Best practice guidelines

Green and golden bell frog habitat

CMA Sydney Metropolitan Catchment Management Authority

Australian Government

Department of Environment & Climate Change NSW

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1 Introduction

The green and golden bell frog is an endangered species which needs careful management to ensure its survival. It has specific habitat needs throughout its life cycle. This document informs people of ways in which they can create and maintain bell frog habitat in their gardens or on land they own or manage.

Presently, the green and golden bell frog occurs in only 43 areas throughout NSW. Find out if these frogs live in your area before implementing any of the suggested techniques in this guideline. See sections 3.1 and 4 for more information.

This guideline will help:

- homeowners who would like to create green and golden bell frog habitat in their garden
- farmers and other rural property owners who would like to adapt a farm dam and its surroundings to benefit the frog
- managers of industrial sites or business premises who wish to enhance parts of their site to benefit the local green and golden bell frog population
- councils and other organisations that wish to enhance or provide green and golden bell frog habitat in areas they manage.

Photo: S. Marks

Figure 1: Green and golden bell frogs often bask in the sun

2 About the green and golden bell frog and its habitat requirements

Photo: L. Jurd

Figure 2: Green and golden bell frog tadpoles

Photo: L. Jurd

Figure 3: Juvenile green and golden bell frogs

2.1 About the green and golden bell frog

The green and golden bell frog is mostly green in colour, with patches of brown, a gold stripe running along the side and blue colour on the inside of the thighs. Tadpoles are dark grey-brown, with a pinkish tinge on the underside. Males rarely exceed 8 cm in length, whilst females grow to approximately 10 cm in length.

The frogs are usually located in and around water bodies such as wetlands, lakes and dams, and often on sites which humans have disturbed such as abandoned quarries. Their preferred habitats always contain plenty of vegetation in and around water.

Their diet typically consists of beetles, ants, spiders, crickets and smaller frogs, including the young of their own species.

Males call while floating in the water to attract females. Their call is a long sound followed by a medium sound, then two short sounds (brrrrrrk-brrrrk-brrk-brrk). The frogs normally breed during spring and summer. Tadpoles take about 10–12 weeks to turn into frogs. For more information on the lifecycle of the green and golden bell frog, see www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10483.

2.2 Distribution and abundance

The green and golden bell frog was once very common and was regularly found in residential gardens, around farms and on commercial and industrial properties across much of south eastern Australia.

The frog has disappeared from most of its former range. There are only about 40 isolated remnant populations left scattered across the coastal parts of NSW (Figure 4).

The green and golden bell frog is listed as endangered in the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Reasons for the disappearance and overall general decline in the species are thought to include:

- loss of habitat
- disease (frog chytrid fungus)
- introduced fish (e.g. plague minnow (*Gambusia holbrooki*) and carp (*Cyprinus carpio*), which eat the eggs, tadpoles and hatchlings)

- cane toads (*Bufo marinus*) and other introduced animals which prey on the frog or compete with it for habitat.

The above factors are thought to be working together to bring about the frog's overall decline. More information on predators and threats is given in section 6.2.

The green and golden bell frog can colonise, use and survive in a wide range of habitats, including highly modified sites such as disused industrial areas. The frog requires different habitat during different parts of its life cycle, including habitat for:

- breeding
- foraging
- refuge
- movement.

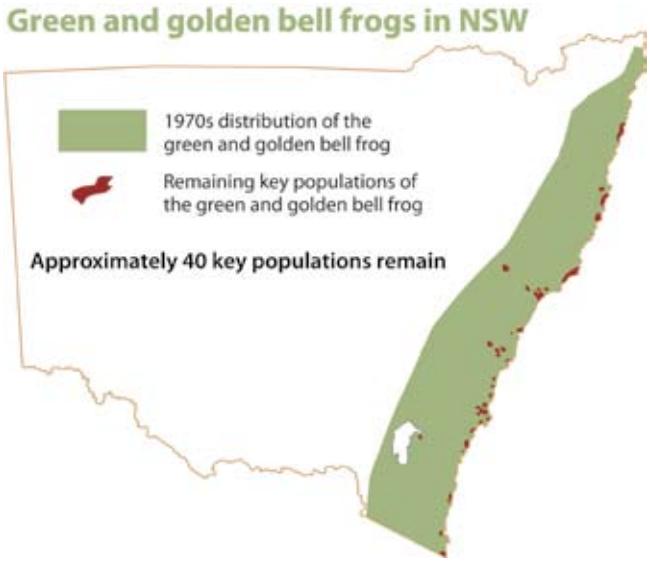

Figure 4: Former and current distribution of green and golden bell frogs

Obviously, not all projects will be able to provide habitats to meet all the needs of the frog's life cycle. There will often be restrictions on how much room can be made available and what type of habitat can be provided. However, all attempts should be made to at least provide some habitat for breeding, foraging, refuge and movement. Those with larger landholdings such as rural landowners, businesses or councils, might be able to include all habitat components on a particular site or ensure areas of habitat are connected.

