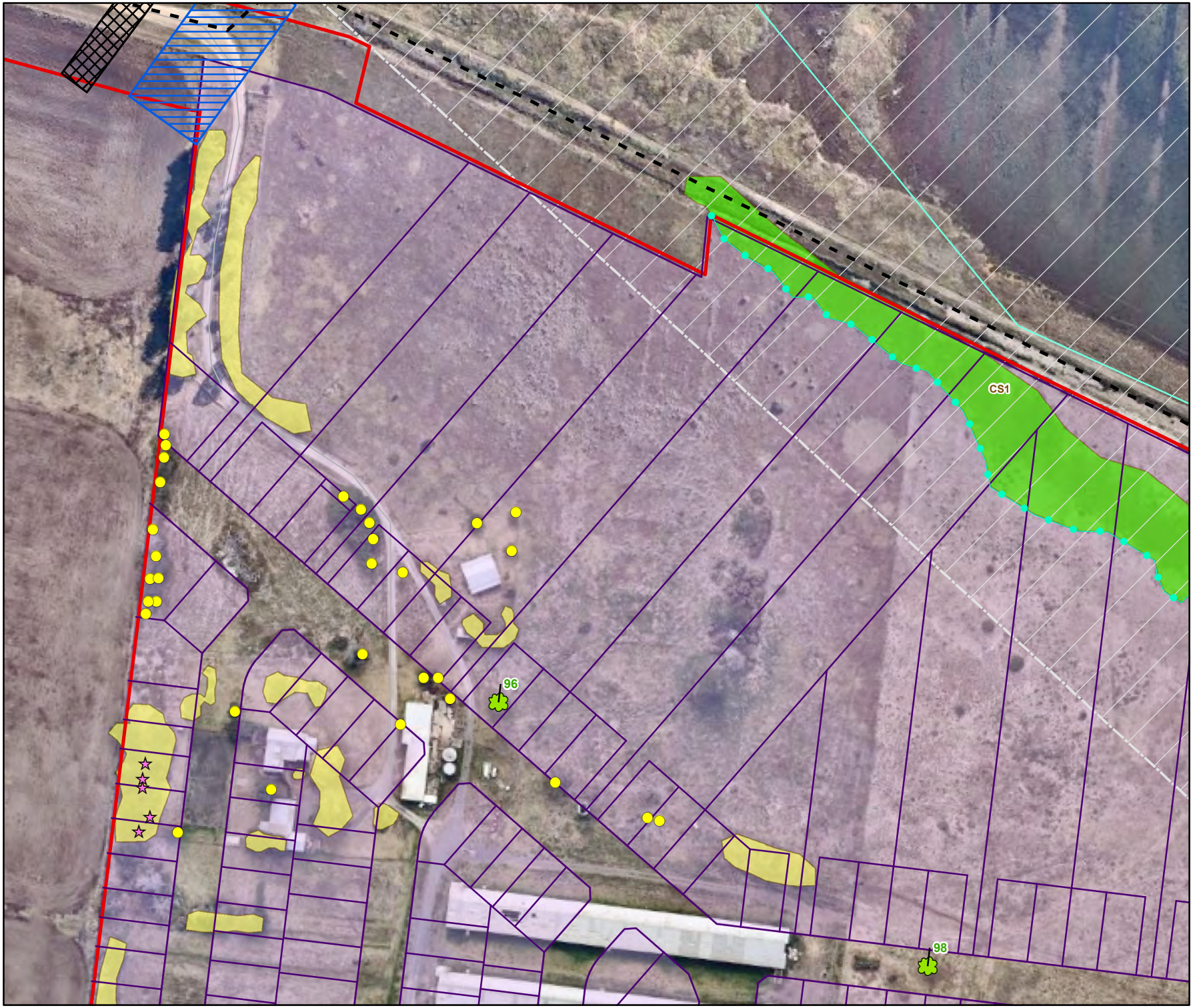
16303_Fig02_MgmtPlan_MB 3/11/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Vehicle and machinery entry/exit point
- Washdown bay and rumble strips
- Retained vegetation protection / No-Go fencing
- Proposed lot boundaries
- Scattered Small Tree
- Planted tree
- Planted vegetation

FFG Act Listed Flora

- Fragrant saltbush

Ecological Vegetation Class

- Coastal Saltmarsh (EVC 9)

Figure 2b

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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16303_Fig02_MgmtPlan_MB 3/11/2023 dvaladares

Aerial source: Nearmap 2022

Legend

- Study Area
- Precinct boundary
- ESO
- Indicative stockpile area
- Retained vegetation protection / No-Go fencing
- Proposed lot boundaries
- Planted tree
- Planted vegetation
- Scattered Tangled Lignum

Ecological Vegetation Class

- Coastal Saltmarsh (EVC 9)

Figure 2c

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

0 25 50

Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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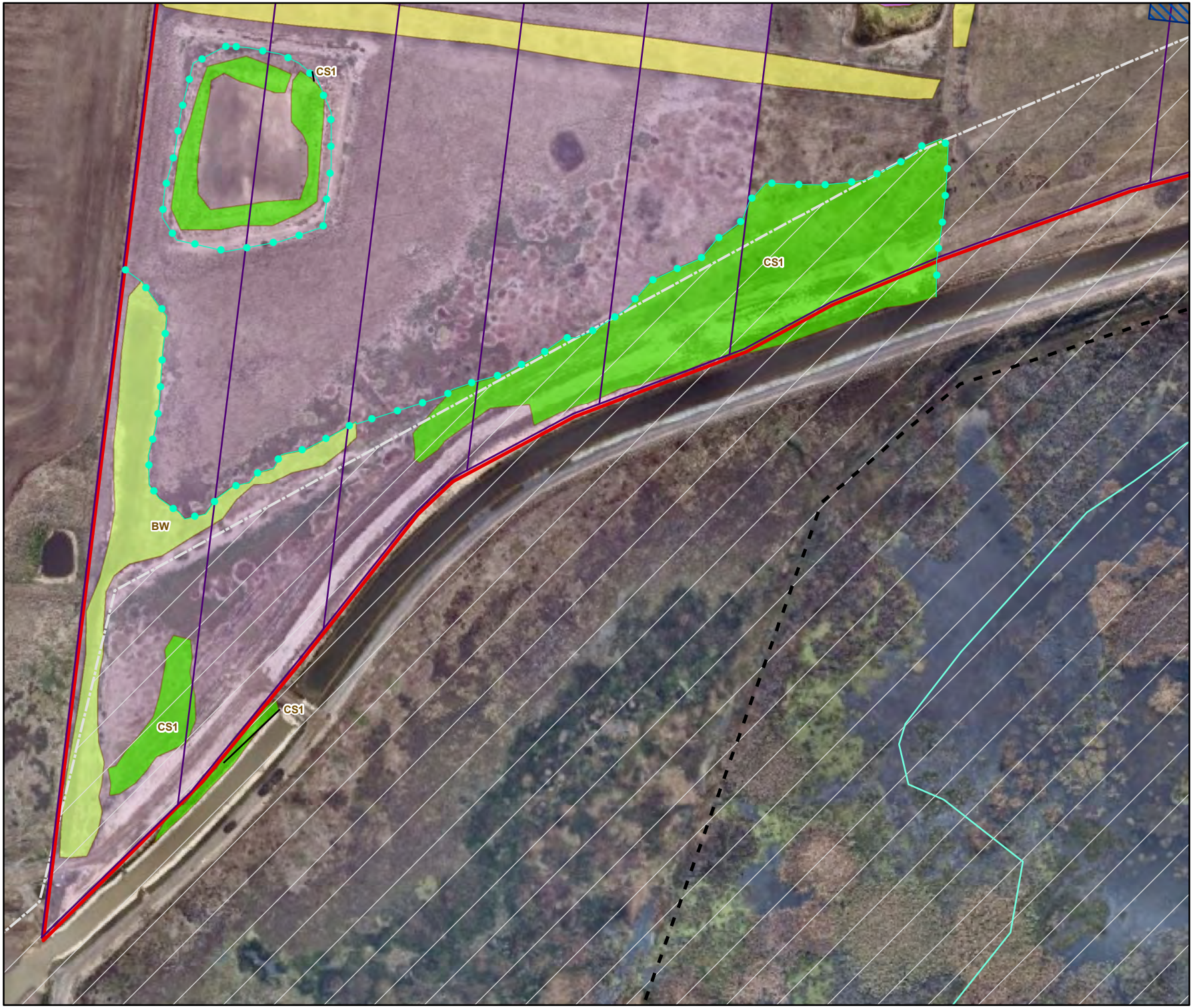
Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Indicative stockpile area
- Retained vegetation protection / No-Go fencing
- Proposed lot boundaries
- Planted vegetation
- Scattered Tangled Lignum

Ecological Vegetation Class

- Brackish Wetland (EVC 656)
- Coastal Saltmarsh (EVC 9)

Figure 2d

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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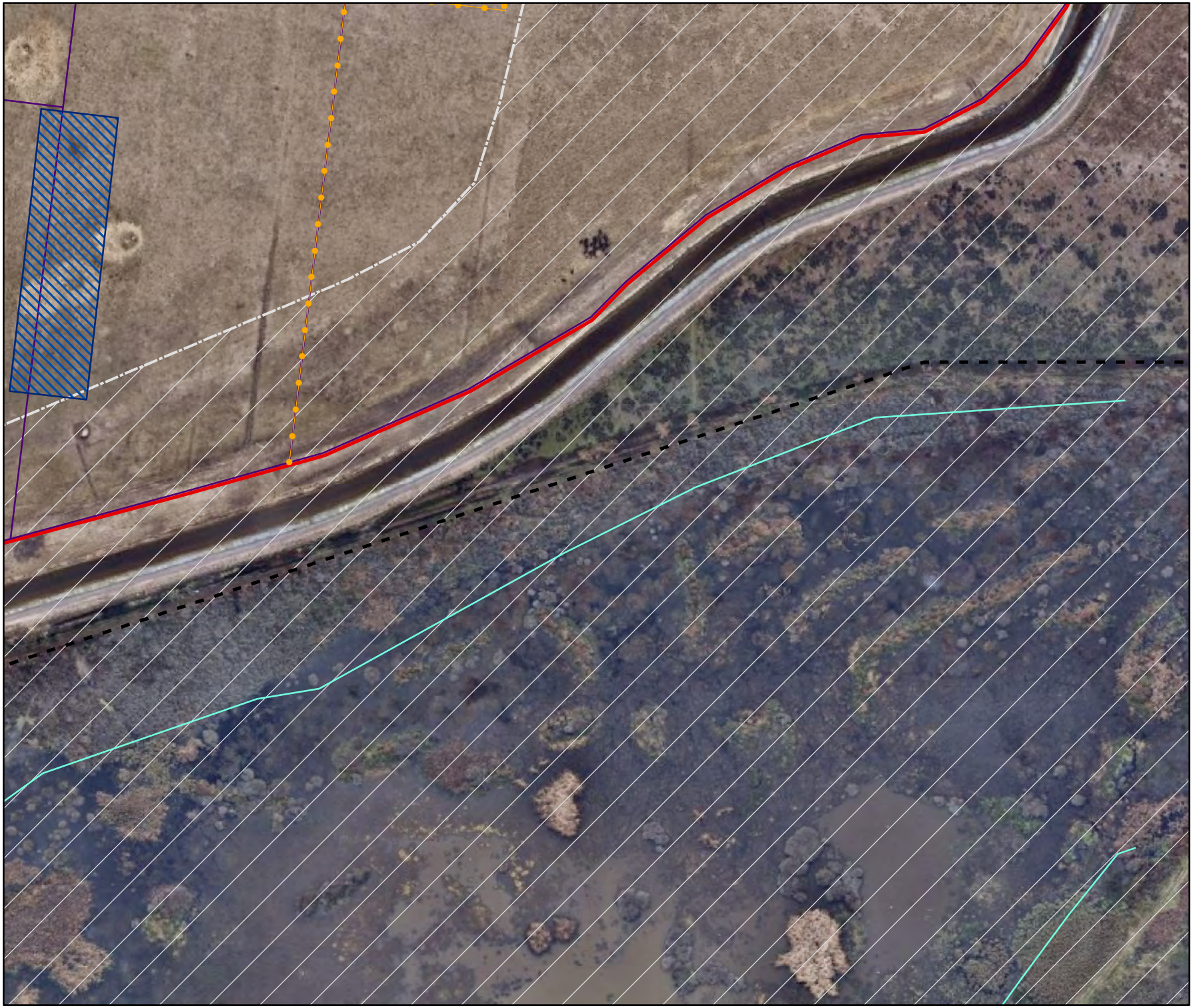
16303_Fig02_MgmtPlan_MB 3/11/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Indicative stockpile area
- Frog exclusion, safety and sediment fencing
- Proposed lot boundaries

Figure 2e

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:2,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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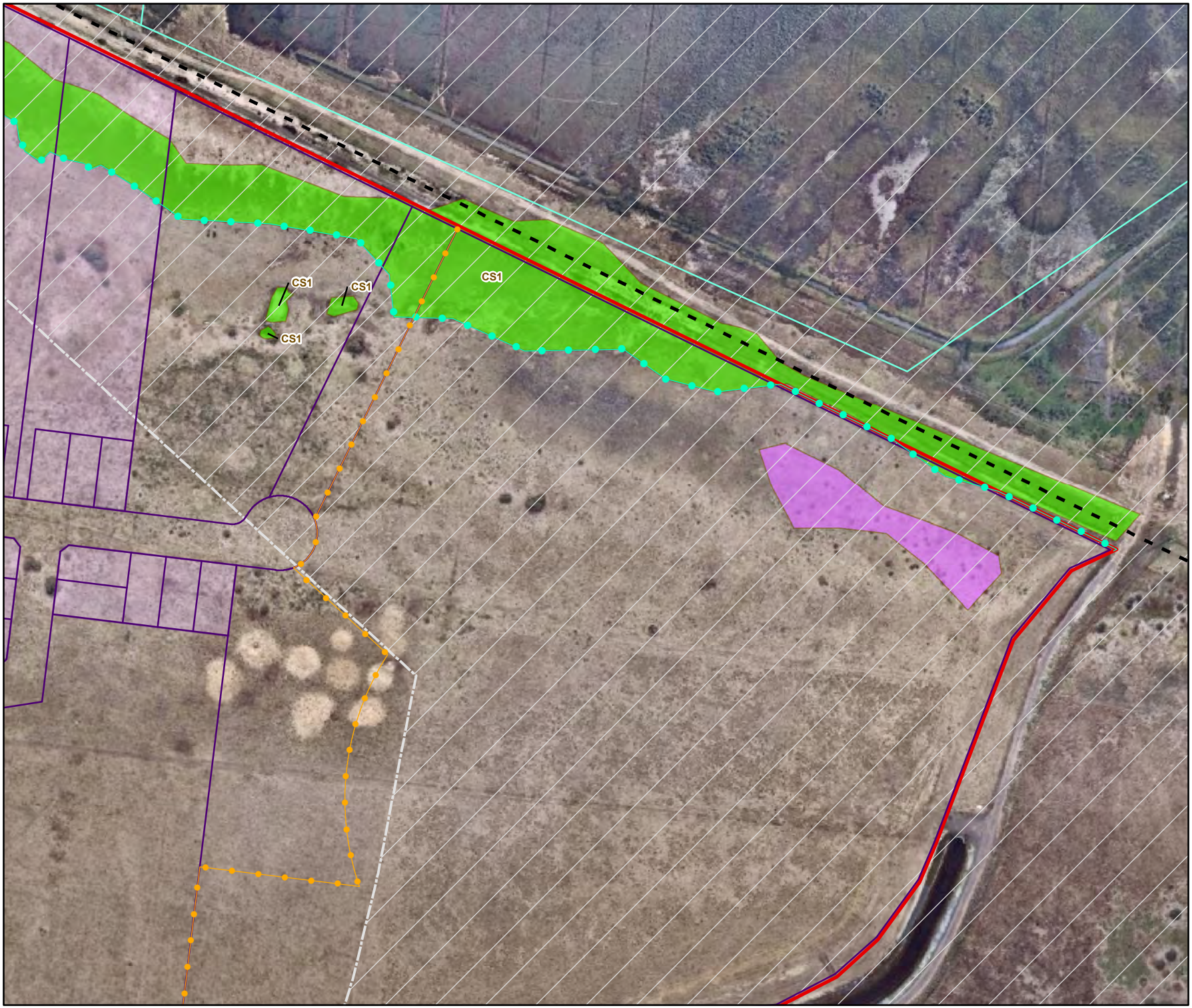
Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Retained vegetation protection / No-Go fencing
- Frog exclusion, safety and sediment fencing
- Proposed lot boundaries
- Scattered Tangled Lignum

Ecological Vegetation Class

- Coastal Saltmarsh (EVC 9)

Figure 2f

Management Plan

Construction Environment Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:2,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_MgmtPlan_MB 3/11/2023 dvaladares

Aerial source: Nearmap 2022

APPENDICES

Appendix 1 – Planting List

Table A1.1. Species suitable for planting within Coastal Saltmarsh (EVC 9) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Sclerostegia arbuscula	Shrubby Glasswort	Medium Shrub	150
Avicennia marina ssp. australasica	White Mangrove	Medium Shrub	150
Suaeda australis	Austral Seablite	Small Shrub	400
Frankenia pauciflora var. gunnii	Southern Sea-heath	Small Shrub	400
Wilsonia humilis	Silky Wilsonia	Prostrate Shrub	400
Additional understorey life forms			
Sarcocornia quinqueflora	Beaded Glasswort	Medium Herb	
Samolus repens	Creeping Brookweed	Medium Herb	
Hemichroa pentandra	Trailing Hemichroa	Medium Herb	
Triglochin striatum	Streaked Arrowgrass	Medium to Tiny Non-tufted Graminoid	
Juncus kraussii ssp. australiensis	Sea Rush	Large Non-tufted Graminoid	
Distichlis distichophylla	Australian Salt-grass	Medium to Tiny Non-tufted Graminoid	

Table A1.2. Species suitable for planting within Plains Sedgy Wetland (EVC 647) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Carex tereticaulis	Hollow Sedge	Large Tufted Graminoid	500
Additional understorey life forms			
Epilobium billardierianum	Variable Willow-herb	Large Herb	
Potamogeton tricarinatus s.l.	Floating Pondweed	Medium Herb	
Myriophyllum simulans	Amphibious Water-milfoil	Medium Herb	
Stellaria angustifolia	Swamp Starwort	Medium Herb	
Lilaeopsis polyantha	Australian Lilaeopsis	Medium Herb	
Neopaxia australasica	White Purslane	Small Herb	
Lobelia pratioide	Poison Lobelia	Small Herb	
Helichrysum aff. rutidolepis (Lowland Swamps)	Pale Swamp Everlasting	Small Herb	

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Eryngium vesiculosum	Prickfoot	Small Herb	
Lachnagrostis filiformis (perennial variety)	Wetland Blown-grass	Medium Tufted Graminoid	
Lachnagrostis filiformis	Common Blown-grass	Medium Tufted Graminoid	
Glyceria australis	Australian Sweet-grass	Medium Tufted Graminoid	
Eleocharis acuta	Common Spike-sedge	Medium to Tiny Non-tufted Graminoid	
Amphibromus sinuatus	Wavy Swamp Wallaby-grass	Medium to Tiny Non-tufted Graminoid	

Table A1.3. Species suitable for planting within Brackish Wetland (EVC 656) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Gahnia filum	Chaffy Saw-sedge	Large Tufted Graminoid	600
Additional understorey life forms			
Persicaria decipiens	Slender Knotweed	Large Herb	
Epilobium billardierianum ssp. billardierianum	Smooth Willow-herb	Large Herb	
Sarcocornia quinqueflora	Beaded Glasswort	Medium Herb	
Samolus repens	Creeping Brookweed	Medium Herb	
Suaeda australis	Austral Seablite	Medium Herb	
Selliera radicans	Shiny Swamp-mat	Small Herb	
Crassula helmsii	Swamp Crassula	Small Herb	
Mimulus repens	Creeping Monkey-flower	Small Herb	
Juncus kraussii ssp. australiensis	Sea Rush	Large Non-tufted Graminoid	
Phragmites australis	Common Reed	Large Non-tufted Graminoid	
Poa poiformis	Coast Tussock-grass	Medium to Small Tufted Graminoid	
Lachnagrostis filiformis	Common Blown-grass	Medium to Small Tufted Graminoid	
Bolboschoenus caldwellii	Salt Club-sedge	Medium to Tiny Non-tufted Graminoid	
Distichlis distichophylla	Austral Salt-grass	Medium to Tiny Non-tufted Graminoid	
Schoenoplectus pungens	Sharp Club-sedge	Medium to Tiny Non-tufted Graminoid	
Triglochin striatum	Streaked Arrowgrass	Medium to Tiny Non-tufted Graminoid	
Calystegia sepium	Large Bindweed	Scrambler or Climber	

Table A1.4. Species List of Recommended Plants for Revegetation within Growling Grass Frog habitat.

Scientific Name	Common Name
Fringing and emergent	
Calystegia sepium	Large Bindweed
Carex appressa	Tall Sedge
Carex fascicularis	Tassel Sedge
Carex gaudichaudiana	Fen Sedge
Crassula helmsii	Swamp Crassula
Epilobium billardierianum	Smooth Willow-herb
Glyceria australis	Australian Sweet-grass
Lachnagrostis filiformis	Common Blown-grass
Lycopus australis	Australian Gypsywort
Melaleuca ericifolia	Swamp Paperbark
Poa labillardierei var. *labillardierei*	Common Tussock-grass
* *Potamogeton ochreatus*	Blunt Pondweed
Ranunculus amphitrichus	Running Marsh Flower
Emergent	
Alisma plantago-aquatica	Water Plantain
Amphibromus fluitans	River Swamp Wallaby-grass
Baumea articulata	Jointed Twig-sedge
Cladium procerum	Leafy Twig-sedge
* *Eleocharis acuta*	Common Spike-sedge
Juncus amabilis	Hollow-rush
Juncus gregiflorus	Green Rush
Juncus procerus	Tall Rush
Juncus sarophorus	Broom Rush
Persicaria decipiens	Slender Knotweed
Persicaria praetermissa	Spotted Knotweed
Persicaria subsessilis	Hairy Knotweed
Ranunculus inundatus	River Buttercup
Schoenoplectus tabernaemontani	River Club-sedge
Submergent	
Ceratophyllum demersum	Hornwort
Myriophyllum caput-medusae	Coarse Water-milfoil
Myriophyllum crispatum	Upright Water-milfoil
Myriophyllum simulans	Amphibious Water-milfoil
Potamogeton crispus	Curly Pondweed
Floating Submergent	

Scientific Name	Common Name
Carex gaudichaudiana	Fen Sedge
Hydrocotyle sibthorpioides	Shining Pennywort
Lythrum salicaria	Small Loosestrife
Neopaxia australasica	White Purslane
* *Ottelia ovalifolia*	Swamp Lily
Potamogeton ochtreatus	Blunt Pondweed
Potamogeton pectinatus	Fennel Pondweed
Rumex bidens	Mud Dock
* *Triglochin procerum*	Water Ribbon (emergent form)
* *Vallisneria americana*	Ribbon-weed
Villarsia reniformis	Running Marsh Flower

Notes: * Indicates highly desirable vegetation for Growling Grass Frog, # Limit use of this species, as it may become invasive

Table A1.5. Species List of Recommended Plants for Revegetation within wet areas, low-lying areas and watercourses of the Marshall plains and Waurn Ponds flats areas, and in the Mount Duneed and surrounding basalt flows (City of Greater Geelong 2023).

Scientific Name	Common Name	Life form
Acacia melanoxylon	Blackwood	Understory Tree or Large Shrub
Eucalyptus camaldulensis	River Red-gum	Canopy Tree
Eucalyptus ovata	Swamp Gum	Canopy Tree
Melaleuca lanceolata	Moonah	Canopy or Understory Tree
Acacia verticillata	Prickly Moses	Medium Shrub
Bursaria spinosa	Sweet Bursaria	Medium Shrub
Correa reflexa	Common Correa	Medium Shrub
Goodenia ovata	Hop Goodenia	Medium Shrub
Hymenanthera dentata	Shrub Violet	Medium Shrub
Leptospermum continentale	Prickly Tea-tree	Medium Shrub
Leptospermum lanigerum	Woolly Tea-tree	Medium Shrub
Ozothamnus ferrugineus	Shrub Everlasting	Medium Shrub

APPENDIX 5 – GROWLING GRASS FROG CONSERVATION MANAGEMENT PLAN

ecology & heritage partners

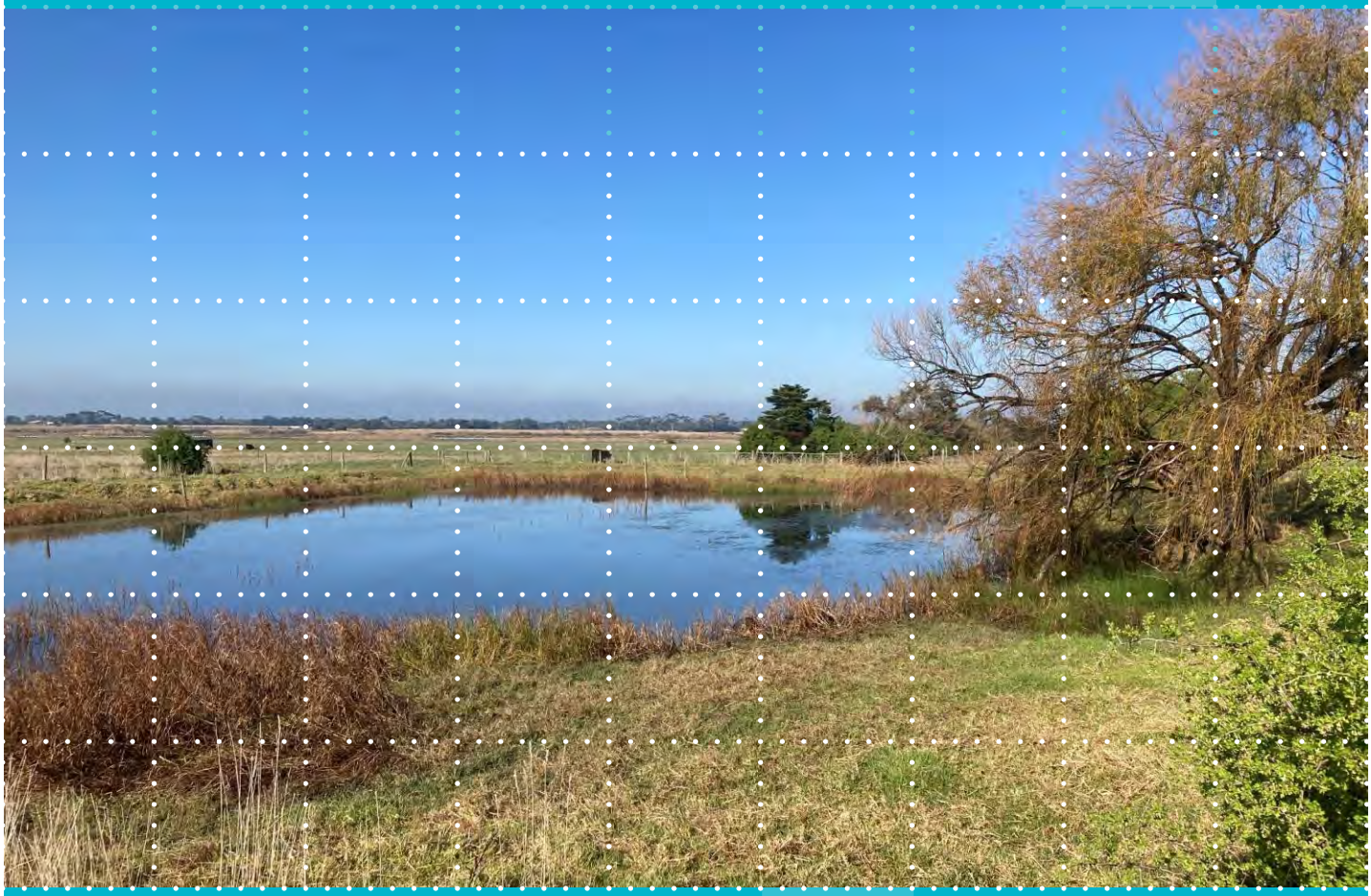
Final Report

Growling Grass Frog *Litoria raniformis* Conservation Management Plan for the Proposed Development at 78-88 Groves Road, Armstrong Creek, Victoria

Prepared for

AC Manager Pty Ltd

January 2024



Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road Ascot Vale VIC 3056 **GEELONG:** PO Box 8048 Newtown VIC 3220
BRISBANE: Level 22 / 127 Creek Street Brisbane QLD 4000 **ADELAIDE:** 8 Greenhill Road Wayville SA 5034
www.ehpartners.com.au

DOCUMENT CONTROL

Assessment	Growling Grass Frog *Litoria raniformis* Conservation Management Plan for the Proposed Commercial Development at 78-88 Groves Road, Armstrong Creek, Victoria
Address	78-88 Groves Road, Armstrong Creek, Victoria
Project number	16303
Project manager	Alex Wilkinson (Consultant Zoologist)
Report reviewer	Aaron Organ (Director / Principal Ecologist)
Mapping	Monique Elsley (GIS Co-Ordinator)
File name	16303_EHP_GGFCMP_78-88GrovesRd_Final_08012024
Client	AC Manager Pty Ltd
Bioregion	Otway Plain
CMA	Corangamite
Council	Greater Geelong Shire

Report versions	Comments	Comments updated by	Date submitted
Draft CMP	-	-	13/07/2022
Draft v2 CMP	Comments from AC Manager Pty Ltd	AW	30/08/2022
Final CMP	-	AW	16/09/2022
Final v2 CMP	Comments from CoGG and DCCEEW	AW, SH	13/10/2023
Final v3	Comments from DCCEEW	AW	9/11/2023
Final v4	Comments from DEECA	AW	21/12/2023
Final v5	Comments from DCCEEW	AW	8/01/2024

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Ecology and Heritage Partners acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

ACRONYMS AND ABBREVIATIONS

Acronym	Description
CaLP	*Catchment and Land Protection Act 1994*
CMA	Catchment Management Authority
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEECA	Victorian Department of Energy, Environment and Climate Action
DELWP	(former) Victorian Department of Environment, Land, Water and Planning
DEPI	(former) Victorian Department of Environment and Primary Industries
DoE	(former) Commonwealth Department of Environment
DoEE	(former) Commonwealth Department of Environment and Energy
DSEWPaC	(former) Commonwealth Department of Sustainability, Environment, Water, Populations and Communities.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EVC	Ecological Vegetation Class
FFG Act	*Flora and Fauna Guarantee Act 1988*
FIS	Flora Information System
GGF	Growling Grass Frog *Litoria raniformis*
HabHa	Habitat Hectare
NES	National Environmental Significance
NVIM Tool	Native Vegetation Information Management Tool (DEECA)
P&E Act	*Planning and Environment Act 1987*
PMST	Protected Matters Search Tool (DCCEEW)
VBA	Victorian Biodiversity Atlas (DEECA)

EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd were commissioned by AC Manager Pty Ltd to prepare a Conservation Management Plan (CMP) for the nationally significant Growling Grass Frog *Litoria raniformis* for the proposed residential development at 78-88 Groves Road, Victoria (Figure 1).

The proposed action will include clearance and redevelopment across much of the western portion of the site. Based on the proposed action, one effluent pond representing low quality habitat, one effluent pond representing moderate quality potential breeding habitat, and some areas of low-quality foraging and dispersal habitat will be lost. In total, 16.502 hectares of Growling Grass Frog habitat at the development site will be lost. The study area is likely used as dispersal corridor by the known population that occurs in Baenches Wetland. Frogs may opportunistically utilise the effluent ponds in study area. The intention of this CMP is to detail the Management strategy to mitigate the loss of Growling Grass Frog dispersal habitat.

Growling Grass Frog Habitat Creation

In order to mitigate the loss of 16.502 hectares of Growling Grass Frog habitat at the development site, management actions will be undertaken for the creation and protection of 8.2 hectares of Growling Grass Frog habitat at a first party offset site. This includes the construction of one large 1-hectare wetland (Wetland 1) and a smaller 0.5-hectare wetland (Wetland 2), in addition to 6.7 hectares of foraging and dispersal habitat (Figure 3). The creation of dedicated Growling Grass Frog waterbodies and the improvement of adjacent terrestrial habitat will provide high quality breeding and foraging habitat for the species, and improve habitat connectivity and dispersal corridors through the property to ensure that dispersal opportunities between known Growling Grass Frog populations at Sparrovale and Baenches wetlands are maintained. Habitat improvements within and directly surrounding the constructed wetlands will provide additional foraging and refuge habitat.

Management Actions

Created waterbodies and habitat will be secured and protected from the surrounding residential land uses and decommissioned broiler farm proposed for removal, and be managed for the purposes of conservation of Growling Grass Frog through the control of pest animals and environmental weeds. The created habitat areas will be protected via an on-site security mechanism, to ensure the land is secured and managed appropriately.

The use of the study area as a dispersal corridor will be maintained and enhanced via the creation of two new wetlands, and the embellishment and improvement of existing foraging habitat.

Appropriate population and habitat monitoring schedules will be implemented to assess the impact of the development and/or monitor the suitability of the site's management regime.

CONTENTS

1 INTRODUCTION

1.1 Project Background

Ecology and Heritage Partners Pty Ltd were commissioned by AC Manager Pty Ltd to prepare a Conservation Management Plan (CMP) for the nationally threatened Growling Grass Frog *Litoria raniformis* for the proposed development at 78-88 Groves Road, Armstrong Creek, Victoria (Figure 1). The site is proposed to be developed for residential purposes, with construction planned to commence in January 2025 and run for approximately 12 months.

Targeted surveys for Growling Grass Frog conducted by Ecology and Heritage Partners (Ecology and Heritage Partners 2021) confirmed that the study area is utilised by an existing population of the species present within Baenches Wetland to the south (Figure 1).

This document provides a detailed plan to mitigate against potential impacts to the existing Growling Grass Frog population and associated habitats, and details the proposed creation and monitoring of new habitat within the study area during pre-development, development, and post-development stages.

A development plan has been prepared as part of the planning permit application for the proposed development, and this plan includes the provision of a dedicated habitat, including a large pond and one smaller pond in a movement corridor that will be constructed to ensure the existing dispersal corridor through the study area that connects Baenches Wetland and Sparrovale Wetlands is maintained. As part of this design, areas containing some characteristics of the species habitat (i.e. exposed rock, ephemeral ponds) will be retained and enhanced where possible. Enhanced existing and constructed new habitat will result in the provision of waterbodies situated along a large dispersal corridor to allow unimpeded frog breeding and dispersal. These waterbodies will be designed and constructed in accordance with the Growling Grass Frog Habitat Design Standards (DELWP 2017).

1.2 Objectives

The overall aim of this CMP is to provide detailed measures to ensure the proposed activity does not have a significant impact on the Growling Grass Frog population and supporting habitat. This CMP outlines management actions to meet this objective through the protection, enhancement, and ongoing management of newly created Growling Grass Frog habitat. The CMP also outlines monitoring requirements to ensure that the species is not adversely affected during works and following development of the site. Specifically, this CMP aims to:

- Determine what management actions are required to complete the proposed development without negatively impacting the resident Growling Grass Frog population;
- Provide a map showing the extent of current Growling Grass Frog habitat within the study area and surrounds;
- Demonstrate measures taken to avoid and minimise impacts during the project planning stage;

- Provide detailed management measures to further minimise impacts on the Growling Grass Frog population during development works;
- Provide detailed management and habitat design measures which provides for the construction, maintenance and enhancement of a permanent breeding site for Growling Grass Frog including:
    - Pre-development: habitat enhancement requirements, including development design considerations; details of design, construction and location of additional habitat;
    - During development: management requirements for protecting existing habitat from sedimentation and pollution and direct disturbance that may result from development activities; providing advice and recommendations on other habitat protection requirements, such as establishment of 'no-go' zones and clearly marked fencing; and,
    - Post-development: management requirements, including vegetation, water quality, protection of habitat from current and potential future threats (such as foxes, feral and domestic cats and Eastern Gambusia).
- Outline monitoring, maintenance and reporting requirements post development; and,
- Provide the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) with sufficient information to continue their assessment of the referred activity (Section 1.4), and ultimately progress the implementation of the management plan during development works.

The following sections detail the subject site, the project and legislative context and the key project stakeholders.

1.3 Study Area

The study area is located at 78-88 Groves Road, Armstrong Creek and is approximately 85 kilometres south-west of Melbourne's CBD (Figure 1). The study area covers approximately 41.48 hectares and is bound by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and private property to the west. Importantly, Baenches Wetland (which is adjacent to the Armstrong Creek Water Frontage) forms part of a large wetland complex of which part is protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as the Port Phillip Bay (western shoreline) and Bellarine Ramsar Site. The Sparrovale Wetland also drains into this site via the Barwon River.

