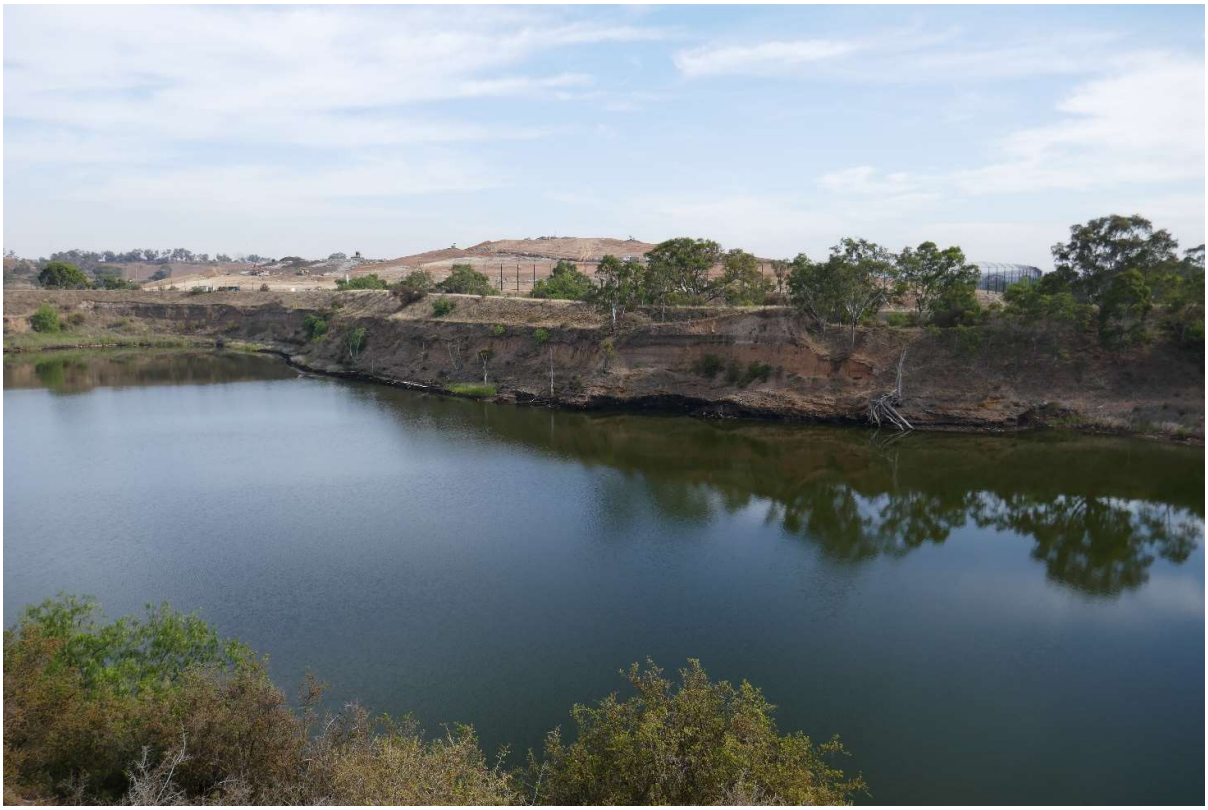

Growling Grass Frog Management Plan
Star Dam Cummings Road Maddingley

February 2019

Prepared for:
Calleja Transport

Report by:
Zone Environmental

DISTRIBUTION

Growling Grass Frog Management Plan
February 2019

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By

Zone Environmental

David Maltby

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1 INTRODUCTION

The Maddingley Brown Coal (MBC) mine has operated since 1948, with landfill activities commencing in 1978. The Calleja Group has owned and managed the MBC site located in Bacchus Marsh since acquisition in 1990. There are currently three main activities on site: Excavating of brown coal and other landscape supplies, solid waste landfill deposited in the historic quarry void, and materials recycling. The MBC site was recently designated by the Victorian Government as a waste-hub of State significance due to the large buffers, potential capacity and acceptance of metal recycling residues. MBC has established itself as a company responsive to changing community and environmental needs with the development of sustainable waste manage options with new projects to generate electricity from methane gas extraction and Waste to Energy and biological processing for municipal landfill diversion alternatives.