Photo: R. Parker-Wright

Figure 5: Bell frog breeding area, Kooragang Island

2.3 Breeding habitat

The green and golden bell frog successfully breeds in and around a wide variety of water bodies. These range in size from large freshwater and estuarine lakes to small temporary pools and depressions.

The species has been recorded in coastal swamps, marshes, dune swales, lagoons, lakes and other estuary wetlands as well as around riverine floodplain wetlands, billabongs and ponds in slow flowing or non-perennial streams.

Constructed water bodies such as stormwater detention basins, farm dams, areas bunded by earthworks and by road or rail structures, drains, ditches and other excavated areas that can capture water such as quarries and brick pits have been used as breeding habitat. Smaller or less obvious structures have also been used, such as water tanks, bunded safety areas surrounding industrial chemical storage areas, wells, irrigation pits, water troughs, laundry tubs and old bath tubs.

2.4 Foraging habitat

Green and golden bell frogs' preferred foraging areas generally contain flowering plants, grasses and foliage. Plants that form tussocks provide foraging habitat and shelter. This vegetation may be near breeding habitat sites or some considerable distance away. Section 5.1 provides more details on appropriate vegetation for foraging habitat.

Photo: J. Denby

Figure 6: Created pond with foraging and refuge habitat

2.5 Refuge habitat

Refuge habitat contains areas in which the frog can escape from dangers such as predation or fire, and can retreat to avoid climatic extremes for short periods. Refuge habitat can also include sites where individuals might hide over winter and spend extended periods during cooler months in an inactive state.

The frog may also be found at times amongst human refuse including dumped building materials that substitute for natural shelter. These can include piles of sheet iron, fibro, concrete and bricks.

When unfavourable conditions occur, these shelter sites may be occupied by many green and golden bell frogs.

Photo: J. Denby

Figure 7: Connectivity habitat, including wetlands, vegetation and grassy areas

2.6 Connectivity habitat

Connectivity habitat enables frogs to move between different areas of habitat at different times of the year. It also allows for interaction between frogs from different populations so populations can adapt and survive.

Connectivity habitat generally includes:

- wet areas such as river banks or wetlands
- drainage lines
- stormwater culverts
- swales
- periodically damp areas
- connecting or partially connecting areas of vegetation the frog prefers
- easements
- laneways
- grassy open areas that do not restrict movement.

3 Implementing a green and golden bell frog habitat project

Governments, residents, community groups and businesses throughout NSW are working together to create or enhance habitat for the frog. Providing extra habitat may help to boost the numbers of the species.

The Department of Environment and Climate Change (DECC) has developed population management plans for some important bell frog populations in NSW. These plans identify actions that can be undertaken in different locations to help the frog survive. For further information on these plans, contact DECC's Environment Line on 131 555 or write to the Green and Golden Bell Frog Recovery Plan Coordinator, Biodiversity Conservation Section, DECC, PO Box 1967, Hurstville, NSW 2220.

Photo: M. Schulz

Figure 8: Green and golden bell frog

3.1 How to find out if there is a population or suitable habitat nearby

To find out if there are green and golden bell frogs in your area:

- see section 4 of this guideline
- refer to DECC's Wildlife Atlas – see http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp
- phone DECC's Environment Line on 131 555
- contact your local council
- conduct a mini survey – in spring or summer, during or just after rain, listen for the males calling at the nearest wetland.

To find out if there is suitable habitat nearby:

- contact DECC's Environment Line on 131 555, or your local council, as they may have vegetation mapping available for your area
- see section 2 of these guidelines.

3.2 Plan the project

Before planning your green and golden bell frog project, it might be helpful to educate yourself about the frog's habits and habitat. You can read these guidelines, visit Sydney Olympic Park or other sites where green and golden bell frog habitat have been constructed, and consult the following websites:

- www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10483
- www.environment.nsw.gov.au/resources/nature/hyprfrog.pdf.

Next, work out what components of green and golden bell frog habitat already exist on land you own or manage, or what components need to be created.

Think about what organisations can work with you on your project. Contact your local council, and search online for local environmental and community groups who may be interested in supporting your project. Also, read the next section of these guidelines. Neighbours or local businesses may be interested in helping.

When deciding how much money to spend on your project, consider applying for additional funds. See 'Funding' below.

Prepare a project timeline. Your local council may be able to help you with this.

3.3 Seek approvals

If you do not own or manage the land in question, ensure you have the permission of the landowner or manager before starting any work.

Check with your local council and DECC that what you propose to do conforms with environmental standards and legislation. For example, under your council's zoning scheme, installation of ponds may require a development application to be submitted and fencing to be erected to conform with safety requirements.