The study area is currently used for agriculture and farming, with a residence, outbuildings, and five broiler sheds on site. Two effluent treatment ponds exist in the centre of the site, and a dam is located in the south-west corner. The study area gently slopes to the south, with no ridges or crests within or immediately adjacent to the site. The study area is within the Armstrong Creek East Precinct Structure Plan (PSP), and is covered by the Armstrong Creek East Native Vegetation Precinct Plan (NVPP) (SMEC 2010). It is important to note that the eastern boundary of the property has changed since the preparation of the PSP and NVPP, due to public acquisition in accordance with the PAO12. This area was acquired by the City of Greater Geelong to facilitate the construction of the Balog Channel, which was also subject to Commonwealth approval (EPBC 2015/7533).

There is no native vegetation within the study area that is designated for retention or removal in the Armstrong Creek East NVPP (SMEC 2010). Two patches of Coastal Saltmarsh (Habitat Zones HZ2 and HZ3) immediately adjacent to the southern boundary of the study area are designated for retention in the NVPP. It is understood

that the land covered by these habitat zones was once part of the property, but was publicly acquired in accordance with the PAO12.

According to the Department of Energy, Environment and Climate Action (DEECA) NatureKit Map (DEECA 2023), the study area is located across two bioregions: the Otway Plain and Victorian Volcanic Plain. It is situated within the jurisdiction of the Corangamite Catchment Management Authority (CMA) and the Greater Geelong City Council municipality.

1.4 Project and Legislative Context

In November 2022, a project referral was submitted for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2022/09357), which included a Growling Grass Frog Conservation Management Plan (GGFCMP) prepared by Ecology and Heritage Partners Pty Ltd. On 23 December 2022, the proposed action was declared a "Controlled Action" and will be assessed under Preliminary Documentation, which requires the proponent to provide an updated version of the GGFCMP that aligns with the management actions and details outlined in the Offset Management Plan prepared by Ecology and Heritage Partners (2023).

Sparrovale wetland and associated drainage lines are adjacent to the study area in the north and have characteristics of the species preferred habitat. There is an opportunity to deliver constructed new Growling Grass Frog habitat in the north and north-east of the study area which will ensure the maintenance of dispersal corridors and habitat connectivity for the species between the Baenches Wetland and Sparrovale wetlands. These areas are described below (

Table 1. **Growling Grass Frog habitat creation breakdown**

Table 1) and represented on Figure 2 and 3, and will provide enhanced breeding, dispersal and foraging habitat for Growling Grass Frog within the study area. Areas identified for habitat creation have the primary aim of ensuring there is an overall improvement for the species (i.e. provision of high-quality breeding and foraging habitat) (Figure 3).

Table 1. Growling Grass Frog habitat creation breakdown

Created Area	Description		Area of Habitat (Ha)
Area 1	Wetland habitat	Wetland 1	1
		Wetland 2	0.5
Area 2	Terrestrial habitat around constructed wetlands and in the movement corridor		6.7

1.5 Project Stakeholders and Previous Reports

The following stakeholders have been consulted during preparation of this CMP: DCCEEW, DEECA (Table 2).

Table 2. Consultation breakdown

Stakeholder	Consultation type	Date
DEECA	Phone call/s	July 2022
DCCEEW	Phone call/s, Email/s	August 2022, October 2023

This CMP has been developed with reference to relevant research, best practice management guidelines and the following reports previously prepared for the site and immediate surrounds:

- Offset Management Plan: Residential Development at 78-88 Groves Road, Armstrong Creek, Victoria (EPBC 2022/09357) (Ecology and Heritage Partners 2023);
- Targeted Growling Grass Frog surveys and legislative advice for 78-88 Groves Road, Armstrong Creek, Victoria (Ecology and Heritage Partners 2021a);
- Ecological Assessment: 78-88 Groves Road, Armstrong Creek, Victoria (Ecology and Heritage Partners 2023); and,
- Growling Grass Frog Habitat Assessment: 78-88 Groves Road, Armstrong Creek, Victoria (Ecology and Heritage Partners 2021b).

In addition to reports focussing on the 78-88 Groves Road, Armstrong Creek, the literature review has included numerous reports and research papers that have either referenced the site or provided information specific to the retention and management of Growling Grass Frog on site.

2 GROWLING GRASS FROG

2.1 Species Profile

The Growling Grass Frog is listed as Vulnerable under the EPBC Act, Vulnerable under the *Flora and Fauna Guarantee Act* 1988 (FFG Act), and Vulnerable under the National Action Plan for Australian Frogs (Tyler 1997). It is one of the largest frog species in Australia, reaching up to 104 millimetres in length, with females usually larger (60–104 millimetres) than males (55–65 millimetres) (Barker *et al*. 1995). The species varies in colour and pattern, but is generally olive to bright emerald green, with irregular gold, brown, black or bronze spotting (Plate 1).

Plate 1. Growling Grass Frog (Source: Ecology and Heritage Partners Pty Ltd)

Growling Grass Frog is largely associated with permanent or semi-permanent still and slow flowing waterbodies (i.e. streams, lagoons, farm dams and old quarry sites) (Barker *et al*. 1995). Individuals can also use temporarily inundated waterbodies for breeding purposes providing they contain water over the breeding season (Organ 2010). The species is typically associated with waterbodies supporting an extensive cover of emergent, submerged and floating vegetation (Robertson *et.al*. 2002; Heard *et.al*. 2010).

Emergent vegetation provides basking sites for frogs and protection from predators, while floating vegetation provides suitable calling stages for adult males, breeding and oviposition (egg deposition) sites (Heard *et.al*. 2004). Terrestrial vegetation (grasses, sedges), rocks and other ground debris around a wetland perimeter also provide foraging, dispersal and over-wintering sites for frogs (Heard *et.al*. 2010). Recent studies have revealed that the spatial orientation of waterbodies across the landscape is one of the most important habitat determinants influencing the presence of the species at a given site (Robertson *et al*. 2002; Heard *et al*. 2010). Waterbodies supporting the aforementioned habitat characteristics, and which are located within close proximity to each other are more likely to support a population of Growling Grass Frog, compared with isolated sites lacking important habitat features.

Although formerly widely distributed across southern eastern Australia, including Tasmania (Littlejohn 1963, 1982; Hero *et al*. 1991), the species has declined markedly across much of its former range (Mahony 1999). Historically, this species has been recorded from most regions of Victoria, with the exception of Mallee and Alpine areas (Littlejohn 1963, 1982; Hero *et al*. 1991). The known range of this species has contracted dramatically over the past two decades and in many areas, particularly in south and central Victoria, populations have experienced serious declines and local extinctions. The key factors in decline include habitat destruction and fragmentation, drought, increased predation by vertebrate predators, and adverse impacts from the water-borne fungal pathogen *Batrachochytrium dendrobatydis*, which causes chytridiomycosis disease (Chytrid Fungus) (Heard *et.al*. 2012). This highlights the importance of preserving the species by protecting or enhancing remnant or intact habitat areas, particularly those surrounded by high density or impending development.

2.2 Local Abundance and Distribution

Growling Grass Frog has previously been recorded in high abundance within the nearby Baenches Wetland in 2019, 2021 (ALA 2022), 2020 (S. LeBel *pers. obs*.) and 2021 (Ecology and Heritage Partners 2021a). The Victorian Biodiversity Atlas (VBA) also contains several records of Growling Grass Frog previously recorded within 10 kilometres of the study area, notably to the north adjacent to Reedy Lake (DELWP 2021b). The most recent of these records are from 2016, which occur within the nearby Reedy Lake and Lake Connewarre complexes, and which also fall within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site.

Two Growling Grass Frog were recorded within a waterbody within the study area, on the third survey night of targeted surveys for the species (Ecology and Heritage Partners 2021a).

Given the high quality and large extent of suitable habitat to the south (Baenches Wetland) and north (Sparrovale), it is likely that the study area is utilised by the species as a dispersal corridor between these two areas.

2.3 Relevant Threatening Processes

Potential threatening processes for Growling Grass Frog resulting from the proposed development come from two main sources: impacts from construction activities (including removal of known habitat), and impacts resulting from the construction of a potential barrier to movement between habitat within the study area and potential habitat in Sparrovale wetlands and drainage lines to the north.

2.3.1 Hydrology and Water Quality

Based on known information of water quality tolerances and preferences by Growling Grass Frog it appears that the species requires waterbodies containing low levels of nitrates, nitrides and phosphates (Ashworth 1998; Organ 2002, 2003). Water quality may be particularly important for larval development and recruitment. It should also be noted that studies have shown conflicting findings on the relationship between basic water quality parameters and wetland occupancy (Heard and Scroggie 2008). For example, Wassens (2005) found a preference for wetlands with a relatively low pH, whereas Hamer and Organ (2008) found the opposite to be the case. Similar discrepancies have been found with conductivity (Heard and Scroggie 2008), and this relationship is also confounded by the fact that conductivity may affect the prevalence of Chytrid fungus (2.3.2). Efforts to control basic water quality parameters for Growling Grass Frog may be unnecessary; however, conductivity should not increase beyond the approximate limit for the species of 10000 µS/cm (Heard and Scroggie 2008).

All stormwater flow and discharge from the surrounding area will be directed away from the site or treated before entering the site to ensure that there is no negative impact to water quality or that external contaminants are inadvertently introduced to the constructed wetlands. However, construction activities associated with the development have the potential to result in release of sediment-laden runoff into the constructed wetlands. There is also the potential for accidental spillage of chemicals from the construction area to runoff into the wetlands. Increase in sediment input and input of toxic substances into Victorian rivers and streams due to human activities are both threatening processes under Schedule 3 of the FFG Act.

2.3.2 Chytrid Fungus

There is evidence to suggest that the decline of many frog species in Australia and elsewhere could be related to the disease caused by the water-borne fungal pathogen *Batrachochutrium dendrobatidis*, commonly referred to as Chytrid fungus. Chytrid fungus is a major threat to amphibian populations in Australia, with at least one species driven to extinction and populations of other threatened species, particularly the Growling Grass Frog, severely compromised (DEWHA 2006). The disease that results from Chytrid fungus infection causes significant physical and physiological problems for frogs, such as skin flaking, reduced food intake, cardiac arrest and mortality (Peterson 2012). Infection of amphibians with the fungus is listed as a 'key threatening process' under the EPBC Act.

There is an inherent risk of spreading the fungus within and between areas in the landscape by the movement of infected frogs and tadpoles, water, soil and vegetative material; the outcome of which can be extremely deleterious if it is introduced into Growling Grass Frog populations presently free of the disease. Chytrid prevalence has found to be decreased in wetlands with elevated salinity levels and higher temperatures (Heard *et al.* 2012).

2.3.3 Human Access

Human occupancy within the study area has the potential to result in disturbance by persons entering the existing and proposed species habitat. This may lead to the degradation of habitat in or around the waterbody due to rubbish dumping, mechanical disturbance of vegetation from trampling, and weed invasion.

The placement of walking and/or bicycle paths and trails will be prohibited within the 'no impact' buffer zone within the existing Growling Grass Frog and proposed constructed habitat to minimise human disturbance in these areas. Construction activities must also be restricted in known habitat areas to minimise human and vehicular disturbance during the development study area. An exclusion zone will be implemented around the constructed wetlands to protect the core Growling Grass Frog habitat on site.

2.3.4 Weeds

Increased weed encroachment into areas of indigenous or planted terrestrial and aquatic vegetation in wetland complexes may occur due to runoff from development. Weeds may also be transported via construction equipment and machinery, and people/animals entering the Precinct. 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 /or foraging site.

Consequently, a Weed Management Plan will be prepared to identify potential threats associated with pest plant species, that may impact environmental values within the study area. The Weed Management Plan will provide appropriate management actions to address weed infestations and vertebrate pest species, to ensure environmental values within the study area are maintained and enhanced.

2.3.5 Noise

Noise from building and other works relating to the development will comply with the Building works – Local Law requirements (Greater Geelong City Council 2014), where building or other works may not emit excessive

or offensive noise. Works can only be carried out on any land between the hours 7:00 am and 6:00 pm on weekdays, 9:00 am and 6:00 pm on Saturdays, Sundays and public holidays. Restricting noise created by building works will allow males to call to attract a mate, and thus the noise associated with construction and the future use of the area (i.e. commercial use) is unlikely to reduce breeding success by the species.

2.3.6 Light Pollution

Growling Grass Frog are a predominantly nocturnal species. Artificial light pollution may increase the risk of predation of Growling Grass Frog by foxes and Cats and may also disrupt mating activities of the species. As such, sources of artificial light from the surrounding development will be directed away from the existing and proposed constructed habitat. There will be no additional lighting directed towards the existing and proposed habitat, to allow frogs to move along the corridor undisturbed, and to avoid any negative impact caused by artificial light pollution. Overall, there are likely to be no significant impacts related to noise and light pollution associated with the project.

2.3.7 Dogs, Cats and Exotic Predators

Dogs and Cats

Unrestrained dogs *Canis familiaris* and Cats *Felis catus* have the potential to roam into Growling Grass Frog wetlands within the Precinct. Cats in particular are known to predate upon dispersing or sheltering frogs. Predation of native wildlife by Cats is a threatening process under Schedule 3 of the FFG Act. Surrounding residential development is likely to introduce unrestrained cats that may also hunt and kill Growling Grass Frog. It is understood that a Cat curfew is currently enforced in the City of Greater Geelong with domestic cats required to be indoors from sunset to sunrise, which will minimise the risk to frogs. Feral cats are not declared an established pest on private land in Victoria, and as such, feral cats cannot be controlled within the study area. However, if a feral cat is observed within the property more than once, it should will be trapped and taken to the local Council where it will be humanely destroyed. It is the responsibility of the proponent to engage a licenced trapper to complete this work.

The entire constructed wetland habitat and surrounding 50 metre terrestrial buffer will be appropriately fenced with safety fencing and dog exclusion fencing to exclude public access and avoid unrestrained access into the created habitat areas by dogs and their owners.

Eastern Gambusia

The introduced Eastern Gambusia has been identified as a possible factor in the decline of species in the "bell frog species complex", which includes Growling Grass Frog (Mahony 1999; White and Pyke 1996; Hamer *et al*. 2002) because it eats the eggs and tadpoles of these species (Morgan and Buttermer 1996). This species may reduce the potential of a site to support breeding populations, although the extent of predation depends on aquatic vegetation and habitat complexity, and waterbody permanency (Hamer et al. 2002). Predation by Eastern Gambusia on tadpoles of Growling Grass Frog may be a significant threat to the species.

Red Fox

Red Fox is likely to move through the study area. The species is known to hunt and eat adult members of the bell frog species complex. Feral Animal Control measures will be considered for development in the study area to reduce the population size of foxes.

2.4 Growling Grass Frog Habitat within the Study Area

The study area contains two artificial waterbodies (i.e. two effluent treatment ponds) of which one is considered to currently provide suitable wetland habitat for Growling Grass Frog. The waterbodies were initially examined during a site assessment undertaken on 18 October 2021, with further assessments completed during targeted surveys in November 2021. During the site assessment, the quality and extent of suitable habitat was determined, taking into account the following habitat variables:

- Quality of vegetation and presence of weeds;
- Aquatic vegetation cover (% cover of emergent, submergent and floating aquatic plants);
- Hydroperiod, water depth and water flow;
- Availability of refuge sites (e.g. rocks, logs)
- Proximity to other suitable habitat in the surrounds;
- Evidence of introduced predators; and
- Evidence of litter and/ or disturbance.

The first effluent treatment pond (site 1) was located in the centre of the site (Plate 2). The entire periphery of the pond was fringed by Rushes *Juncus sp*. and Sedges *Carex sp.*, along with small patches of planted vegetation near the water edge. The fringing vegetation provides high quality habitat for tadpoles, while floating vegetation provides suitable habitat for calling males. Water levels were deep and turbid, with red algal blooms present on the surface. Areas adjacent to the waterbody consisted of open pasture/ introduced grasses, which may be used by Growling Grass Frog during dispersal events (i.e. warm, wet conditions; Plate 4). No disturbance (i.e. pugging, scats) was noted at the pond as the area was effectively fenced off from cattle.

Targeted surveys conducted in November 2021 (Ecology and Heritage Partners 2021b) detected two Growling Grass Frog at this site, confirming that the area provides suitable breeding and dispersal habitat for the species. Active searching undertaken at the time of the survey also identified several rocky ledges and banks which provide suitable microhabitats that may be used for thermoregulation and overwintering.

The second effluent pond (site 2) was located to the south of the first treatment pond (Plate 3). It contained a sparse perimeter of rushes and sedges, with a low percentage of emergent vegetation also present. Water level were similarly deep and turbid. In addition, a number of rocks were observed along the banks of the waterbody, which could provide important refuge from predators and opportunities for thermoregulation. However, in contrast to site 1, the waterbody was heavily pugged due to frequent access by the numerous cattle present on the property (Plate 5). Consequently, this ongoing disturbance was considered to substantially degrade the quality of habitat for Growling Grass Frog and other locally common frog species. No frogs were observed or heard utilising this site during any of the targeted surveys. Despite this, the location

of the waterbody means that it is likely to be used as part of the dispersal corridor for the species when dispersing between Sparrovale and Baenches Wetlands.

It is important to note that a farm dam (site 3) was located in the southwestern corner of the study area and considered in the initial habitat assessment. The site was not readily accessible due to the presence of cattle in the surrounding area. However, observations made from a distance indicated that the banks of the waterbody had a moderate cover of groundcover vegetation and the occasional planted shrub. Confirmation was later received from the landowner that the dam is dry and no longer captures water (Ecology and Heritage Partners 2021b). As such, this area is not considered to provide suitable wetland habitat for Growling Grass Frog.

Plate 2. Site 1 (Ecology and Heritage Partners Pty Ltd 18/10/2021).

Plate 3. Site 2 (Ecology and Heritage Partners Pty Ltd 18/10/2021).

Plate 4. Open pasture and Growling Grass Frog foraging habitat used during dispersal events (Ecology and Heritage Partners Pty Ltd 24/05/2022).

Plate 5. Ephemeral waterbody with exposed rock and pugging in the study area. Possible migration path for Growling Grass Frog between effluent pond and proposed constructed wetlands (Ecology and Heritage Partners Pty Ltd 24/05/2022).

3 CONSERVATION MANAGEMENT PLAN

3.1 Proposed Habitat Creation

Growling Grass Frog habitat creation will be achieved through the provision of the following:

- The creation of one large (1 hectare) and one smaller (0.5 hectare) wetland waterbodies (Figure 3);
- The creation of 6.7 hectares of Growling Grass Frog terrestrial habitat (Figure 3);
- The preparation of a Landscape Masterplan by a qualified wetland revegetation specialist and the project zoologist. The Landscape Masterplan provides a detailed account of all habitat improvement works within the No-Go-Area;
- Include rock mattresses, covering minimum 20% of the bank area, as refuge and overwintering sites around the wetland margin (Figure 3); and
- Weed and pest animal control.

No-Go areas will be established in existing Growling Grass Frog habitat prior to its removal and created habitat prior to, during and post-created habitat construction. All habitat improvement works within the No-Go-Area will be undertaken by a qualified and experienced wetland revegetation specialist / contractor in accordance with the provisions of this CMP, the OMP and an approved Landscape Masterplan. There will be ongoing management of threatening processes such as weed and pest animal control, and there will be no introduction of predatory species to created habitat.

Created habitat areas will include the provision of terrestrial habitat (rock, logs and other ground debris) and aquatic habitat (aquatic vegetation). Habitat creation within and directly surrounding the wetland will also provide direct connection of suitable habitat between constructed wetland habitat, Baenches wetland and Sparrovale wetland.

As indigenous flora provides valuable habitat for indigenous fauna, any landscape plantings that are undertaken as part of the proposed works will be conducted using indigenous species sourced from a local provenance, rather than exotic deciduous trees and shrubs. The Growling Grass Frog Habitat Design Standards (DELWP 2017) has been reviewed to provide a list of suitable species to be used when establishing vegetation within the Growling Grass Frog habitat (Attachment C). Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out ponds, thus potentially rendering them unsuitable for the species and providing vantage points for predatory birds.

3.1.1 Creation of Dedicated Growling Grass Frog Wetlands

The clustering of waterbodies is an important factor in allowing Growling Grass Frog to move between waterbodies when water conditions change, and it has been shown that the likelihood of frogs occupying a particular waterbody is largely dependent upon the distance to a nearby occupied site (Hamer and Organ 2006). A development plan and Landscape Masterplan will be prepared as part of the planning permit application for the proposed development, and these plans include the provision of a series of two permanent wetlands and ponds on the eastern boundary of the study area. Habitat creation will involve the construction of Growling Grass Frog wetlands covering a total area of approximately 1.5 hectares, and the creation of 6.7

hectares of Growling Grass Frog terrestrial habitat, near a focal population so that new populations can colonise and persist in these areas. Emphasis has been placed on the quality of the habitat within the corridor, which extends approximately 220 meters from the northern boundary to the southern boundary (Figure 3).

The creation of the dedicated wetlands will provide breeding and dispersal opportunities for the species, thus ensuring future dispersal connectivity for the known population through the study area between Sparrovale wetland to the north and Baenches wetland to the south of the site. The habitat design will broadly conform with the *Growling Grass Frog habitat design standards* (DELWP 2017).

The dedicated Growling Grass Frog breeding wetlands identified in Figure 3 must be:

- Designed to permanently contain water utilising filtered Balog Channel water, groundwater, direct rainwater and recycled water;
- Supplied with the best feasible water quality consistent with the Growling Grass Frog Habitat Design Standards (DELWP 2017);
- Able to sustain appropriate vegetation to provide habitat (see below);
- Will be clay-lined to retain water with a loamy or sand-substrate topsoil;
- Include rock mattresses, covering minimum 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins (DELWP 2017, Figure 3);
- Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out wetlands, thus potentially rendering them unsuitable for the species;
- Designed, constructed and managed so that they predominantly comprise open water low water turbidity, be still, and have low nitrate, phosphate, and salinity levels; and,

Be able to be drained via an effective and straightforward drainage mechanism (if constraints such as topography allow). Water will be pumped out using a 150 millimetre diesel pump across approximately two days.

A typical arrangement of a Growling Grass Frog wetland is provided below (Plate 6). All Growling Grass Frog wetlands will contain appropriate water levels (i.e. some ponds with permanent water and others with variable water levels) and be constructed between 1.5 metres and 4 metres (ideally) in depth. The maximum depth will vary between wetlands depending upon the local topography constraints.

A water balance (including inflows, outflows, evaporation etc.) must be undertaken for each Growling Grass Frog wetland to determine the required depth of the open water area. The water balance will be based on historical rainfall simulation modelling over a 10-year period (i.e. 2010-2020). The minimum operating depth must be 1.5 metres over 50% of the total wetland surface area.

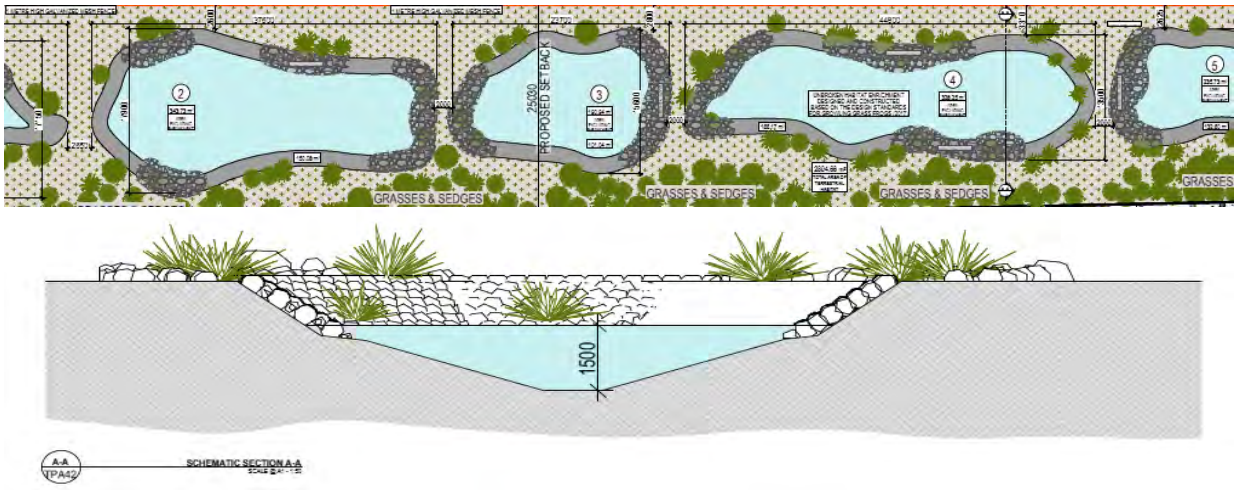

Plate 6. Example of a typical Growling Grass Frog wetland arrangement, including rocky areas located between and around the perimeter of a wetland extending into the aquatic habitat.

Growling Grass Frog wetlands are required to support an extensive cover of aquatic and semi-aquatic vegetation, specifically to cater for an extant breeding population of Growling Grass Frog and to ensure that there is sufficient nutrient uptake to enhance water quality in wetlands. To achieve these habitat requirements, in each Growling Grass Frog wetland there will be three distinct zones (as shown in Plate 7):

- Zone 1: Littoral/ Ephemeral Wetland Zone: This zone incorporates the terrestrial planting area. Here the aim is to establish a moderate percentage cover of vegetation with bare ground areas for frog refuge occupying the margins of the wetland. The margins will remain dry for extended periods, whilst the littoral/ephemeral zone will be subject to periodic inundation, and therefore must support plants able to tolerate wet conditions. A study by Heard *et al.* (2008) recorded most frogs perching on bare soil, rocks and leaf litter near the water's edge, with few occupying terrestrial vegetation stands. Their results indicated a preference for a low structural diversity in the vertical plane of terrestrial microhabitats. This zone will be created to incorporate the following structural features based on known sites where the species occurs:
    - A minimum width of five metres of ephemeral wetland zone will be created;
    - A minimum topsoil depth of 150 mm within all wetland planting areas;
    - The planting area will contain floristically diverse and structurally similar vegetation planted at a nominal density of six individuals per square metre with the provision for areas of bare ground between plantings;
    - Plant species will reflect the Wet Verge Sedgeland Ecological Vegetation Class (EVC 932) and include, where appropriate, native vegetation including Common Spike-sedge (in low densities to prevent spreading), rushes *Juncus* spp and Tussock Grasses *Poa* spp. High density planting is not encouraged as Growling Grass Frog seek refuge under rocks and timber debris;
    - A selection of large concave (300-1,500 mm diameter) and small (3-5 boulders/m^2) rocks, extending at least one metre into the entry zone;

  - Rock mattresses, covering approximately 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins; and,
  - Rock piles and large woody debris around the outer wetland margins and dense areas of rocks and logs along the banks, extending down a minimum of five metres from the water's edge. Exposed rocks retain heat more readily and are beneficial to frogs compared to cooler shaded sections (i.e. Growling Grass Frog is known to use rocks for thermoregulation). Woody debris provide additional refugia and attract invertebrate prey. The location and spacing of refugia will vary to optimise microhabitat diversity.

- Zone 2: Entry Zone - This zone incorporates part of the aquatic planting area and refers to the edge of the wetland where frogs can enter the water. The zone will be subject to frequent drying and will require plant species capable of tolerating fluctuating water levels. The following structural features will be incorporated:
  - A profile length of at least one metre;
  - A shallow 1:8 grade slope containing a variety of rocks and logs from the bank, with rocks down to at least one metre below the freeboard water level; and,
  - The shallow marsh planting area will extend from 0-0.25 metres below the water level. Terrestrial and aquatic species will be planted at a density of six plants per square metre;
- Zone 3: Embankment - This zone incorporates part of the aquatic planting area and will provide a variety of aquatic vegetation, i.e. emergent (low density), submergent and floating plants (higher densities), for potential frog courtship, egg-laying, metamorphling/ tadpole cover and territorial displays. Typical aquatic vegetation will include Water Ribbon *Triglochin procerum*, Water Plantain *Alisma platago-aquatica*, and submerged or floating aquatic vegetation including Floating Pondweed *Potamogeton tricarinatus*, Nardoo *Marsilea drummondii*, and White Purslane *Neobassia proceriflora* (refer Attachment C). Heard *et al*. (2008) observed many Growling Grass Frog in or on mats of submergent and floating vegetation in post-breeding months. The study demonstrated that occupied microhabitats characterised by a high cover of floating vegetation over still, deep water, were more frequently occupied than high emergent or fringing cover, or high woody stem density. This zone will be created to incorporate the following structural features:
  - A profile length of at least five metres;
  - A 1:2.5 grade slope abruptly steepening (variable grade) in the final approach to the adjacent deep-water zone;
  - A deep marsh planting area extending from 0.25-0.5 metres below the water level;
  - Plantings at a nominal six individuals per square metre for semi-aquatic plants (emergent species) and three individuals per square metre for aquatic species to a depth of 0.5 metres; and,
  - Within 1-3 years the zone will support at least 40% submergent, 20% floating, and 30% emergent vegetation.

Recommended species for wetland planting known to be present in Growling Grass Frog habitats are provided in Attachment C. Newly vegetated wetlands are particularly vulnerable to damage caused by species of

waterfowl, from foraging, roosting and nesting. Accordingly, any newly planted vegetation will be protected by appropriate netting, to allow vegetation to establish and provide suitable habitat for Growling Grass Frog.

The wetland revegetation specialist must consider the following additional issues when developing the Landscape Masterplan:

- Timing of works - works will be undertaken between April and August inclusively and ideally planting should occur in late winter/ early spring, providing there is adequate rainfall;
- All works must be subject to disease control in accordance with the measures contained in Section 5.1 and the *Hygiene Protocols for the Control of Diseases in Australian Frogs* (Murray *et.al*. 2011) (Attachment D); and,
- Protective netting will be installed, where required, to prevent damage to aquatic plants by waterfowl.

The following species must not be introduced into Created Habitat Area 1 and 2 or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation;

  - Narrowleaf Cumbungi *Typha domingensis*
  - Broadleaf Cumbungi *Typha orientalis*
  - Lesser Reed-mace *Typha latifolia*
  - Common Reed *Phragmites australis*
  - Tall Spike-rush *Eleocharis sphacelata*

If these species are observed within Created Habitat Area 1 and 2 during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

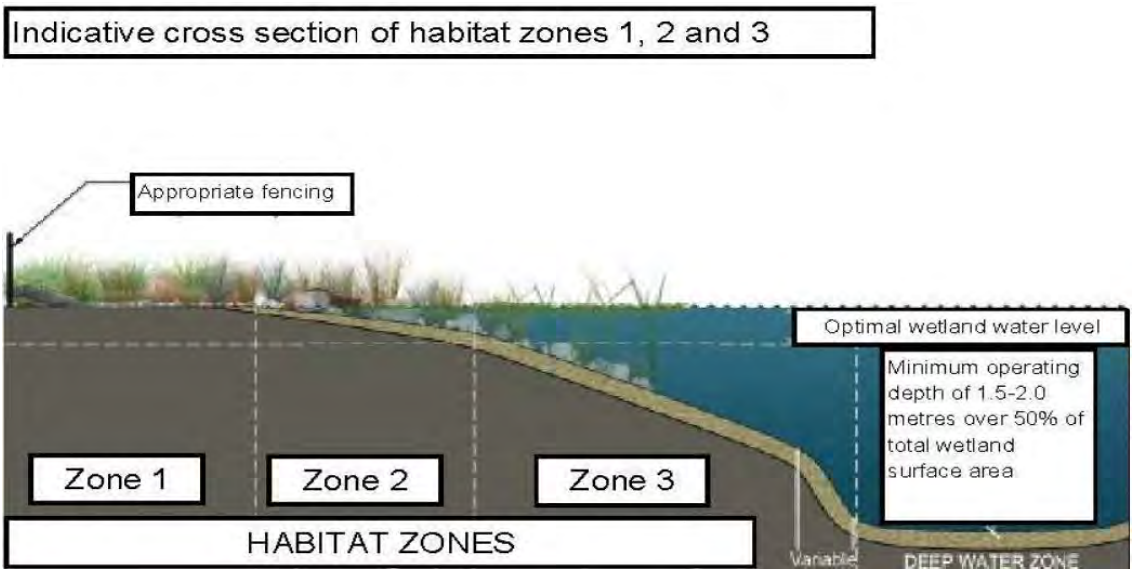

Plate 7. Indicative cross-section of Growling Grass Frog wetland habitat zones.

3.1.2 Alignment of the proposed constructed habitat with the Growling Grass Frog Habitat Design Standards (DELWP 2017)

The degree to which proposed constructed habitat in the proposed offset area meets the *Growling Grass Frog Habitat Design Standards* is provided below (Table 3).

Table 3. Adherence to Growling Grass Frog Habitat Design Standards (DELWP 2017)

Masterplan habitat standards	Constructed Habitat	Comments
Wetland clusters (nodes)		
Clusters contain at least 10 off-stream wetlands (including existing wetlands)	No	There is insufficient space for 10 off-stream wetlands. However the two constructed wetlands are proposed to link larger clusters of wetlands in neighbouring Baenches and Sparrovale Wetlands.
Wetlands less than 200-300 m apart	Yes	-
75% of wetlands should have a permanent hydroperiod (particularly Sept to Feb)	Yes	-
Variety of wetland types within a cluster	Yes	-
50% of wetlands to be 'anti-chytrid' (high rock cover, warm shallows, moderate salinity)	Likely	The aim is to achieve this standard, however will be a function of ongoing management.
All wetlands offline (i.e. except during 'exceptional' floods)	Yes	-
Wetland size and morphology		
Area of most created wetlands must be at least 0.3 ha; where space is limited, wetlands to be at least 0.15 ha (in all cases submergent zone must be at least 0.1 ha)	Yes	-

Masterplan habitat standards	Constructed Habitat	Comments
At least one wetland should be large (>0.7 ha)	Yes	-
All wetlands must have a deep water zone (maintained at greater than 1.5 m deep) of at least 50% of surface area	Yes	-
Emergent vegetation zone of 30-40%, and should include a littoral zone with fluctuating water levels	Yes	-
Incorporate a variety of slopes in banks	Yes	-
Wetlands lined (e.g. clay liner) to prevent leakage, with soil over the liner	Yes	-
Hydroperiod		
75% of wetlands in a cluster to have a permanent hydroperiod; all wetlands should hold water between Sept. to Feb.	Likely	Wetlands likely to have a permanent hydroperiod due to reliable water source (i.e. Balog Channel water (filtered through silt fencing to exclude Eastern Gambusia), groundwater, direct rainwater and recycled water from the residential development). Monitoring to ensure water levels do not drop below 0.5 metres.
Created wetlands designed to be able to be dried out (drained)	Yes	-
Thermal properties		
Wetlands to incorporate an extensive shallow, permanently inundated zone	Yes	-
Wetlands incorporate rock piles around at least 20% of margin, extending into water	Yes	-
'Anti-chytrid' wetlands to have c. 50% rock cover	Yes	-
Aquatic vegetation		
Planting density to establish c. 50% submergent/floating cover within 2-3 years	Likely	Intention is meet this standard but depends on performance over period.
Diverse vegetation established, in line with Growling Grass Frog planting species list	Yes	-
Water quality		
pH between 6.0 and 8.5	Likely	Intention is meet this standard but depends on performance over period.
Salinity up to c. 5.0 mS/cm	Likely	Intention is meet this standard but depends on performance over period.
Turbidity <40	Likely	Intention is meet this standard but depends on performance over period.
Terrestrial habitat		
A minimum 50 m buffer of wetlands from development (i.e. roads/buildings)	Yes	-

Masterplan habitat standards	Constructed Habitat	Comments
Shared use paths and minor infrastructure (e.g. passive recreation) must not be constructed closer than 30 m from wetland	Yes	-
c. 50% of area within 10 m of wetlands to be low grassy vegetation to 10 cm height; ≤20% cover of tussock-forming graminoids	Yes	-
Rock piles established around wetlands	Yes	-
No mulch within 50 m of a wetland	Yes	-
No trees or shrubs within 10 m; < 10% cover of trees/shrubs within 100 m of wetlands	Yes	-
The area between 10 m and 100 m should primarily have an open structure (e.g. short mown grass) with scattered denser plantings of tussock-forming vegetation	Yes (although some buffer <100m wide)	-
Other		
Inclusion of a fish exclusion filter between Growling Grass Frog wetlands and water source(s)	Yes	-
Groundwater is generally the preferred water source	Yes	However, wetlands will also use direct rainwater and local recycled water as supplementary water sources.

3.1.3 Habitat Maintenance

Maintenance of the constructed wetlands habitat area is to be undertaken as is identified through monitoring, with particular focus on the maintenance of aquatic vegetation diversity and structure, and terrestrial habitats. Once habitat improvement works are complete, it is considered that the constructed waterbodies will primarily be self-sustaining and not require significant interventionist management, including the regulation of water levels.

Overall habitat conditions for Growling Grass Frog will be maintained within the site through the identification of issues during the monitoring program and through the implementation of suitable rectification measures. A summary of general maintenance requirements include:

- Regularly consult an experienced zoologist for maintenance issues that could impact on the Growling Grass Frog population and associated habitat;
- Undertake routine monitoring to investigate the success of aquatic and terrestrial plant establishment and weed densities;
- Replace any failed plantings;
- Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides;
- Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary; and,
- Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage).

3.1.4 Habitat Connectivity Surrounding the Study Area

Aside from providing crucial habitat for Growling Grass Frog and other locally common frog species, the constructed wetlands within the study area will provide an important source of connectivity between suitable habitat to the south of the study area (i.e. Baenches Wetland) and the newly created Sparrovale Wetlands.