The Calleja Group recently acquired the Star Dam site to protect the southern buffers of the landfill and for the potential development of the Star Dam (old coal mining pit) for Potential Acid Sulphate Soil (PASS) disposal on the site at 181 Cummings Road, Maddingley. Sites for safe management of PASS materials are required to support significant public transport infrastructure projects that will generate substantial volumes of naturally occurring PASS materials. While the “Star Dam” is not actually a “dam” the name is in common usage and will be kept to avoid confusion.

The purpose of this paper is to outline the MBC management plan for the development of Growling Grass Frogs (GGFs) habitat enhancement as part of this development.

Key references guiding this proposal are:

- DELWP Growling Grass Frog Habitat Design Standards, Melbourne Strategic Assessment, 2017. (the guideline).
- Star Dam Growling Grass Frog Survey Report, Jan 2019 commissioned by MBC and provided by Water Technology consultants.
- Star Colliery Dam Site Potential Acid Sulphate Soil (PASS) Environmental Management Plan.

2 POTENTIAL ACID SULPHATE SOIL MANAGEMENT

Potential Acid Sulphate soils are soils that formed under waterlogged conditions when oxygen was not readily available. PASS material must be managed in accordance with the EPA Victoria Industrial Waste Management Policy (Waste Acid Sulphate Soils). The EPA has developed a guideline for management of acid sulphate soils (Publication 655.1) that sets out procedures and controls for the classification of both actual acid sulphate soils and potential acid sulphate soils.

Actual acid sulphate soils will not be accepted at the Star Dam site. PASS material once identified in an excavation may either be managed onsite or if necessary, taken offsite to a site such as the Star Dam that has an EPA approved Environment Management Plan for the acceptance of PASS material.

A safe way of managing PASS material is to store them in such a fashion so as to prevent exposure to air that can result in the oxidisation of pyrite within the soils and formation of acid. Placing PASS material below the water table in a void such as the Star Dam is a safe management method for these materials.

3 EXISTING SITE SETTING

The Star Dam site is comprised of a former coal mining pit surrounded by overburden dumps to the south and Parwan Creek to the north and west. The former coal mining void is characterised by generally steep sided banks that terminate at the base of mining void at up to 20 metres below the water surface. The coal mine was developed by the removal of approximately 8 metres of overburden soil that has been dumped to the south of the pit. The coal faces in the Star Dam are assumed to be consistent with the faces within the MBC mine that have a terminal face of approximately 75^{o} from horizontal. There is limited wetland type vegetation within the Dam excavation except where placement of overburden has allowed the establishment of reeds.

3.1 Wetland Types

The current site is a steep sided water body with mainly very deep water across the entire pit. There are limited zones with reed growth and no rocky banks. Much of the water perimeter has exposed brown coal that does not appear to support significant vegetation growth.

3.2 Size

The Star Dam has a perimeter of approximately 1,000 m and a surface area of 5 ha.

3.3 Shape

The Star Dam has an irregular shape that follows the course of Parwan Creek to the north and west. The water body is bounded by Cummings Road to the east and has a more linear final profile on the south. The maximum dimensions of the dam are approximately 400 m width and 200 m in length.

3.4 Depth, gradients and water level variation

Current depth of the Star Dam is largely greater than 10 metres. There are some shallower zones in the south eastern corner where a ramp has allowed for the placement of fill material. Similarly, along the southern boundary there are zones where overburden dumping from the bank appears to have occurred reducing the depth in sections close to the edge of the bank.

The water level in the pit fluctuates with seasonal conditions. Higher evaporation in the summer months together with lower surface water and groundwater inflows leads to lower water levels than winter months. Seasonal variation is in the range of approximately one metre.

A very small percentage of the pit has water levels less than 5 metres. At the end of the summer dry period much of the vegetated zone is completed located above the water as the steep drop-offs combined with the coal face is unsuitable for establishment of emergent vegetation.