You may also need to obtain a licence from DECC when working within threatened species habitat or within an endangered ecological community. This will ensure that the creation of habitat for the green and golden bell frog does not harm the habitat of another threatened species. See www.environment.nsw.gov.au/wildlifelicences/ScientificResearchLicences.htm for more information or phone DECC's Wildlife Licensing Unit on (02) 9585 6540.

3.4 Funding

You may need to apply for funding to carry out your project.

Grants may be available from:

- Caring for our Country (formally Natural Heritage Trust) – www.nrm.gov.au/funding/index.html
- Environmental Trust – www.environment.nsw.gov.au/grants/envtrust.htm
- Threatened Species Network – www.wwf.org.au/ourwork/species/tsngrants/
- your local catchment management authority
- philanthropic organisations
- Grants Link – www.grantslink.gov.au/Info.aspx?NodeID=8.

4 Ways in which different people can help

Several groups of people can get together to create green and golden bell frog habitat. They include:

- residents in urban areas
- rural landowners
- business and industrial site managers
- councils and other government departments.

Photo: L. Jurd

Figure 9: Green and golden bell frogs have successfully bred in this pond in Riverstone, which is made from an inflatable wadding pool

4.1 Residents

Presently, the green and golden bell frog is known to exist in the following residential areas: Arncliffe, Avoca, Bombo, Davistown, Greenacre, Hammondville, Hexham, Kurnell, Merrylands, Minnamurra, Mt Druitt, North Ryde, North Wyong, Port Macquarie, Riverstone, Rosebery, St Marys and Woonona.

In some of these highly urbanised areas, the frogs may use habitat available in nearby wetlands but also spend part of their life cycle in residential gardens (Figure 10). If several residents provide a small amount of breeding or foraging habitat on their property, there will be a mosaic of habitat for the frog to occupy across a larger area.

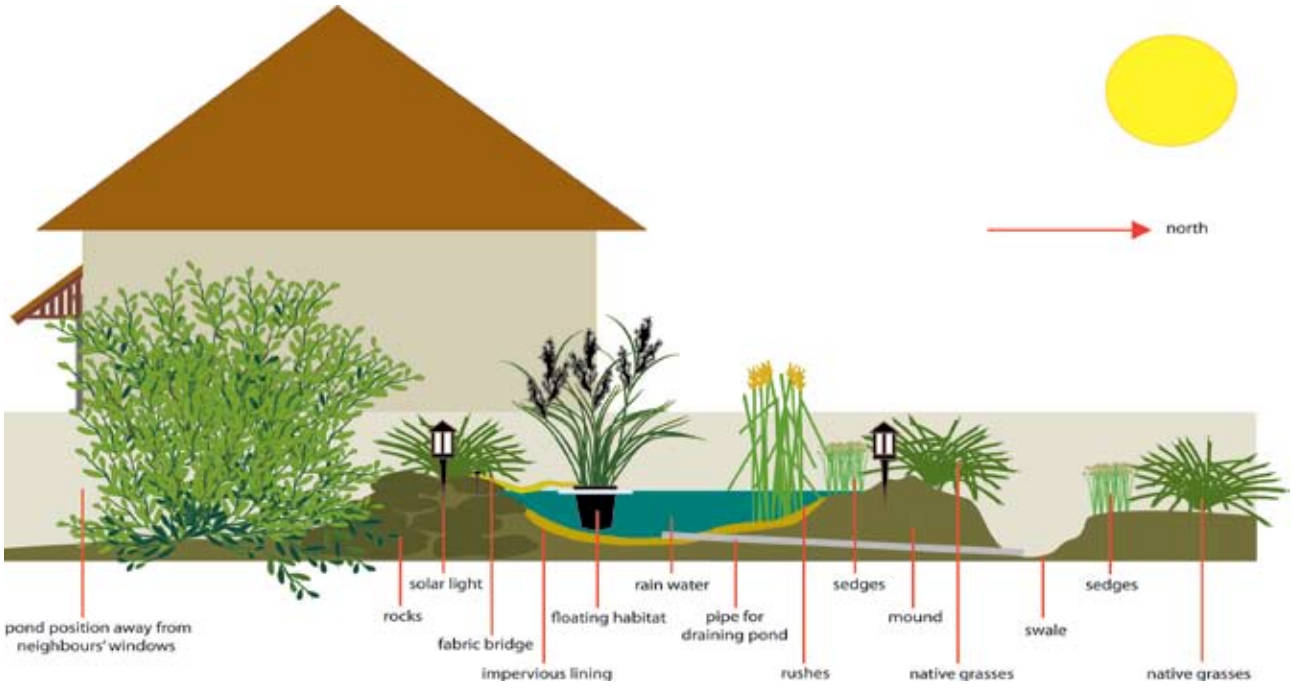

Illustration: J. Denby

Figure 10: Example of residential bell frog habitat

Checklist for suburban residents

- ☐ Plant some frog-friendly vegetation, preferably around a pond or wet area (see section 5.1).
- ☐ Build an above-ground pond for the frog (see section 5.2).
- ☐ Keep habitat areas free of weeds and chemicals.
- ☐ Keep your pet away from frog habitat areas.
- ☐ Read the short brochure, *Protecting and restoring green and golden bell frog habitat*, available on www.environment.nsw.gov.au/threatenedspecies.
- ☐ Report any observations of frogs to the NSW Wildlife Atlas online www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp) or report them to DECC online at www.environment.nsw.gov.au/surveys/BellFrogOnlineForm2.htm or by phoning Environment Line on 131 555.