Wetlands that are created within a suitable distance of known Growling Grass Frog populations are likely to be colonised by the species, provided they contain the necessary habitat characteristics such as suitable size, patches of emergent and submerged vegetation, have good water quality, provide a diversity of pond habitats and are not disconnected from the existing populations by significant barriers. In addition, having a variety of wetlands/ waterbodies in the local area with varying characteristics will provide greater opportunities for the persistence and dispersal of Growling Grass Frog populations (i.e. some with permanent water for habitat connectivity, and others with an ephemeral water level to increase the likelihood that they are free of predatory fish [e.g. Eastern Gambusia]).

Through the design, construction and establishment of aquatic vegetation in local wetlands (where possible), and ongoing maintenance and management, there is a significant opportunity to increase the overall quality of Growling Grass Frog habitat in and surrounding the study area. This will contribute to the long-term viability (population processes) of local populations.

3.2 Roles and Responsibilities

AC Manager Pty Ltd and all consultants, contractors and staff associated with the development works, have a duty of care to:

- Avoid and minimise the occurrence and extent of potential impacts and threats to Growling Grass Frog individuals, populations, and the species, during the development and associated activities;
- Take all reasonable actions to protect and maintain the environment, during construction and associated activities;
- Report any issues or actions that may have the potential (even if marginal) to cause or exacerbate impacts and threats to the Growling Grass Frog population as well as the environment; and,
- Ensure that their actions are in accordance with the relevant environmental legislation, policies, management authorisations, permits and management protocols, including this CMP.

Implementation of this CMP will require the collaboration of a range of stakeholders. The following parties will be responsible for, or may potentially become involved in the implementation and support of the plan:

3.2.1 Direct Involvement

- **AC Manager Pty Ltd** – Overall implementation of this CMP, including:
    - Ensure that the Growling Grass Frog population and created habitats are protected within the study area, and that connectivity is maintained for the ongoing movement of the species between the waterbodies within the study area and Sparrovale and Baenches wetlands;
    - Ensuring appropriate resources are available for the implementation of this CMP;
    - Ensuring all site personnel who are implementing the CMP are appropriately qualified and have been inducted (Section 3.3.1);

- Providing assistance and advice to all project personnel to fulfil the requirements of this CMP;
- Acting as the principal point of contact in relation to environmental performance;
- Commissioning a Zoologist during salvage and relocation operations and ongoing monitoring, compliance and providing to DCCEEW;
- Addressing any complaints and adopting a consistent approach to achieving the objectives of this CMP; and,
- Liaising with relevant authorities and organisations when necessary.

- **Wetland revegetation specialist/ contractor** – Required to adhere to the recommendations of this CMP, in relation to all works relating to the construction of new areas of Growling Grass Frog habitat. Any amendment to the location or design of the new Growling Grass Frog habitat would need to be discussed with a suitably qualified zoologist and DEECA.
- **DEECA –** DEECA will assess the suitability of this plan under the FFG Act, particularly the requirements specified in the action plan developed for Growling Grass Frog.
- **Experienced zoologist** (in relation to Growling Grass Frog) – Will be involved during the implementation of the plan, including undertaking salvage and relocation, and the monitoring of populations and habitats prior to, during and after the decommissioning works to ensure habitats remain suitable. The zoologist is also required to provide ongoing advice in relation to on-site management issues.

3.2.2 Encouraged Involvement

- **Geelong City Council** – Responsible for assessing the suitability of future developments (e.g. residential, industrial) in the vicinity of the study area, and would need to consider the implications of these proposals on the Growling Grass Frog population and habitats. Local authorities are also encouraged to provide assistance in the implementation of the plan, particularly in relation to the future monitoring and management of the Growling Grass Frog population and associated habitats. Community education about the importance of the resident Growling Grass Frog population and associated habitats is also encouraged.

3.3 Management Safeguards and Controls

3.3.1 Inductions

A suitably qualified and experienced zoologist will conduct site inductions for all persons engaged to work on site throughout the duration of the development. The induction will include the following.

- Information regarding the environmental values within and surrounding the study area, including the significance of the site and the local region for Growling Grass Frog;
- Diagnostic, ecological and behavioural information relating to Growling Grass Frog;
- The legislative context of the proposed action;

- An outline of the Duty of Care of all persons on site to avoid and minimise the occurrence and extent of potential impacts to the environment and Growling Grass Frog;
- All no-go zones and sensitive habitat areas for Growling Grass Frog;
- The key objectives and measures outlined in this CMP; and,
- The provision of an information pamphlet (Attachment A) summarising key points.

3.4 Habitat Protection

While the effluent ponds will not be retained as part of the construction works, other key habitat features within the study area may be preserved and enhanced where possible (e.g. ephemeral waterbodies and exposed rocks). These features will be integrated into the constructed wetland habitat for Growling Grass Frog.

Protection of the existing habitat and associated refuge sites will be achieved through the installation of temporary frog exclusion fencing around the outer perimeter of the habitat area prior to the commencement of construction to provide a physical barrier between the development area and existing habitat. Details of the fencing requirements are provided below. Following completion of construction and habitat creation, the entire constructed wetland habitat will be appropriately fenced to exclude public access to the wetlands.

3.4.1 Habitat Protection and Management

3.4.1.1 Frog Exclusion Fencing

Temporary frog exclusion fencing will be re-instated around the effluent treatment ponds and/or constructed wetlands prior to the commencement of construction to provide a physical barrier between the development area habitat to be removed and/or created habitat. An example of suitable frog exclusion fencing is shown in Plate 8. The following controls apply to the installation of sediment/ frog exclusion fencing:

- Fencing must be constructed of a cloth or plastic material and only appropriate fencing material that withstands variable weather conditions over long periods of time must be used;
- Fencing must be installed at least one metre high, with an additional 0.2 metres buried below-ground. An additional 0.2 metres at the top of the fence must be bent/ angled over at less than 90 degrees to the vertical on the frog habitat side (not the excluded habitat side) to prevent frogs from climbing or hopping over the fence;
- Refugia for shelter must be placed at least one metre away from the fence and any vegetation within one metre of the fence must not exceed 0.5 metres to prevent frogs from escaping (i.e. low-growing grasses will be planted).
- Fences must be taut without creases or folds;
- Fence posts must be installed on the outer fencing side (i.e. excluded habitat side) and fastened with nails or similar, and lie flush with fencing material to prevent frogs from climbing up posts and escaping over the fence; and,
- Regular inspection of the fencing is required to ensure its effectiveness, including:
    - Inspections of fencing between May and August, prior to Growling Grass Frog breeding season and the repair or replacement of any damaged or ineffective material;

- Maintenance of vegetation within one metre of fencing at less than 0.5 metres high; and,
- Removal of any litter or other debris caught in fencing which could assist frogs to climb over.

Plate 8. Example of suitable frog exclusion fencing (fence posts must be on the outside and not within the Offset Area)

3.4.1.2 Safety Fencing

Prior to the completion of the development, the entire constructed wetland area will be appropriately fenced to exclude public access to the habitat.

Integration of safety fencing and frog fencing will also be considered, as a single fence which achieves the purposes of safety, unauthorised access prevention, and a barrier for preventing frogs accessing paved areas is achievable and preferable in terms of functionality, aesthetics and maintenance.

Performance Indicators

The following performance indicators are required as part of fencing:

- Access to the offset site is appropriately controlled, incidents of unauthorised access are reported to Victoria Police and noted in the corresponding annual management and monitoring report;
- Posts around the perimeter of the offset site are established for monitoring and management purposes; and,
- All fencing activities and repairs are effectively documented.

Adaptive Management

- Adaptive management should be undertaken over the management of the offset site, including reviewing the need to implement new fencing if persistent incident of unauthorised access occurs; and,
- Install additional signage around areas that areas of the site subject to regular unauthorised access.

3.4.1.3 Sediment Fencing

Installation of sediment retention structures will be implemented to divert flow away from exposed soils and prevent contaminated stormwater and/or sediment laden run-off from accessing the Offset Area. Sediment fencing will be installed on the development side of the Safety and Frog Exclusion fencing. Such structures should will include silt fences, straw bales, coir logs, rock or gravel sausages, catch drains, earth banks, slopes

and batters and/or rock bunds (Plate 9; Plate 10). A wide range of sediment retention structures are described in detail in EPA (2004a).

Maximum post spacing	Installation condition
2m	No support wire or backing mesh.
3m	Support weir attached along top of the fabric at 1m intervals. Wire mesh or PVC safety mesh backing.

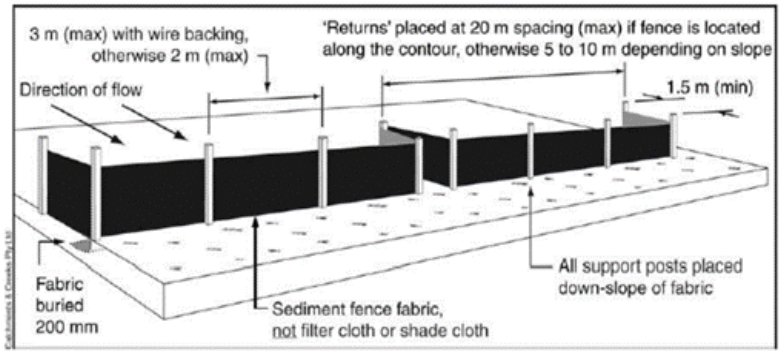

Plate 9. Typical silt fencing specifications

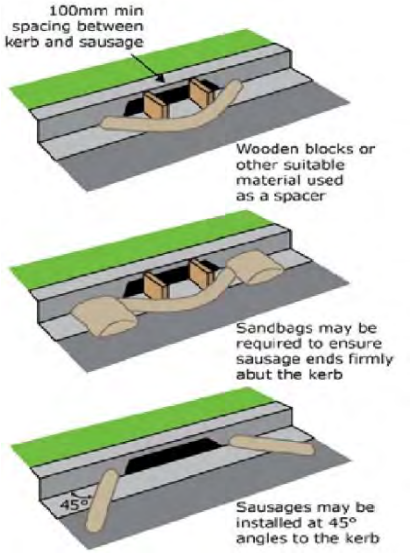

Plate 10. Typical geotextile fence and gravel sausages

3.5 Migration Period

Growling Grass Frog's will be allowed to migrate from existing habitat (effluent ponds) and colonise the newly constructed wetland habitat. This is proposed to occur over one breeding season, following completion of the constructed wetland habitat. Growling Grass Frog individuals are predicted to migrate along an existing ephemeral waterbody and surrounding foraging habitat situated north-east of the effluent ponds, which extends to the proposed constructed wetland (Ecology and Heritage Partners 2022).

No construction will occur in proximity to the likely migration path between the effluent pond (existing habitat) and constructed wetland (created habitat) or in identified Growling Grass Frog habitat on-site (terrestrial or aquatic). The created wetland habitat will be constructed first before impacts occur and then there will be a breeding season 'frog migration' period, which should is intended to allow Growling Grass Frogs to colonise newly created wetlands from the existing areas of Growling Grass Frog habitat (Table 4).

Impacted Growling Grass Frog habitat (i.e. Effluent Pond 1 and 2) will only be removed once all Growling Grass Frog individuals are confirmed to have migrated to constructed wetlands or elsewhere. This will be confirmed via targeted surveys for the species at the impacted wetlands following the migration period. In the event that Growling Grass Frog individuals do not migrate to constructed wetlands and are detected at impacted wetlands during targeted surveys, Growling Grass Frog individuals will be relocated via a salvage and relocation process conducted by a qualified zoologist suitably experienced in frog capture and release.

Table 4. Timeline of Growling Grass Frog migration period

Stage	April '24	May '24	June '24	July '24	Aug '24	Sept '24	Oct '24	Nov '24	Dec '24	Jan '25	Feb '25	Mar '25	April '25
Construction of GGF wetlands													
GGF migration period													
Installation of frog exclusion fencing													
Removal of dams													
Commence residential development													

3.6 Timing of the Management Actions

The proposed constructed wetland habitat will be constructed prior to the commencement of the development to allow frogs to naturally colonise the wetlands during the species active season. In the immediate vicinity of the existing and proposed constructed wetland habitat, the new habitat corridor will be constructed first to minimise development impacts to Growling Grass Frog. Development will then follow. The planned sequence is:

1. Pre-construction phase – commencement of the constructed wetland habitat;
2. Migration phase – completion of the constructed wetland habitat; migration of Growling Grass Frog from existing habitat (effluent pond) into constructed wetland; removal of existing habitat (effluent pond); construction may commence in areas outside the immediate vicinity of the existing and proposed constructed wetland habitat and migration path;
3. Construction phase – construction of remaining residential development likely over several stages; and,
4. Post-construction phase – maintenance and monitoring.

Development of the Growling Grass Frog constructed wetland habitat will occur during the pre-construction phase. Following completion of the constructed wetland habitat, and for one breeding season, no construction will occur in the likely migration path between the effluent pond (existing habitat) and constructed wetland (created habitat). The created habitat will be constructed first and then there will be a breeding season 'frog migration' period, which should allow Growling Grass Frogs to colonise newly created wetlands from the existing areas of Growling Grass Frog habitat. In areas that fall outside this migration path, the construction phase may commence prior to or during the pre-construction period, but the order in which they will be developed is yet to be finalised.

Once completed and colonised, permanent frog exclusion fencing will be installed along the perimeter of the constructed wetland to prevent frogs accessing development areas (Appendix 1).

The control of pest animals such as foxes will be undertaken in accordance with local government laws and relevant legislation. Given the threat posed by feral predators such as Red Fox, an assessment of feral predators in the movement corridor will be completed prior to the commencement of construction, and if evidence of these species are found, appropriate control measure will be implemented immediately to reduce the potential threat posed by predatory pests.

3.7 Management of Wetland Hydroperiod

The newly constructed wetlands will be hydrologically independent from nearby wetlands and drainage lines (which aims to limit exposure to Eastern Gambusia) and will be located to facilitate connections with other Growling Grass Frog populations in the area. In order to maintain permanent wetlands, a water delivery system will be constructed to maintain water levels in the wetlands. The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Adult Eastern Gambusia grow to approximately 6-10 centimetres in length and their live born young are a minimum 6 millimetres long and 1 millimetre wide. While Eastern Gambusia is likely present within the Balog Channel, the sediment filter silt fence is suitable for excluding all individuals from the constructed wetlands (Plate 11). The silt fence will have an approximate porosity of 0.22 millimetres, with an estimated 10 x 10 metre square area, 500 millimetre above ground, allowing an approximate discharge capacity of 300l/s (200ML per day). The base is proposed to include 200 millimetres of compacted class four crushed rock, while the silt fence will be buried 100 millimetres beneath crushed rock to prevent fish exiting under the fence.

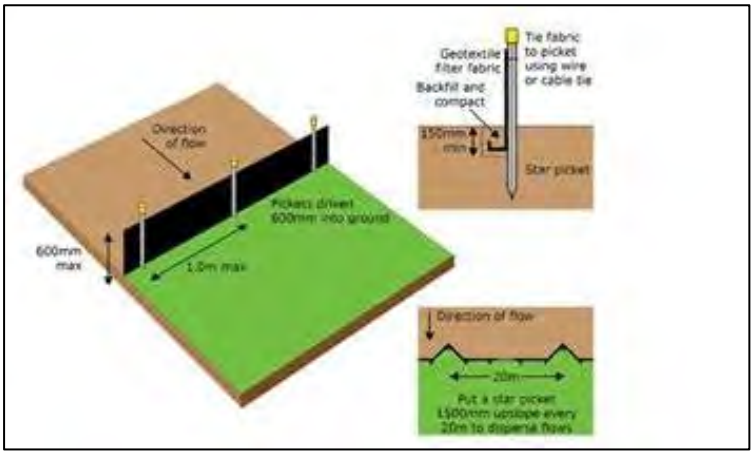

Plate 11. Silt fence example installation (EPA 2004)

Groundwater, direct rainwater and recycled water (post-residential construction) will then be used to maintain water levels in the wetlands, including during periods of low rainfall (e.g. drought). The specifics of the groundwater water delivery system are to be finalised but are likely to utilise a self-sustaining solar-powered groundwater pump system. The specifics of the water delivery system are to be finalised.

The ongoing persistence of the resident Growling Grass Frog population within the study area will be achieved through the monitoring of wetland hydroperiods, and through the establishment and ongoing management

of fringing and aquatic vegetation within constructed wetlands. Water levels will be assessed monthly over the species breeding season (October to March).

Depth gauges will be installed in all ponds, and wetland depth will be monitored monthly for the first two years following construction. This monitoring will continue over the life of the Growling Grass Frog Offset Management Plan, but the frequency of the water level monitoring will be reviewed after the initial two-year period and a decision will be made regarding ongoing water level monitoring requirements based on results of the first two years (e.g. if the water delivery system is not maintaining stable water levels at the required depth).

Water will be released from the water delivery system if levels fall below 0.5 metres within the constructed wetlands during the species active breeding season (Spring and Summer) and will be regularly filled in order to retain water over the entire breeding season. Wetlands will be drained (i.e. via a pump) and allowed to completely dry out should Eastern Gambusia be detected and/or if the water quality within the proposed wetlands is not suitable for breeding by the species. Wetlands will only be drained outside of the Growling Grass Frog active season (i.e. Spring and Summer) and will be re-filled using the water delivery system once the wetlands have completely dried and once evidence of predatory fish is no longer detected. Although absence of predatory fish cannot be confirmed, a high probability of absence can be inferred if the species is not detected during dip net surveys undertaken during consecutive water quality monitoring checks. The cause of Eastern Gambusia introduction will be investigated and the water delivery system repaired (if necessary).

Based on previous studies, fluctuating water levels and flooding are known to stimulate breeding in Southern Bell Frogs in the semi-arid region of Western NSW (Wassens 2005).

3.7.1 Primary Water Source

The Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland.

Groundwater and direct rainwater will be the primary ongoing water source for the constructed wetlands, while recycled water will be drawn on as a supplementary water source if required. Groundwater supply will be self-sustaining, using a solar-powered groundwater pump. The pipe will be capped, and a perforated section of pipe will be submerged in the waterbody at the end of the pipe to avoid any frogs or tadpoles being injured by pumping activities.

Groundwater will be supplemented by direct rainwater and recycled water (post-residential construction) to ensure sufficient water availability and ensure water quality metrics are met, as per the Growling Grass Frog Habitat Design Standards (DELWP 2017). The recycled water tank will be fitted with a multi parameter to identify if water quality parameters and nutrient levels are unsuitable for the species (i.e. salinity, pH, turbidity, dissolved oxygen, temperature, nitrate and phosphate). Growling Grass Frog have been found to inhabit wetlands with salinity levels over 5mS/cm. Warmer water temperatures (up to 27°C) minimise the risk of chytrid fungus infection, and tadpole hatching occurs in water between 24 to 27°C. Elevated nitrate and phosphate concentrations are known to have an impact on the survivability of Growling Grass Frog, and it is thought that the species requires waterbodies containing lower levels of nitrates and phosphates. The approximate salinity limit for the species is 5000 µS/cm. The holding tank will not be released into the constructed wetlands if salinity levels within the tank exceed 50000 µS/cm or temperatures fall below 18°C or

above 27°C (or above 24°C during tadpole hatching periods). Additionally, dissolved oxygen should be maintained within an acceptable range for aquatic biota, and water should have low turbidity (<40NTU's), be still, maintain acidity between pH 6.0-8.0 and have low nitrogen (<1.0 mg/L) and phosphorous (<1.0mg/L) levels.

3.8 Removal of Effluent Ponds

3.8.1 Pre-clearance Searches and Salvage

Upon completion of vegetation slashing (if required), pre-clearance surveys for adults, metamorphs and tadpoles and salvage (if required) will take place immediately prior to removal of effluent ponds.

This will involve two observers actively searching soil, vegetation and other ground debris for frogs within and surrounding the ponds following the methodology outlines in Section 3.9.

3.8.2 Effluent Pond De-watering

Removal of effluent ponds will occur following completion of constructed wetland habitat and after one Growling Grass Frog breeding season, to allow migration of Growling Grass Frog individuals from the effluent ponds into constructed habitat.

Draining the ponds is expected to be undertaken within the 48 hours of completion of the pre-clearance searches. Wherever a pond/wetland is to be dewatered, adequate filter systems will be required to prevent fauna (e.g. frogs, tadpoles, waterbirds, fish) from being sucked up into the pump. Filters will be designed and installed such that the suction at the intake point (i.e. the point where fauna would be most likely to encounter the pump system), and at the water surface near the intake, is minimised, so that fauna are not drawn into the pump. The 'filter' could be as simple as fine mesh placed over or around the water pump inlet, so long as it effectively excludes fauna. An exclusion fence should be installed around the pump in addition to attaching a screen (at least 5 mm mesh size) to the pump intake to help further minimise the risk of fauna impacts during the dewatering process.

Prior to filtering, the ponds will be netted/trapped to remove tadpoles in line with Section 3.9.1. Where possible, water should be extracted from relatively high in the water column (within 20 centimetre of the water's surface) rather than lower down, and well away (>5 m) from submerged aquatic vegetation, to lessen the likelihood of fauna (particularly tadpoles of the Growling Grass Frog) from being sucked up into the pump. For threatened wetland-dependant birds, particular care will be given to maximise the safety of young birds, as these are considered the most likely individuals that may stray too close to the pump intake.

A qualified zoologist (with appropriate licences under the Wildlife Act) will be on site during the entire dewatering of the ponds to actively search for Growling Grass Frog as the water level decreases. Dewatering is to occur in stages (15-centimetre increments) to allow the qualified zoologist to actively search for frogs and tadpoles that may be missed during salvaging. As the water level in the ponds decreases it is expected that frogs will be more easily detected. Dewatering is to cease when frogs and/or tadpoles are detected and only commence after capture by a qualified zoologist.

3.8.3 Removal of Terrestrial Habitat

Habitat removal can be completed after the diurnal and nocturnal surveys have been completed and the ponds have been drained. This will involve an observer actively searching soil, vegetation and other ground debris (e.g. rocks and logs) for frogs during excavation. A qualified zoologist will be present at all times whilst vegetation and topsoil are being removed from the ponds and immediate surrounds. All excavation works will be closely observed for frogs whilst the vegetation and topsoil are removed.

The vegetation and topsoil are to be removed with extreme care by an excavator operator who will be briefed by the zoologists on salvage methods. The excavation of the ponds will involve removing terrestrial habitat in the following stages:

- Scraping across the surrounding vegetation in a manner that uproots the plants, which is the most effective way of detecting frogs refuging at the base of plants (particularly tussocks and reeds). They will also lift any large rocks and/or logs surrounding the ponds. The zoologist will then search the base of excavated plants and the immediate area in which the plants and/or other refuge were removed.
- Scraping the topsoil, to a depth of approximately 30 centimetres, with the zoologist observing closely for excavated or disturbed frogs. The operator may also be required to spread some of the excavated material in the 'stockpile' area to allow for active searching;
- The zoologist will also then search the 'stockpile' area for frogs that may be trapped in excavated material (e.g. vegetation, logs, soil clods); and,
- Once excavated soil and vegetation has been searched for frogs it will be moved to a safe area away from the construction activities and left piled here for several days so that any frogs still within the pile can escape on their own.

In the event that a Growling Grass Frog is unearthed, construction works will be halted temporarily within a 10 metre radius of the frog. The zoologist will then capture the individual(s) and remove them from the area of impact, prior to approving re-commencement of construction works. Frogs will be removed in accordance with the approved handling techniques.

If vegetation clearance is expected to take more than one day, additional searches of habitat and stockpiles will be undertaken in the morning each day before vegetation and topsoil removal begins. All suitable microhabitat, including within thick vegetation, under rocks, rubbish, soil and other ground debris will be actively searched.

3.8.4 Filling of Waterbodies

Upon the completion of the draining and removal of terrestrial habitat and topsoil surrounding the waterbodies (as outlined above), and removal of aquatic fauna (e.g. frogs, tadpoles and metamorphs), approval will be given by the zoologist for filling of the ponds. This should be undertaken immediately after the salvage has been completed so that this portion of the ponds will not be filled again with rainwater, and frogs may not recolonise the ponds.

A qualified zoologist will be on site for the first day of filling to ensure there are no Growling Grass Frog remaining in the area. In the event that Growling Grass Frog are found during later construction activities, when a suitably qualified zoologist is not present on site, works will be halted within a 10 metre radius of the

frog and the works supervisor will be immediately notified. The works supervisor will be required to contact a nominated zoologist immediately. An attempt to capture the frog by any contractor should not be undertaken unless the capturer is using disposable, non-toxic PVC gloves and has a suitable container in which to keep the animal in a cool place out of direct sunlight until a qualified zoologist arrives. Frogs will be held in a sterile, ventilated plastic container (e.g. terrarium) with a moist sponge, and stored in a dark, quiet, ventilated area. Handling and hygiene protocols will be followed as described in Section 3.9 and Attachment B.

3.9 Salvage and Relocation

The suitability of salvage and relocation measures is considered on a case-by-case basis by DEECA. Passive relocation of Growling Grass Frog individuals from effluent pond 1 and 2 (existing habitat) will be implemented initially, with frogs encouraged to naturally migrate from the effluent ponds and colonise the newly constructed habitat during the species' active period. If any individuals remain, the salvage and relocation of Growling Grass Frog individuals from the effluent ponds prior to and during removal of habitat will be required.

Salvage and relocation of frogs from the proposed constructed habitat area prior to habitat creation activities may also be required from an animal ethics perspective and aims to reduce the occurrence of death, injury or displacement of individuals.

All areas where rock beaching is to be incorporated must be identified using clearly visible timber stakes and/or bunting prior to works being carried out so that the area can be searched by a suitable qualified Zoologist and appropriate salvage and relocation protocols initiated.

The salvage and relocation measures outlined below will be undertaken both immediately prior to and during the development works, as required. Salvage measures will be undertaken by a qualified zoologist experienced with these operations. Salvage will involve a suitably qualified zoologist actively searching soil, vegetation and other ground debris (i.e. checking under boulders that may be shifted and under vegetation that is within an area where rock beaching is to be incorporated) for frogs immediately prior to, and during habitat improvement works.

3.9.1 Capture

The following procedure will be undertaken:

- Frogs will only be captured by suitably qualified and experienced zoologists, who are capable of purposeful capture that does not result in unnecessary stress, energy expenditure or injury to the fauna.
- Zoologists will change to a new pair of disposable latex gloves between each frog capture in accordance with the Hygiene Protocol (Murray *et.al*. 2011) (Attachment D). Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up.

3.9.2 Handling

The following procedure will be undertaken:

- Frogs and tadpoles will only be handled by suitably qualified and experienced zoologists, and will be handled as little as possible to avoid inadvertent removal of skin secretions which can predispose them to infection.
- Zoologists will change to a new pair of disposable latex gloves between the handling of each frog and tadpole, in accordance with the Hygiene Protocol (Murray *et.al*. 2011) (Attachment D). Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are handled.

3.9.3 Holding

The following procedure will be undertaken:

- Frogs will be placed into new and clean plastic sample bags, with a 'one bag – one frog' policy, in accordance with the Hygiene Protocol (Murray *et.al*. 2011) (Attachment D). Bags will not, under any circumstances, be reused.
- All frogs captured will be assessed for signs of injury or illness, particularly for signs of Chytrid Fungus infection, in accordance with the Hygiene Protocol (Murray *et.al*. 2011) (Attachment D). If any individuals show signs of illness, their sample bag will be clearly marked, and the necessary actions outlined in the Protocol will be implemented.
- If a large number of frogs are being captured, additional resources will be called upon to assist, so that frogs and tadpoles can be captured and released within Created Habitat Area 1. This is to avoid individuals being held in the sample bags for any longer than necessary.

3.9.4 Transporting

The following procedure will be undertaken:

- As only on-site relocation will be undertaken, the transportation of frogs will only require ferrying of individuals in their sample bags on foot across Created Habitat Area 1.

3.9.5 Releasing

The following procedure will be undertaken:

- Frogs salvaged during construction of habitat will be released into neighbouring Sparrovale wetland and associated drainage line immediately into favourable micro-habitats that afford protection from exposure and predation. Frogs salvaged during the removal of existing wetland habitat (i.e. effluent pond Site 1) will be released into the newly constructed Growling Grass Frog wetland. Frogs will be released into areas with suitable rock, debris and/or dense vegetation providing adequate refuge.
- All frogs will be visually monitored after release to ensure that they do not show signs of stress or vulnerability. If individuals show such signs, they will continue to be monitored until adequate recovery is evident. If recovery does not become apparent and no signs of recovery are being displayed, the individual may be required to be re-captured and transported to a veterinarian or wildlife carer.

3.9.6 Stressed and Injured Animals

The following procedure will be undertaken:

- Prior to the commencement of habitat removal and associated activities, the zoologists will locate and obtain the contact details of the closest wildlife carer and veterinarian.
- The zoologists undertaking the salvage and relocation of the frogs will be suitably qualified and experienced in recognising the indicators of mild-moderate stress in animals. Such recognition informs the judgement to intervene. The following are indicators of mild-moderate stress in animals:
- Fast and shallow breathing; and,
- Temporarily unresponsive to stimuli (listless).
- If an animal is displaying greater than one of these indicators at the same time, an extreme of one of these indicators, or one of these indicators for a prolonged time, then the zoologists will be prepared to intervene. Depending on the situation, such intervention may include:
    - Continued visual monitoring of the individual until adequate recovery is evident;
    - A pause of any activities that may cause further stress; and,
    - Re-capture of the individual and transportation to a veterinarian or wildlife carer.
- If an animal is injured or sick, the zoologist will call for a pause on any activities that may exasperate the situation and immediately make arrangements for the animal to be taken care of. Depending on the severity of injury or illness, this may mean organising the animal to be transported to a wildlife shelter for rehabilitation; or to a veterinarian for medical attention or euthanasia.
- In the event that an animal is severely injured and requires euthanasia immediately (i.e. on site) this is to be undertaken at the zoologists discretion using methods outlined in their Animal Ethics Permit.

3.9.7 Contingency Plan

The following procedure will be undertaken:

- If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors will be required to contact a zoologist and temporarily halt works. Contractors will be made fully aware of the appearance of GGF, via a site induction by a qualified zoologist to the Project Manager and/or Contractor(s), to describe GGF and how to identify them if found during works;
- The person encountering the frog will report it to a nominated principal contact of AC Manager Pty Ltd upon which all works will stop within the vicinity of the site. The zoologist will be contacted immediately;
- No one may attempt to capture the frog unless it is directly within harm's way. If possible, a photo of the frog will be taken and sent to the zoologist via mobile phone messaging for identification; and,
- Any specimens found in harm's way will be stored in an appropriate container and kept in a cool place out of direct sunlight until a qualified zoologist arrives.

3.10 Population and Habitat Monitoring

Appropriate survey and monitoring methods for Growling Grass Frog is an important component to effectively conserve the species (Heard *et al.* 2010). Methods based on research and commensurate with the objective (e.g. determining wetland occupation versus population size versus reproductive success) are required to adequately identify the impact of an action, along with the most appropriate management actions and the effectiveness of such actions (Heard *et al.* 2010). Such surveys will be conducted to assess the impact of the development and/or monitor the suitability of a site's management regime, or to monitor the species status throughout a region (which may also relate to regional scale management strategies etc.).

3.10.1 Population Monitoring

Population monitoring will be undertaken annually during the development and annually for the entire 10-year management period.

Each monitoring event will comprise diurnal and nocturnal surveys and will include the following (as a minimum). If, at the end of the annual monitoring the results indicate a decline in the Growling Grass Frog population or degradation of Growling Grass Frog habitat, the CMP will be re-evaluated and adapted accordingly.

Diurnal Surveys

The following will be undertaken as part of the diurnal surveys:

- Habitat assessment (type/cover of vegetation and refugia; water quality; disturbance, litter, erosion).
- Active searching for frogs (in and 20-metres around the waterbody, including aquatic and terrestrial vegetation, rocks, logs and other refugia).
- Dip netting for tadpoles and predatory fish.

Nocturnal Surveys

The following will be undertaken in accordance with Survey Guidelines for Australia's Threatened Amphibians (DSEWPaC 2011) as part of the nocturnal surveys:

- At least four nights of surveys (two early in active season when calling and mobility is high, and two later in the season when tadpoles and metamorphs greatest).
- Early in the active season, surveys will be at least 120 minutes (call-playback and active searching aquatic and terrestrial vegetation, rocks, logs and other refuge for frogs in and 20-metres around the waterbody).
- During the latter part of the active season, the 120-minute survey will involve dip netting for tadpoles and metamorphs, and active searching for metamorphs and sub-adults as detailed above.

All surveys will be conducted in weather conditions considered optimal for detection (i.e. warm and humid, overnight temperature not less than 14°C, preferably post rain) and when the species is known to be active elsewhere (reference sites).

Tadpole surveys

- Surveys will be undertaken annually for the first five years post-development, and conducted every second year, at minimum, following the fifth year. Commercially-available, collapsible bait-traps constructed of nylon netting will be baited with fluorescent glow sticks, and then set at the completion of each spotlight survey, in an effort to capture tadpoles at predetermined locations. At least two traps will be set at each wetland for a minimum of two nights over the breeding period of Growling Grass Frog. Traps will be suspended (use of floats) so that at least part of the trap emerges above water-level, allowing tadpoles to breathe.
- Traps will be retrieved the following morning and checked for tadpoles and predatory fish. All tadpoles caught will be identified to species level, counted and released. Alternatively, dip nets will be used to sample for tadpoles at, or in the vicinity of sites where calling males are identified.

3.10.2 Photo point monitoring

The landowner undertakes to establish three permanent photo-points across the offset site. Photographs taken from these points will be representative of the vegetation and objectives of the OMP (e.g. areas of high threat weed invasion). Photographs will be taken during the annual monitoring period annually and clearly labelled. Each photo will be taken from as near to the same point each year and will use the same direction, trajectory and camera settings as is practicable.

Annual monitoring must be undertaken by the landowner (or an appointed entity on behalf of the landowner), and must include an assessment of:

- Photographs taken at established photo-points;
- The extent, severity, trend and presence of current weed species and any new and emerging weed species.
- The extent, severity, trend and presence of pest animal activity;
- Biomass levels, visually assessed across the site;
- Evidence of unpermitted human/stock access; and,
- Any new threats.

The annual monitoring must be undertaken for each year of the ten years of this CMP.

3.10.3 Habitat Monitoring

Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog wetland habitat. After the fifth year, monitoring frequency will be conducted every second year, at minimum, with the frequency of monitoring to be determined based on the results of the first five years.

Several site-specific habitat variables will be assessed during the monitoring period, including:

- Wetland depth, flow, permanency and a visual assessment of water quality;
- Availability and suitability of shelter and over-wintering sites;

- Vegetation diversity, structure, composition and percentage of cover;
- Presence of introduced fish, particularly Eastern Gambusia and Goldfish; and,
- Presence of pollutants, rubbish and other threatening processes.

Vegetation Monitoring

- Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas. After the fifth year, monitoring frequency will be determined based on the results of the first five years, with monitoring occurring every second year at minimum
- Monitoring of vegetation will be conducted in autumn and spring.
- Replace any failed plantings.
- Increase planting density by planting additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody); as required.
- Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides.
- Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from wetlands/waterways.
- Identify and remove barriers to frog dispersal.
- Where relevant gross pollutant traps and/or sediment filters will be checked and, if necessary, subsequently cleaned, particularly after heavy rain or storm events.

As required, based on conditions:

- Increasing the intensity of feral animal controls.
- Additional refuge sites such as rocks, logs and dense low-lying vegetation will be added if it is considered, during site monitoring, that the area of shelter is insufficient.
- Routine maintenance of grassed areas within the reserve area around the periphery of the waterbodies.
- Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage).
- Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary.

Pest Plant Monitoring

- Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas. After the fifth year, monitoring frequency will be determined based on the results of the first five years, with monitoring occurring every second year at minimum.

- Where possible, weeds will be controlled by hand or with the use of implements.
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- When used in riparian areas, will be directly sponged or wicked onto weeds to minimise off target damage.
- Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March).
- Any weed control works must be completed in a manner that minimises soil disturbance.
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen.

The following species must not be introduced into the offset area or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation:

- Narrowleaf Cumbungi *Typha domingensis*
- Broadleaf Cumbungi *Typha orientalis*
- Lesser Reed-mace *Typha latifolia*
- Common Reed Phragmites australis
- Tall Spike-rush *Eleocharis sphacelate*

If these species are observed within the offset area during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

3.10.4 Water Quality Monitoring

Water quality monitoring sites will be established within the constructed waterbodies immediately following the completion of the constructed wetlands. Water quality sampling will adhere to the EPA's reference document: S*ampling and analysis of waters, wastewaters, soils and wastes* (EPA 2009). Water quality results will be compared to the GGF Habitat Design Standards water quality standards and the State Environment Protection Policy (SEPP) Water for Victoria objectives (EPA 2018; DELWP 2017).

A monitoring program has been designed to identify any potential reduction in water quality if conditions deteriorate from the water quality outlined in the GGF habitat design standards. Management actions will be implemented if chemical spills are detected or if there is a noticeable deterioration in water quality. Several 'Spill Response Kits' will be provided if an oil or fuel spill occurs, appropriate training will be provided on how to use the kits if a spillage occurs on site. If water quality results exceed trigger values (see below) and/or are outside SEPP objectives, a review of appropriate measures will be conducted and correction actions will be taken, if required, to ensure the water quality is suitable for Growling Grass Frog.