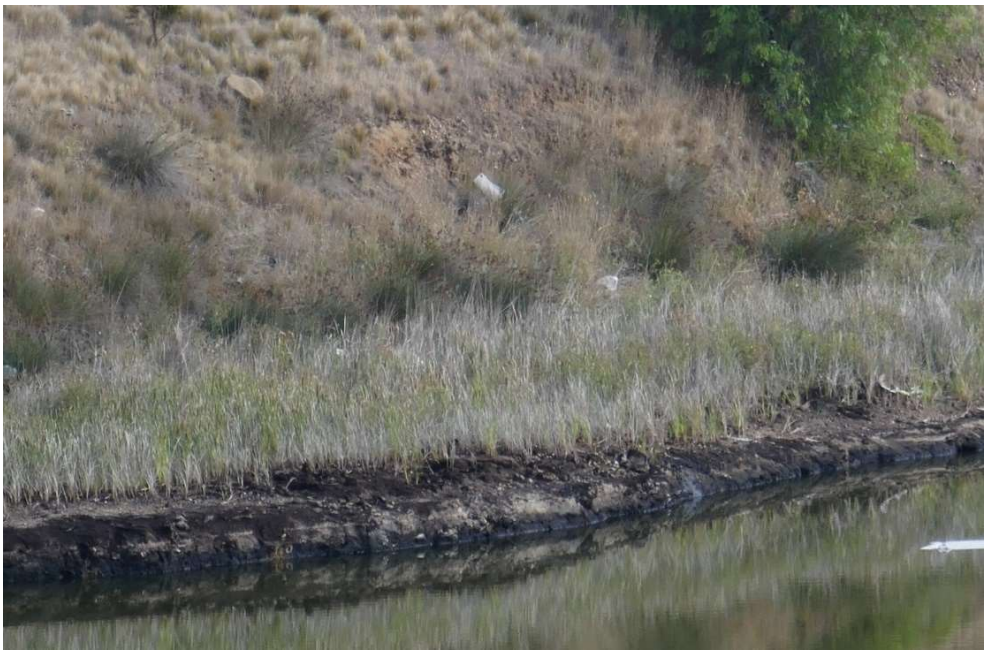
3.5 Hydroperiod

The Star Dam is a permanent water body.

3.6 Wetland Lining and Substrate for vegetation

The Star Dam is below a groundwater water table feature and as such does not require a liner. However, the coal exposed along most of the bank perimeter is unsuitable for emergent vegetation.

The two following images show typical bank substrates, the first shows exposure of coal down to the water with slopes overly steep for vegetation establishment. The second shows a layer of coal at the water edge that has no vegetation but with reeds above on a narrow shelf above the coal. Club rushes can be observed on the bank above the reeds these club rushes tend to grow where seepage from the overlying unconfined Fyansford aquifer into the pit is occurring.



3.7 Thermal properties

The Star Dam is a deep steep sided pit with limited shallow zones. As such warmer zones are limited to a couple of locations where spoil material has been previously dumped. There are no sections of rocky banks. The water in the pit has limited exposure to warming from the sun in the summer.

3.8 Water source

The Star Dam water is a combination of groundwater and surface water inflows. The total dissolved solids concentration in the water suggests that the groundwater inflow is a significant contributor to water present on site.

3.9 Water quality

The water quality on the Star Dam is brackish with total dissolved solids concentration of 6,600 mg/litre

3.10 Aquatic vegetation

There is established vegetation on sections of the Star Dam where fill placement has occurred. The vegetation where present is largely dominated by the Common Reed (Phragmites Australis).

3.11 Predators

There is limited information on the presence of predatory fish in the Star Dam. There are aquatic birds that could potentially prey on GGFs in the dam.