Photo: R. Wellington

Figure 11: A farm dam in Kioloa providing green and golden bell frog habitat features

4.2 Rural landowners

Presently, the green and golden bell frog is known to exist in the following rural areas: south-east of Grafton, South West Rocks, Clybucca, Crescent Head and Hat Head, north of Port Macquarie, east of Bulahdelah and near Myall Lakes, south of Nelson Bay, Moffat's Swamp near Raymond Terrace, areas around Maitland, Cessnock and Kurri Kurri, near Jerry's Plains and near Muswellbrook, Hexham, North Wyong, Bungendore, Captains Flat and Carwoola in the southern highlands, lower Crookhaven–Shoalhaven River, Greenwell Point, Jervis Bay, Lake Conjola, Durras Lake, Sussex Inlet, Moruya Heads, Merimbula, Tanja and Cobargo.

Checklist for rural landholders

- ☐ Fence off part or all of a dam from stock so fringing vegetation can grow and edges are not trampled.
- ☐ Landscape a dam with rocks, logs and water plants like rushes and sedges.
- ☐ Plant tussock vegetation in clumps above the dam rim.
- ☐ Allow a grassy area to remain ungrazed.
- ☐ Make a water hole section of a non-perennial creek or a billabong frog-friendly by following the advice in sections 5.1 and 5.2.
- ☐ Remove introduced fish and do not stock fish in a frog habitat dam.
- ☐ Limit the use of farm chemicals near habitat areas.
- ☐ Re-create a riparian zone along creeks and provide off-stream watering points where possible.
- ☐ Protect wetland areas from trampling and grazing, and reconsider drainage works that alter or restrict flows to these areas.
- ☐ Report sightings of any frogs seen on-site to the NSW Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp) or report them to DECC online at www.environment.nsw.gov.au/surveys/BellFrogOnlineForm2.htm or by phoning Environment Line on 131 555.

Illustration: J. Denby

Figure 12: Example of rural bell frog habitat

Most rural properties have stock watering or irrigation dams that could provide habitat for the green and golden bell frog (Figure 12). They might also have stream channels and other floodplain features that sometimes hold water or become boggy. Coastal rural properties may have remnant areas of coastal wetland. All these features can provide habitat for the green and golden bell frog with some minor landscaping or changed management practices. See the rural landowner checklist.

Photo: G. Daly

Figure 13: Bell frog habitat in a detention basin adjacent to a waste facility, Port Kembla

4.3 Industry and business

The green and golden bell frog is known to exist in the following industrial areas: Arncliffe, Greenacre, Kooragang Island, Port Kembla, Kurnell, Homebush Bay, Camellia, Rosebery, Botany.

Industrial or business premises are often located on sites that are poorly drained or may have been wetland areas (Figure 13). Consequently, quite a few industrial sites are located near remnant green and golden bell frog populations.

Checklist for industrial and business premises

- ☐ Create frog habitat on unused parts of the site by creating a pond or incorporating foraging or refuge habitat (sections 2.4 and 2.5).
- ☐ Plant frog-friendly plants that create shelter or foraging habitat, or allow frogs to move from place to place along site boundaries.
- ☐ When considering changes or new developments on a site, attempt to provide or retain frog habitat.
- ☐ Plan mowing and slashing activities to avoid areas with sedges and rushes, or near breeding habitat.
- ☐ Avoid moving logs, rocks or established rubbish piles during winter months (April–August). This is when green and golden bell frogs are in their inactive state and especially sensitive to disturbance.
- ☐ Amend site management plans to include ways to help or protect frogs on-site.
- ☐ Develop a reporting mechanism for any frogs observed on the site by staff and send these reports to the NSW Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp) or report them to DECC online at www.environment.nsw.gov.au/surveys/BellFrogOnlineForm2.htm or by phoning Environment Line on 131 555.

Photo: R. Wellington

Figure 14: Bell frog habitat in rock platform seep pools, Bass Point

4.4 Other organisations

Councils and state government departments

Land in public ownership and under the control of a council or a state government department often includes:

- strips of land along streams, canals or drains
- corridors along powerlines, pipelines, railway lines or roadways
- flood mitigation, drainage and detention features.

All these features could be enhanced to provide habitat features for the green and golden bell frog and provide connectivity between remaining populations (Figure 15).

Golf courses

Golf courses often have:

- water hazards that can be colonised by the frog
- extensive grassy areas that provide excellent foraging habitat
- areas that can link habitat in urbanised areas.