Weekly monitoring will be undertaken until the water quality conditions return to the GGF Habitat Design Standards water quality standards or within SEPP Waters of Victoria (WoV) objectives (EPA 2003).

During each monitoring event, the proponent will also undertake surveys in the neighbouring wetlands to determine prevailing conditions of Sparrovale and Baenschs Wetlands, primarily relating to water quality and Growling Grass Frog wetland occupancy.

Site Specific Trigger Values

Trigger values will be established and based on immediate post-construction water quality within the created waterbodies. The triggers will be assessed against predominantly against the GGF Habitat Design Standard water quality standards (DELWP 2017). The following trigger values will be used:

- If turbidity is >20% than 40.0 (upper target value);
- If nitrogen is >1.0 mg/L;
- If phosphorous is >0.1 mg/L;
- If electrical conductivity is >1% above 5.0 mS/cm (target value c. <5.0 mS/cm);
- If dissolved oxygen concentration is <1% of the background condition recorded in adjacent wetlands known to contain a population of GGF (Sparrovale / Baenches);
- If pH ±0.5pH unit from targeted range (target range between 6.0 – 8.5pH); and,
- All other water quality parameters (including any nutrients or heavy metals) have not substantially exceeded the GGF Habitat Design Standard parameters (i.e. no statistically significant difference (alpha >0.05).

Sampling frequency

In order to demonstrate if water quality has returned/remained at target values, water quality monitoring will be conducted every four months for at least two years post-construction, and continue until the water source system stabilizes. For instance, the recycled water sources may vary in quantity and potentially quality until the entire site is developed.

The frequency of the water quality monitoring will be reviewed after the initial two-year period and a decision will be made on whether ongoing water chemistry monitoring is required.

3.11 Annual Monitoring Reporting and Review

The following will be implemented to inform of relevant issues, milestones and habitat and population monitoring results to ensure the regulatory authorities (i.e. DEECA, DCCEEW) are informed of the progress of the implementation of this CMP (Table 5):

- A summary of the results of all monitoring procedures, habitat creation (i.e. wetlands) and any maintenance activities will be provided to DCCEEW on an annual basis throughout the 5-year implementation of the CMP. This annual audit will also outline the progress of the CMP implementation and identify any key issues and management responses;
- Management actions may need to be amended or updated if new information becomes available, or if management actions are considered inappropriate or inadequate for the long-term persistence of Growling Grass Frog within the site. New information may become available through ongoing monitoring procedures or following review of ongoing reporting submitted to DCCEEW.

Recommendations based on this information will be provided to the responsible land manager. This is particularly important in order to establish and maintain suitable wetland hydroperiods within the constructed wetlands;

- In addition to revisions triggered by adaptive management, additional changes to this CMP may be required following the EPBC Act assessment and approval process. Assuming the project is approved under the EPBC Act, conditions stipulated by DCCEEW may specify specific controls regarding the proposed reporting and review process, monitoring program and management activities etc; and,
- Any proposed amendments or deviations to the actions and requirements of this CMP must be approved by DCCEEW, and the plan must be updated with any approved changes.

3.12 Schedule of Management Actions

Table 5. Schedule of management actions

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
1 and ongoing	**1. Creation of Dedicated Growling Grass Frog Wetlands.** The creation of dedicated Growling Grass Frog waterbodies within the proposed wetlands will provide additional breeding and foraging habitat for the species and improve habitat connectivity and frog dispersal.	Following establishment of no-go zone and exclusion fencing	The created wetland habitat will be constructed prior to and during development to allow frogs to naturally colonise the wetlands during the species active season. Design features of constructed wetlands: 1. Wetlands will be designed to permanently contain water and the Balog Channel will be the initial primary water source for the constructed wetlands with supplementary groundwater also used, if required. Water will be piped from the Balog Channel initially, with a sediment filter preventing Eastern Gambusia from accessing the wetland. Groundwater, direct rainwater and recycled water (post-residential construction) will then be used to maintain water levels in the wetlands, including during periods of low rainfall (e.g. drought). The specifics of the groundwater water delivery system are to be finalised but are likely to utilise a self-sustaining solar-powered groundwater pump system. 2. Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction. 3. Supplied with the best feasible water quality consistent with the Growling Grass Frog Habitat Design Standards. 4. Able to sustain appropriate vegetation to provide habitat (see below). 5. Will be clay-lined to retain water with a loamy or sand-substrate topsoil. Include rock mattresses, covering minimum 20% of the bank area, as alternative refuge and overwintering sites around the wetland margins (Plate 6, Figure 3). Trees and/or large shrubs must not be planted within 20 metres of the banks of Growling Grass Frog wetlands as this may shade out ponds, thus potentially rendering them unsuitable for the species. Designed, constructed and managed so that they predominantly comprise open water, low water turbidity, be still, and have low nitrate, phosphate, and salinity levels.	3.1

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
1 and ongoing	**2. Salvage and Relocation** The salvage and relocation of Growling Grass Frog individuals from within the Created Habitat Area 1 prior to habitat creation	Both immediately prior to and during the development works, as required	Salvage and relocation (if required) will be undertaken as follows: The salvage and relocation of Growling Grass Frog individuals from within the Created Habitat Area 1 may need to be undertaken prior to habitat construction activities. Salvage and relocation procedures may be initiated to reduce the occurrence of death, injury or displacement of individuals. All areas where rock beaching is to be incorporated must be identified using clearly visible timber stakes and/or bunting prior to works being carried out. The area will be searched by a suitably qualified zoologist and appropriate salvage and relocation protocols initiated. If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors are required to temporarily halt works in that area, contact a zoologist and follow procedures outlined in section 3.9.7.	3.9
1 and ongoing	**3. Migration of Growling Grass Frog from effluent pond (existing habitat) into constructed wetland**	Prior to and during construction	The habitat corridor will be constructed prior to commencement of construction in the adjacent residential development area to allow frogs to naturally migrate from the effluent pond (existing habitat) and colonise the constructed wetlands during the species active season.	3.5
1 and ongoing	**4. Removal of Effluent Ponds (possible salvage and relocation)** The removal of Effluent Pond 1 where Growling Grass Frog was recorded	Prior to and during construction	Removal of effluent ponds will occur following completion of constructed wetland habitat and after one Growling Grass Frog breeding season, to allow migration of Growling Grass Frog individuals from the effluent ponds into constructed habitat. The following steps will be undertaken during removal of effluent ponds: 1. Pre-clearance searches and salvage; 2. De-watering of effluent ponds; 3. Removal of terrestrial habitat; 4. Filling of ponds. Salvage and relocation (if required) will be undertaken as follows: 1. The salvage and relocation of Growling Grass Frog individuals from Effluent Pond 1 and 2 will be undertaken prior to their removal.	3.8 3.9

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			2. Salvage and relocation procedures may be initiated to reduce the occurrence of death, injury or displacement of individuals. 3. The area will be searched by a suitably qualified zoologist and appropriate salvage and relocation protocols initiated. 4. If a suitably qualified zoologist is not present during a stage of development where GGF is located on site, contractors are required to temporarily halt works in that area, contact a zoologist and follow procedures outlined in section 3.9.7.	
1 and ongoing	**5. Staged development.** Development of the Groves Road site will be undertaken over multiple stages to protect existing habitat until the dispersal corridor has been constructed.	Throughout construction	Development of the site will be staged as follows: 1. The created wetland habitat will be constructed prior to commencement of residential construction in the adjacent development area to allow frogs to naturally colonise the wetlands during the species active season. 2. Frog Exclusion fencing will be installed along the border of the constructed wetland habitat with the development area once frog colonisation has occurred. Fencing will be installed prior to the commencement of residential construction in areas adjacent to the constructed wetland to prevent Growling Grass Frog from entering the residential development area during and after residential construction. Impacted Growling Grass Frog habitat (i.e. Effluent Pond 1 and 2) will only be removed once all Growling Grass Frog individuals are confirmed to have migrated to constructed wetlands or elsewhere. This will be confirmed via targeted surveys for the species at the impacted wetlands following the migration period. 3. Temporary frog fencing in all areas will be decommissioned once permanent frog exclusion fencing and all construction activities within the constructed wetland habitat have been completed.	3.1 3.4 3.1 3.6
1 and ongoing	**6. Establish no-go zones and temporary exclusion fencing.** Protect existing habitat (prior to its removal) and subsequently the habitat corridor and no-go areas during construction.	Prior to commencement of construction	Temporary frog exclusion fencing and signage will be installed around the outer perimeter of Created Habitat Area 1 prior to the commencement of construction (see Figure 3).	3.1 3.8 3.10
		Prior to and during construction of the habitat corridor / frog migration	Fencing will be installed along the entire boundary of the development areas during construction during construction of created wetland habitat and the Growling Grass Frog migration from effluent pond. This is to prevent Growling Grass Frog from entering the development area during and after construction.	

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
		Following completion of permanent exclusion fencing	Temporary frog fencing in all areas will be decommissioned once and all construction activities, Growling Grass Frog migration, and permanent frog exclusion fencing within the constructed wetland habitat have been completed.	
		Monthly	Fencing and "no-go" zones inspected monthly for damage or evidence of dumping/activity.	
		As required	All no-go zones and sensitive habitat areas for Growling Grass Frog clearly signed and discussed during on site inductions.	
1 and ongoing	**7. Revegetation and constructed wetland and habitat creation of Created Habitat Areas.** New constructed wetland habitat (Created Habitat Area 1) and the area within the movement corridor (Created Habitat Area 2) will be created through the provision of appropriate revegetation and habitat enhancement.	During stage 1 in Created Habitat Area 1. Following earthworks and landscaping of wetlands within movement corridor (Created Habitat Area 2)	The creation of constructed Growling Grass Frog wetland habitat will include the provision of terrestrial habitat (rock, logs and other ground debris) and aquatic habitat (supplementary aquatic vegetation). Habitat creation and enhancements activities associated with Created Habitat Area 1 at the large constructed pond will commence prior to, or during the first stage of the development. 1. To achieve these habitat requirements, in each Growling Grass Frog wetland there will be three distinct zones (as shown in Plate 7). 2. Timing of works - works will be undertaken between April and August inclusively and ideally planting should occur in late winter/ early spring, providing there is adequate rainfall. 3. All works must be subject to disease control in accordance with the measures contained in section 5.1 and the Hygiene Protocols for the Control of Diseases in Australian Frogs (Murray *et.al*. 2011) (Attachment D). 4. Protective netting will be installed, where required, to prevent damage to aquatic plants by waterfowl. 5. Trees and/or large shrubs must not be planted within 20 meters of the banks of Growling Grass Frog wetlands. 6. A minimum topsoil depth of 150 mm within all wetland planting areas. 7. The planting area will contain floristically diverse and structurally similar vegetation, planted at a nominal density of six individuals per square meter with the provision for areas of bare ground between plantings.	3.1 3.4 3.8 4.1 Attachment C

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			8. Recommended species for wetland planting known to be present in Growling Grass Frog habitats are provided in Attachment C. The following species must not be introduced into Created Habitat Area 1 and 2 or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation; • Narrowleaf Cumbungi *Typha domingensis* • Broadleaf Cumbungi *Typha orientalis* • Lesser Reed-mace *Typha latifolia* • Common Reed *Phragmites australis* • Tall Spike-rush *Eleocharis sphacelata*	
1 and ongoing	**8. Chemical/petroleum spill and hard rubbish dumping.** Protect existing and constructed Growling Grass Frog habitat from contamination.	Both immediately prior to and during the development works, as required	1. Chemical and fuel storage area to be established as far from Growling Grass Frog habitat as practical. 2. Equipment to be regularly serviced and inspected daily. 3. Personnel to undergo adequate training in equipment usage. 4. Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc. 5. Inspection of all drainage points leading to the water bodies for chemical spills, leaks, and rectify where necessary. 6. Once-off intensive hard litter removal (and if required between normal maintenance schedules). 7. Several 'Spill Response Kits' will be maintained on site in areas where chemicals are stored and in construction areas. Appropriate training will be provided on how to use the kits if a spillage occurs on site.	2.3.1 3.10.3 5.3.2
1 and ongoing	**9. Chytrid management.** Chytrid fungus is a major threat to amphibian populations in	During habitat construction and management of created habitat	1. All footwear and equipment (e.g. nets, buckets, callipers, headlamps, waders), will be thoroughly cleaned and disinfected before entering and exiting the constructed wetland, and between sites including between the site of salvage and No-Go-Areas.	2.3.2 3.9.2 3.10

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	Australia. Hygiene Protocol will be used to guide best practice Chytrid management.	areas, throughout construction and post-construction (when residential development and offsite site maintenance occurs for both GGF Wetlands and the 6.7ha foraging and dispersal habitat).	2. Any equipment used to handle frogs and tadpoles will be cleaned and disinfected between each use. 3. The tyres of all vehicles will be cleaned and disinfected before entering and exiting the construction area of the proposed wetlands habitat (if required). 4. The tyres/tread and other parts of machinery and plant (e.g. the excavator bucket; pumps) involved in the habitat construction and associated activities, will be cleaned and disinfected before entering the construction area of the proposed wetlands habitat. 5. A new pair of disposable latex gloves will be used between each frog and tadpole. Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up. 6. Frogs will be placed into new and clean plastic sample bags, with a 'one bag– one frog' policy. Bags will not, under any circumstances, be reused. 7. Disinfection methods will follow the procedures outlined in the Hygiene Protocol.	5.1 Attachments B, D
		During salvage and relocation.	Follow handling guidelines for salvage and relocation (see section 5.1 and Attachments B, D).	
		Ongoing	Sterilise footwear before entering created habitat areas.	
1 and ongoing	**10. Manage artificial lighting and noise.** Artificial light and noise will be kept to a minimum to reduce impacts to Growling Grass Frogs.	During construction activities	1. Construction activities will comply with the Greater Geelong City Council Building works – Local Law requirements (Greater Geelong City Council 2014). 2. Building or other works that may produce noise can only be carried out between the hours 7.00 am and 6.00 pm on weekdays, 9.00 am and 6.00 pm on Saturdays, Sundays, and public holidays. 3. Sources of artificial light from the surrounding development will be directed away from the existing habitat, constructed wetland and migration corridor.	2.3.5 2.3.6
		Design and installation phase	1. No additional lighting directed towards the existing habitat or constructed wetlands. 2. Shields will be placed on lights to reduce lateral light spill. 3. If necessary embedded lights will be used on walkways adjacent to the constructed wetland habitat. 4. Use of high intensity lights in white or blue range (<50 nm wavelengths) will be avoided.	

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
1 and ongoing	**11. Monitor and control pest fauna species.** If Eastern Gambusia is observed within Created Habitat Area 1, protocols outlined in Section 3.7 will be implemented. Feral Animal Control measures will be implemented in the study area to reduce the population size of foxes.	Both immediately prior to and during the development works, as required	1. Assessment of feral predators within Created Habitat Area 1 and 2 prior to the commencement of construction. 2. If evidence of foxes is found, appropriate control measure to be implemented immediately. 3. Destroying any dens discovered on site.	2.3.7 3.7 3.10.2 5.3.7
		During wetland habitat construction	1. The newly constructed wetlands will be hydrologically independent from Sparrovale and Baenches wetlands. 2. The wetlands will contain a drainage outlet at the lowest point of the waterbody for removing some or all water from the system.	
		Monitor fish in autumn and September.	1. Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas (Created Habitat Areas 1, 2). After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum. 2. Wetlands will be drained (i.e. via a pump) and allowed to completely dry out should Eastern Gambusia be detected. 3. Wetlands will only be drained outside of the Growling Grass Frog active season (i.e. not to be drained in Spring and Summer). 4. Wetlands will be re-filled naturally once the wetlands have completely dried and once evidence of predatory fish is no longer detected. Although absence of predatory fish cannot be confirmed, a high probability of absence can be inferred if the species is not detected during dip net surveys undertaken during consecutive water quality monitoring checks. The cause of Eastern Gambusia introduction will be investigated and the water delivery system repaired (if necessary)..	
		Opportunistic and ongoing	Destroy any fox dens found on site.	
1 and ongoing	**12. Monitor and managed vegetation in habitat corridor.**	Twice annually (autumn and spring) in years 1	1. Monitoring of created habitats will continue for ten years and will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas	5.3

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	Once constructed, habitat in the created habitat areas will need to be maintained through ongoing revegetation or slashing.	and 2. Annually for the first five years following the completion of construction.	(Created Habitat Areas 1, 2). After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum. 2. Monitoring of vegetation will be conducted in autumn and spring. 3. Replace any failed plantings. 4. Increase planting density by planting additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody); as required. 5. Control any weeds invading terrestrial habitat by hand, or spot treatment methods with frog sensitive herbicides. 6. Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from wetlands/waterways and ponds. 7. Identify and remove barriers to frog dispersal. 8. Where relevant gross pollutant traps and/or sediment filters will be checked and, if necessary, subsequently cleaned, particularly after heavy rain or storm events.	
		As required, based on conditions.	1. Increasing the intensity of feral animal controls. 2. Additional refuge sites such as rocks, logs and dense low-lying vegetation will be added if it is considered, during site monitoring, that the area of shelter is insufficient. 3. Routine maintenance of grassed areas within the reserve area around the periphery of the waterbodies. 4. Monitor the level of any public disturbance in and around Growling Grass Frog habitat and manage accordingly (e.g. fencing repairs and signage). 5. Revise mitigation and monitoring measures in agreement with responsible authorities, if necessary.	
1 and ongoing	**13. Pest plant monitoring and control.** It is important to ensure that any weed control works using herbicides are both targeted (i.e.	Monitoring quarterly for two years, then biannually.	Monitoring of created habitats will be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas (Created Habitat Areas 1, 2). After the fifth year, monitoring frequency will be determined based on the results of the first five years, and conducted every second year, at minimum.	3.1 5.3.5 5.3.10

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	spot spraying) and undertaken at the right time of the year. Where possible, weeds will be controlled by hand or with the use of implements.	Ongoing pest plant controls as required	1. Where possible, weeds will be controlled by hand or with the use of implements. 2. Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant; 3. When used in riparian areas, will be directly sponged or wicked onto weeds to minimise off target damage. 4. Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March). 5. Any weed control works must be completed in a manner that minimises soil disturbance. 6. Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen. The following species must not be introduced into Created Habitat Areas 1 and 2 or included in the list of suitable species to be planted in order to avoid the risk of constructed wetlands becoming choked with vegetation; • Narrowleaf Cumbungi *Typha domingensis* • Broadleaf Cumbungi *Typha orientalis* • Lesser Reed-mace *Typha latifolia* • Common Reed Phragmites australis • Tall Spike-rush *Eleocharis sphacelate* If these species are observed within Created Habitat Areas 1 and 2 during habitat monitoring a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and support open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.	
1 and ongoing	**14. Water quality monitoring.** A monitoring program has been designed to identify any	Both immediately prior to and during	1. A water quality monitoring site will be established at two sites within the constructed wetland prior to the commencement construction immediately following the completion of the constructed wetlands.	3.10.3

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	potential reduction in water quality if conditions deteriorate from the baseline (pre-construction) water quality conditions.	the development works, as required	2. Trigger values will be established and based on pre-construction water quality within the constructed wetland. Given that there is no long-term water quality data for the constructed wetland the following trigger values will be used: • If turbidity is >20% than 40.0 (upper target value); • If nitrogen is >1.0 mg/L; • If phosphorous is >0.1 mg/L; • If electrical conductivity is >1% above 5.0 mS/cm (target value c. <5.0 mS/cm); • If dissolved oxygen concentration is <1% of the background condition recorded in adjacent wetlands known to contain a population of GGF (Sparrovale / Baenches); • If pH ±0.5pH unit from targeted range (target range between 6.0 – 8.5pH); and, • All other water quality parameters (including any nutrients or heavy metals) have not substantially exceeded the GGF Habitat Design Standard parameters (i.e. no statistically significant difference (alpha >0.05). 3. Water quality monitoring will be conducted on a monthly basis as soon as approvals are granted, prior to commencement of construction, to establish any relevant background conditions. 4. Weekly monitoring will be undertaken until the water quality conditions return to background conditions or within SEPP Waters of Victoria (WoV) objectives (EPA 2003).	
1 to 5	**15. Growling Grass Frog Population Monitoring** Surveys will be conducted to assess the impact of the development and/or monitor the suitability of a site's management regime.	Annually during the development and for the first 5 years following the completion of construction	Each monitoring event will comprise diurnal and nocturnal surveys. 1. At least 4 nights of surveys will be conducted; at least two in the early part of the active season (to collect data when calling and mobility is high) and two later in the season (when reproductive output is greatest i.e. tadpoles, metamorphs). 2. Tadpole surveys will be undertaken annually for the first five years post-development, and conducted every second year, at minimum, from the fifth year. 3. Monitoring of created habitats will be undertaken every six months for the first two years during the development, and annually for the entire 10-year management period.	3.10.1 5.2

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
			Contingency management actions provided above will be implemented if a population trigger event occurs (Section 6.2) and informed by all monitoring results, including population, habitat and water quality. The trigger events were developed with reference to the EPBC Act triggers endorsed for Growling Grass Frog populations at other offset sites and sites containing a significant population (Ecology and Heritage Partners 2022). There are currently no guidelines for determining unacceptable population change and total. Local extinction risk is more commonly measured by the probability of occupied wetlands declining below a threshold, however given only two wetlands are proposed for construction, population levels are considered a more appropriate indicator (DELWP 2017). 4. If, after implementation of contingency management actions, monitoring results indicates a continued decline in the Growling Grass Frog population or degradation of Growling Grass Frog habitat, the OMP will be re-evaluated and adapted accordingly.	
2 and ongoing	**16. Management of Constructed Wetland Hydroperiod** Water levels will be checked monthly over the species breeding season (October to March).	Following completion of construction of wetland and ongoing	Design features and active management to be implemented: 1. Balog Channel water will be the initial water source for the constructed wetlands. Groundwater and direct rainwater will be the primary ongoing water source for the constructed wetlands, with recycled water providing a supplementary water source. 2. The wetlands will contain a drainage outlet at the lowest point of the waterbody for removing some or all water from the system. 3. Water levels will be checked monthly over the species breeding season (October to March). 4. Depth gauges will be installed in all ponds, and wetland depth will be monitored monthly for the first two years following construction.	3.7
2 and ongoing	**17. Management of Wetland Hydroperiod** Water levels will be actively checked monthly over the species breeding season (October to March).	Following completion of construction of wetland and ongoing	Design features and active management to be implemented: 1. Water quality and levels within the constructed wetland will be regularly monitored as part of the monitoring program outlined in the Section 3.10.1. 2. A depth gauge will be installed in the constructed wetland.	3.7 3.10
1 to 10	**18. Annual Monitoring Reporting and Review.**	Annual reporting as required	1. The annual audit will outline the progress of the CMP implementation and identify any key issues and management responses.	3.11

Year	Objective	Timing of activity	Standard to be achieved	Related section(s)
	A summary of the results of all monitoring procedures, habitat creation (i.e. wetlands) and any maintenance activities will be provided to DCCEEW on an annual basis throughout the 10-year implementation of the CMP.		2. Management actions may need to be amended or updated if new information becomes available, or if management actions are considered inappropriate or inadequate for the long-term persistence of Growling Grass Frog within the site. 3. New information may become available through ongoing monitoring procedures or following review of ongoing reporting submitted to DCCEEW. Recommendations based on this information will be provided to the responsible land manager. 4. In addition to revisions triggered by adaptive management, additional changes to this CMP may be required following the EPBC Act assessment and approval process. Any proposed amendments or deviations to the actions and requirements of this CMP must be approved by DCCEEW, and the plan must be updated with any approved changes.	

4 RISK ASSESSMENT

An assessment of potential risks associated with the objectives of this plan are outlined within Table 8. All risks are considered manageable and actions within subsequent sections of this CMP address relevant risks.

4.1 Risk Assessment Matrix

A risk-based assessment has been undertaken to identify the potential threat the planned future development poses on the existing Growling Grass Frog population and associated habitats.

The adopted framework involved the following steps:

- Establish context. Set the context for the risk-based assessment through the identification and definition of values.
- Identify potential impacts and issues. Review potential effects and the identification of possible causes of changes to environmental values.
- Consequence analysis. Assess the consequences of identified effects assuming the effective implementation of risk reduction through elimination, mitigation and management. The criteria for determining the consequence of impacts are outlined below (Table 6). In some instances, the consequence criteria may produce inconsistent designations (i.e. an impact may be assessed as widespread but readily reversible). In these instances, the technical specialists used their professional judgement to determine the overall consequence on the ecological value.
- Frequency analysis. Estimate the frequency or likelihood of a change to environmental values occurring assuming the effective implementation of risk reduction. The criteria for determining the likelihood of impacts are outlined below (Table 7).
- Analyse residual risk. Analyse the risk of change to environmental values occurring using qualitative or quantitative techniques that define risk as follows: Risk = Consequence x Likelihood. The risk evaluation matrix is provided below.
- Risk reduction. Identify risk reduction controls and measures (avoidance, mitigation and management measures).

The results of the risk assessment are provided in below.

Table 6. Qualitative criteria for likelihood and consequence

Descriptor	Description
Likelihood	
1 - Almost Certain	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is expected to occur more than once over the duration of the development.
2 - Likely	A hazard, event and pathway exist, and harm has occurred in similar scenarios and is likely to occur at least once over the duration of the development.
3 - Possible	A hazard, event and pathway exist, and harm has occurred in similar scenarios and may occur over the duration of the development.

Descriptor	Description
4 - Unlikely	A hazard, event and pathway exist, and harm has occurred in similar scenarios but is unlikely to occur over the duration of the development.
5 - Rare	A hazard, event and pathway are theoretically possible on this project and has occurred to a limited extent in similar scenarios but is not anticipated over the duration of the development.
Consequence	
Negligible/Very Low	Where impacts from development will not result in any impacts to Growling Grass Frog or the environment. Negligible impacts are localised and temporary in nature, with no noticeable consequences
Minor	Where a risk from development will not adversely affect Growling Grass Frog or the environment, provided management actions are implemented. Minor impacts are noticeable but localised to the project footprint and short-term in nature. They can be effectively mitigated through standard mitigation measures. Values affected by Minor impacts are generally recognised as being important at a local or regional level.
Moderate	Moderate impacts directly or indirectly affect Growling Grass Frog or the environment within the broader project locality and are short or moderate term in nature. Impacts can be ameliorated with specific mitigation measures.
High	Occurs when proposed activities are likely to exacerbate threatening processes. High impacts are substantial and significant changes that affect Growling Grass Frog or the environment within the project locality and are moderate to long-term in nature. Impacts are potentially irreversible and avoidance through appropriate design responses or the implementation of specific mitigation measures is required.
Major	Arises when an impact will potentially cause irreversible or widespread harm to Growling Grass Frog or the environment that is irreplaceable because of its uniqueness or rarity. Major impacts are significant or irreversible changes that affect the Growling Grass Frog or the environment.

Table 7. Risk Evaluation Matrix

		Increasing Likelihood				
		Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Negligible/Very Low	Very Low	Very Low	Very Low	Low	Moderate
	Minor	Very Low	Low	Low	Moderate	Moderate
	Moderate	Low	Low	Moderate	High	High
	High	Low	Moderate	High	Major	Major
	Major	Moderate	High	Major	Major	Major

Table 8. Risk Assessment Results

Risk	Potential Consequence(s)	Risk Assessment Matrix Score	Management Options to Minimise Risk
Construction of a barrier to movement between the study area, Sparrovale Wetlands and Baenches Wetlands	• Decline or loss of Growling Grass Frog population on site • Loss of genetic diversity of the population	**Moderate** Likelihood: Unlikely Consequence: High	• Provision of a dedicated movement corridor • Provision of additional breeding habitat
Introduction or spread of Chytrid fungus	• Chytrid fungus infection • Death of Growling Grass Frog individuals • Decline or loss of Growling Grass frog population on site • Decline or loss of Growling Grass frog populations outside the study/offset areas (i.e. within surrounding wetlands)	**High** Likelihood: Possible Consequence: High	• Implement hygiene protocols (Section 5.1, Attachment D) • Monitor health and abundance of Growling Grass Frog population within the study area • Regular water quality monitoring • Constructed wetlands to be 'anti-chytrid' (high >50% rock cover, moderate salinity up to 5000 µS/cm, water temperatures between 18 to 27°C, and warm shallows between 24 to 27°C) in order to minimise the risk of Chytrid fungus within the wetlands and therefore minimise the risk of this disease spreading to surrounding wetlands (Sparrovale/Baenches) and associated frog populations. This risk will also be minimised through the implementation of extensive hygiene protocols (as per Murray et al. 2011).
Decline in water quality within constructed wetlands	• Decline of Growling Grass frog population on site • Reduced breeding activity and recruitment within constructed wetlands • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**Moderate** Likelihood: Unlikely Consequence: High	• Installation and routine maintenance of sediment and erosion controls in key areas • Installation of rock banks, boulders and logs to stabilise soils in affected areas. • Habitat augmentation. • Establishment of water quality monitoring sites within constructed waterbodies immediately following wetland construction completion. Monitoring will be conducted every 4 months for two years post-construction to ensure sediment controls and other water quality issues are managed. Water quality monitoring will follow the program outlined in the GGFCMP (Appendix 5), and remedial action will be triggered if water quality parameters are detected to be outside the suitable range for Growling Grass frog (as specified in the Hygiene Protocols (Murray et al.

			2011) and Habitat Design Standards (DELWP 2017).
Wetlands dry over summer	• Decline of Growling Grass frog population on site • Reduced breeding activity and recruitment within constructed wetlands • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**Low** Likelihood: Unlikely Consequence: Moderate	• Wetlands will be regularly filled in order to retain water over the entire breeding season. Depth gauges will be installed in all wetlands, and wetland depth will be monitored monthly for the first two years following construction. If required (i.e. water levels are recorded at or below 0.5 metres during Spring and Summer), supplementary groundwater will be delivered into the wetlands to ensure adequate water levels are maintained. This supplementary water is unlikely to be required due to the proposed adequate waterbody depth (between 1.5 and 4 metres) and design (clay-lined for water retention), and due to the utilisation of reliable depth gauges and water delivery systems. Additionally, a water balance (inflows, outflows, evaporation etc.) will be undertaken for each wetland to determine the required depth, and will be based on historical rainfall simulation modelling over a 10-year period (i.e. 2024-2033).
Growling Grass Frog killed during development works on site	• Death of individual Growling Grass Frog leading to Decline of Growling Grass frog population on site	**Moderate** Likelihood: Unlikely Consequence: High	• Salvage and relocation procedures will be initiated to reduce the occurrence of death, injury or displacement of individuals • Salvage and relocation measures will be undertaken both immediately prior to and during the development works, as required • Salvage measures will be undertaken by a qualified zoologist experienced with these operations • Salvage will involve a suitably qualified Zoologist actively searching for frogs immediately prior to, and during habitat improvement works
Frogs fail to successfully migrate into constructed wetlands.	• Decline of Growling Grass frog population on site • Loss of genetic diversity of the population due to reduced recruitment from outside the study area	**High** Likelihood: Possible Consequence: High	• Waterbodies to be designed and constructed in accordance the Growling Grass Frog Habitat Design Standards (DELWP 2017) • Population monitoring to be undertaken annually during the development,for the first 5 years following the completion of construction of the Growling Grass Frog habitat areas, and a minimum of every two years until year 10

			• Monitoring of created habitats to be undertaken every six months for the first two years during the development, and annually for the first five years following the completion of construction of the Growling Grass Frog habitat areas • If frogs do not successfully migrate from effluent pond 1 and existing habitat during the breeding season migration period, they will be relocated by a qualified zoologist prior to habitat removal
Chemical/petroleum spill and hard rubbish dumping	• Decline of Growling Grass frog population on site • Loss of genetic diversity of the population due to reduced recruitment from outside the study area • Increased Mortality • Degradation of Growling Grass Frog Habitat quality	**Low** Likelihood: Rare Consequence: High	• Equipment to be regularly serviced and inspected daily. • Personnel to undergo adequate training in equipment usage • Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc.; • Chemical treatments (for rectifying acidity or alkalinity in the event of a spill); • Once-off intensive hard litter removal (if required between normal maintenance schedules). • Spill kits maintained on site in areas where chemicals are stored and in construction areas
Disturbance by persons entering the constructed wetland habitat	• Degradation of habitat • Rubbish dumping • Mechanical disturbance of vegetation from trampling • Weed invasion • Introduction of Chytrid fungus • Accidental spillage of chemicals	**Moderate** Likelihood: Possible Consequence: Moderate	• Exclusion fencing • Regular Weed Management • Informative signage • Community awareness and education
Increased pest plants and animals	• Weed growth can smother frog habitat • Degradation of habitat • Predation of Growling Grass Frog by pest animals such as foxes and feral cats • Invasion of introduced fish, particularly Eastern	**Low** Likelihood: Unlikely Consequence: Moderate	• Implementation of weed and pest animal Management Plan • Weed control works monitored regularly • Regular monitoring of habitat and evidence of pest animals • The control of pest animals such as foxes and feral cats

	Gambusia and Carp leading to Growling Grass Frog eggs and tadpoles being consumed by invasive fish • Decline or loss of Growling Grass frog population on site • Loss of genetic diversity of the population due to reduced recruitment from outside the study area		• Ongoing monitoring to identify waterbodies invaded by introduced fish. • Assessment of feral predators within the Growling Grass Frog habitat area prior to the commencement of construction • If evidence of foxes or feral cats is found, appropriate control measure to be implemented immediately • Destroying any dens discovered on site • Drainage outlet installed for removing some or all water from the system within the habitat corridor. The water would be pumped to surface and then allowed to flow to the Sparrovale wetland • Ongoing monitoring to identify ponds invaded by introduced fish to inform if draining is required • Planting of additional native vegetation, or conversely, removal of wetland vegetation if it is smothering the waterbody
Noise and Light Pollution	• Disturbance of Growling Grass Frog breeding activity • Decline of Growling Grass frog population on site	**Low** Likelihood: Possible Consequence: Minor	• Compliance with Geelong City Council's Building Works – Local Law requirements (2014) • No additional lighting directed towards the created waterbodies
Erosion and sedimentation	• Decline in water quality • Reduced recruitment/breeding within constructed waterbodies	**Low** Likelihood: Possible Consequence: Minor	• Installation and routine maintenance of sediment and erosion controls in key areas • Installation of rock banks, boulders and logs to stabilise soils in affected areas • Increase maintenance and monitoring operations in affected areas until problem areas are improved.

5 RISK MANAGEMENT AND CONTINGENCY PLANNING

This section identifies a range of management actions to ensure that the constructed wetland habitat area and habitat to be removed (prior to its removal) is maintained to appropriate standards. If any of these circumstances arise, this section outlines the management responses required in order to ensure habitat within the site continues to support the species. Adaptive management is paramount to the successful implementation of this CMP.

It should be noted that this section does not aim to identify an exhaustive list of possible stochastic events and subsequent resolutions, but a select number of key issues based on existing knowledge gained through the implementation of other Growling Grass Frog CMPs across the greater Melbourne and Geelong region.

Some issues that are likely to require contingency measures are provided.

5.1 Disease Transmission and Spread

There is evidence to suggest that the decline of many frog species in Australia and elsewhere could be related to the disease caused by the water-borne fungal pathogen, commonly referred to as Chytrid Fungus. Chytrid Fungus is a major threat to amphibian populations in Australia, with at least one species driven to extinction and populations of other threatened species, particularly L. raniformis, severely compromised (DEWHA 2006). The disease that results from Chytrid Fungus infection causes significant physical and physiological problems for frogs, such as skin flaking, reduced food intake, cardiac arrest and mortality (Peterson 2012). Infection of amphibians with the fungus is listed as a 'key threatening process' under the EPBC Act.

There is an inherent risk of spreading the fungus within and between areas in the landscape by the movement of infected frogs and tadpoles, water, soil and vegetative material, the outcome of which can be extremely deleterious if it is introduced into Growling Grass Frog populations presently free of the disease. Human activities and movements can exacerbate the risk of disease spread, and as such hygiene protocols for vehicles, equipment, footwear, handling, holding and transporting of frogs and tadpoles are paramount.

Such hygiene protocols will be implemented throughout the construction works. The Hygiene Protocol (Murray et.al. 2011) will be used to guide best practice Chytrid management. This document is provided as Attachment D, and includes, but is not exclusive to the following.

- All footwear and equipment (e.g. nets, buckets, callipers, headlamps, waders), will be thoroughly cleaned and disinfected before entering and exiting the constructed wetland habitat;
- Any equipment used to handle frogs and tadpoles will be cleaned and disinfected between each sample;
- A new pair of disposable latex gloves will be used between each frog and tadpole. Gloved hands will be dipped in the local water in the immediate area so that loss of skin secretions is minimised when frogs are picked up;

- Frogs will be placed into new and clean plastic sample bags, with a 'one bag– one frog' policy. Bags will not, under any circumstances, be reused;
- The tyres of all vehicles will be cleaned and disinfected before entering and exiting the constructed wetland habitat (if required);
- The tyres/tread and other parts of machinery and plant (e.g. the excavator bucket; pumps) involved in the habitat construction and associated activities, will be cleaned and disinfected before entering the construction area of the constructed wetlands habitat; and
- Disinfection methods will follow the procedures outlined in the Hygiene Protocol.