3.12 Terrestrial Habitat

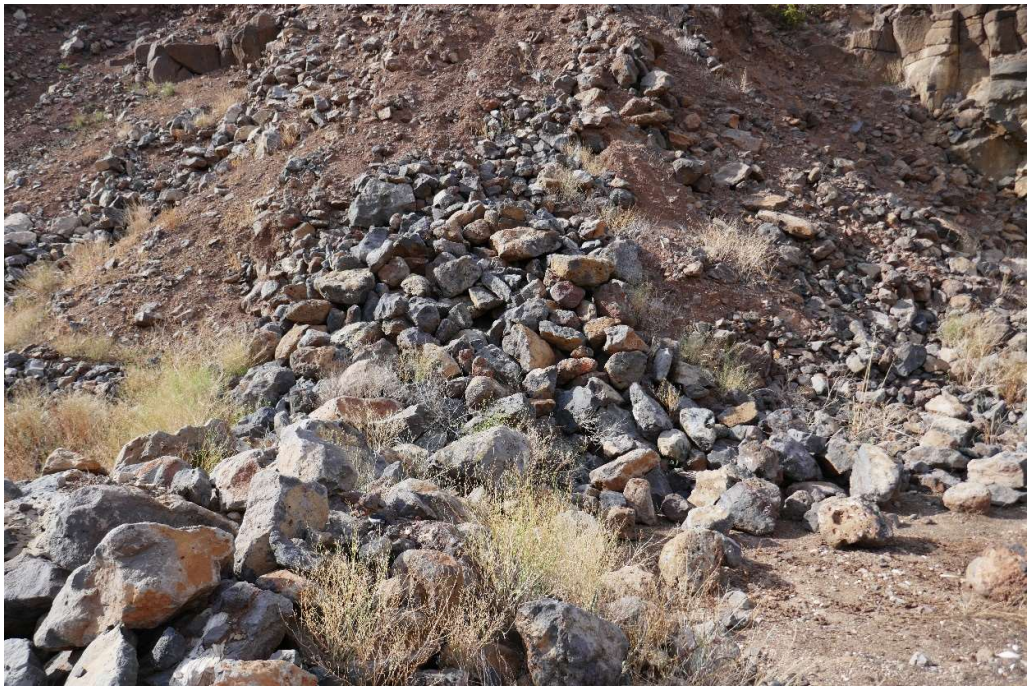
No significant alteration to the terrestrial habitat surrounding the dam is proposed. The terrestrial vegetation is dominated by invasive weed species such as a serrated tussock, boxthorns and scotch thistles. There are remnant river red gums located south of the dam and in Parwan Creek. MBC will use existing weed control contractors to reduce infestations of invasive weeds in particular, boxthorns, scotch thistles and serrated tussock.

4 PROPOSED DESIGN

4.1 Proposed Actions

It is planned to improve the habitat of the Star Dam by the importation and placement of a combination of PASS, clean fill, structural fill and boulders. The methodology proposed is to create ramps into the dam at the south eastern corner and south western section of the dam. Utilising these ramps trucks will import fill material that will be placed into the dam to reduce the depth of the dam. PASS material will only be placed in the deeper section of the pit and no higher than 2 metres below the minimum summer water elevation. Some deeper sections of dam will remain with water depth up to 5 metres.

Clean fill will then be placed around the perimeter of the dam where practicable. Clean fill and boulders will be used to fill up the bank and below the water line to create a more gently sloping back profile that will support vegetation and be less susceptible to erosion and slope failure. The clean fill will be used to create a sequence of shallow and steep banks, around the perimeter of the dam. Onsite boulders will be placed at strategic locations around the dam to create basking sites for the GGFs. A photo of suitable boulders existing onsite in the old quarry follows.



4.2 Wetland Types

The Growling Grass Frogs require a range of habitats to provide food, shelter, allow breeding and egg-laying, tadpole development, and for chytrid fungus control (the disease chytridiomycosis caused by waterbourne pathogen Batrachochytrium dendrobatidis).

Favourable habitat conditions include:

- Permanent water in the ponds with seasonal hydroperiods.

- Ponds with still or slow-moving water with both warm shallow and deeper water, with steep drop offs to escape predators.
- Rock piles near the margins and in the shallows of the pool with minimal tree canopy coverage
- Abundant and appropriate aquatic (submerged and emergent) and terrestrial vegetation for shelter, calling, breeding and egg deposition, safe movement between water sources.
- An acceptable quality water source not likely to introduce pollutants, pesticides, excess nutrients or heavy metals.
- Conditions identified for chytrid fungus control; warm, shallow waters with stable surface water temperatures; moderate salinity; rock piles to allow sun basking.

The proposed actions will provide habitat that meets all the above criteria.