Golf course managers could restrict the use of chemicals in water features and mow areas in stages to benefit frogs.

Sewage treatment plants (STPs)

Target sites: Tura Beach STP, Durras Lake water treatment facility, Holsworthy STP, Cox's Creek Reserve (old STP site), Warwick Farm (old STP site), Sussex Inlet STP, Shoalhaven Heads STP, Shellharbour (Blacks Beach) STP, Nth Cronulla (Kurnell) STP, Bayswater Power Station (STP).

STPs or old STPs are often colonised by green and golden bell frogs. So far, it is unknown why bell frogs are found at such sites. It could be water quality or the reliable water supply that is helping the frog to survive.

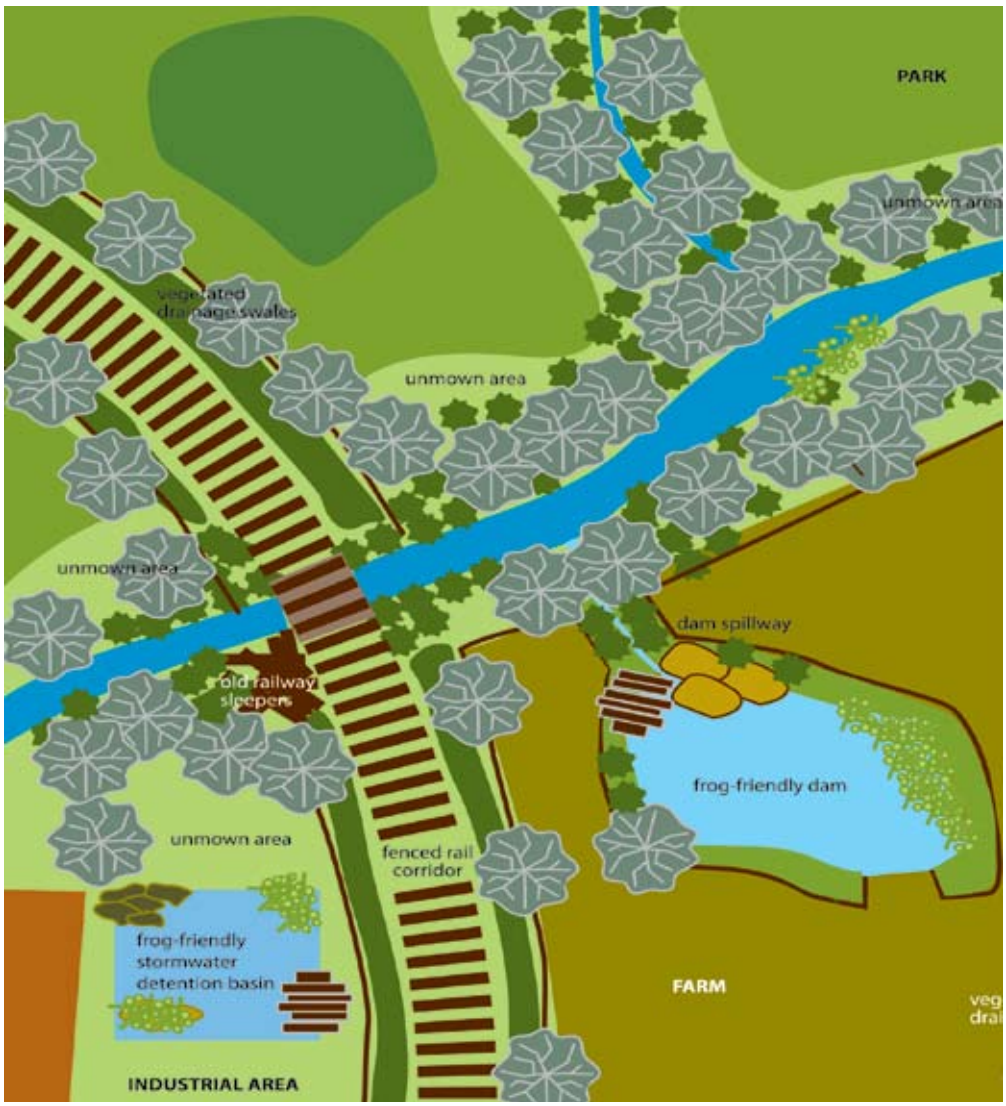

Illustration: J. Denby

Figure 15: Bell frog habitat integrated across a variety of land uses

Checklist

Councils

- ☐ Include construction of green and golden bell frog habitat as an ameliorative or precautionary measure for developments near existing habitat.
- ☐ Create or enhance habitat in or near detention and drainage easements.
- ☐ Modify Water Sensitive Urban Design features in new developments to include green and golden bell frog habitat features.
- ☐ Train staff in green and golden bell frog habitat management.
- ☐ Develop habitat features to enhance key population areas.
- ☐ Plan mowing and slashing activities to avoid areas with sedges and rushes, or near breeding habitat.
- ☐ Avoid moving logs, rocks or established rubbish piles during winter months (April–August). This is when green and golden bell frogs are in their inactive state and especially sensitive to disturbance.