5.2 Population Decline

Local frog populations are known to vary on spatial and temporal scales depending upon habitat conditions at a particular site. For the site as a whole, regular population monitoring will determine if the Growling Grass Frog population is no longer present. Obvious causes of decline will be rectified if possible and as close as possible to the time of detection. Some of these actions may include:

- Habitat augmentation, such as the installation of additional rocks and other refuge features;
- Planting of additional vegetation, or conversely, removal of wetland vegetation (if it is smothering the waterbody);
- Identification and removal of barriers to dispersal; and,
- Increasing the intensity of feral animal controls.

5.2.1 Growling Grass Frog Population Targets and Contingency

Contingency management actions will be activated if unacceptable monitoring cycle/s occurs (Table 9). If, at the end of the annual surveys, the results indicate a trigger event in the Growling Grass Frog population or significant degradation of Growling Grass Frog habitat, the OMP will be re-evaluated and adapted accordingly, and adaptive management actions will be undertaken.

Some management actions that may be required to be undertaken by the proponent or council include:

- Installation of additional refuge sites if considered necessary;
- Clean out wetlands to remove silt or other debris, or to rectify chemical imbalances;
- Minimise and control erosion or active sources of sedimentation;
- The implementation of water quality improvement measures which could include supplementary vegetation planting or installation of additional rock beach or screen areas;
- Control or eradication of pest animal species throughout the constructed wetland area;
- Maintain permanent signage within and throughout the constructed wetland area adjacent to pathways, to identify dogs to be on leash throughout the area, and no fishing or introduction of fish into wetlands.

Contingency management actions provided above will be implemented if a population trigger event occurs (Table 9) and informed by all monitoring results, including population, habitat and water quality. The trigger events were developed with reference to the EPBC Act triggers endorsed for Growling Grass

Frog populations at other offset sites and sites containing a significant population (Ecology and Heritage Partners 2022). There are currently no guidelines for determining unacceptable population change and total. Local extinction risk is more commonly measured by the probability of occupied wetlands declining below a threshold, however given only two wetlands are proposed for construction, population levels are considered a more appropriate indicator (DELWP 2017).

Table 9. Growling Grass Frog population triggers for contingency management actions

Type	Trigger
Action	Failure of Growling Grass Frog to colonise the wetland site. In the event that <3 individuals are recorded across the entire offset site for each of the first two years.
Action	Failure of Growling Grass Frog to achieve a viable population at the wetland site. In the event that <8 individuals are recorded across the entire offset site on both the third and fourth breeding seasons following commencement of the OMP.
Action	An annual decline of ≥10% in any three successive years in the number of individuals recorded during annual surveys across the entire offset site.
Action	A cumulative decline of >25% in annual average number of individuals recorded across the entire offset site during annual surveys over any successive two or three-year period. This action is not triggered if the >25% decline occurs over one-year as seasonal variation is common and does not necessarily indicate a critical issue.

5.3 Degradation of Habitat

The degradation of Growling Grass Frog habitats can occur through a wide range of active and passive processes. Typical processes contributing to habitat degradation include:

- Lack of adequate maintenance;
- Ongoing erosion and sedimentation;
- Chemical and/or hard rubbish influx following flood events;
- Increased weed encroachment into areas of indigenous or planted terrestrial and aquatic vegetation
- Vegetation trampling, removal and/or dieback; and,
- Low water levels and/or poor water quality.

Significantly degraded habitat is unlikely to support Growling Grass Frog, as it reduces the dispersal and breeding opportunities which would normally be facilitated by areas of non-degraded habitat. Any evidence of habitat degradation will be noted as part of the monitoring program (Section 3.10) and management response actions will depend on the type of process that is causing a reduction in overall habitat quality for Growling Grass Frog. Potential processes leading to habitat degradation and possible responses are detailed in the following sections.

5.3.1 Erosion and sedimentation

The following procedure will be undertaken:

- Installation and routine maintenance of sediment and erosion controls in key areas;
- Installation of rock banks, boulders and logs to stabilise soils in affected areas; and,
- Increase maintenance and monitoring operations in affected areas until problem areas are improved.

5.3.2 Chemical and/or hard rubbish influx following flood events

The following procedure will be undertaken:

- Engage a specialist contractor, as required, to clean up contaminants such as oil spills, etc.;
- Chemical treatments (for rectifying acidity or alkalinity in the event of a spill);
- Inspection of all drainage points leading to the waterbody for chemical spills, leaks, and rectify where necessary; and,
- Once-off intensive hard litter removal (if required between normal maintenance schedules).

5.3.3 Vegetation dieback

The following procedure will be undertaken:

- Increase maintenance and monitoring operations in affected areas; and,
- Replace dead vegetation as required.

5.3.4 Unauthorised site access and significant dumping of hard rubbish

The following procedure will be undertaken:

- Maintenance of protective fencing and addition of signage; and,
- Once-off intensive hard litter removal (if required between normal maintenance schedules).

5.3.5 Management and Maintenance

The ongoing maintenance of ponds and wetlands, particularly the maintenance of aquatic vegetation diversity and structure and terrestrial habitats will be essential to ensure these habitat types become and remain suitable for the species. Once established, ponds and wetlands are expected to be self-sustaining. Maintenance of created habitats will be implemented every six months for the first two years post habitat and vegetation installation, and on an annual basis thereafter.

- If necessary, additional vegetation will be planted to ensure that habitat with waterbodies and terrestrial habitats remains suitable;
- Additional refuge sites such as rocks, logs and dense low-lying vegetation will be added if it is considered during site monitoring, that the area of shelter is insufficient;
- Routine maintenance of grassed areas around the periphery of the waterbodies;
- Wetlands will be kept free of predatory fish, such as Eastern Gambusia and Redfin. The ongoing monitoring program will identify invaded ponds and subsequently instruct managers that draining is required;

- Where possible, weeds will be controlled by hand or with the use of implements. Alternatively, a frog sensitive herbicide (non-residual herbicide) will be selectively used. The use of other herbicides or pesticides within, or in close proximity to ponds, wetlands/waterways, shelter sites and likely dispersal areas will be prohibited;
- Building material and other unwanted materials (e.g. plastic, polystyrene) will be removed from the constructed wetland. The removal of rubbish is particularly important over the first few years during pond and wetland establishment, however refuge habitat such as woody debris must remain in place, as covered in section 3.9; and,
- Where relevant, gross pollutant traps and/or sediment filters will be checked every 6 months and cleaned when required, particularly after heavy rain or storm events.

5.3.6 Long Term Wetland Maintenance

The clean out of constructed waterbodies will typically be required every 15–20 years to remove sediment and build-up of organic material, or as considered necessary from annual habitat monitoring inspections. For this purpose, ponds and wetlands/waterways will have a 150 millimetre diesel pump to draw down the water level where possible.

Clean-out will only be undertaken once ponds and wetlands have been assessed by a water quality expert and it is determined that sediment build-up and organic matter has accumulated to the point necessary to require clean-out. Clean-out will be undertaken in a staged approach (i.e. cleaned out gradually over a couple of years).

Prior to wetland clean-out, a suitably qualified zoologist will be consulted to give advice in relation to the appropriateness of such actions in terms of the potential impacts the operations may have on tadpoles in the waterbodies and/or resident frog populations. Wetlands and ponds must be re-established with a diversity of wetland plants and refuge sites if these habitat features are disturbed during the draining process.

5.3.7 Pest Fish Management

In areas that are subject to routine flooding, where the incursion of fish is unavoidable, the provision and maintenance of dense submerged and floating aquatic vegetation can increase Growling Grass Frog recruitment and survival rates by providing a greater amount of submerged cover for eggs and tadpoles. While it is preferred that all waterbodies be kept fish-free, in an urban setting the introduction of fish through routine flood events, dispersal of fish eggs by birds or artificial introduction by residents, is likely. However, if Eastern Gambusia is observed within the constructed waterbodies, the protocols outlined in section 3.4.1 will be implemented that may include draining the wetland outside of the Growling Grass Frog active season (i.e. Spring and Summer) to remove this species from the wetland system.

5.3.8 Trenching

Any trenches left open overnight must be backfilled in intervals of approximately 10 metres, in order to provide temporary escape ramps for any fauna which may fall in. If trenches are left open overnight, checks for trapped fauna must be made in the morning, prior to any works commencing on-site. Fauna salvage activities must be undertaken by a qualified fauna handler, under a current Management Authorisation.

5.3.9 Signage

Temporary signage will be installed along the perimeters of all existing Growling Grass Frog wetlands in order to:

- Prevent accidental entry by construction personnel; and,
- Discourage vegetation trampling, introduction of fish into wetlands or waterways, rock disturbance and rubbish ingress by construction workers during the construction phase.

All signage will be maintained until construction works are complete.

Permanent signage will be installed at key locations near the constructed wetlands habitat in order to:

- Educate local residents about the presence of Growling Grass Frog;
- Discourage vegetation trampling, rock disturbance and rubbish ingress and prohibit rubbish dumping within the wetland area; and,
- Exclude public access to the constructed wetland habitat.

5.3.10 Pest Plant Control

The control of pest plants within dedicated Growling Grass Frog habitat is a major requirement for management, as habitat within the site is under continual pressure from the invasion of introduced grasses and weeds (e.g. Artichoke Thistle *Cynara cardunculus* and African Boxthorn *Lycium ferocissimum*). Excessive weed growth can smother and reduce the quality of frog habitat for breeding and foraging. In order to control and/or eradicate these weed species, several on-going techniques can be used including physical removal, brush cutting and herbicide application. Herbicide must only be applied to weeds by using the spot-spraying technique, in order to prevent off-target issues.

It is important to ensure that any weed control works using herbicides are both targeted (i.e. spot spraying) and undertaken at the right time of the year, as this can also reduce the requirement for future weed control activities.

The following controls apply to all on-site weed control works:

- Weed management must be undertaken throughout all open space areas, with particular attention given to vegetated areas which are not subject to routine maintenance;
- Any weed control works must be completed in a manner that minimises soil disturbance;
- Herbicide use must be minimised to avoid adverse effects on frogs and invertebrates;
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- Where herbicides are used, selective application is preferable to broad area application;
- Non-residual herbicides must not be used;
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen; and,

Weed control works must be monitored regularly to assess their effectiveness and follow-up / evaluation works must be completed. With any weed control works it is important to establish a cover of native species as soon as possible to occupy the newly vacated environment. While native species will naturally re-colonise such areas, so will exotic species if weed seed is present in soil.

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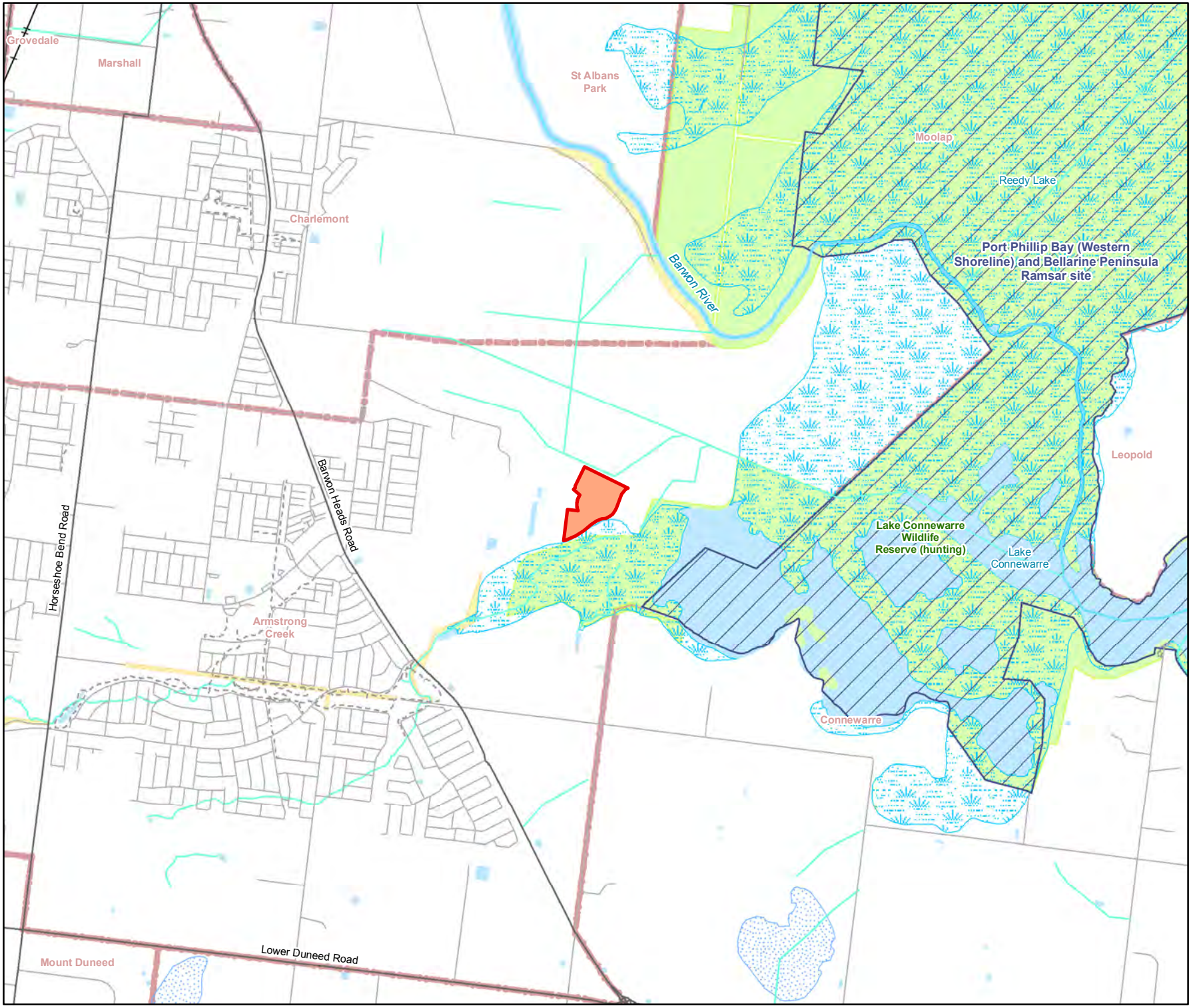
FIGURES



Legend

- Study Area
- Railway
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Ramsar wetland
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Growling Grass Frog Conservation Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 250 500

Metres

Map Scale: 1:2,500,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

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Legend

- Study Area
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Existing dams
- Survey sites
- Growling Grass Frog foraging habitat
- Growling Grass Frog foraging habitat impact area

Figure 2

Proposed development plan

Growling Grass Frog Conservation Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 75 150

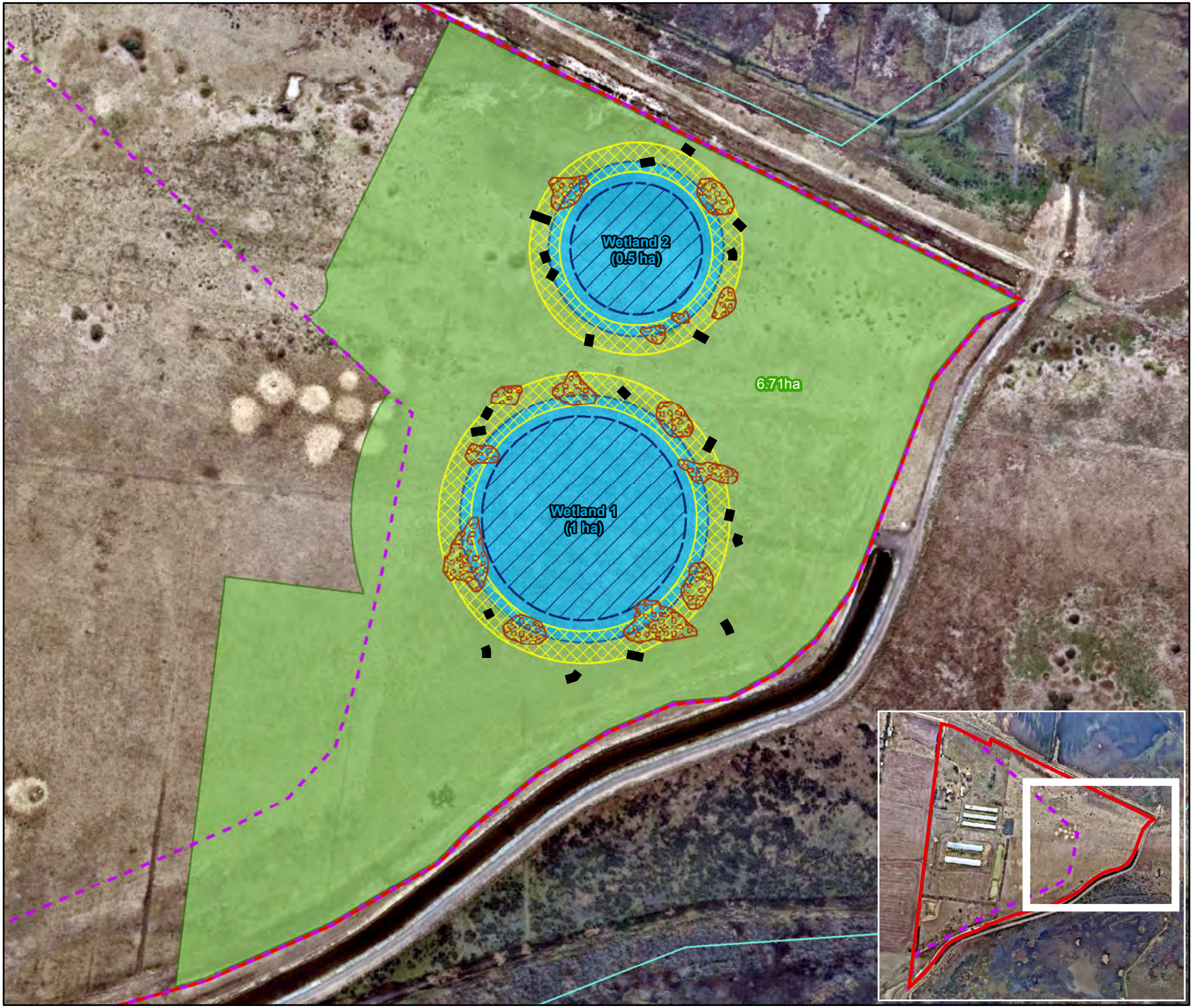
Metres

Map Scale: 1:5,200 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_DevPlan_GGF 11/10/2023 dvaladares

Aerial source: Nearmap 2022



Legend

- Study Area
- ESO2 extent
- Proposed Constructed Wetland Offset Areas
- Proposed Constructed Terrestrial Habitat Offset Area
- Deep water submergent vegetation zone (>1.5m)
- Emergent vegetation zone
- Rock beds
- Logs and woody debris

Figure 3

Conservation Management Plan for Growling Grass Frog

Growling Grass Frog Conservation Management Plan for 78-88 Groves Road, Armstrong Creek

0 30 60
Metres

Map Scale: 1:2,300 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig03_CMP_GGF 11/10/2023 dvaladares

Aerial source: Nearmap 2022

ATTACHMENTS

ATTACHMENT A - INDUCTION PAMPHLET

Staff and contractor induction: Growling Grass Frog at 78-88 Groves Road, Armstrong Creek

Background

Growling Grass Frog is listed as vulnerable under the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act) and threatened under the Victorian ***Flora and Fauna Guarantee Act 1988***. The species is also protected under the ***Wildlife Act 1975***.

This species of frog has been recorded at an effluent pond at 78-88 Groves Road, Armstrong Creek. Due to the proposed works, extensive measures are required to avoid and minimise the occurrence and extent of potential impacts to Growling Grass Frog individuals, populations, and the species, that may be associated with the proposed action, are required. One of these measures is to undertake the salvage and relocation of individuals from the disturbance footprint, during all activities related to habitat removal and earthworks.

Both Commonwealth and State referral authorities are involved in this project, and it is imperative that all persons working at 78-88 Groves Road, during the aforementioned activities, assume a duty of care to avoid and minimise impacts to Growling Grass Frog.

Species description

Growling Grass Frogs:

- Are bright emerald to dull green frog, with brown to gold blotches and a warty back (Plate 1 and Plate 2);
- Can vary in size from 55 – 100 mm depending upon maturity;
- Are active during the months of September to April, and generally inactive during the rest of the year (hiding under logs and rocks, in soil cracks, in dense vegetation);
- Make a distinctive call, resembling 'growling' or a far-off motorbike, between October and December;
- Can be found in a range of habitats including, creeks, drainage lines, wetlands, dams, quarry holes; and
- Can move quite long distances during the active season (e.g. 2 km);

Plate 1. Growling Grass Frog ***Litoria raniformis***

Plate 2. Growling Grass Frog ***Litoria raniformis***

Salvage and Relocation

At least two zoologists will be on site during initial disturbance associated with each filling stage. The zoologists will guide all persons managing and undertaking these activities, and will salvage and relocate any individuals encountered. No persons other than the zoologists are to intervene with the salvage and relocation activities, unless specifically requested to do so by the zoologists.

What to do if you find a Growling Grass Frog

Should a Growling Grass Frog be encountered by persons on site other than the zoologists engaged to carry out the salvage and relocation, the following protocol applies:

1. The person encountering the frog will report it to the site supervisor, upon which a stop works will be initiated. The zoologist will be contacted immediately.
2. No one may attempt to capture the frog unless it is directly within harm's way. If possible, a photo of the frog will be taken and sent it to the zoologist via mobile phone messaging for identification.
3. If feasible, the zoologist will attend the site, and capture and relocate the frog, in accordance with all procedures and protocols outlined in the Salvage and Relocation Plan.
4. If this is not feasible, the site supervisor will use the emergency frog handling kit available at the quarry's site office, to capture the frog and place it in the container provided, until the zoologist can attend to assess the frog and relocate it.
5. The emergency frog handling kit will include:
    - At least 3 plastic holding containers, 20 x20 centimetres in size, sealable but with adequate aeration (i.e. several holes in the lid of the container to provide some air flow);
    - A box of disposal latex gloves;
    - A laminated fact sheet of how to handle and store the frog.

Contacts at Ecology and Heritage Partners Pty Ltd for this project are: Alex Wilkinson, Consultant Zoologist, 03 9377 0100 or 0447 025 323 or Aaron Organ, Director, 03 9940 1411 or 0425 873 159

ATTACHMENT B - FROG HANDLING KIT FACT SHEET

Emergency Growling Grass Frog (GGF) Handling Kit and Instructions

Growling Grass Frogs are only to be captured and placed in to the container provided if it is in harm's way and/or if the project zoologist has instructed you to do so.

Step 1 Is it a GGF?

Is it a bright emerald to dull green frog, with brown to gold blotches and a warty back?

Is it between 55 – 100 mm?

Does it look something like this?

Step 2 Call the project zoologist

Ecology and Heritage Partners Pty Ltd 03 9377 0100; Alex Wilkinson 0447 025 323 or Aaron Organ, 0425 873 159

Step 3 Capture the GGF

Put on a new pair of disposal gloves.

Take the plastic holding container provided with you.

Capture the frog and immediately place it in the holding container.

Place the lid on the holding container, if possible, place a small amount of plant material from where you captured the frog into the container.

Step 4 Store the GGF

Place the container with the frog in a cool, dark environment, completely out of harm, until the zoologist arrives.

Do not store the frog for any greater than 2 hours.

Step 5 Dispose equipment

Dispose of the gloves and the plastic holding container used.

Ensure that there are enough provisions for another event.

Inventory of the Handling Kit

At least 3 plastic holding containers, 20x20 centimetres in size, sealable but with adequate aeration (i.e. several holes in the lid of the container to provide some air flow).

A box of disposal latex gloves.

This laminated fact sheet of how to handle and store the frog.

ATTACHMENT C - WETLAND VEGETATION SPECIES

Table C1: Species List of Recommended Plants for Revegetation

Botanical Name	Common Name
Fringing and emergent	
Calystegia sepium	Large Bindweed
Carex appressa	Tall Sedge
Carex fascicularis	Tassel Sedge
Carex gaudichaudiana	Fen Sedge
Crassula helmsii	Swamp Crassula
Epilobium billardierianum	Smooth Willow-herb
Glyceria australis	Australian Sweet-grass
Lachnagrostis filiformis	Common Blown-grass
Lycopus australis	Australian Gypsywort
Melaleuca ericifolia	Swamp Paperbark
Poa labillardierei var. *labillardierei*	Common Tussock-grass
* *Potamogeton ochreatus*	Blunt Pondweed
Ranunculus amphitrichus	Running Marsh Flower
Emergent	
Alisma plantago-aquatica	Water Plantain
Amphibromus fluitans	River Swamp Wallaby-grass
Baumea articulata	Jointed Twig-sedge
Cladium procerum	Leafy Twig-sedge
* *Eleocharis acuta*	Common Spike-sedge
Juncus amabilis	Hollow-rush
Juncus gregiflorus	Green Rush
Juncus procerus	Tall Rush
Juncus sarophorus	Broom Rush
Persicaria decipiens	Slender Knotweed
Persicaria praetermissa	Spotted Knotweed
Persicaria subsessilis	Hairy Knotweed
Ranunculus inundatus	River Buttercup
Schoenoplectus tabernaemontani	River Club-sedge
Submergent	
Ceratophyllum demersum	Hornwort
Myriophyllum caput-medusae	Coarse Water-milfoil
Myriophyllum crispatum	Upright Water-milfoil
Myriophyllum simulans	Amphibious Water-milfoil
Potamogeton crispus	Curly Pondweed
Floating Submergent	
Carex gaudichaudiana	Fen Sedge
Hydrocotyle sibthorpioides	Shining Pennywort
Lythrum salicaria	Small Loosestrife

Botanical Name	Common Name
Neopaxia australasica	White Purslane
* *Ottelia ovalifolia*	Swamp Lily
Potamogeton ochtreatus	Blunt Pondweed
Potamogeton pectinatus	Fennel Pondweed
Rumex bidens	Mud Dock
* *Triglochin procerum*	Water Ribbon (emergent form)
* *Vallisneria americana*	Ribbon-weed
Villarsia reniformis	Running Marsh Flower

* Indicates highly desirable vegetation for Growling Grass Frog
\# Limit use of this species, as it may become invasive

ATTACHMENT D - BEST PRACTICE GUIDELINES FOR THE MANAGEMENT OF CHYTRID FUNGUS (MURRAY *ET.AL*. 2011)

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

JCU JAMES COOK UNIVERSITY

A REPORT FOR THE AUSTRALIAN GOVERNMENT DEPARTMENT OF SUSTAINABILITY, ENVIRONMENT, WATER, POPULATION AND COMMUNITIES

Hygiene protocols for the control of diseases in Australian frogs

June 2011

Prepared by:

[1]Kris Murray, [1]Lee Skerratt, [2]Gerry Marantelli, [1]Lee Berger, [3]David Hunter, [4]Michael Mahony and [5]Harry Hines

Author Affiliations

[1] School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Queensland
[2] Amphibian Research Centre, PO Box 1365 Pearcedale, Victoria 3912
[3] Environment Protection and Regulation, New South Wales Office of Environment and Heritage
[4] School of Environmental and Life Sciences, The University of Newcastle, NSW
[5] Ecological Assessment Unit, Conservation Management Branch, Queensland Parks and Wildlife Service

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Cover photo: *Taudactylus eungellensis* – Eungella day frog. K. Murray

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> Murray, K., Skerratt, L., Marantelli, G., Berger, L., Hunter, D., Mahony, M. and Hines, H. 2011. Hygiene protocols for the control of diseases in Australian frogs. A report for the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

Table of Contents

Hygiene protocols for the control of diseases in Australian frogs

1. Who should use this document?

- This protocol is intended for use nationally by conservation agencies, zoos, scientific research staff, industry organisations (e.g., the pet industry), wildlife consultants, fauna surveyors, students, frog keepers, wildlife rescue and carer groups, frog interest groups/societies and other key interest groups who regularly deal with or are likely to encounter frogs.

- This protocol outlines the expectations of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) regarding precautionary procedures to be employed when working with frogs in Australia. The protocols were developed in collaboration with recognised experts in the fields of wildlife health, husbandry, research and conservation. The intention is to promote implementation of hygiene procedures by all individuals working with Australian amphibians.

- DSEWPaC recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation should accompany any licence applications or renewals submitted to the relevant regulatory bodies for independent consideration. Variations should follow a risk analysis process which broadly involves hazard identification, risk assessment, risk management and risk communication.

Where *ex-situ* activities are proposed, these guidelines should be used in conjunction with the "**Guidelines for captive breeding, raising and restocking programs for Australian frogs**", which can be found here: http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11**.**

2. Objectives

The objectives of the hygiene protocols are to:

- Improve the control of diseases in Australian frogs
- **Improve preparedness for an emergency response** to new amphibian disease incursions in Australia
- **Recommend best-practice procedures** for personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs
- **Suggest workable strategies** for those regularly working or considering working in the field with frogs or where frogs may exist
- **Provide background information** and guidance to people who provide advice or supervise frog related activities
- **Inform regulatory bodies and animal care and ethics committees** for their consideration when granting permit approvals

3. Introduction

Amphibians have declined globally. In the first global amphibian assessment, at least 43% of amphibian species with sufficient data were found to have declined in recent decades, 34 species were extinct and a further 88 were possibly extinct (Stuart et al. 2004). In 2010, approximately 30% of amphibians were threatened globally (http://www.iucnredlist.org/documents/summarystatistics/2010_4RL_Stats_Table_1.pdf).

Diseases are responsible for many amphibian declines and extinctions and their risk needs to be addressed. Laurance et al. (1996) first proposed the 'epidemic disease hypothesis' to account for Australian amphibian declines. Shortly after, an unknown chytridiomycete fungus was seen infecting the skin of sick and dying frogs collected from montane rain-forests in Queensland and Panama during mass mortality events associated with significant population declines (Berger et al. 1998; Longcore et al. 1999). The fungus was subsequently found to be highly pathogenic to amphibians in laboratory trials by inducing development of skin pathology, morbidity and mortality similar to that seen in the wild frogs. The disease was called chytridiomycosis and the fungus described as a new species *Batrachochytrium dendrobatidis* (Bd), also known as the amphibian chytrid fungus.

Bd has been found infecting over 350 species in two amphibian orders (Anura and Caudata) from all continents where amphibians occur (http://www.bd-maps.net/). Sixty-three (~28%) of Australia's 223 (as listed by IUCN 2008) amphibian species are now known to be wild hosts for Bd (Murray et al. 2010a; Murray et al. 2010b), and over half of Australia's species may be naturally susceptible to Bd in the wild (Murray et al. 2011; Murray and Skerratt in press).

While the discovery of chytridiomycosis has sparked renewed appreciation for the role that diseases can play in threatening wildlife populations and species, it is not the only disease currently affecting amphibians, nor is it likely to be the last. Ranavirus, for example, has been observed to induce mass mortality events in frog and salamander populations in the UK and North America. In response to these global threats, the World Organisation for Animal Health (OIE) has listed both chytridiomycosis and ranavirus as "notifiable" diseases to help control their spread. Similarly, numerous conferences and reports have been assembled to produce standards in managing diseases in wild and captive amphibian populations. Together, these measures highlight the importance of developing **agreed hygiene protocols for the control of diseases in Australian frogs**. This document fulfils this role.

4. Key disease issues in amphibian populations

Here we review the most significant diseases of amphibians, including some that have zoonotic potential and some that have not been detected in Australia. There are many described diseases of amphibians but only a few are known to be an important threat to wild amphibians or other taxa including humans. Some become an issue in captive amphibian populations where management is inadequate. As research on this topic is limited, there are also likely to be many unknown diseases of amphibians which may pose a risk. Disinfection methods have not been validated for all pathogens. Any risk management strategy to minimise the impact of diseases of amphibians should take into account this uncertainty. For detailed reviews see Hemingway et al. (2009) and Berger et al (2009) for diseases in wild populations and Wright and Whitaker (2001) that also includes diseases in captivity.

4.1. Fungi

4.1.1. *Batrachochytrium dendrobatidis*

Batrachochytrium dendrobatidis (Bd) is a fungal pathogen capable of driving amphibian species to perilously low numbers or extinction. In Australia, the oldest record of Bd is from a museum frog specimen collected in south-east Queensland near Brisbane in 1978 (Department of the Environment and Heritage 2006a), which coincides with sudden frog declines in a number of species and two species extinctions in the region (Berger et al. 1998; Hines et al. 1999). Subsequent amphibian declines in central coastal Queensland (1985-86) and the Wet Tropics (1990-95) suggest that *B. dendrobatidis* spread north to its current northern limit at Big Tableland near Cooktown (Laurance et al. 1996; Berger et al. 1999; Skerratt et al. 2010). In southern Australia, the spread of *B. dendrobatidis* is poorly documented but its distribution extends down the entire east coast to Tasmania (first detected in 2004) (Obendorf and Dalton 2006; Pauza and Driessen 2008). Two separate foci occur in other states, one in southwest Western Australia, where the earliest record dates to 1985, and another around Adelaide in South Australia (earliest record 1995) (Murray et al. 2010a). The Northern Territory is currently considered amphibian chytrid free (Skerratt et al. 2008; Skerratt et al. 2010; Murray et al. 2011).

In the majority of infected animals for most of the time, clinical signs of chytridiomycosis are absent. The period of showing signs is typically short and mostly limited to those amphibians that die. Central nervous system signs predominate, including behavioural change, slow and uncoordinated movement, abnormal sitting posture, tetanic spasms, loss of righting reflex and paralysis. Skin changes associated with chytridiomycosis are typically microscopic and not detectable at the clinical level with any degree of confidence, although abnormal skin shedding occurs (skin shed more frequently and in smaller amounts) and erythema (tissue reddening) of ventral surfaces and digits may be seen. For what to do if you encounter a sick or dead amphibian in Australia, see section 6.7. below. For a detailed factsheet about chytridiomycosis, see the Australian Wildlife Health Network website (http://www.wildlifehealth.org.au/AWHN/FactSheets/Fact_All.aspx).

4.1.2. *Mucor amphiborium*

This fungus is an important cause of morbidity and mortality in platypus in Tasmania and amphibians are a potential reservoir host (Gust et al. 2009). Amphibian mucormycosis is a systemic disease caused by the fungus, *Mucor amphibiorum*. Severely infected amphibians have fungi disseminated through their internal organs and skin. The fungi incite formation of granulomas that consist of inflammatory cells and fibrous tissue. At postmortem, the liver contains small pale nodules up to about 5 mm in diameter and usually in massive numbers. These nodules can also be seen in other organs such as the kidney, lung, mesentery, urinary bladder, subcutaneous sinuses and skin. The microscopic fungi are found inside these nodules. *M. amphibiorum* is a primary pathogen and can infect normal amphibians, but in the wild it appears to cause only sporadic infections. Possibly the usual inoculating dose in the wild is not high enough to cause epidemic disease. In captivity it can cause fatal outbreaks in collections. For more information on mucormycosis, see http://www.jcu.edu.au/school/phtm/PHTM/frogs/mucor/mucoramphibiorum.htm.

4.1.3. Oomycetes

Water moulds (family Saprolegniaceae, phylum Oomycota) are ubiquitous in surface water. High levels of infection with *Saprolegnia ferax* caused mortality of Western toad (*Bufo boreas*) egg masses in northwestern United States and were sufficient to affect local populations (Kiesecker et al. 2001). Epidemics may be associated with fish stocking or environmental cofactors.

4.2. Viruses

There are a number of viruses that are known to cause disease and mortality in amphibians, including ranaviruses, frog erythrocytic virus, Lucké tumor herpesvirus, herpes-like virus of skin, calicivirus and leucocyte viruses (Hemingway et al. 2009). In Europe and America the most important of these for their ability to cause mass mortalities and potentially population declines are the ranaviruses (Hyatt et al. 2000). Ranaviruses have been identified in a range of ectothermic vertebrates, including fish, amphibians (frogs, toads, salamanders) and reptiles (lizards, turtles, snakes). Some species can infect a broad host range across all these taxa.

Ranaviral disease is an emerging infectious disease overseas as it is being detected over an increasing geographic range and in more species (Hemingway et al. 2009). While ranaviral disease in wild amphibians has not been frequently observed in Australia, antibodies to ranaviruses have been detected widely (NSW, Qld, NT) in cane toads (*Bufo marinus*) (Zupanovic et al. 1998). Bohle iridoviris (BIV) was first found causing death in wild caught metamorphs of *Limnodynastes ornatus* and has since been detected in wild, moribund adult *Litoria caerulea* from Townsville and captive juvenile *Pseudophryne coriacea* from Sydney (Speare et al. 2001; Cullen and Owens 2002). Laboratory studies in Australia have also shown that cane toads (*Bufo marinus*) and a range of native frogs are susceptible to BIV (Speare et al. 2001). Tadpoles appear the most susceptible, while juvenile frogs were more susceptible than adults. Data on the geographical origin and time of emergence or introduction of ranaviruses in Australia is not known. Ranaviruses not currently found in Australia can cause disease in native Australian amphibians in experimental challenges; for example, Venezuelan Guatopo virus was able to kill *Litoria caerulea* in experimental trials (http://www.jcu.edu.au/school/phtm/PHTM/frogs/otherdiseases-viruses.htm). We need to prevent the introduction of pathogenic ranaviruses into Australia.