4.3 Size

Constructed wetlands should be designed to be as large as is practicable, taking into account the site's constraints. This protects from the effects of drought, increasing the likelihood of a permanent body of water. Larger wetlands can contain a greater quantity and diversity of food and shelter types.

The Star dam size will be reduced only a few percent below the current 5 ha by the proposed actions.

4.4 Shape

The GGF guidelines state that wetlands should be shaped wide enough to maximise the area of deep water for submerged and floating vegetation and must not be too narrow which would impact on depth capacity. The size of the Star Dam is such that shallow water depth is not an issue.

Islands in wetlands are not permitted as they would attract excessive birds increasing contamination and predation.

While the creation of causeways could potentially create islands if that is considered desirable, the decision to create islands or leave causeways connected to land so as to allow land-based predators to access nesting birds will be made subject to consultation with relevant agencies at the completion of the filling.

4.5 Depth, gradients and water level variation

Water depth is important as it determines aquatic vegetation structure and composition, supporting a dense cover of submergent and floating vegetation and preventing domination by emergent aquatic plants such as Common Reed (Phragmites australis) and bulrushes (Typha spp.) which tend to choke shallow wetlands.

The emergent vegetation zone must incorporate a littoral zone that is subject to fluctuating water levels due to seasonal evaporation rates and rainfall variation. This is important for nutrient cycling and growth of aquatic plants and the zone is used by the GGF to ambush prey on bare soil/exposed mud and to perch on rocks and ground cover vegetation at the water's edge.

The guideline state:

- The deep water submergent vegetation zone is preferably 60-70 % of the total wetland surface area at normal water level (minimum 50%).
- The water depth in the submergent zone must be maintained at greater than 1.5m. Wetlands with greater depths are desirable.
- The emergent vegetation zone should occupy 30-40% of the wetland area and should include a littoral zone with fluctuating water levels (eg from normal levels to summer draw down).
- A variety of slopes must be incorporated into the bank design, including steep drop offs.

The proposed works will meet or exceed all these guideline requirements.

4.6 Hydroperiod

Extinction risk for Growling Grass Frog populations is lower in wetlands with a permanent hydroperiod. Designs should aim for permanent hydroperiod or one that is as long as practicable given constraints (size and water supply).

Timing is important as wetlands need to contain water during the breeding season (Sept to February [around Melbourne]). Eggs are laid in Spring (mostly in October November) and tadpoles develop over several months with most tadpoles having emerged as frogs by the end of May.

Ideally water levels should draw down naturally over later summer and autumn.

The Star Dam will remain a permanent water body with seasonally fluctuating water levels.

4.7 Wetland Lining and Substrate for vegetation

Lining material used to cover coal will be comprised of PASS at depth and clean fill soils in the zone where water levels fluctuate and down to 2 metres. As the water level in the dam is below surrounding groundwater elevations a liner is not required to reduce seepage.

4.8 Thermal properties

The guideline states:

- Wetlands must be large and deep to provide thermal inertia (resistance to temperature change).
- Wetlands must incorporate extensive, shallow permanently inundated emergent zone where water temperatures will be elevated due to sun radiation.
- Warm waters (up to 27 degrees Celsius pg 3) with moderate salinity has been found to lower the rates of chytrid fungus infection and frog mortality compared to colder, fresher water. Most Growling Grass Frog wetlands should therefore be designed to achieve “anti-chytrid” thermal properties in at least 20% of their perimeter with jumbled piles of rocks extending into the wetland at least one meter from normal water level. In basalt regions aim to incorporate more margin with rocks (up to 50% margin, budget allowing) – where excavated rock is freely available for use on site. Designs should include rock piles in the shallows to act as heat banks as rocks warm under the sun and transfer heat to shallow pond waters. Using a variety of rock sizes 10 cm-1 m diameter.

- To prevent shading, shallows should be free of dense emergent aquatic plants (typha spp.) and shrubs and trees.
- To cut prevailing winds embankments would be useful and can be constructed from excavated material.

Shallows are warmer due to solar radiation, which accelerates vegetation growth and tadpole development. The hatching of tadpoles depends on the water temperature, with 18-24C being optimal. Lower water temperatures can mean tadpoles take up to 5 days to hatch.