Golf courses

- ☐ Enhance fairway water features to include plants that are part of green and golden bell frog habitat (section 5.1).
- ☐ Manage golf course chemical use, such as herbicides, pesticides and fertilisers, to avoid green and golden bell frog habitat and impacts on water quality.
- ☐ Plan mowing and slashing activities to avoid areas with sedges and rushes, or near breeding habitat.
- ☐ Avoid moving logs, rocks or established rubbish piles during winter months (April–August). This is when green and golden bell frogs are in their inactive state and especially sensitive to disturbance.

Sewage treatment plants

- ☐ Develop a management strategy for the frog at sewage treatment plants near green and golden bell frog populations.
- ☐ Provide habitat features as part of sewage treatment plant landscapes and gardens (sections 5.1 and 5.2).

All organisations

- ☐ Alert staff to be vigilant for the frog on-site and report observations to the NSW Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp) or report them to DECC online at www.environment.nsw.gov.au/surveys/BellFrogOnlineForm2.htm or by phoning Environment Line on 131 555.

5 Creating habitat

The main components of any green and golden bell frog habitat are appropriate vegetation and a pond.

5.1 Suitable habitat plants

Plants should be planted around water bodies, placed in water bodies when appropriate (e.g. reeds), and dispersed over the site.

Suitable and unsuitable plant species for the frog are listed below:

Photo: N. Izquierdo

Figure 16: Spiny mat rush (*Lomandra longifolia*) is an ideal habitat plant for the green and golden bell frog as it forms tussocks in which the frog can shelter

Photo: C. Ramsay

Figure 17: Vegetation that emerges from water bodies provides habitat for green and golden bell frogs to bask and escape predators

Grasses and grass-like plants to be planted near the breeding pond

Common name	Scientific name
Red leg grass	(*Bothriochloa macra)*
Windmill grass	(*Chloris truncata)*
Wallaby grass	(*Danthonia caespitosa)*
Wallaby grass	(*Danthonia linkii)*
Blue flax lilly	(*Dianella caerulea)*
Mauve flax lilly	(*Dianella revoluta)*
Tasmanian flax lilly	(*Dianella tasmanica)*
Long lovegrass	(*Eragrostis elongata)*
Blady grass	(*Imperata cylindrica)*
Spiny mat rush	(*Lomandra longifolia)*
Weeping grass	(*Microlaena stipoides)*
Water couch	(*Paspalum distichum)*
Swamp foxtail	(*Pennisetum alopecuroides)*
Large tussock grass	(*Poa labillardieri)*
Snow grass	(*Poa siebriana)*
Kangaroo grass	(*Themeda australis)*

Wetland plants to be planted in the water body

Carex appresa
Carex fasicularis
Gahnia siebriana
Crinum pedunculatum
Isolepis nodosa
Juncus krausii
Juncus usitatus
Phragmites australis
Restio tetraphyllus
Bolboschoenus fluviatillis
Alisma plantago aquatica
Amphbromus neesi
Baumea articulata
Baumea rubiginosa
Bolboschoenus caldwelii
Cotula coronoipifolia
Eleocharis acuta
Lepironia articulata
Philydrum lanuginosum
Schoenoplectus mucronatus
Schoenoplectus validus
Sueda australis
Triglochlin procerum
Triglochlin striata
Schoenoplectus vallidus
Baumea articulata
Carex appressa
Eleocharis sphacelata
Isolepis nodosa
Juncus usitatus.

It is better to plant local native species from the list above than species exotic to your area. For advice on local endemic species, contact your local DECC Parks and Wildlife office, catchment management authority or council.

Never plant *Juncus acutus*, *Typha* sp. or *Cortaderia selloana* (Pampas grass) as these species are noxious weeds, and threaten other endangered plants and animals as well as the green and golden bell frog.

When creating foraging habitat, it is a good idea to plant relatively low plants including groundcovers, grasses and sedges across the site, and plant taller aquatic plants near water or periodically wet areas. If you can, include plants that form tussocks for shelter, such as such as *Lomandra* and *Dianella* species. As these attractive plants are often used for landscaping, they are easily found in neighbourhood nurseries.

5.2 Building a pond

Green and golden bell frogs will use a wide variety of water bodies as habitat.

Different options for ponds include:

- those with a clay base
- prefabricated ponds
- those made with pond liners
- above ground plastic swimming pools or concrete troughs
- ponds made out of old bath tubs, plastic tubs or laundry tubs.

A pond previously used for fish can be converted into a frog pond if fish and spawn are removed. Make sure you drain and dry out any pond that has previously been used for fish. Refill the pond and develop the frog habitat features described in sections 5.1 and 5.2.