Clinical signs of acute ranaviral disease may be seen in tadpoles, metamorphs, juveniles and adults. In general, amphibians infected with ranavirus may show decreased activity, ascites (accumulation of fluid in the peritoneal cavity), anasarca (accumulation of serous fluid in various tissues and cavities of the body), skin ulceration, focal and systemic haemorrhages and death. For what to do if you encounter a sick or dead amphibian in Australia, see section 6.7. below. For a detailed factsheet about ranaviral disease, see the Australian Wildlife Health Network website (http://www.wildlifehealth.org.au/AWHN/FactSheets/Fact_All.aspx).

4.3. Bacteria

The range of bacteria reported as causing disease in amphibians is small. Bacterial septicaemia can cause significant disease in captivity. Infection with Aeromonas spp., non-haemolytic group B Streptococcus, Flavobacteria and chlamydia have caused outbreaks in captive amphibians and Mycobacteria can cause chronic problems. Another group of bacteria can be carried by amphibians with minimal effect and are potentially capable of causing

infections in humans (zoonotic diseases). Salmonella and Leptospira are in this category and are a potential risk to humans, livestock and domestic pets, see below.

4.4. Myxozoa

Myxosporean parasites (*Myxidium* spp.) in the brain and liver of declining Australian frogs, the Green and Golden Bell frog (*Litoria aurea*) and the Southern Bell frog (*Litoria raniformis*), have recently been reported to be associated with disease and may have a significant impact on wild frogs (Hartigan et al. 2011).

4.5. Mesomycetozoa

Ichthyophonus sp. occurs the USA where it is often an incidental finding in tadpoles, frogs and salamanders but may cause morbidity and mortality. It infects muscles and adult frogs with massive infections become lethargic and emaciated. Massive acute lethal infections with numerous mortalities occur infrequently in ranid larvae (D. Green, unpubl., Mikaelian et al. 2000)

4.6. Alveolates

A *Perkinsus*-like organism is a major cause of mortality events in tadpoles in the US. Occurs predominantly in tadpoles of *Rana* spp. and may cause mortality rates of 80-99% in a pond over the course of 2-6 weeks (Davis et al. 2007). Weakly swimming, bloated and floating tadpoles are found.

4.7. Zoonotic Diseases

Guidelines for preventing human exposure to amphibian disease are available at the Centre for Disease Control website- http://www.cdc.gov/healthypets/animals/reptiles.htm

4.7.1. *Salmonella*

Amphibians may carry pathogenic *Salmonella* species, but rarely show signs of disease (Anver and Pond 1984). Prevalence of salmonellas isolated in clinically normal amphibians is generally greater than 10% and bacterial levels can be high (Sharma et al. 1974). In Australia, *Salmonella* were isolated from 12.7% (19/150) of *B. marinus* collected from the wild and 9 serotypes were identified. All nine had previously been isolated in Australia from humans and livestock (O'Shea et al. 1990). An outbreak of gastroenteritis in humans near Rockhampton possibly originated from green tree frogs (*Litoria caerulea*) contaminating drinking water in rainwater tanks (Taylor et al. 2000). Some strains of salmonellae are cosmopolitan while others are not found in Australia, but could be imported.

4.7.2. *Leptospira*

Leptospira are spirochaetal bacteria that usually invade the kidney of vertebrates and are excreted in the urine. Humans and domestic animals are susceptible to various strains of *Leptospira* usually from the species *Leptospira interrogans*. Serious acute and chronic disease occasionally with death can result. Little is known about the occurrence of *Leptospira* in amphibians, and on their significance as reservoir hosts for leptospirosis in humans. No studies appear to have been done on leptospires in amphibians in Australia. However in

Barbados, toads (*Bufo marinus*) and frogs (*Eleutherodactylus johnstonei*) were found to be reservoirs for serovars of *Leptospira* pathogenic to humans (Gravekamp 1991).

4.7.3. *Spirometra erinacei*

The adult stage of the tape worm *Spirometra erinacei* inhabits the small intestine of carnivores such as the cat, dog, fox and dingo. The first larval stage occurs in copepods and the second larval stage (spargana) are long, flat white worms that can infect amphibians and other vertebrates in muscles and under the skin. Sparganosis occurs in around 5% of Australian frogs and heavy burdens are associated with severe disease (Berger et al. 2009). Sparganosis is a public health problem in Asia, usually occurring as subcutaneous or intramuscular infections. Humans become infected by drinking water with infected copepods, eating undercooked frogs, and the worms can also migrate from frog flesh into skin wounds

5. National and border biosecurity

Unregulated trade in animals, as well as unintentional shipment, is suspected to have been a major contributor to the spread of emerging infectious diseases such as chytridiomycosis (Skerratt et al. 2007). There are numerous bodies and regulatory levels that attempt to provide guidance about how to minimise the risk of pathogen spread and transmission in amphibians.

5.1. World Organisation for Animal Health (OIE)

The World Organisation for Animal Health (OIE) lists key diseases as "notifiable" to promote the reporting and management of diseases among member countries. Preventing the spread of amphibian diseases across international borders is important, and both chytridiomycosis (Article 8.1.1) and ranavirus (Article 8.2.1:) are now listed as notifiable diseases in the OIE Aquatic Animal Health Code (http://web.oie.int/eng/normes/fcode/). To access these codes, follow these links:

- **Chytridiomycosis**: http://web.oie.int/eng/normes/fcode/en_chapitre_1.8.1.pdf
- **Ranavirus**: http://web.oie.int/eng/normes/fcode/en_chapitre_1.8.2.pdf

The codes outline recommendations for the "**Importation or transit of *aquatic animals and aquatic animal products* for any purpose from a country, zone or compartment"**:

- **Provided commodities are treated in a manner that inactivates the disease agent (Bd or ranaviruses),** Competent Authorities should not require any disease conditions when authorising the above activities, regardless of the disease status of the exporting country
- However, in cases where it could otherwise reasonably be expected that commodities pose a risk of Bd or ranavirus transmission, a risk assessment should be carried out in accordance with the recommendations in the Aquatic Code. The exporting country would then be notified of the outcome of the risk assessment before trade commences.

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Where commodities do not meet this condition and/or a reasonable risk remains, there are additional requirements that depend on the disease status of the country, zone or compartment.

Freedom from disease:

Importation of live aquatic animals from a country, zone or compartment declared free from disease (Bd or ranavirus) requires an **international aquatic animal health certificate** issued by the Competent Authority confirming disease free status.

- A country may make a **self declaration of freedom from disease** (Bd or ranaviruses) if one of the following conditions is met:

    1. It has no amphibians or other susceptible species AND basic biosecurity conditions have been continuously met for a period of 2 years
    2. There has been no observed occurrence of the disease for at least the past 10 years despite conditions that are conducive to its clinical expression AND basic biosecurity conditions have been continuously met for a period of 10 years
    3. Targeted surveillance has been in place for at least the past 2 years without detection of disease (Bd or ranaviruses) AND basic biosecurity conditions have been continuously met for a period of 2 years
    4. For a country that previously made a self declaration of freedom from disease, it may regain that status after detection of the disease if the affected area was declared an infected zone and a protection zone was established AND infected populations have been destroyed or removed from the infected zone by means that minimise the risk of further spread of the disease AND the appropriate disinfection procedures have been completed AND if the conditions of 3.) above are met.

- A zone or compartment may also be declared free from disease by the Competent Authority if it meets similar conditions to the above. Where a zone or compartment extends over more than one country, declarations must be made by all the Competent Authorities involved.

- A disease free status can be maintained if basic biosecurity conditions are continuously maintained. Targeted surveillance may be discontinued provided conditions that are conducive to clinical expression of disease exist. However, in infected countries and in all other cases where conditions are not conducive to clinical expression of disease, zones or compartments can only maintain a disease free status if targeted surveillance is maintained.

Unknown or known infected country, zone or compartment:

For the importation of live aquatic animals and aquatic animal products for any purpose (e.g., aquaculture, processing for human consumption, use in animal feed, agricultural, laboratory, zoo, pet trade, industrial or pharmaceutical use):

In general, the Competent Authority of the importing country should

- require an **international aquatic animal health certificate** stating the commodities have been appropriately treated to inactivate disease agents
- OR undertake a risk assessment and apply appropriate risk mitigation measures

The risk assessment and risk mitigation measures will vary with purpose of the importation or transit of commodities. Please see the Aquatic Code at the links provided above for more details.

5.2. AUSVETPLAN and AQUAVETPLAN

In Australia, management of animal disease emergencies normally defaults to protocols outlined in the Australian Veterinary Emergency Plan (AUSVETPLAN - http://www.animalhealthaustralia.com.au/programs/eadp/ausvetplan/ausvetplan_home.cfm) or the Australian Aquatic Veterinary Emergency Plan (AQUAVETPLAN - http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan). However, few of the diseases for which specific plans have been developed concern diseases of free-ranging wildlife. No amphibian diseases are currently included in AUSVETPLAN or AQUAVETPLAN.

5.3. Key Threatening Process and Threat Abatement Plan (TAP)

Chytridiomycosis was listed as a Key Threatening Process in Australia in 2002. A Threat Abatement Plan (TAP) for infection of amphibians with chytrid fungus resulting in chytridiomycosis was subsequently prepared by representatives of the Commonwealth Government. These documents can be accessed here:

- **Key Threatening Process:** http://www.environment.gov.au/biodiversity/threatened/ktp/frog-fungus.html
- **TAP:** http://www.environment.gov.au/biodiversity/threatened/publications/tap/chytrid.html
- **TAP Background document:** http://www.environment.gov.au/biodiversity/threatened/publications/tap/pubs/chytrid-background.pdf

Recommendation 1.1.3 of the TAP proposes that a risk-based approach be used for chytridiomycosis using AUSVETPLAN as a model (Department of the Environment and Heritage 2006b). However, this has not progressed. Nation-wide mapping protocols and disease risk models have been developed as suggested in the TAP and should serve as the basis for cost-sharing arrangements between states and for setting research and management priorities (Skerratt et al. 2008; Murray et al. 2010a; Murray et al. 2010b; Skerratt et al. 2010; Murray et al. 2011). Implementing this step remains a priority.

5.4. Biosecurity Australia

Risk analysis performed by Biosecurity Australia in **“Quarantine requirements for the importation of amphibians or their eggs into zoological facilities”** and **“Quarantine requirements for the importation of amphibians or their eggs for laboratory purposes”** (Animal Biosecurity Policy Memorandum 2003/26) does not list chytridiomycosis as a risk since it is endemic in Australia. However, this disregards the risk of importation into chytrid free areas or the introduction of novel strains. Although chytridiomycosis is not specifically mentioned, the general hygiene strategies recommended should still prevent the release of imported strains of *B. dendrobatidis* during the initial two years. After two years the amphibians can be released without testing for *B. dendrobatidis*. However, if being released into a chytrid free area, the same requirements imposed on Australian bred amphibians under the Threat Abatement Plan would apply.

Risk analysis performed by Biosecurity Australia in **"Quarantine requirements for the importation of amphibians or their eggs into zoological facilities"** and **"Quarantine requirements for the importation of amphibians or their eggs for laboratory purposes"** (Animal Biosecurity Policy Memorandum 2003/26) mentions ranaviruses:

- "The veterinary certificate must… certify that… for both live amphibians or amphibian eggs…, as far as can be determined, no case of ranavirus infection (including frog virus 3, Redwood Park virus, Regina ranavirus), or ranid herpesviruses has been diagnosed at the premises of origin during the 12 months prior to certification."

Importation of amphibians must meet the requirements of two Commonwealth departments, 1) Department of Agriculture, Fisheries and Forestry (DAFF) and 2) the DSEWPaC. The relevant documents can be accessed here:

- **DAFF:**
  Zoological facilities - http://www.jcu.edu.au/school/phtm/PHTM/frogs/aqis/2003-26a.pdf
  Laboratory purposes - http://www.jcu.edu.au/school/phtm/PHTM/frogs/aqis/2003-26b.pdf
- **DSEWPaC:** http://www.environment.gov.au/biodiversity/wildlife-trade/index.html. This site also has the requirements for export of amphibians from Australia.

6. Hygiene management

Hygiene management issues can be broadly classed into *in-situ* (field based) and *ex-situ* (facility based) categories. While general **isolation and disinfection** hygiene management principles apply to both, greater detail on '**Guidelines for captive breeding, raising and restocking programs for Australian frogs'** can be found here: http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11.

6.1. In-situ (site) hygiene management

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Numerous hygiene guidelines for handling wild frogs exist, including Daszak et al. (2001), NSW NPWS (2008), NWHC (2001), Speare et al. (2004) and CCADC (2008). Most recently, Phillott et al. (2010) provide a detailed review and synthesis of hygiene considerations that aim to minimise the risk of exposure of amphibians to pathogens in field studies.

It is important to recognise that humans may aid in the:

- **transmission** (passing of disease from an infected to an uninfected individual), and
- **spread** (movement of disease geographically)

of diseases, within and among amphibian populations For researchers working with amphibians or within areas where amphibians may occur, the risk of disease transmission within these habitats and the spread of disease among populations may be increased due to:

- **movement** of frogs or personnel between isolated areas of habitat or between captive husbandry and laboratory facilities and the field
- **handling** of amphibians

It is therefore essential that personnel working with amphibians or within amphibian habitats take care to minimise disease transmission and spread. In order to do this, it is important that frog workers recognise the boundaries between sites/populations.

This is especially important where **rare, geographically restricted or threatened amphibian species** are concerned and when the spread of diseases can have serious consequences for species survival.

Phillott et al. (2010) recommend that field researchers evaluate their activities to determine the relative risk of pathogen transmission and spread compared with background levels (i.e., the risk posed by other mechanisms of disease transmission or pathogen dispersal) and implement appropriate strategies to minimise this risk during field studies. For a **hygiene protocol checklist and suggested field kit** see section 7. The risk of transmission and spread should also be evaluated by researchers, animal ethics committees and government agencies issuing permits.

6.1.1. Defining a site

Defining the boundary of a site may not be straightforward. In some places, the boundary between sites will be obvious but in others it may not. Undertaking work at a number of sites or conducting routine monitoring at a series of sites within walking distance creates obvious difficulties with boundary definitions. It is likely that defining the boundary between sites will differ among localities.

In general:

- watershed and geographical barriers should be used to designate separate sites
- river/stream tributaries should be considered separate sites
- wetlands, ponds, lakes etc. separated by dry land should be considered separate sites
- upstream locations separated by considerable distance (e.g., 500 m) should be considered separate sites
- any obvious break, barrier or change in habitats should be treated as separate sites, particularly if there is no known interchange of frogs between sites

6.1.2. Determining the order of visitation of multiple field sites

When a field trip encompasses several field sites, or a number of locations are being visited in succession, the order of visitation should be determined according to the presence of known pathogens and diseases.

- **Areas known to be absent of disease should be visited first, followed by areas of unknown status, followed by known infected areas**

6.1.3. On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be taken to minimise the possibility of transfer of disease from personnel, footwear, equipment and/or vehicles. A list of suitable disinfectants, their required concentrations and exposure times for various purposes is summarised by Phillott et al. (2010) and is reproduced in Table 1 below.

Personnel

- **Hands, arms, knees etc. should be cleaned to remove debris and washed** or wiped with a suitable disinfectant. It is preferable to do this before entering the vehicle or moving to another site.

Footwear and clothing

- **Footwear must be thoroughly cleaned and disinfected** at the commencement of fieldwork and between each sampling site. This can be achieved by initially scraping boots clear of mud and standing the soles in a disinfecting solution. The remainder of the boot should be rinsed or sprayed with a disinfecting solution. Clothing that has significant contact with frogs and the environment should also be subjected to changing or cleaning

Disinfecting solutions should be prevented from entering any water bodies. Several changes of footwear/clothing bagged between sites might be a practical alternative to on-site cleaning. In high value sites, dedicated equipment and clothing stored at the entry to the site may be desirable. (e.g., in a lockbox)

Equipment

- Equipment such as nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc. that are used at one site must be **cleaned and disinfected** before re-use at another site
- Disposable items should be used where practical/possible

Non-disposable equipment should be used only once during a particular field exercise and disinfected later or disinfected at the site between uses using procedures outlined below in Table 1.

Vehicles

Transmission of disease from vehicles is generally unlikely to be a problem. However, if a vehicle is used to traverse a known frog site and could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should be cleaned and disinfected. This is particularly important where vehicles are used in areas not normally frequented by other vehicles. Disinfection should be carried out at a safe distance from water bodies to minimise the risk of chemical contamination.

6.1.4. Principles of cleaning and disinfection

Designing an effective disinfection protocol requires understanding of the properties of disinfectants and target pathogens, and practical consideration of the equipment or processes requiring disinfection. As well as understanding the efficacy of various disinfecting processes, it is important to consider the safety of any disinfection protocol to the environment and the animals on which they will be used. Key distinctions include:

- **Cleaning**: The physical removal of all visible organic and inorganic debris from items
- **Disinfection:** A physical (e.g., UV light) or chemical (e.g., bleach) process to reduce the numbers and/or viability of microorganisms (e.g., bacteria, fungi or viruses) on an object, surface or material
- **Sterilization:** A physical or chemical process that removes all microorganisms from an object, surface or material

Thorough cleaning and disinfection reduces most of the risk of transferring amphibian pathogens. Sterilization of objects is labour intensive and less practical for most routine applications.

Cleaning alone does not render an object free of pathogens. However, it is important to thoroughly clean objects prior to disinfection or sterilization.

- Thorough cleaning physically removes many or most pathogens that are trapped in organic debris
- Thorough cleaning makes successful disinfection more likely
- Cleaning allows disinfectants to directly contact the surfaces of an object
- Warm or hot water improves the ability to remove organic materials from objects
- Regular cleaning of all items used should be performed
- Use of detergents aid cleaning by loosening organic material from the surface of objects and help to break apart biofilms of microorganisms that can resist disinfection
- Thorough rinsing of detergents from objects is essential after cleaning

Disinfection of an item by application of an appropriate chemical agent after cleaning reduces pathogen numbers and viability and minimises potential for disease transmission. Things to consider include:

- **Efficacy of the disinfectant and the type of pathogens that must be eliminated.** For example, some microorganisms such as Mycobacterium spp. or Cryptosporidium spp. are very resistant to most common disinfectants
- **The potential for toxicity to amphibians that are exposed to the disinfectant.** Amphibians are very sensitive to some disinfectant residues and thorough rinsing of all disinfectants is required after use
- **Concerns about human exposure to disinfectants and about discharge of disinfectants into the environment**
- **Safety for use on different materials.** Some disinfectants may be corrosive to materials or tools used in amphibian facilities
- **Ease of use and disposal**
- **Cost**

Table 1. Disinfection strategies suitable for killing *Batrachochytrium dendrobatidis, Mucor amphibiorum* and ranaviruses in field studies. From Phillott et al. (2010) and Webb et al. (submitted).

Application	Disinfectant	Strength	Time	Target pathogen
Surgical equipment and other instruments (e.g. scales, callipers)	Benzalkonium chloride	1 mg ml–1	1 min	*B. dendrobatidis*
	Ethanol	70%	1 min	*B. dendrobatidis* Ranaviruses
Collection equipment and containers	Sodium hypochlorite (bleach contains 4% sodium hypochlorite)	1%	1 min	*B. dendrobatidis*
		3%	1 min	Ranaviruses
	Path X or quaternary ammonium compound 128	1 in 500 dilution	0.5 min	*B. dendrobatidis*
		1 in 100 dilution	10 min	*M. amphibiorum*
	Trigene	1 in 5000 dilution	1 min	*B. dendrobatidis*
	F10	1 in 1500 dilution	1 min	*B. dendrobatidis*
	Virkon	2 mg ml–1	1 min	*B. dendrobatidis*
		1%	1 min	Ranaviruses
	Nolvasan	0.75%	1 min	Ranaviruses
	Potassium permanganate	1%	10 min	*B. dendrobatidis*
	Complete drying		>3 h	*B. dendrobatidis*
	Heat 60°C		30 min	*B. dendrobatidis* Ranaviruses
	Heat 37°C		8 h	*B. dendrobatidis*
	Sterilising UV light		1 min	Ranaviruses only
Footwear	Sodium hypochlorite (bleach contains 4% sodium hypochlorite)	1%	1 min	*B. dendrobatidis*
		3%	1 min	Ranaviruses
	Path X or quaternary ammonium compound 128	1 in 500 dilution	0.5 min	*B. dendrobatidis*
		1 in 100 dilution	10 min	*M. amphibiorum*
	Trigene	1 in 5000 dilution	1 min	*B. dendrobatidis*
	F10	1 in 1500 dilution	1 min	*B. dendrobatidis*
	Phytoclean (30% benzalkonium chloride)	0.075%	1 min	*B. dendrobatidis*
		5%	1 min	*M. amphibiorum*
	Complete drying		>3 h	*B. dendrobatidis*
Cloth (e.g. carry bags, clothes)	Hot wash 60°C or greater		30 min	*B. dendrobatidis* Ranaviruses

6.2. Handling of frogs in the field

The spread of pathogens may occur as a result of handling frogs. In addition to spreading disease among captured frogs, handling may stress animals making them more susceptible to infection from other sources or more likely to succumb to infection.

- **Capture, handling and housing of wild amphibians should be minimised or avoided where possible**
- Where handling is necessary, care must be taken to ensure individuals do not have their exposure to pathogens elevated over their background exposure levels.

Direct transfer of pathogens during capture and handling of successive adult amphibians can be reduced by using:

- **single-use gloves** (latex, nitrile or vinyl), and/or
- **single-use lightweight plastic bags**
- **adequate cleaning of hands and handling equipment**

Many researchers use disposable plastic bags to catch and/or restrain frogs followed by handling/processing with disposable gloves. As some tadpoles may suffer lethal effects when exposed to latex, nitrile or vinyl gloves (Cashins et al. 2008), researchers should only use gloves that have been proven or rendered safe (e.g., by rinsing with water) for the study species.

In situations **where gloves are not available or suitable:**

- hand washing with 70% ethanol (allowing hands to dry) between handling individual frogs is acceptable (note, repeated use on human skin is not recommended). Alcohol is toxic to frogs so hands must be washed thoroughly in water after treatment with alcohol
    - If 70% ethanol is not available or suitable, the minimum treatment is hand-washing in the water to which the amphibian is normally exposed.

In situations **where amphibians must be held temporarily:**

- Individuals should be housed in **single-use containers (e.g. plastic bags) or in containers disinfected** between each animal
- Adults should not be held in groups
- Tadpoles from the same water body may be housed for short periods in a common container, although overcrowding should be avoided

Longer holding times (>60 min) will require changes to water and the provision of appropriate food (>24 h). Tadpoles should always be treated with care to prevent damage on capture and with movement of water within holding containers. If animals must be removed from the field for greater periods and later returned, it should always be to the same site.

6.3. Housing frogs and tadpoles

- **Frogs and tadpoles should only be removed from a site when absolutely necessary.**

Detailed **'**Guidelines for captive breeding, raising and restocking programs for Australian frogs' can be found at: http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11. See also 'A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs**'** (Pessier and Mendelson 2010) at: http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

When frogs or tadpoles are to be collected and held for a period of time, the following measures are recommended:

- Isolate animals obtained at different sites
- Aquaria set up to hold frogs should not share water, equipment or any filtration system. Splashes of water from adjacent enclosures or drops of water on nets may transfer pathogens between enclosures
- Ensure that tanks, aquaria and any associated equipment are disinfected prior to housing frogs or tadpoles
- Tanks and equipment should be cleaned, disinfected and dried after frogs/tadpoles are removed

6.4. Marking, invasive and surgical procedures

Strict hygiene standards must be maintained during amphibian marking procedures including implanting internal radio transmitters, passive integrated transponder (PIT) tags, visible implant alphanumeric (VIA) tags, visible implant elastomer (VIE) tags and toe tipping or clipping.

Due to the high permeability of amphibian skin, special disinfectants are required.
The **only suitable, commercially available preparation for disinfecting wounds** is:

- **Bactine®** spray (active ingredient 0.14% w/w benzalkonium chloride and 2.6% w/w lidocaine hydrochloride in a non-alcohol base)
- **Chlorhexidine** (0.75% diluted from 2% Nolvasan®) is also suitable for surgical disinfection
- Alcohol, phenol and iodine based disinfectants **should not be used** because they are potentially toxic and can destroy mucus and wax that prevent dehydration and microbial infection of amphibian skin. Contrary to the recommendations of previous hygiene protocols, Betadine® or other povidone-iodine products are not recommended for use as disinfectants for amphibians until species-specific toxicity has been determined (Phillott et al. 2010).

Toe tipping (removal of most distal phalange) or toe clipping (amputation of a greater proportion of the digit):

- should occur through the **interphalangeal joints**

- Scissors should be **sterilised in 70% ethanol** and dried before use on frogs in the field
- For studies in which diagnostic testing of disease is important, the diagnostic test step (e.g., swabbing for Bd) should be undertaken before any other processing step to minimise the potential for false-positives due to cross contamination

PIT, VIE and VIA tags should be inserted with a **sterile, single-use applicator**.

6.4.1. Sealing wounds

- A c**ryanoacrylate** compound such as Vetbond® (active ingredient n-butyl cryanoacrylate) as a tissue adhesive after toe tipping or clipping is recommended. Vetbond® can also be used to seal incisions made during subdermal injection of VIA, VIE and PIT tags
- A disinfectant such as **Bactine**® should be applied before the adhesive to avoid trapping microbes
- Less expensive industrial adhesives ('superglues') should not be used as a replacement for surgical tissue glues

However, this procedure may only be possible in larger amphibians. In smaller animals, it can be difficult to isolate toes for application and internal marking devices such as PIT tags may be unsuitable. Moisture can interfere with setting times and adhesion so care must be taken to ensure setting has occurred before release. Problems may be experienced in their application to stream- or pond-dwelling amphibians, but can be avoided by using a small piece of sterile absorbent dressing to draw surplus water from the wound before application of the adhesive (Phillott et al. 2010).

6.4.2. Equipment

- Equipment used in marking or surgery should be appropriately **disinfected**
- Disposable sterile instruments should be used where practical/possible
- Instruments should be disinfected or changed in between each frog
- All used **disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed of or sterilised appropriately** at the completion of fieldwork
- Disinfecting solutions must not come into contact with frogs or be permitted to contaminate any water bodies

6.5. Return of captive animals to the wild

- In general, if wild frogs or tadpoles are housed for any period of time in a captive situation (e.g. laboratory, zoo or captive breeding facility), **they should not be returned to the wild**

Exceptions to this can occur if they have been kept in isolation, their captive history is free of undiagnosed morbidity or mortality and they have had rigorous pathogen screening before release. This is usually beyond the means of most studies.

Detailed **'**Guidelines for captive breeding, raising and restocking programs for Australian frogs' can be found at:

http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11. See also 'A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs' (Pessier and Mendelson 2010) at: http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

6.6. Displaced frogs

- **Displaced frogs should be treated as if they are infected and should not be transported anywhere for release to the wild**

Displaced frogs are native frog species and introduced cane toads (*Bufo marinus*) that have been unintentionally transported from one place to another. This may typically occur with the transport of fresh produce and landscaping supplies. 'Banana Box' frog is the term used to describe several native frog species (usually *Litoria gracilenta, L. fallax, L. caerulea, L. rubella, L. infrafrenata* and *L. bicolor*) commonly transported in fruit and vegetable shipments and landscaping supplies. There is risk of spread of disease if these frogs are transferred from place to place.

When encountering a displaced frog:

- Contact a **licensed wildlife carer** organisation to collect the animal. The frog may then undergo a quarantine period along with an approved disinfection treatment
- Post-quarantine, and dependant on local state legislation and policies, the frog may be transferred to a **licensed frog keeper** once permission from the relevant regulatory body has been received. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Frogs held by licensed frog keepers are **not to be released to the wild** except with relevant regulatory body approval

Displaced frogs may also be made available to recognised institutions for research projects, display purposes or offered to a museum as scientific specimens once approval has been provided by the relevant regulatory body.

- **Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs unless they are of a species not local to the area**

Local frogs encountered in these situations should be assisted off roads, away from dwellings, or out of swimming pools preferably to the nearest area of vegetation or suitable habitat.

6.6.1. Cane toads

Cane toads are known amphibian disease carriers and should not be knowingly transported or released to the wild.

If a cane toad is discovered it should be humanely euthanized in accordance with the recommended Animal Welfare procedures. Care should be taken to avoid euthanasia of native species due to mistaken identity.

6.7. Sick and dead animals

Dead amphibians or live animals showing clinical signs of disease must be regarded as having a high infection risk to healthy animals and rigorous hygiene measures are required.

- **Sick and dead frogs should be collected and sent for disease diagnosis**

No effective and practical field treatment for chytridiomycosis has been demonstrated. Similarly, no treatment regimes for ranaviral infection of frogs have been described. The collection of sick and dead frogs for expert diagnosis may improve disease surveillance activities, which can help detect disease introduction and enable emergency responses. It is also useful to assess the risk of pathogen transmission to other individuals or spread to other populations. A procedure for the preparation and transport of a sick or dead frog is given below. Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist determining the extent of the disease and the number of species affected. For more information about sick and dead amphibians, see http://www.jcu.edu.au/school/phtm/PHTM/frogs/pmfrog.htm.

Collection:

- Do not use bare hands to handle sick or dead frogs
- Disposable gloves should be worn when handling sick or dead frogs
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination
- If the frog is dead, keep the specimen cool and preserve as soon as possible to avoid decomposition

Preserving specimens:

- Specimens can be **preserved/fixed in 70% ethanol or 10% buffered formalin**
- Cut open the belly and place the frog in about 10 times its own volume of preservative
- Where no preservative is available, **specimens can also be frozen**. If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can also be sent for analysis (e.g., a preserved foot, leg or a portion of abdominal skin)

Transportation:

- **If the frog is alive and likely to survive transportation**, place the frog into either a moistened cloth bag with some damp leaf litter or into a plastic bag with damp leaf litter and partially inflated before sealing
- Remember to **keep all frogs separated** during transportation
- **If the frog is alive but unlikely to survive transportation** (death appears imminent), euthanize the frog and place the specimen in a freezer or preservative. Once frozen/preserved the specimen is ready for shipment
- **All containers should be labelled** showing at least the species (if known), date and collection location
- Preserved samples can be sent in jars or wrapped in wet cloth, sealed in bags and placed inside a padded box
- Send frozen samples in an esky with dry ice

- Place live or frozen specimens into a small Styrofoam esky. Seal esky with packaging tape before sending
- Send the package by courier and declare any hazardous or flammable contents (e.g., 70% ethanol)

7. Hygiene protocol checklist and field kit

The following checklist and field kit are designed to assist with minimising the risk of transferring pathogens between frogs and sites in field studies (follows NSW 2008)

Have you considered the following questions before handling frogs in the field:

- Has your proposed field trip been sufficiently well planned to consider hygiene issues?
- Have you considered the boundaries between sites (particularly where endangered species or populations at risk are known to occur)?
- Have footwear disinfection procedures been considered and a strategy adopted?
- Have you planned the equipment you will be using and developed a disinfection strategy?
- Are you are planning to visit sites where vehicle disinfection will be needed? If so, do you have a plan to deal with vehicle disinfection?
- Have handling procedures been planned to minimise the risk of frog to frog pathogen transmission?
- Do you have a planned disinfection procedure to deal with equipment, apparel and direct contact with frogs?

If you answered NO to any of these questions please re-read the relevant section of the *Hygiene Protocols for the Control of Disease in Australian Frogs* and apply a suitable strategy.

Field hygiene kit

When planning to survey frogs in the field a portable field hygiene kit should be assembled to assist with implementing the hygiene protocols. Recommended contents of a field hygiene kit would include:

- Plastic box to store field equipment
- Small Styrofoam esky
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle for disinfectants
- Disinfecting solutions
- Scraper or scrubbing brush for cleaning mud off footwear, vehicles etc.
- Bucket for mixing disinfecting solutions and soaking
- Plastic bags, large and small for hygienic temporary animal handling/holding
- Sharps or other container for safe waste disposal
- Materials for dealing with sick and dead frogs (see section 6.7.)

Detailed 'Guidelines for captive breeding, raising and restocking programs for Australian frogs' can be found at: http://www.environment.gov.au/biodiversity/invasive/projects/index.html#threat-10-11. See also 'A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs' (Pessier and Mendelson 2010) at: http://www.cbsg.org/cbsg/workshopreports/26/amphibian_disease_manual.pdf#search=%22amphibian%22

8. Important Australian contacts

8.1. Sick and dead frogs

To arrange receipt and analyse sick and dead frogs, make contact with experts at any of the organisations below prior to dispatching package:

Australian Registry of Wildlife Health
Taronga Conservation Society,
Australia
PO Box 20
MOSMAN NSW 2088
Phone: 02 9978 4749

School of Public Health, Tropical Medicine and Rehabilitation Sciences
James Cook University
Douglas Campus
TOWNSVILLE QLD 4811
Phone: 07 4796 1735

School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308
Phone: 02 4921 6014

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ATTACHMENT E - SITE PHOTOGRAPHS

Photograph E1 – Effluent Pond 1 – existing Growling Grass Frog habitat to be removed.

Photograph E2 – Drainage line and retarding wall immediately adjacent to the south and south-east border of the study area.

Photograph E3 – Saltmarsh in drainage line immediately adjacent to the north and north-east border of the study area.

Photograph E4 – Sparrovale Wetland and drainage line beyond the northern boundary of the study area looking north.

Photograph E5 – Ephemeral waterbody with exposed rock and extensive pugging in the study area. Possible migration path for Growling Grass Frog between effluent pond and proposed constructed wetland.

Photograph E6 – Effluent Pond 2 – Low quality Growling Grass Frog habitat to be removed

APPENDIX 6 – WEED MANAGEMENT PLAN

Final Report

Weed Management Plan: 78-88 Groves Road, Armstong Creek, Victoria.

Prepared for

AC Manager Pty Ltd

November 2023

Ecology and Heritage Partners Pty Ltd

MELBOURNE: 292 Mt Alexander Road, Ascot Vale VIC 3032 **GEELONG:** 230 Latrobe Terrace, Geelong West Vic 3218

BRISBANE: Level 22, 127 Creek Street, Brisbane QLD 4000 **ADELAIDE**: 22 Greenhill Road, Wayville SA 5034

CANBERRA: PO Box 6067, O'Connor ACT 2602 **SYDNEY:** Level 5, 616 Harris Street, Ultimo, NSW, 2007

DOCUMENT CONTROL

Assessment	Weed Management Plan
Address	78-88 Groves Road, Armstong Creek, Victoria
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Project manager	Alex Wilkinson (Senior Zoologist)
Report reviewer	Alex Wilkinson (Senior Zoologist)
Report author	Sarah Hill (Zoologist)
Mapping	Petra Sorensen (GIS Officer)
File name	16303_EHP_WMP_78-88GrovesRd_ArmstrongCreek_Final_09112023
Client	AC Manager Pty Ltd
Bioregion	Otway Plain and Victorian Volcanic Plain
CMA	Corangamite
Council	City of Greater Geelong

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Ecology and Heritage Partners acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

CONTENTS

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by AC Manager Pty Ltd to prepare a Weed Management Plan, which includes a Weed Control Plan, for 78-88 Groves Road, Armstong Creek, as well as a 40-metre long section of Groves Road extending west from the property (the study area). The study area is covered by the Armstrong Creek East Native Vegetation Precinct Plan (NVPP) (SMEC 2010).

A referral (EPBC 2022/09357) to the Commonwealth Minister of Climate Change, Energy, the Environment and Water (DCCEEW) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was submitted to determine potential impacts to matters of National Environmental Significance (NES). On 3 January 2023 it was determined that the proposed action is a controlled action under section 75 and section 87 of the EPBC Act. As such, Ecology and Heritage Partners prepared draft Preliminary Documentation (PD) and an Offset Management Plan (OMP) to address potential impacts, mitigation measures and potential offset strategies associated with two matters of NES (Growling Grass Frog *Litoria raniformis major*; and Spiny Peppercress *Lepidium aschersonii*).

A section of the study area is Growling Grass Frog terrestrial habitat and is proposed for improvement within an on-site Offset Area, and that this land must meet specific standards prescribed by the GGF Habitat Design Standards (DELWP 2017). These design standards state that invasive and exotic species must not be used in the terrestrial and aquatic habitat zones, respectively. Therefore, it is important that Weeds of National Significance (WoNS) and other noxious environmental weed species, in accordance with the *Catchment and Land Protection Act 1994* (CaLP Act), are addressed. The scope of this report is to prepare the following:

- 2-year Weed Management for the residential development area within 78-88 Groves Road, Armstrong Creek, as well as a 40-metre long section of Groves Road extending west from the property;
- 10-year Weed Management for the proposed on-site Offset Area within 78-88 Groves Road, Armstrong Creek, particularly with a focus on the control and management of WoNS and noxious weed species to help enhance the habitat of GGF.

This WMP has been prepared to meet these GGF Habitat Design Standards, and in response to a request for further information provided by the City of Greater Geelong on 9 Jan 2023. Additionally, the WMP is intended to support and supplement the management actions provided in the OMP.