Warm shallows potentially increases the invertebrate food sources available to the frogs and has been shown to supress chytrid fungus.

The proposed works at the Star Dam will provide both deep and extensive shallow zones and will incorporate zones of basalt rock boulders both above and below the shoreline. These works will significantly increase the habitat value for GGFs.

4.9 Water source

Growling Grass Frogs require water for at least 6 months of the year over the breeding season.

Threats to the species include changed hydrological regimes including timing, frequency, volume and speed of flows, and lowering of groundwater through pumping of aquifers.

The guideline state:

- Groundwater is generally preferred where feasible.

The proposed works at the site will not significantly alter the water quality, elevation or seasonal water level elevations within the pit.

4.10 Water quality

Moderate to low salinity is preferred. Poor water quality including nutrients, turbidity, pollutants such as pesticides, detergents and heavy metals threatens species survival. High nutrient levels increase algae and plant growth, starving the tadpoles of supportive oxygen levels.

Fresh (non-saline) water from rainwater, stormwater is less effective for reducing chytrid.

The water in the Star Dam is saline. The following table shows the water quality in the pit compared to guidelines. The salinity of the pit water could be reduced if water was pumped from the pit prior to winter rainfall events that would tend to dilute the water in the dam. MBC will investigate the possibility of the draw down of small volumes of water each year to reduce the tendency for increases in salinity from evaporative concentration.

Parameter	Target Value	Star Dam	Comment
Dissolved Oxygen	To be determined	6.26mg/L	Well oxygenated
Total Nitrogen(mg/L)	<1.0	0.1	(Nitrate)
Ammonia (mg/L)	<0.01	<0.01	
pH	6.0 – 8.5	8.1	Alkaline
Salinity (us/cm)	<5000	10980	Saline
Turbidity (NTU's)	<40		Visually Clear

In order to manage suspended solid levels and thus turbidity within the dam, Fill will only be placed in a small section of the dam at any given period. The dam area is approximately 5 ha and fill placement will be confined to zones no greater than 500 m^2 or less than 1% of the dam area.

4.11 Aquatic vegetation

Tall emergent vegetation such as reeds and rushes provide protection to adult frogs from predation.

Submerged and floating attached vegetation protects tadpoles and eggs. Females lay up to 4,000 eggs in foamy jelly rafts which sink into submerged vegetation within 12 hours. Tadpoles hide in the aquatic vegetation or move to deeper water if disturbed

Grass and shrub cover on the banks protects emerging froglets from predators.

Favourable habitat features abundant aquatic vegetations, and rock piles around the margins and in the shallows.

Growling Grass Frogs are 'sit and wait' predators, eating a wide range of insects and small lizards, fish, tadpoles and frogs.

Short open vegetation allows Growling Grass Frogs to catch insects for food.

The guideline states:

- If conditions are suitable initial plantings should spread quickly so the whole wetland does not need to planted out:
  - Plant submergent species on the slopes rather than the maximum depth.
  - The proportion of wetland planted will be determined during planning phase

- Planting density aims to establish 50% cover of submergent/floating vegetation in the deep water zone and patches of emergent vegetation within several years. Emergent plantings of generally 4-6 plants per square metre. Less plants per square metre for submergent plants.
- A diversity of vegetation is highly desirable. Select species from Appendix 1 (as determined by water salinity/local water quality).
- In the deep water, submergent/floating species must include Water Ribbons (Cycnogeton procerum) and a species form the genus Potamogeton (if brackish water Fennel Pondweed (Stuckenia pectinate).
- Do not use exotic species.
- Common Reed (Phragmites Australis) and bulrushes (Typha ssp) do not need to be planted as they are likely to establish naturally over time.

The filling works will take decades to complete and much of the bank improvement works can only be achieved once filling of the lower sections of the pit has been completed. Vegetation of the pit will occur in the latter stages of the rehabilitation program.

Vegetation will be selected from DELWP design standards or chosen in consultation with Melbourne Water and the Parwan Landcare Group. Small test plots will be trialled in the shallow section of the Star Dam ensuring that only non-invasive species will be selected for trials.

4.12 Predators

Growling Grass Frogs are active in the warmer months (September to March), in the sun on mild sunny days. They usually call, feed and move around after dark.