A green and golden bell frog pond can be constructed anywhere, from backyards to industrial premises. Ponds should be raised above the ground, as they can exclude ground frogs which may compete with, or prey on, bell frog eggs and tadpoles. While bell frogs may use in-ground ponds, breeding may not be successful if ground frogs are present. A pond should have sides at least 35 cm above ground level and preferably a lip that turns outwards. An inward-turning lip may prevent frogs from getting out of the water and cause them to drown.

Ponds should also be:

- relatively shallow (no more than a metre in depth at maximum) but varying in depth to allow for different growth stages
- still or, at most, very slow flowing
- ephemeral or permanent (ideally either periodically drying out or with fluctuating water depth – a permanent water body with associated ephemeral depressions that periodically hold water is likely to be an ideal combination)
- near a range of preferred vegetation such as clumps of sedges and rushes, away from trees (as many trees shed leaves which are poisonous to green and golden bell frogs) and in a sunny position without heavy shading, to allow frogs to bask in the sun
- free of exotic fish such as carp and plague minnow
- characterised by having both emergent and submerged aquatic plants which provide food and shelter for tadpoles, and encourage aquatic insects on which the frog can feed
- surrounded by rock piles or logs on which the frog can bask and in which the frog can hide.

If you have a fish pond, drain and dry out the pond and place your fish in an indoor aquarium. Refill the pond.

Contact your local council before constructing your pond to find out if there are any local regulations you must comply with.

Remember that it is illegal to move frogs or tadpoles. The frogs will find you. Green and golden bell frogs are able to move considerable distances and can find new ponds on their own.

Photo: Sydney Olympic Park Authority

Figure 18: Raised pond with out-turning lip at Sydney Olympic Park

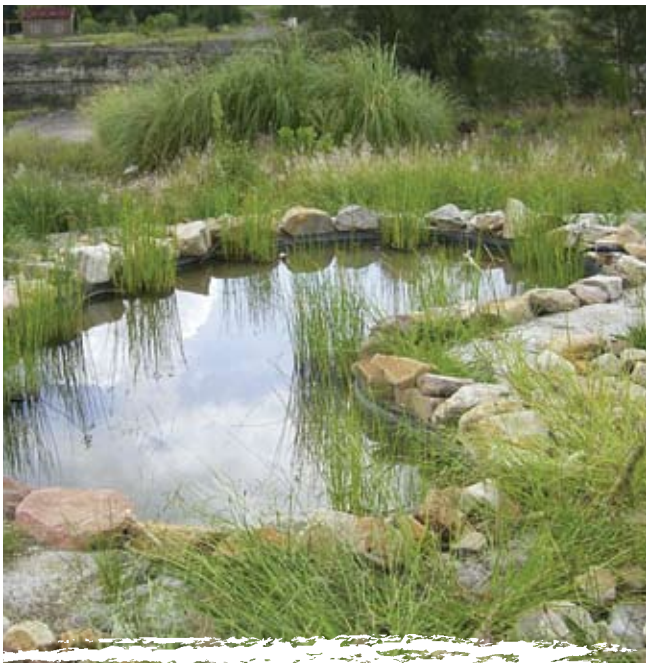

Photo: Sydney Olympic Park Authority

Figure 19: Inground pond with emergent, submergent and surrounding vegetation

5.3 Fencing, underpasses and other habitat features

When creating foraging habitat in urban settings, ground level lighting and compost piles help to attract insects on which the frog feeds.

Features that can be implemented to create or improve **refuge habitat** include:

- dense tussock forming vegetation
- deep fissures and earth cracks in mud
- underground holes and burrows
- rotting logs with hollows
- logs embedded in the earth or piles of timber
- rock piles.

When creating connectivity habitat, underpasses or other ways to enable frogs to cross busy roads may have to be constructed. Viaducts, culverts and openings under retaining walls, buildings or roads could be used.

Frog fencing may need to be installed to direct the movement of frogs away from busy roads or towards underpasses to allow them to move safely between habitats.

A frog fence can be made of any durable material but will need to have a roof and lip or curve to prevent frogs climbing over it. The fence will need to be at least one metre high so frogs cannot jump over it. There should also not be any vegetation within a metre of the fence to prevent frogs hopping from plants over the fence.

Several different styles of fencing include:

- curved metal posts embedded into the ground with the curve facing the frogs' habitat. Shade cloth is attached from the curve edge to the ground and can be dug in up to 20 cm deep to help prevent frogs burrowing under it and escaping.
- recycled plastic planks and posts with a metal hood.

Underpasses should be considered in any new residential or industrial development and when constructing new roads.

Photo: N. Corkish

Figure 20: An example of a frog-proof fence against an existing cyclone fence at the Kurnell Desalination Plant

Photo: R. Wellington

Figure 21: Stormwater dish drain, Davistown

The frog is highly mobile, may use different habitat components from time to time and, where these are some distance apart, will need to be able to move between them. Consider constructing vegetation corridors between different habitat areas. Encourage your neighbours, whether they are residents, industry or government, to create connecting habitat through nature strips, drains and swales (Figure 21).