1.2 Objectives

The purpose of this Weed Management Plan is to identify and prioritise control of noxious and high threat weed species to facilitate a program to clean-up and rehabilitate the study area. The objectives of the Weed Management Plan are to:

- Identify the location, species and extent of weed infestation as well as current and/or proposed treatment methods;
- Outline the relevant national and state legislative requirements for pest and weed control;

- Outline mitigation and monitoring measures to control and, if possible, eliminate populations of pest plants and animals within the study area, including the time of year the treatment is to be carried out;
- Protect and secure environmental values within the study area and adjoining habitats, where possible;
- Ensure that the activities in the study area do not exacerbate existing weed impacts, which may in turn cause economic or environmental impacts to surrounding landholders;
- Achieve ecologically appropriate on-ground management of pest species within the study area; and,
- Avoid impacts of pest animal control on non-target species.

1.3 Study Area

The study area comprises the land located at 78-88 Groves Road, Armstrong Creek, as well as a 40-metre long section of Groves Road extending west from the property and is approximately 85 kilometres south-west of Melbourne's CBD (Figure 1). The study area covers approximately 41.48 hectares and is bound by Sparrovale Wetland and private property to the north, private property and Public Land Water Frontage (Armstrong Creek) to the south-east, and private property to the west. The study area includes 8.2 hectares proposed to form an on-site Offset Area to be managed for GGF. Importantly, Baenschs Wetland (which is adjacent to the Armstrong Creek Water Frontage) forms part of a large wetland complex, part of which is protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), as the Port Phillip Bay (western shoreline) and Bellarine Ramsar Site. The Sparrovale Wetland also drains into this site via the Barwon River.

The study area is currently used for agriculture and farming, with a residence, outbuildings, and five broiler sheds on site. Two effluent treatment ponds exist in the centre of the site, and a dam is located in the south-west corner. It is generally flat, with no ridges or crests within or immediately adjacent to the site.

The study area is covered by the Armstrong Creek East Native Vegetation Precinct Plan (NVPP), as part of the Armstrong Creek East Precinct Structure Plan (PSP) (SMEC 2010). According to the Department of Energy, Environment and Climate Action (DEECA) NatureKit Map (DEECA 2023a), the study area is located within both the Otway Plain and Victorian Volcanic Plain bioregion, Corangamite Catchment Management Authority (CMA) and the City of Greater Geelong Council municipality.

2 METHODS

2.1 Nomenclature

Common and scientific names of vascular plants follow the Victorian Biodiversity Atlas (VBA) (DELWP 2022) and the Census of Vascular Plants of Victoria (Walsh and Stajsic 2007). Vegetation community names follow DEECA's Ecological Vegetation Classes (EVC) benchmarks (DEECA 2023b).

2.2 Site Assessment

A site assessment was undertaken on 20 May and 3 June 2022 to determine the presence of native and non-native vegetation in areas affected by the ESO2. An additional field assessment was undertaken on 18 April 2023 to assess the full extent of the road reserve along Groves Road (as shown in Figure 2), as well as private land within 30 metres either side of the road. This private land was assessed from Groves Road.

During these assessments, the study area was walked, with all commonly observed vascular flora and fauna species recorded, the overall condition of vegetation and habitats noted, and all observed exotic flora species recorded (Appendix 3), with significant weed species identified and mapped (including WoNS and CaLP Act noxious weeds). EVCs were determined with reference to DEECA pre-1750 and extant EVC mapping (DEECA 2023a) and their published descriptions (DEECA 2023b). Common and scientific names within this plan follow the Victorian Biodiversity Atlas (VBA) (DELWP 2022).

2.3 Assessment Qualifications and Limitations

This report has been written based on the quality and extent of the ecological values and habitat considered to be present at the time of the desktop and/or field assessments being undertaken.

A comprehensive list of all terrestrial flora and fauna present within the study area was not undertaken as this was not the objective of the assessment. Rather a list of commonly observed species and weeds was recorded to assist in determining the broader biodiversity values present within the study area.

Ecological values identified within the study area were recorded using a hand-held GPS or tablet with an accuracy of +/-5 metres. This level of accuracy is considered to provide an accurate assessment of the ecological values present within the study area; however, this data should not be used for detailed surveying purposes. The terrestrial flora and fauna data collected during the field assessment and information obtained from relevant desktop sources is considered to adequately inform an accurate assessment of the ecological values present within the study area.

3 RESULTS

3.1 Vegetation condition

Several patches of native vegetation, four scattered native trees and scattered occurrences of Tangled Lignum *Duma florulenta* were recorded within the study area as part of the site assessment. The remainder of the study area comprised introduced and planted vegetation, present as pasture grass, native and non-native trees, noxious herbaceous and woody weeds and ornamental gardens (Plate 1).

Native vegetation in the study area is representative of three EVCs: Coastal Saltmarsh (EVC 9), Plains Sedgy Wetland (EVC 647) and Brackish Wetland (EVC 656). The presence of these EVCs is broadly consistent with the modelled extant (2005) native vegetation mapping (DEECA 2023a), with the exception of the presence of Brackish Wetland (EVC 656). The adjacent wetland, saltmarsh systems and poor drainage exacerbated by historical agricultural practices have likely driven the modification process, resulting in the vegetation observed during the field assessment. Patches of Coastal Saltmarsh were in low-moderate condition and were observed along the northern and southern boundaries of the study area, fringing the south-western artificial dam and within and north of the road reserve of Groves Road (Plate 2 and 3). Brackish Wetland was present as one moderate quality patch along a drainage line within the south-western section of the study area (Plate 4) and one patch of Plains Sedgy Wetland was present adjacent to an artificially constructed wetland within private property north of Groves Road.

Areas not supporting native vegetation had a high cover (>90%) of exotic grass species, many of which were direct-seeded for use as pasture. Scattered native grasses were generally absent from the study area.

3.2 Weeds

Non-native areas were dominated by environmental weeds such as Toowoomba Canary-grass *Phalaris aquatica*, Ribwort *Plantago lanceolata*, Couch *Cynodon dactylon var. dactylon* and Kikuyu *Cenchrus clandestinus* (Plate 5). Coastal Saltmarsh within Sparrovale Wetlands comprised a high cover of the environmental weeds Prostrate Knotweed *Polygonium aviculare* and Creeping Saltbush *Atriplex prostrata*, and scattered occurrences of Tall Wheat-grass *Lophopyrum ponticum* (Plate 2).

Noxious weeds, as defined under the CaLP Act, were prevalent throughout the study area, with Artichoke Thistle *Cynara cardunculus*, Spear Thistle *Cirsium vulgare* and African Boxthorn *Lycium ferocissimum* dominating the ground layer throughout the northern areas (Figure 2; Plate 6 and 7). Bathurst Burr *Xanthium spinosum* and Variegated Thistle *Silybum marianum* were also present in patches of moderate density (Figure 2). African Boxthorn is also a Weed of National Significance (WoNS).

Planted non-native and native tree species were common throughout the study area. Ornamental gardens surrounded the residency and entrance driveway (Plate 1) with shelter belts bordering multiple fence lines within the study areas west. The Shelter belts were predominately Radiata Pine *Pinus radiata* or planted native and non-native Eucalyptus species (Plate 8).

A list of priority weed species observed and their status is provided below (Table 1).

Table 1. Priority weed species identified within the study area.

Common Name	Scientific Name	Noxious Status	WoNS	Estimated Cover	Predicted Threat Level	Control Priority
African Boxthorn	*Lycium ferocissimum.*	C	Y	Moderate-High	High	High
Artichoke Thistle	*Cynara cardunculus subsp. flavescens*	C	-	Moderate	High	High
Spear Thistle	*Cirsium vulgare*	R	-	Low-Moderate	High	High
Bathurst Burr	*Xanthium spinosum*	C	-	Moderate	High	High
Variegated Thistle	*Silybum marianum*	R	-	Low	High	High
Tall Wheat-grass	*Atriplex prostrata*	-	-	Low	Moderate	Moderate
Prostrate Knotweed	*Polygonum aviculare*	-	-	Low	Moderate	Moderate
Creeping Saltbush	*Atriplex prostrata*	-	-	Low	Moderate	Moderate
Toowoomba Canary-grass	*Phalaris aquatica*	-	-	Low	Moderate	Moderate
Kikuyu	*Pennisetum clandestinum*	-	-	Low	Moderate	Moderate
Ribwort	*Plantago lanceolata*	-	-	Low	Moderate	Moderate
Green Couch	*Cynodon dactylon var. dactylon*	-	-	Low	Moderate	Moderate

Notes: WoNS= Weeds of National Significance, C = Regionally Controlled; R = Restricted.

Plate 1. Planted ornamental gardens near the residency (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 2. Low quality Coastal Saltmarsh along the study area's northern boundary (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 3. A fringing patch of Coastal Saltmarsh in the South-western artificial dam road (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 4. Patch of sedge-dominant Brackish Wetland within a drainage line along the south-western boundary (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 7. Spear Thistle within the study area (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 8. Planted native Eucalyptus tree with tree guard (Ecology and Heritage Partners Pty Ltd 3/06/2022).

3.3 Pest Fauna Species

There is evidence that the study area is currently occupied by two pest fauna species listed under the CaLP Act. A Red Fox *Vulpes vulpes* was observed within the study area during the site assessment, in addition to an occurrence of fox scat (Plate 9). No burrows were observed within the study area, and it is likely that the fox utilises the study area opportunistically for hunting purposes. Evidence of European Rabbit *Oryctolagus cuniculus* was also observed in the form of scat (Plate 10), and it is likely that they are present in the wider landscape and have the potential to become established in the study area as surrounding agricultural land is developed. Both Red Fox and the European Rabbit are listed as Established Pest Animals under the CaLP Act.

Plate 9. Fox scat within the study area (Ecology and Heritage Partners Pty Ltd 3/06/2022).

Plate 10. European Rabbit scat within the study area (Ecology and Heritage Partners Pty Ltd 3/06/2022).

4 LEGISLATIVE AND POLICY IMPLICATIONS

4.1 Catchment and Land Protection Act 1994

The *Catchment and Land Protection Act 1994* (CaLP Act) contains provisions relating to catchment planning, land management, noxious weeds and pest animals. Under the CaLP Act, landowners are responsible for the control of any infestation of noxious weeds and pest animals to minimise their spread and impacts. Landowners must, to the best of their ability:

- Eradicate regionally prohibited weeds;
- Prevent the growth and spread of regionally controlled weeds; and,
- Prevent the spread of — and as far as possible eradicate — established pest animals on their land.

Declared noxious weeds are plants proclaimed under the CaLP Act because they cause environmental or economic harm or have the potential to cause such harm. Noxious weeds are defined as either State Prohibited (S), Regionally Prohibited (P), Regionally Controlled (C), or Restricted (R). This classification is dependent on the type and level of threat to primary production, Crown land, the environment and community health.

These categories are further defined under the Act as per the descriptions below:

- State Prohibited (S). These weeds do not occur in Victoria, but pose a significant threat if they invade and can reasonably be expected to be eradicated;
- Regionally Prohibited (P). Regionally Prohibited Weeds are not widely distributed in a Region but are capable of spreading further and should be managed with the goal of eradicating them from the Region. Landowners and managers, including public authorities responsible for the management of Crown lands, are responsible for control of these weeds on their lands;
- Regionally Controlled (C). These weeds are usually widespread and are considered important in a particular region. To prevent their spread, continuing control measures are required. Landowners have the responsibility to take all reasonable steps to control and prevent the spread of these weeds on their land and the roadsides that adjoin their land; and,
- Restricted (R). This category includes plants that pose an unacceptable risk of spreading in this State or to other parts of Australia. Trade for these plants is prohibited.

Land managers are required under the CaLP Act to prevent the growth and spread of Regionally Controlled Weeds occurring on the land for which they are responsible. Land managers that do not control Regionally Controlled weeds may be issued with a Land Management Notice or Directions Notice that required specific control work to be undertaken.

Pest animals are classified as either Prohibited Pest Animals (P), Controlled Pest Animals (C), Regulated Pest Animals (R) or Established Pest Animals (E). Pest animals are classified in Victoria as either *not established in the wild* or *established in the wild.* Pest animals that are not established in the wild include prohibited, controlled and regulated pest animals and largely refer to species that would be a *threat to primary production, Crown land, the environment or community health* if they did establish in the wild. These species require a

permit to keep in Victoria. Established pest animals are those species that have established populations in the wild and are *a serious threat to primary production, Crown land, the environment or community health.*

4.1.1 Noxious Weeds Recorded

Five weeds listed as noxious under the CaLP Act were recorded within the study area during the assessment. Three species are Regionally Controlled weeds within the Corangamite Catchment (African Box-thorn, Artichoke Thistle and Variegated Thistle), whilst two are Restricted weeds (Spear Thistle and Variegated Thistle) (Table 1). The spread of listed noxious weeds must be appropriately controlled throughout the study area in accordance with the CaLP Act.

4.1.2 Pest Animals Recorded

There is evidence that the study area is used by two pest fauna species listed under the CaLP Act. There was evidence that Red Fox and European Rabbit visit the site opportunistically, where a Red Fox was recorded during the site assessment, and both fox and rabbit was recorded within the study area. However, there was no immediate evidence of burrows or dens within the study area.

Red Fox and European Rabbit are listed as established pest animals under the CaLP Act.

4.2 Weeds of National Significance (WoNS)

The National Weeds Strategy Executive Committee was established in 1997, which concluded that the greatest impact from weed problems within Australia was related to the effect and spread of specific individual species. On this basis, they developed a list of Weeds of National Significance, commonly known as 'WoNS'.

The determination of WoNS is the first attempt to prioritise weeds over a range of land uses at the national level. WoNS are those weeds that have been identified as already causing significant environmental damage and must be eradicated (i.e. reduced to <1% cover abundance). It is the landowner's responsibility to ensure weeds are controlled to the specified amount under the legislation. Fines or prosecution are possible if landowners do not control weeds within their land.

Sections 70, 70A and 71 of the CaLP Act for all declared noxious weeds, irrespective of category or region, prohibits the:

- Transport of a noxious weed or its propagules within Victoria.
- Deposition on land of a noxious weed or its seeds (DPI 2008).

Priority weeds present in the study area are provided above (Table 1). Contractors undertaking the works should be able to identify plants to species level and should have knowledge of the most appropriate control techniques for the relevant species.

4.2.1 Recorded WoNS

One WoNS, African Boxthorn was recorded within the study area (Table 1). This species was prevalent throughout the study area with an estimated moderate to high cover, and especially dominated the ground layer throughout the northern areas.

This species should be a priority for monitoring and control to ensure its extent does not increase as a result of the project, as they have the potential to outcompete and replace native species, creating uniform dense stands and weed dominated landscapes.

4.3 Flora and Fauna Guarantee Act 1988 (FFG Act)

'The invasion of native vegetation by environmental weeds' is listed as a potentially threatening process under the FFG Act. Section 4 of that Act states that it is the responsibility of all public authorities to have regard to the flora and fauna and management objectives of the Act. The FFG Act also lists the establishment of several environmental weeds as potentially threatening processes, which includes one species recoded within the study area: Tall Wheat-grass. The FFG Act restricts this species from being released or abandoned into the wild in Victoria.

5 MANAGEMENT ACTIONS

Vegetation within the study area contains a range of environmental and noxious weeds, and preventing the further spread of noxious weeds and invasive fauna species is a priority for ecological management of the study area.

Pest animal and weed control should be undertaken by an experienced contractor(s). A licensed contractor should ensure that the appropriate control techniques are based on individual situations and the targeted species. Contractors will also need the be aware of the potential for new infestations of exotic flora and fauna species not currently present on the site and undertaken appropriate weed control as necessary.

5.1.1 Weed Control Approach and Timeline

Ongoing weed control is the primary management action within the study area. The priority of this Weed Management Plan is to control and significantly reduce the spread of noxious weed species (ideally <1% cover). Weed control objectives should also aim to eliminate high priority weeds including African Boxthorn, Bathurst Burr, Artichoke Thistle, Spear Thistle, and Variegated Thistle from the site. The extent of most weeds in the study area is small enough that they could be successfully eradicated. Weed control methods are in accordance with, and should be applied in conjunction with the Sparrovale Wetland – Weed Management Plan (City of Greater Geelong 2019). Preparation of a detailed Weed Management Plan may be required.

Weed management should begin as soon as possible. Timings and methods for weed control is provided in Appendix 1. Intense weed control must be undertaken in the first year of management with a follow up assessment in the second year to evaluate the success of management actions. Weed management in the second year should be adjusted in response to extent of remaining weed cover.

Weed control works must be carried out by an experienced contractor. Licensed weed control contractors will have a greater ability to make appropriate decisions on which technique to use based on individual situations and the targeted species. Contractors will also need to be aware of the potential for new outbreaks of weed species not recorded in this assessment and implement appropriate weed control techniques as necessary.

Several management techniques are recommended to control weeds, including physical removal, brush cutting and herbicide application. In most cases, herbicide will only be applied to weeds by using the spot-spraying technique, to prevent damage to non-target species. A summary of weed management techniques is provided in Appendix 1 and expanded upon in Appendix 2.

Weed control works should be adaptive and consider the shift in priority of weed management based on seasons and after successful control of other priority species, or if new weed species colonise or emerge as a threat.

5.1.2 Priorities for Weed Management

This information provides a guide for weed control within the study area. Priorities for weed management are shown in Table 1 and have been based on the following criteria:

Threat Level

High: Rapidly spreading species with the potential for high ecological impacts.

Moderate: Moderately spreading species with the potential for high ecological impacts.

Low: Slow spreading species with the potential for high ecological impacts.

Infestation Level

High: Weed infestation over large areas across the site.

Moderate: Weed infestation over moderate areas on the site.

Low: Localised weed infestation across the site.

Control Priority

High priority: Issue poses a high level of threat to ecological values and needs to be addressed immediately and on a frequent basis.

Moderate priority: Issue has a high to moderate threat level and needs to be addressed in the short-term or on a regular basis.

Low priority: Issue has a medium to low threat level, or low likelihood of occurrence, and needs to be addressed on an irregular basis and continue treatment as required.

5.2 Weed Control Plan

As part of this Weed Management Plan report, a Weed Control Plan has been prepared (Appendix 1), which sets out actions, timing, and focuses on removing any exotic vegetation within the study area that creates a weedy shrub layer, and secondarily focuses on the removal of any WoNs and noxious weeds.

Weed control will primarily target key weed species listed in Table 1, and focus on areas of high weed abundance by commencing weed control from the edge of the population and converging towards the centre of the population. Spring and summer are appropriate seasons to target many weeds as they are actively growing in this period and herbicide application is more effective. Autumn may also be an appropriate time to control some weeds (Muyt 2001).

It is important that realistic timeframes for weed control works are implemented in order to apply a definite structure to weed management within the study area.

Licensed weed control contractors will make appropriate decisions on which technique to use based on site-specific considerations. Contractors will also need to be aware of the potential for new outbreaks of weed species not recorded in this assessment and implement appropriate weed control techniques as necessary. If any other high priority noxious weeds are identified within the study area, appropriate weed control works must be undertaken in accordance with relevant legislation / local laws.

It is likely that several control methods will need to be employed, including spraying, manual removal, hand pulling, burning, and cutting and painting. Various weed control techniques are outlined in Appendix 2.

The following general guidelines should be taken as basic management principles for weed control:

- Weed control methodology for eradicating graminoid and herbaceous weeds will consist of manual removal and/or spot spraying weeds with an appropriate herbicide;
- A dye should be used in the spray to mark where the spraying has occurred;

- Weed control will initially be focused in areas that contain woody weeds (i.e. African Boxthorn);
- A moderate to high number of African Boxthorn and Artichoke Thistle were identified during the survey across large sections of the site. It is therefore considered unlikely that these species will be completely eradicated from the study area. Control methods should focus on preventing the spread of (and eradicating as far as possible) these established weeds;
- Only a limited number of Bathurst Burr, Spear Thistle and Variegated Thistle were identified during the survey and each was mostly confined to small areas, so it is considered possible to eradicate these species from the study area. Follow-up surveying will note whether these species have re-emerged;
- Monitor for WoNS and/or CaLP Act listed environmental weeds adjacent to the study area, and control any encroachment into the study area;
- All remaining herbaceous and graminoid weed species are to be controlled at or below current levels;
- Weed control will be conducted in a manner that minimises soil disturbance and any off-target impacts on native flora species;
- Where herbicide application is employed, non-residual herbicides are to be employed;
- This WMP should be evaluated and adapted over time as the weed issues shift to different species and are reduced with successful control;
- Weed control works will be monitored regularly to assess their effectiveness, follow up works will be performed, and the feasibility of management objectives evaluated;
- Eradication of certain weeds may not be realistic due to the nature of the weed itself (i.e. highly dispersive) or the level of infestation (predominant throughout the landscape). Eradication may be achieved where:
    - The weed occupies only a small area and will not reinvade from adjoining areas;
    - The infested area is known and at low density;
    - The control method used kills all plants before maturity; and,
    - The weed seed does not remain dormant on the soil, or the infestation is detected before seeds are released (Weeds CRC 2004).

In consultation with the ecologist responsible for monitoring and reporting, the nominated contractor undertaking weed control works will make appropriate decisions on which technique to use based on site specific considerations. It is likely that several control methods will be required, including spraying, manual removal, hand pulling, and cutting and painting. A broad summary of weed control timelines and protocols is provided in Appendix 1 and Appendix 2.

Weed management measures have been developed to comply with regulations outlined in the CaLP Act for noxious weeds and environmental weeds. Appropriate implementation of the weed control measures outlined in this Plan will ensure compliance with responsibilities under the CaLP Act.

5.2.1 *Weed Control within Growling Grass Frog Habitat*

The control of pest plants within dedicated Growling Grass Frog habitat is a major requirement for management, as habitat within the site is under continual pressure from the invasion of introduced grasses and weeds (e.g. Artichoke Thistle and African Boxthorn). Excessive weed growth can smother and reduce the quality of frog habitat for breeding and foraging. In order to control and/or eradicate these weed species, several on-going techniques can be used including physical removal, brush cutting and herbicide application. Within these GGF habitat areas, herbicide must only be applied to weeds by using the spot-spraying technique, in order to prevent off-target issues. Weed management must be limited to hand removal or with the use of implements in the migration zone when GGF are moving from the effluent ponds to the newly constructed wetlands.

Currently, the study area is dominated by exotic vegetation and has a high percentage of exotic grasses and herbs (>90%). Growling Grass Frog wetlands must support an extensive cover of aquatic and semi-aquatic vegetation, specifically to cater for an extant breeding population of Growling Grass Frog and to ensure that there is sufficient nutrient uptake to enhance water quality in wetlands. To achieve these habitat requirements, in each Growling Grass Frog wetland there will be three distinct zones, which will incorporate the following considerations based on the GGF Habitat Design Standards (DELWP 2017):

- Zone 1: Littoral/ Ephemeral Wetland Zone: This zone incorporates the terrestrial planting area, with a moderate percentage cover of vegetation within bare ground areas for frog refuge occupying the margins of the pond. The margins will remain dry for extended periods, whilst the littoral/ephemeral zone will be subject to periodic inundation, and therefore must support plants able to tolerate wet conditions. Structural features to be incorporated within this zone are outlined within the GGFCMP (Ecology and Heritage Partners Pty Ltd *in prep*) and are based on known sites where the species occurs.
- Zone 2: Entry Zone- This zone incorporates part of the aquatic planting area and refers to the edge of the pond where frogs can enter the water. The zone will be subject to frequent drying and will require plant species capable of tolerating fluctuating water levels. Structural features to be incorporated within this zone are outlined within the GGFCMP (Ecology and Heritage Partners Pty Ltd *in prep*).
- Zone 3: Embankment- This zone incorporates part of the aquatic planting area and will provide a variety of aquatic vegetation (i.e. emergent, submergent and floating plants). Typical aquatic vegetation will include species such as Water Ribbon, and submerged or floating vegetation (e.g. Floating Pondweed). GGF have been observed in or on mats of submergent and floating vegetation in post-breeding months, and more frequently occupy microhabitats with a high cover of floating vegetation over still, deep water. Structural features to be incorporated within this zone are outlined within the GGFCMP (Ecology and Heritage Partners Pty Ltd *in prep*).

It is not necessarily crucial for GGF habitat to universally comprise native grasses near the water's edge, however improvement on the current levels of native grasses must be undertaken. Revegetation is not discussed in this Plan but is recommended in the future. A revegetation guide for the study area is provided in Appendix 3, where a recommended list of plants for revegetation within Growling Grass Frog habitat is provided in Table A3.4.

It is important to ensure that any weed control works using herbicides are both targeted (i.e. spot spraying) and undertaken at the right time of the year, as this can also reduce the requirement for future weed control

activities. Where possible, weeds will be controlled by hand or with the use of implements. Pest plant controls should be undertaken in Year 1 and ongoing as required. Weed control within areas of newly constructed GGF wetland habitat (Offset Area 1) and within the movement corridor (Offset Area 2), must incorporate the following:

- Where possible, weeds will be controlled by hand or with the use of implements;
- Weed management must be limited to hand removal or with the use of implements in the migration zone when GGF are moving from the effluent ponds to the newly constructed wetlands;
- Weed management must be undertaken throughout all open space areas, with particular attention given to vegetated areas which are not subject to routine maintenance;
- Any weed control works must be completed in a manner that minimises soil disturbance;
- Herbicide use must be minimised to avoid adverse effects on frogs and invertebrates;
- Where herbicide application is necessary, waterway sensitive products such as Roundup Bioactive®, Weedmaster Duo® or Weedmaster 360® must be employed, without the addition of surfactant;
- Where herbicides are used, selective application is preferable to broad area application, and when used in riparian areas, will be directly sponged or wicked onto weeds to minimise off target damage;
- Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March);
- Non-residual herbicides must not be used;
- Pest plants that reproduce sexually (by seed) must be controlled before seeds ripen; and,
- Weed control works must be monitored regularly to assess their effectiveness and follow-up / evaluation works must be completed. With any weed control works it is important to establish a cover of native species as soon as possible to occupy the newly vacated environment. While native species will naturally re-colonise such areas, so will exotic species if weed seed is present in soil.

The following species must not be introduced into the constructed wetland areas (Offset Area 1 or 2) or included in the list of suitable species to be planted, in order to avoid the risk of constructed wetlands becoming choked with vegetation;

- Narrowleaf Cumbungi *Typha domingensis*
- Broadleaf Cumbungi *Typha orientalis*
- Lesser Reed-mace *Typha latifolia*
- Common Reed *Phragmites australis*
- Tall Spike-rush *Eleocharis sphacelate*

If these species are observed within areas of existing or newly constructed habitat during habitat monitoring, a nominated principal contact of AC Manager Pty Ltd must be notified, and a wetland revegetation specialist contractor must be engaged to remove these species so that wetlands remain clear and comprise predominantly open water. A suitably qualified zoologist must be notified prior to removal so that appropriate salvage and relocation activities can be assessed and implemented.

5.2.2 *Scheduling of the Works*

It is not anticipated that complete eradication of all weeds listed in Table 1 will be possible in the two years of the management period, but rather that the area will be improved through containment of high priority weeds. Regarding the proposed Offset Area, the rest of the removal and native vegetation restoration is proposed to take place in years 3 to 10 or maintained if already successfully removed.

Containment of weed species is likely to be a more realistic management approach when dealing with widespread, well-established species (such as the key weed species listed in Table 1, identified within the study area). Containment is aimed at reducing new weed infestations and the need for future control by limiting the extent and intensity of infestations. The key to containment is to focus on treating isolated infestations, rather than core infestations, with the objective of preventing weed populations extending beyond the perimeter of the core infestation (Weeds CRC 2004).

5.3 Performance Indicators

Key performance indicators for the Weed Management Plan include:

- Eradicating woody weeds within the study area and preventing the encroachment of woody weeds into the study area;
- Meeting the requirements of the CALP Act in relation to the eradication and control methods of listed noxious weeds identified within the study area (Table 1; Appendix 1);
- Prevention of high priority pest fauna (Red Fox, European Rabbit) establishment within the study area;
- Controlling remaining herbaceous and grassy weed species;
- Achieving a net decrease in the cover of environmental weeds (<20% coverage); and,
- Minimal impacts to native vegetation, scattered trees and native fauna.

6 RESPONSIBILITIES, MONITORING AND REPORTING

6.1 Responsibilities

AC Manager Pty Ltd is responsible for all management actions described in this plan and are subsequently responsible for engaging relevant experienced contractors where required. An itemised Weed Control Plan for contractor use is provided in Appendix 4 to assist in meeting management action obligations.

6.2 Ongoing Management, Monitoring and Reporting

Monitoring of the site must be implemented to track condition and to identify management issues early.

The following monitoring activities must be followed:

- Continual monitoring and control of invasive species (weeds and pest animals) within the site; and,
- Identifying ongoing management issues requiring remediation (e.g. weeds, and erosion).

It is the contractor's responsibility to ensure weeds are controlled to the specified amount under the CaLP Act. Fines or prosecution are possible if landowners do not control weeds within their land.

Monitoring is required to assess the positive and negative impacts of management actions on the integrity of the study area, and to implement change if required. The outcome of each monitoring assessment will be summarised in a progress report. Ongoing monitoring will also provide feedback to inform an adaptive management approach, which is critical to tailor management actions to prevailing environmental conditions and for the provision of contingency plans.

A regular monitoring program will be undertaken with respect to weed control and pest animal control throughout the study area over the period of this plan. Monitoring will include surveys for weed species, as well as identification of any new outbreaks. Monitoring will be undertaken every 6 months for the life of the Plan (Appendix 1).

A register will be kept for all staff that have completed the environmental site induction which outlines the requirements of this WMP, and their responsibilities associated with the project to adhere to relevant environmental legislation and policies.

Monitoring of the study area will include the following:

- Assessing and mapping the weed control activities and progress against the Weed Control Plan;
- Detailing the weed control method, the amount and type of herbicide employed, and the effectiveness of the weed control technique; and,
- Identifying ongoing management issues requiring remediation (e.g. weeds, erosion).

Monitoring and progress reports should include the following:

- The extent (as a percentage cover), severity, trend (progress against management targets (e.g. eradicate [reduce to 0% cover], maintain [current % cover], reduce [reduce cover from x% to y%]), and presence of current weed species and any new and emerging weed species.

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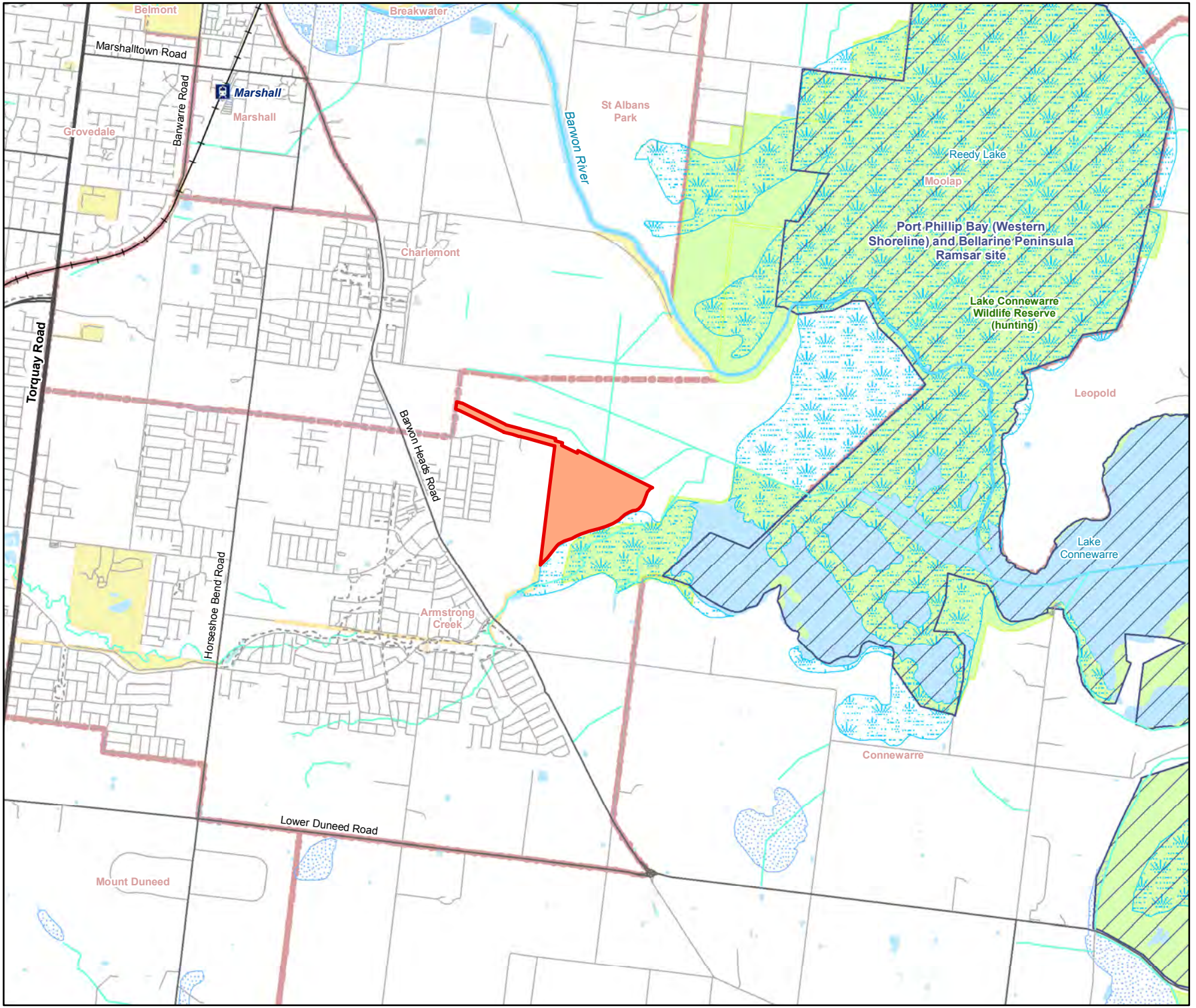
Walsh, N.G., Stajsic, V. 2007. A Census of the Vascular Plants of Victoria, 8th ed. Ed. Royal Botanic Gardens Melbourne.