Several native and introduced fish, feed on eggs and tadpoles. Introduced fish such as Eastern Gambusia (Mosquito Fish), often found in stormwater systems. Also Carp and Redfin, the salinity if the Star Dam reduces the likelihood of the presence of freshwater fish.

The guideline states:

- Grass and shrub cover on the banks protects emerging froglets from predators.
- Islands in wetlands are not permitted as they would attract excessive birds increasing contamination and predation.
- New wetlands should be offline. Those in floodplain should incorporate bund walls to decrease fish incursion
- Incorporate fish exclusion filter in hydraulic connection system between source (storm water or river) and wetland
- Other:
    - Depth requirements assist with predator avoidance
    - Hydroperiod – dry out maintenance capability to control predators
    - Vegetation refuge for tadpoles (and eggs – submerged and floating attached vegetation)

4.13 Terrestrial Habitat

During winter Growling Grass Frogs are mostly inactive and shelter on the land under rocks, fallen, logs or thick vegetation, in ground crevices or debris. They are often away from water bodies and sometimes shelter communally.

Movement between breeding sites (water bodies) is crucial, allowing temporal variation in habitat use and/or recolonisation of sites following local extinction, and maintains genetic diversity.

Adult frogs move across open ground (for example grasslands) to access local foraging resources and breeding sites.

The guideline states:

- Minimum 50 metre buffer from development/major roads/car parks/buildings.
- 30 m buffer plus from normal water level of breeding wetland to minor infrastructure such as shared use paths, passive recreation, stormwater assets.
- Within 10 metre of wetlands normal water level there must be 50% of the area. maintained as low grassy vegetation up to 10 cm in height.

- If tussock forming grasses and sedges are used in the grassy zone planting, density should be no more than 20% cover when mature.
- 50 m buffer from wetland for any mulch used.
- 10 m buffer from normal water level for any shrubs planted.
- Rock pile at least 1 metre deep constructed adjacent to wetland margin using a variety of rock sizes 10cm-1 m diameter.
- Where possible areas between 10 m to 100 m should primarily be short mown grass with open structure (20% cover). They do not need to be native grasses – mown pasture grass or lawn are acceptable.
- Tree cover within 100 m of wetland should not exceed 10%.
- A patchy arrangement of denser plantings of tussock forming species is encouraged and offer potential terrestrial shelters.
- Do not use invasive plant species.

Rehabilitation activities of the land areas around the Star Dam will be consistent with guideline requirements. MBC will use existing weed control contractors to reduce infestations of invasive weeds in particular, boxthorns, scotch thistles and serrated tussock.

5 SUMMARY

The rehabilitation of the Star Dam will provide a significantly enhanced habitat for Growling Grass Frogs (GGFs) that the current unrehabilitated water-filled former coal mining void. The key activities that will be undertaken include:

- Construction of a ramp to allow safe vehicular access to the pit.
- Importation of PASS material and placing of PASS material to a maximum of 2 metres below the lowest seasonal water level in the pit.
- Importation of clean fill and use of existing overburden material on site to fill and shape the Star Dam banks to cover exposed coal and to a allow for a bank profile that is less susceptible to erosion and that will support vegetation growth.
- Stabilisation of banks that are failing due to wave action.
- Importation of boulders to the dam to provide sunning platforms for GGFs and to provide refuges from predators.
- Monitoring of PASS material and dam water quality in accordance with the EPA approver PASS EMP.
- Undertaking of weed control to reduce infestation of endemic and noxious invasive weeds.
- Trialling of suitable local aquatic and emergent vegetation species at the site to determine suitable species.
- Investigate the periodic discharge of water from the dam to reduce the potential of salt from evaporative concentration.
- Removal of truck ramps at the conclusion of fill placement.

The rehabilitation works at the Star Dam will produce a habitat that will be significantly enhanced for Growling Grass Frogs. Key enhancements will include a greater range of water depth to provide microclimates within the dam, more vegetation for food and cover from predators, rock banks for basking and localised water warming. In addition, the banks will be more resistant to wave erosion and support a greater range of aquatic and emergent vegetation.