FIGURES



Legend

- Study Area
- Railway
- Major Road
- Collector Road
- Minor Road
- Proposed Road
- Minor Watercourse
- Major Watercourse
- Permanent Waterbody
- Land Subject to Inundation
- Wetland/Swamp
- Ramsar wetland
- Parks and Reserves
- Crown Land
- Localities

Figure 1

Location of the study area

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

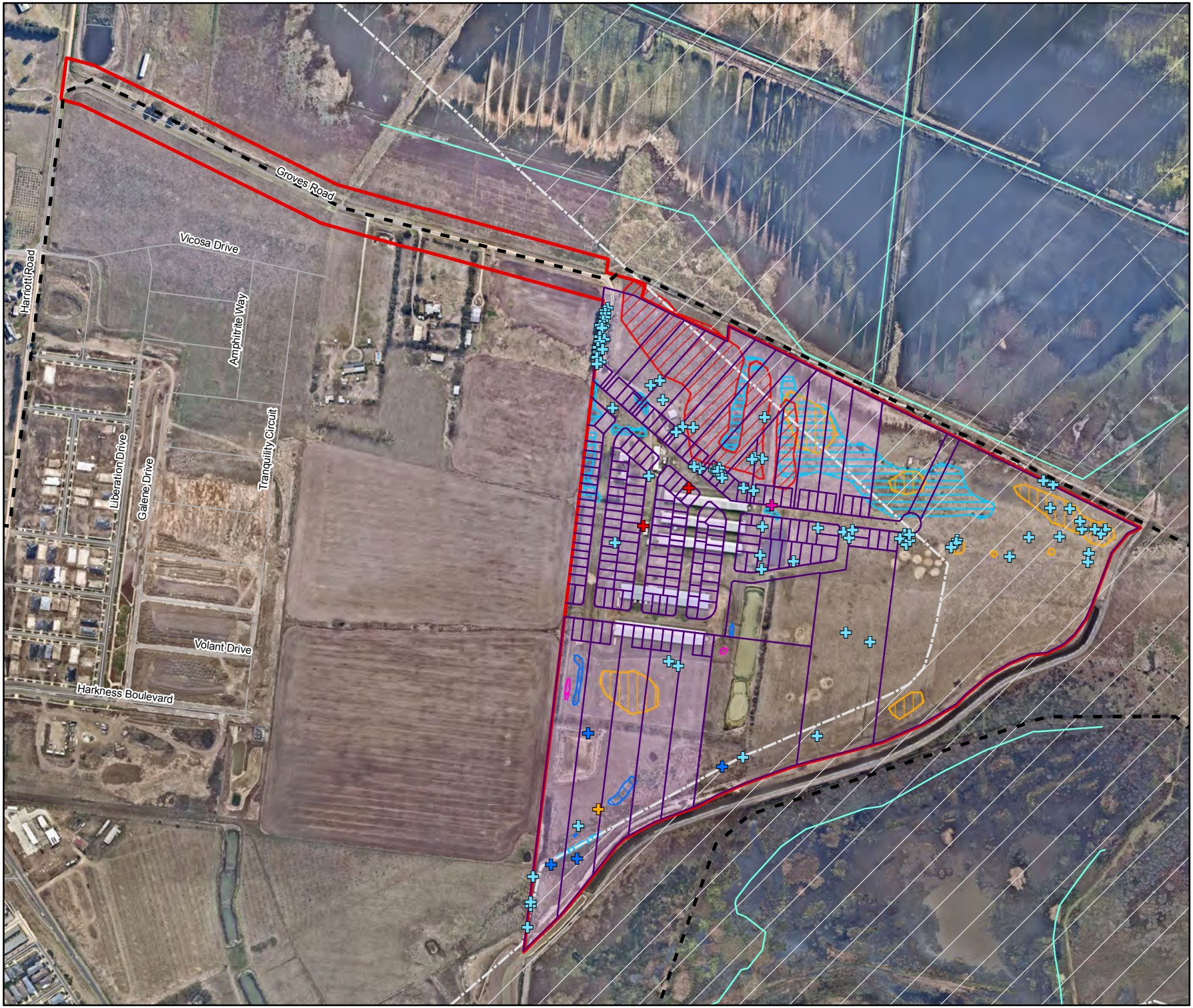
N

0 500 1,000

Metres

Map Scale: 1:40,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners



Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Artichoke thistle
- Bathurst burr
- Boxthorn
- Spear thistle
- Variegated thistle

Noxious weed patch

- Artichoke thistle
- Bathurst burr
- Boxthorn
- Spear thistle
- Variegated thistle

Figure 2 Overview

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 105 210

Metres

Map Scale: 1:7,300 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022

Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Artichoke thistle
- Boxthorn
- Variegated thistle

Noxious weed patch

- Artichoke thistle
- Bathurst burr
- Boxthorn

Figure 2a

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022

Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Artichoke thistle
- Boxthorn
- Spear thistle

Noxious weed patch

- Bathurst burr
- Boxthorn
- Spear thistle
- Variegated thistle

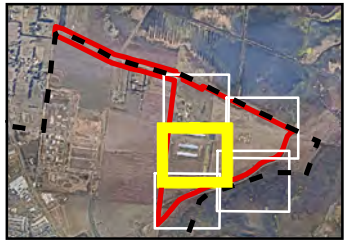


Figure 2b

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

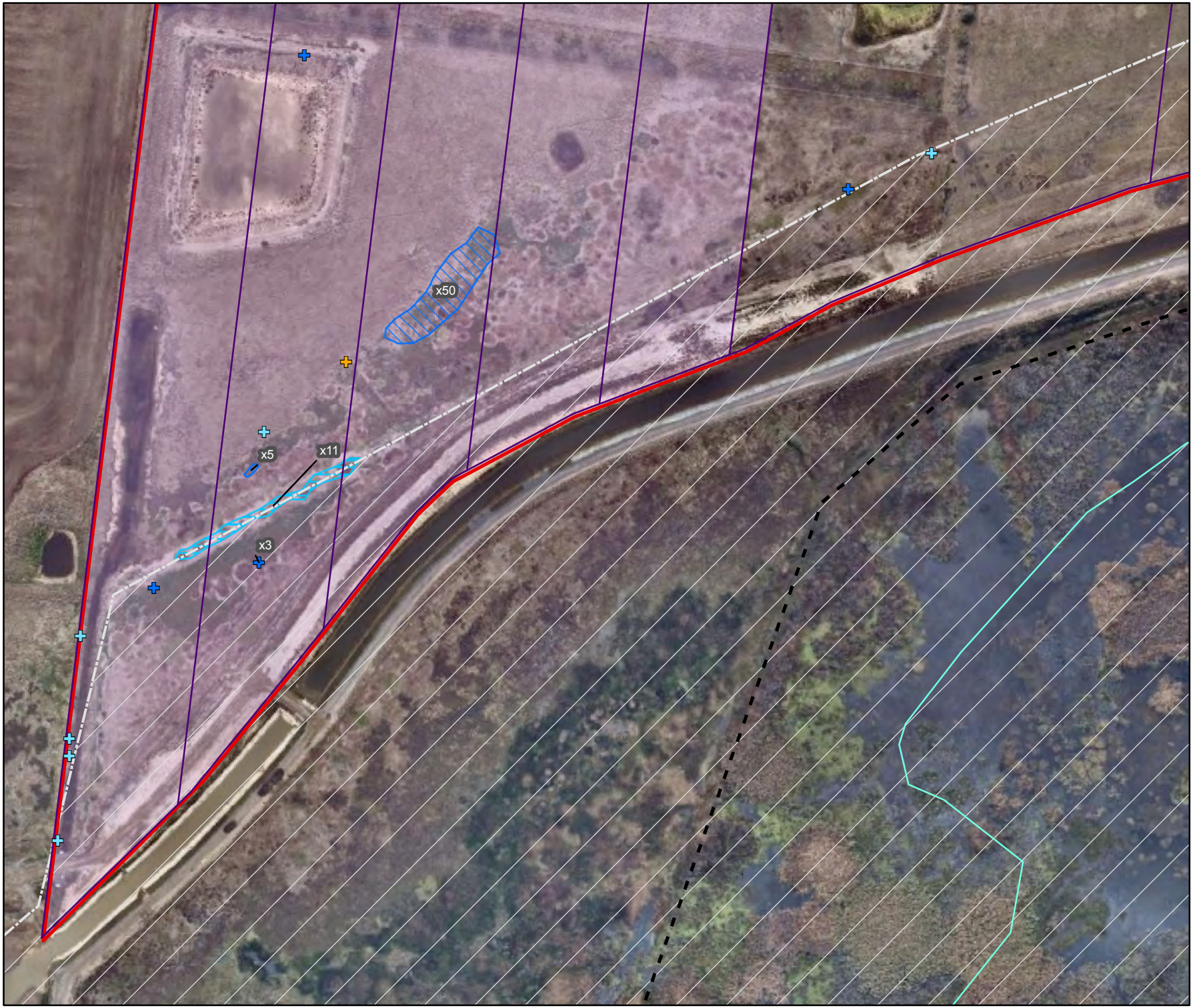
Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Bathurst burr
- Boxthorn
- Spear thistle

Noxious weed patch

- Boxthorn
- Spear thistle

Figure 2c

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

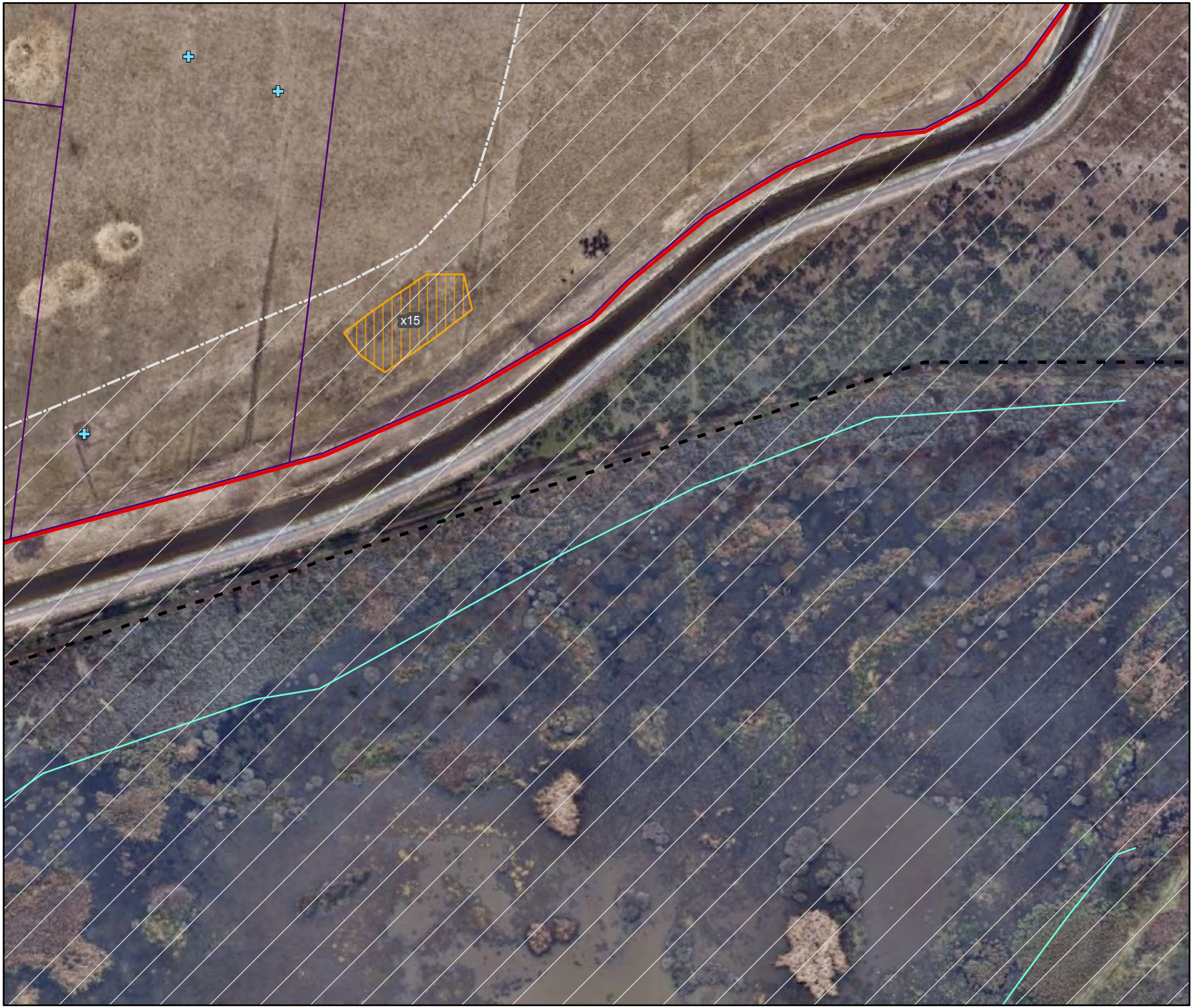
Metres

Map Scale: 1:1,800 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022



Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Boxthorn

Noxious weed patch

- Bathurst burr

Figure 2d

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:2,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022

Legend

- Study Area
- Precinct boundary
- ESO
- Proposed lot boundaries

Noxious weeds

- Boxthorn

Noxious weed patch

- Bathurst burr
- Boxthorn

Figure 2e

Surveyed weeds

Weed Management Plan for 78-88 Groves Road, Armstrong Creek

N

0 25 50

Metres

Map Scale: 1:2,000 @ A4
Coordinate System: GDA 1994 MGA Zone 55

ecology & heritage partners

16303_Fig02_Weeds_MB 8/09/2023 psorensen

Aerial source: Nearmap 2022

APPENDICES

Appendix 1 – Weed Control Plan

Table A1.1 Control protocols for key weed species recorded within the study area

Common name	Scientific Name	Weed Type	Treatment Methods	Timing of Treatment	% Cover (Current)	% Cover (Target after 2 years)	Desired Outcome
African Boxthorn	*Lycium ferocissimum*	Woody	Manual Removal (isolated plants), Cut and Paint with Selective Herbicide	Autumn-winter	30%	<1%. Then maintain <1% in Offset Area (yrs 3-10)	E
Artichoke Thistle	*Cynara cardunculus subsp. flavescens*	Herbaceous	Manual Removal (isolated plants), Spot Spraying with Selective Herbicide (before seeding)	Winter-Spring	40%	<1%. Then maintain <1% in Offset Area (yrs 3-10)	E
Spear Thistle	*Cirsium vulgare*	Herbaceous	Manual Removal (isolated plants), Spot Spraying with Selective Herbicide (before seeding)	Autumn-Spring	<5%	<1%	E
Bathurst Burr	*Xanthium spinosum*	Herbaceous	Manual Removal (isolated plants), Hormone Herbicide (before seeding)	Autumn-Spring	5%	<1%. Then maintain <1% in Offset Area (yrs 3-10)	E
Variegated Thistle	*Silybum marianum*	Herbaceous	Manual Removal (isolated plants), Selective Herbicide (before seeding)	Autumn-spring	1%	<1%	E
Tall Wheat-grass	*Atriplex prostrata*	Herbaceous	Manual Removal	Autumn-spring	1%	<1%	C
Prostrate Knotweed	*Polygonum aviculare*	Herbaceous	Manual Removal (isolated plants), Spot Spraying (before seeding)	Autumn-spring	<5%	<2%	C

Common name	Scientific Name	Weed Type	Treatment Methods	Timing of Treatment	% Cover (Current)	% Cover (Target after 2 years)	Desired Outcome
Creeping Saltbush	*Atriplex prostrata*	Herbaceous	Manual Removal	Any season	<5%	<2%	C
Toowoomba Canary-grass	*Phalaris aquatica*	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	10%	<5%	C
Kikuyu	*Pennisetum clandestinum*	Graminoid	Annual Spraying (before seeding)	Early-mid Spring	10%	<5%	C
Ribwort	*Plantago lanceolata*	Herbaceous	Annual Spraying (before seeding)	Early-mid Spring	10%	<5%	C
Green Couch	*Cynodon dactylon var. dactylon*	Graminoid	Annual Spraying (before seeding)	Winter-Spring	10%	<5%	C

Notes: E = Eliminate; C= Control Biomass and Spread. Percentage cover estimated to the nearest 5%.

Table A1.2 Suggested timeline of weed control works for two (residential site) and ten (Offset Site) years of management.

Weed/Pest Animal	Timing	Target Species	Areas	Action	Comments	Standard to be Achieved
Weeds	**Year 1** – ASAP	Woody Weed Species (i.e. African Boxthorn)	**Across entire study area** (excluding GGF habitat)	Manual Removal and 'Cut and Paint' (using Selective Herbicide) of WoNS to prevent the spread of all woody weeds — and eradicate as far as possible.	• Avoid removal when fauna are actively nesting in the trees • Manual removal of isolated plants • Cut and Paint (i.e. cut at base and apply herbicide to the cut stem) • Selective Herbicide	African Boxthorn to be eradicated as far as possible, but at least significantly reduced and spread prevented. See Table A1.1 for percentage cover target.

Weed/Pest Animal	Timing	Target Species	Areas	Action	Comments	Standard to be Achieved
			GGF habitat	Manual Removal and 'Cut and Paint' (using Selective Herbicide) of WoNS within areas of GGF habitat to prevent the spread of all woody weeds — and eradicate as far as possible.	• Where possible, weeds will be controlled by hand or with the use of implements, with herbicide-use minimised • Where herbicide application is necessary, waterway sensitive products (surfactant-free and non-residual) must be employed • Herbicides must not be used within 10 meters of wetlands during the breeding season (October-March)	

Weed/Pest Animal	Timing	Target Species	Areas	Action	Comments	Standard to be Achieved
	Year 1 – ASAP	Artichoke Thistle, Spear Thistle, Bathurst Burr, Variegated Thistle, Tall Wheat-grass, Prostrate Knotweed, Creeping Saltbush, Toowoomba Canary-grass, Ribwort, Couch and Kikuyu.	**Across entire study area** (excluding GGF habitat)	Control all noxious and environmental weeds	• Manual removal and appropriate disposal of isolated plants: Artichoke Thistle, Spear Thistle, Bathurst Burr, Variegated Thistle and Prostrate Knotweed • Manual removal and appropriate disposal of all: Tall Wheat-grass and Creeping Saltbush • Chemical control (before seeding) (excluding migration area): - Selective Herbicide (spot spraying): Artichoke Thistle, Spear Thistle, Variegated Thistle and Prostrate Knotweed - Hormone Herbicide: Bathurst burr - Annual spraying (before seeding): Toowoomba Canary-grass, Kikuyu, Ribwort, Green Couch • Direct seeding with native grasses in bare areas to prevent further exotic grass spread • Reduction in weed biomass with slashing and mowing to encourage natives to grow and to ensure exotic grass species do not become overgrown and/or set seed (excluding migration area).	Significant control and reduction of herbaceous and graminoid weeds within 2 years. See Table A1.1 for percentage cover target.

Weed/Pest Animal	Timing	Target Species	Areas	Action	Comments	Standard to be Achieved
			GGF habitat	Control all noxious and environmental weeds within areas of GGF habitat	• Where possible, weeds will be controlled by hand or with the use of implements, with herbicide-use minimised • Where herbicide application is necessary, waterway sensitive products (surfactant-free and non-residual) must be employed (excluding migration area) • Herbicides must not be used during migration period or within 10 meters of wetlands during the breeding season (October-March)	
	Year 1 – At 6 month intervals	African Boxthorn, Artichoke Thistle, Spear Thistle, Bathurst Burr and Variegated Thistle.	**Across entire study area**	Monitor for noxious weed encroachment	• Monitor study area for encroachment of noxious weeds from established plants in surrounding areas • Eradicate seedlings when observed	No new noxious weeds established within study area. The outcome of each monitoring assessment will be summarised in a progress report.

Weed/Pest Animal	Timing	Target Species	Areas	Action	Comments	Standard to be Achieved
	Year 2 and 3-10 (Offset Area) – As required and suitable	Artichoke Thistle, Spear Thistle, Bathurst Burr, Variegated Thistle, Tall Wheat-grass, Prostrate Knotweed, Creeping Saltbush, Toowoomba Canary-grass, Ribwort, Couch and Kikuyu.	**Across entire study area** (including GGF habitat)	Ongoing control and reduction of noxious and environmental weeds	Assess all areas and evaluate success of Year 1 control management to determine focus areas and species for the second and following years, and then control them as required to: • Eliminate any remaining WoNS; • Reduce weed biomass; and, • Revegetate with native species areas as required. Control should involve: • Slashing and mowing of exotic species to ensure exotic grass species do not become overgrown and do not set seed • Chemical control of noxious weeds (control methods for each species outlined above) • Manual removal and appropriate disposal of environmental weeds (Tall Wheat-grass, Prostrate Knotweed, Creeping Saltbush, Toowoomba Canary-grass, Ribwort, Couch and Kikuyu)	Ongoing control and reduction of noxious and environmental weeds. Maintain percentage cover reduction.
Pest Animals	**Year 1 and 3-10 (Offset Area)** – At 6 month intervals	Red Fox, European Rabbit	**Across entire study area** (including GGF habitat)	Prevent pest animals from becoming established within the study area	• Monitor study area for burrows and scats • Destroy any fox dens found on site • Engage licensed pest animal contractor if pest animals become established within study area	Pest animal establishment prevented within study area. The outcome of each monitoring assessment will be summarised in a progress report.

Appendix 2 – Weed Control Methods

Weed control measures identified in Appendix 1 are described in detail below. Weed control measures (including type of herbicide) should follow the guidance of an experienced contractor for the control of the weed species identified above.

Herbicides

Spot spraying and Rig-spraying

The application of herbicides is an effective and efficient control technique for a range of woody, herbaceous and grass weeds. The correct use and application of herbicides can provide targeted control of a range of species; however, it must be stressed all use of herbicides must be used in accordance with the manufacturer's specifications and occupational health and safety policies.

Application methods for herbicides include spot spraying with a knapsack for small or sensitive areas, or for targeted species. Rig spraying is best used in larger areas which are not sensitive to high volume application of herbicide and there is limited potential for off-target damage. Dabbing of species with foam tipped application device, with the herbicide applied from an attached bottle, should be used in sensitive areas or in areas where weed control is targeted to a small number of plants, especially bulbs or tuberous plants.

Timing of intervals, plant age and growth seasons, plant stress levels and climatic factors all need to be considered when developing methodologies for the application of herbicides to ensure successful outcomes. Problems exist with ongoing unsuccessful herbicide treatments, which may result in weeds developing herbicide resistance, or the build-up of chemicals in the soil. Surrounding plants' susceptibility to herbicides and ongoing uses of the treated areas should also be considered when choosing the right herbicide to be used in a weed control program, as some herbicides are residual and may persist within the soil for varying durations.

To avoiding impacts to Growling Grass Frog during the Weed Management Plan, use of biodegradable and aquatic friendly herbicides is required, and spraying should not occur within 50 metres of the water's edge due to the presence of Growling Grass Frog habitat. Where hand-weeding/manual removal is possible, this method should be used as a primary method of weed control, particularly in proximity to Growling Grass Frog habitat.

Drill and Fill

Drill and fill, also known as direct injection, is a method where the selected herbicide (usually Glyphosate) is injected though a device into a hole that has been made into the targeted plant (i.e. woody species). The hole is usually made through the use of a drill but sometimes a tomahawk or saw may be used to put small nicks into the targeted plant. It is essential that the hole or nick must always be lower than the first branch containing foliage (i.e. ideally, the lowest possible point on the plant) and also the herbicide is applied into the hole as quick as possible. The general rule of thumb is that the herbicide must be applied within 30 seconds. Holes are scattered around the main trunk at 50 millimetre intervals, depending on the diameter of the trunk and also branches or angle of the trunk. It is essential that a complete ring around the trunk of the plant be made of this herbicide filled holes to ensure plant death, as large gaps may allow sections of the target tree to

survive. Generally, the holes or nicks do not need to be deeper than 20 millimetres but do need to be deep enough to penetrate the outer cambium layer of the tree. This allows the phloem to carry the herbicide into the roots, which will kill the plant over a number of weeks, depending on conditions.

The benefits of this method include: the retention of standing material for habitat, no costs for the removal of the plant from the site; no dragging of material across sensitive areas; and, speed, as the method is fast to execute (i.e. drill and fill, and move on).

The drawbacks of this method are that if it is not executed correctly, trees may re-grow, particularly as accessing the base of the trunk of spiny plants such as Hawthorn and African Box-thorn can be difficult. However, if the application is successful, dead standing vegetation can become a fire hazard and look aesthetically displeasing to the community.

Cut and Paint

The cut and paint method of control requires the cutting of the target species at the very base, under any foliage, and the immediate application of herbicide (usually a glyphosate, dependent on the target species). The application can be done through a 'dabber' bottle or paint brush. Care will be undertaken during application, to avoid splash of herbicide causing non-target damage. Once cut down, the biomass of the target species may sometimes be left on the ground, but usually requires removal. This is particularly necessary if it bears fertile seeds or has the potential to re-shoot from contact with moist ground (i.e. Salix sp.), or covers native vegetation.

Many herbicides are available that are very effective in the control of woody weed species. Typically these herbicides are applied to the stem, trunk or roots of the target plant by 'drill and fill', 'cut and paint' or 'frilling' methods of application. These herbicides can be more effective than manual removal alone, as the chance of the plant re-sprouting is significantly reduced.

Manual/Hand Removal

Some weed species are resilient against other methods of eradication, such as herbicides, and will be targeted by manual removal. Infestations of species such as African Box-thorn, Fennel, Serrated Tussock and Toowoomba Canary-grass will be combated by manual removal techniques.

Additionally, manual removal is a crucial technique when used in conjunction with herbicides for the control of both woody and herbaceous weed species. This combination of weed eradication is advised for almost all weed species. The biomass of the target species may sometimes must be disposed of appropriately and usually requires removal.

Ring-barking

Ring-barking is a viable technique for use when eradicating large woody shrubs and trees. The technique involves the use of a large knife, tomahawk or axe to make a continuous cut around the trunk of the plant. The cut should be 5 to 10 centimetres wide and deep enough to penetrate the heart-wood (Muyt 2001). This technique should not be used when removing species which can reproduce by suckering.

Mowing

While it has been found that mowing may enhance the survival of many weed species, in some instances mowing can be used to control their spread. Areas located in proximity (500 metres – 1 kilometre) to sites of ecological significance that are currently mown, should undergo an intensive mowing regime, particularly in spring. This method of weed control is only effective against species which are prevalent within mown areas. It will prove most effective in controlling the spread of grass species such as Serrated Tussock and Toowoomba Canary-grass. A short, open grassy structure supports Growling Grass Frog foraging, thus mowing and slashing is an appropriate method for managing the exotic grasses for the duration of the Weed Management Plan with respect to managing impacts to Growling Grass Frog.

Appendix 3 – Revegetation Guide

Table A3.1. Species suitable for planting within Coastal Saltmarsh (EVC 9) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Sclerostegia arbuscula	Shrubby Glasswort	Medium Shrub	150
Avicennia marina ssp. australasica	White Mangrove	Medium Shrub	150
Suaeda australis	Austral Seablite	Small Shrub	400
Frankenia pauciflora var. gunnii	Southern Sea-heath	Small Shrub	400
Wilsonia humilis	Silky Wilsonia	Prostrate Shrub	400
Additional understorey life forms			
Sarcocornia quinqueflora	Beaded Glasswort	Medium Herb	
Samolus repens	Creeping Brookweed	Medium Herb	
Hemichroa pentandra	Trailing Hemichroa	Medium Herb	
Triglochin striatum	Streaked Arrowgrass	Medium to Tiny Non-tufted Graminoid	
Juncus kraussii ssp. australiensis	Sea Rush	Large Non-tufted Graminoid	
Distichlis distichophylla	Australian Salt-grass	Medium to Tiny Non-tufted Graminoid	

Table A3.2. Species suitable for planting within Plains Sedgy Wetland (EVC 647) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Carex tereticaulis	Hollow Sedge	Large Tufted Graminoid	500
Additional understorey life forms			
Epilobium billardierianum	Variable Willow-herb	Large Herb	
Potamogeton tricarinatus s.l.	Floating Pondweed	Medium Herb	
Myriophyllum simulans	Amphibious Water-milfoil	Medium Herb	
Stellaria angustifolia	Swamp Starwort	Medium Herb	
Lilaeopsis polyantha	Australian Lilaeopsis	Medium Herb	
Neopaxia australasica	White Purslane	Small Herb	
Lobelia pratioide	Poison Lobelia	Small Herb	

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Helichrysum aff. rutidolepis (Lowland Swamps)	Pale Swamp Everlasting	Small Herb	
Eryngium vesiculosum	Prickfoot	Small Herb	
Lachnagrostis filiformis (perennial variety)	Wetland Blown-grass	Medium Tufted Graminoid	
Lachnagrostis filiformis	Common Blown-grass	Medium Tufted Graminoid	
Glyceria australis	Australian Sweet-grass	Medium Tufted Graminoid	
Eleocharis acuta	Common Spike-sedge	Medium to Tiny Non-tufted Graminoid	
Amphibromus sinuatus	Wavy Swamp Wallaby-grass	Medium to Tiny Non-tufted Graminoid	

Table A3.3. Species suitable for planting within Brackish Wetland (EVC 656) (DEECA 2023b).

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Priority species (trees, shrubs and large tufted graminoids)			
Gahnia filum	Chaffy Saw-sedge	Large Tufted Graminoid	600
Additional understorey life forms			
Persicaria decipiens	Slender Knotweed	Large Herb	
Epilobium billardierianum ssp. billardierianum	Smooth Willow-herb	Large Herb	
Sarcocornia quinqueflora	Beaded Glasswort	Medium Herb	
Samolus repens	Creeping Brookweed	Medium Herb	
Suaeda australis	Austral Seablite	Medium Herb	
Selliera radicans	Shiny Swamp-mat	Small Herb	
Crassula helmsii	Swamp Crassula	Small Herb	
Mimulus repens	Creeping Monkey-flower	Small Herb	
Juncus kraussii ssp. australiensis	Sea Rush	Large Non-tufted Graminoid	
Phragmites australis	Common Reed	Large Non-tufted Graminoid	
Poa poiformis	Coast Tussock-grass	Medium to Small Tufted Graminoid	
Lachnagrostis filiformis	Common Blown-grass	Medium to Small Tufted Graminoid	
Bolboschoenus caldwellii	Salt Club-sedge	Medium to Tiny Non-tufted Graminoid	
Distichlis distichophylla	Austral Salt-grass	Medium to Tiny Non-tufted Graminoid	
Schoenoplectus pungens	Sharp Club-sedge	Medium to Tiny Non-tufted Graminoid	
Triglochin striatum	Streaked Arrowgrass	Medium to Tiny Non-tufted Graminoid	

Scientific Name	Common Name	Life form	Target Tubestock amount (per ha)
Calystegia sepium	Large Bindweed	Scrambler or Climber	

Table A3.4. Species List of Recommended Plants for Revegetation within Growling Grass Frog aquatic habitat.

Scientific Name	Common Name
Fringing and emergent	
Calystegia sepium	Large Bindweed
Carex appressa	Tall Sedge
Carex fascicularis	Tassel Sedge
Carex gaudichaudiana	Fen Sedge
Crassula helmsii	Swamp Crassula
Epilobium billardierianum	Smooth Willow-herb
Glyceria australis	Australian Sweet-grass
Lachnagrostis filiformis	Common Blown-grass
Lycopus australis	Australian Gypsywort
Melaleuca ericifolia	Swamp Paperbark
Poa labillardierei var. *labillardierei*	Common Tussock-grass
* *Potamogeton ochreatus*	Blunt Pondweed
Ranunculus amphitrichus	Running Marsh Flower
Emergent	
Alisma plantago-aquatica	Water Plantain
Amphibromus fluitans	River Swamp Wallaby-grass
Baumea articulata	Jointed Twig-sedge
Cladium procerum	Leafy Twig-sedge
* *Eleocharis acuta*	Common Spike-sedge
Juncus amabilis	Hollow-rush
Juncus gregiflorus	Green Rush
Juncus procerus	Tall Rush
Juncus sarophorus	Broom Rush
Persicaria decipiens	Slender Knotweed
Persicaria praetermissa	Spotted Knotweed
Persicaria subsessilis	Hairy Knotweed
Ranunculus inundatus	River Buttercup
Schoenoplectus tabernaemontani	River Club-sedge
Submergent	
Ceratophyllum demersum	Hornwort
Myriophyllum caput-medusae	Coarse Water-milfoil

Scientific Name	Common Name
Myriophyllum crispatum	Upright Water-milfoil
Myriophyllum simulans	Amphibious Water-milfoil
Potamogeton crispus	Curly Pondweed
Floating Submergent	
Carex gaudichaudiana	Fen Sedge
Hydrocotyle sibthorpioides	Shining Pennywort
Lythrum salicaria	Small Loosestrife
Neopaxia australasica	White Purslane
* *Ottelia ovalifolia*	Swamp Lily
Potamogeton ochtreatus	Blunt Pondweed
Potamogeton pectinatus	Fennel Pondweed
Rumex bidens	Mud Dock
* *Triglochin procerum*	Water Ribbon (emergent form)
* *Vallisneria americana*	Ribbon-weed
Villarsia reniformis	Running Marsh Flower

Notes: * Indicates highly desirable vegetation for Growling Grass Frog, # Limit use of this species, as it may become invasive

Table A3.5. Additional list of plants recommended by the City of Greater Geelong for revegetation within wet areas, low-lying areas and watercourses of the Marshall plains and Waurn Ponds flats areas, and in the Mount Duneed and surrounding basalt flows (City of Greater Geelong 2023).

Scientific Name	Common Name	Life form
Acacia melanoxylon	Blackwood	Understory Tree or Large Shrub
Eucalyptus camaldulensis	River Red-gum	Canopy Tree
Eucalyptus ovata	Swamp Gum	Canopy Tree
Melaleuca lanceolata	Moonah	Canopy or Understory Tree
Acacia verticillata	Prickly Moses	Medium Shrub
Bursaria spinosa	Sweet Bursaria	Medium Shrub
Correa reflexa	Common Correa	Medium Shrub
Goodenia ovata	Hop Goodenia	Medium Shrub
Hymenanthera dentata	Shrub Violet	Medium Shrub
Leptospermum continentale	Prickly Tea-tree	Medium Shrub
Leptospermum lanigerum	Woolly Tea-tree	Medium Shrub
Ozothamnus ferrugineus	Shrub Everlasting	Medium Shrub

Appendix 4 – Contractor Use

Table A4.1. Itemised Weed Control Plan

	Year 1	Materials / other expenses	Year 2	Materials / other expenses	Years 3-10	Materials / other expenses
Rubbish/ litter removal						
Hand removal of rubbish						
Cartage (assuming less than 20km to disposal site)						
Disposal (Including hand loading and unloading)						
Removal of woody weeds (African Boxthorn) to targets shown in Appendix 1 (Table A1.1)						
Manual removal of woody weeds						
Cut and paint of all remaining woody weeds						
Knapsack spot spraying any woody weed seedlings						
Cartage and Disposal						
Control of all herbaceous and graminoid weeds to targets shown in Appendix 1 (Table A1.1)						
Manual removal of weeds where appropriate						
Knapsack spot spraying all herbaceous weeds						

	Year 1	Materials / other expenses	Year 2	Materials / other expenses	Years 3-10	Materials / other expenses
Slashing and mowing of all exotic species to ensure they do not overgrow and set seed						
Cartage and Disposal						
Direct seeding of native grasses into bare areas to meet specification shown in Appendix 3 (If required)						
Supply of tubes for approx. 2 hectares (see Appendix 3 for density)						
Direct seeding of bare areas						
Monitoring and Reporting						
Site Monitoring						
Reporting						
Sub-total						
GST						
Total						
Contingency						
Watering of tubes (per application)						
Water supply (@ $2.22 per kl)						

APPENDIX 7 - Wetland Species

Table A1: Species List of Recommended Plants for Revegetation

Botanical Name	Common Name
Fringing and emergent	
Calystegia sepium	Large Bindweed
Carex appressa	Tall Sedge
Carex fascicularis	Tassel Sedge
Carex gaudichaudiana	Fen Sedge
Crassula helmsii	Swamp Crassula
Epilobium billardierianum	Smooth Willow-herb
Glyceria australis	Australian Sweet-grass
Lachnagrostis filiformis	Common Blown-grass
Lycopus australis	Australian Gypsywort
Melaleuca ericifolia	Swamp Paperbark
Poa labillardierei var. *labillardierei*	Common Tussock-grass
* *Potamogeton ochreatus*	Blunt Pondweed
Ranunculus amphitrichus	Running Marsh Flower
Emergent	
Alisma plantago-aquatica	Water Plantain
Amphibromus fluitans	River Swamp Wallaby-grass
Baumea articulata	Jointed Twig-sedge
Cladium procerum	Leafy Twig-sedge
* *Eleocharis acuta*	Common Spike-sedge
Juncus amabilis	Hollow-rush
Juncus gregiflorus	Green Rush
Juncus procerus	Tall Rush
Juncus sarophorus	Broom Rush
Persicaria decipiens	Slender Knotweed
Persicaria praetermissa	Spotted Knotweed
Persicaria subsessilis	Hairy Knotweed
Ranunculus inundatus	River Buttercup
Schoenoplectus tabernaemontani	River Club-sedge
Submergent	
Ceratophyllum demersum	Hornwort
Myriophyllum caput-medusae	Coarse Water-milfoil
Myriophyllum crispatum	Upright Water-milfoil
Myriophyllum simulans	Amphibious Water-milfoil
Potamogeton crispus	Curly Pondweed

Botanical Name	Common Name
Floating Submergent	
Carex gaudichaudiana	Fen Sedge
Hydrocotyle sibthorpioides	Shining Pennywort
Lythrum salicaria	Small Loosestrife
Neopaxia australasica	White Purslane
* *Ottelia ovalifolia*	Swamp Lily
Potamogeton ochtreatus	Blunt Pondweed
Potamogeton pectinatus	Fennel Pondweed
Rumex bidens	Mud Dock
* *Triglochin procerum*	Water Ribbon (emergent form)
* *Vallisneria americana*	Ribbon-weed
Villarsia reniformis	Running Marsh Flower

Notes: * Indicates highly desirable vegetation for Growling Grass Frog, # Limit use of this species, as it may become invasive

APPENDIX 8 – OFFSET ASSESSMENT CALCULATION

Offset calculator for effluent pond 1 aquatic habitat

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	0.216 ha of GGF potential breeding aquatic habitat	Area	0.22	Hectares	Biodiversity assessment
			Quality	6	Scale 0-10	
			Total quantum of impact	0.13	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	0.13	Adjusted hectares	First party aquatic habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	0.6	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	0.24	181.52%	Yes	Ecological assessment
									Future area without offset (adjusted	0.6	Future area with offset (adjusted hectares)	0.6								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	6	5.00	80%	4.00	3.92				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			

Offset calculator for effluent pond 2 aquatic habitat

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	0.58 ha of GGF foraging aquatic habitat	Area	0.58	Hectares	Biodiversity assessment
			Quality	4	Scale 0-10	
			Total quantum of impact	0.23	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat tree (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	0.23	Adjusted hectares	First party aquatic habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	0.9	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	153.16%	Yes		Ecological assessment
									Future area without offset (adjusted hectares)	0.9	Future area with offset (adjusted hectares)	0.9								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	6	5.00	80%	4.00	3.92				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			

Offset calculator for terrestrial dispersal habitat areas

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community (Clear row)	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat (Clear row)	Yes	15.71 hectares of low quality dispersal GGF habitat	Area	15.7	Hectares	Biodiversity assessment
			Quality	1	Scale 0-10	
			Total quantum of impact	1.57	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat tree (Clear row)	No					
Condition of habitat Change in habitat condition, but no change in extent (Clear row)	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirem	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset									
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0								
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of		Future quality with offset (scale of									
Threatened species habitat																				
Area of habitat	Yes	1.57	Adjusted hectares	First party dispersal habitat construction	Time over which loss is averted (max. 20 years)	10	Start area (hectares)	6.7	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	0%	0.00	80%	0.00	0.00	2.10	133.86%	Yes	Ecological assessment
									Future area without offset (adjusted hectares)	6.7	Future area with offset (adjusted hectares)	6.7								
					Time until ecological benefit	10	Start quality (scale of 0-10)	1	Future quality without offset (scale of	1	Future quality with offset (scale of	5	4.00	80%	3.20	3.14				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirem**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			