Chemicals such as insecticides should never be used on habitat sites.

Photo: Sydney Olympic Park Authority

Figure 22: This rock pile provides a refuge habitat where green and golden bell frogs can safely spend the winter in an inactive state

6 Managing existing habitat

Things that can be done to enhance existing habitat include:

- weed control
- native plant control
- pest control
- improving water quality
- fire management
- monitoring.

6.1 Vegetation management

Your local council may be able to help you with vegetation management. They may operate a bushcare program that could help you establish a group to look after green and golden bell frog habitat. You may also be able to attend workshops and learn about bush regeneration techniques.

Photo: Sydney Olympic Park Authority

Figure 23: Hand removal of a spiny rush (*Juncus acutus*) seedling

Weed control

Weed control should be done during the cooler months (April–August) when the frogs are less active.

Spraying with herbicide should not be undertaken on any frog habitat. Instead, accepted bush regeneration techniques should be used including:

- hand-pulling small soft plants such as many annual weeds, for example, fleabane (*Conza canadensis*), milk thistle (*Silybum marianum*) and grasses; and the seedlings of privet (*Ligustrum ovalifolium*), camphor laurel (*Cinnamomum camphora*) or lantana (*Lantana camara*)
- inserting a knife into the ground near the plant and cutting around the root for plants with rhizomes or long tap roots, for example, asparagus fern (*Asparagus aethiopicus*) and some grasses
- scraping the stem of vines and scramblers, for example, Japanese honeysuckle (*Lonicera japonica*) and morning glory (*Ipomoea cairica*), and plants with extensive root systems, for example, ochna (*Ochna serrulata*) and camphor laurel, with a knife and applying herbicide to the length of the scrape
- cutting small woody weeds as near to ground level as possible and applying herbicide within 20 seconds to the cut, for plants with stems less than 5 centimetres in diameter, for example, lantana, privet and cassia (*Senna bicapsularis*)
- 'frilling' large woody weeds with stems greater than 5 cm in diameter, for example, privet, camphor laurel, coral tree (*Erythrina crista-galli*), by making a cut with a chisel at the base of the plant and applying herbicide into the gap immediately. Continuing in a circle round the trunk, repeat the 'cut and poison' technique at five centimetre intervals. Alternatively, a drill can be used to bore holes in the trunk and fill them with poison every five centimetres round the base.

The leaves and stems of some plant species can remain on-site in small piles to decompose. Other species such as lantana and many vines can re-sprout if left on the ground. To prevent this happening, create a raft or base of branches, palm fronds, fallen timber or rocks and stack small piles of weeds on top. These piles can then also act as shelter for many animal species.

Any fruit or seeds should be removed from plants and placed in bags which should then be emptied into council 'green bins' for removal. Vines that sprout tubers, such as madeira vine (*Anredera cordifolia*), and those with bulbs such as asparagus fern, should also always be placed in bags and never left on piles, as they will quickly re-establish.

Plants with thorns such as blackberry (*Rubus fruticosus*) should be removed from the site as they pose a hazard to the frogs and workers.

The Australian Association of Bush Regenerators website has several good information sheets on weed control – see www.aabr.org.au/index.php?option=com_content&task=view&id=81&Itemid=75. National Trust's *Bush regenerators handbook* is another good resource.

Native plant overgrowth

Generally, green and golden bell frogs like ponds with around 20% of open, unshaded water to bask in. It may be necessary to remove overgrown native plants from within and around the pond.

Hand removal or mechanical techniques should be used in or near ponds or other water bodies to remove overgrown aquatic plants. Do not spray herbicides or any other chemical.

Branches of shrubs and trees overhanging a pond should be pruned and left on-site in piles.

6.2 Pest control

Introduced predators may prey on eggs, tadpoles or adults, including:

- plague minnow – for further details see www.environment.nsw.gov.au/pestsweeds/PlagueMinnows.htm or www.angfa-nsw.org
- carp
- the red fox (*Vulpes vulpes*) – for more information, see www.environment.nsw.gov.au/pestsweeds/Foxes.htm
- feral and domestic cats (*Felis catus*).

If plague minnow get into your pond, let it dry out completely and remove the fish, then refill it.

Remember to keep your dog or cat away from frog habitat areas.

Photo: Sydney Olympic Park Authority

Figure 24: The plague minnow is a major threat to the green and golden bell frog

Try and keep other predators out of areas occupied by the frogs. For example, hanging streamers above your pond can deter predatory birds.

6.3 Water quality

Many Water Sensitive Urban Design (WSUD) features are quite compatible with green and golden bell frog habitat needs or could easily be adapted to them. Councils, when considering WSUD requirements for developments or when undertaking routine maintenance works along drains and around detention basins, have many opportunities to incorporate such habitat features.

Runoff entering green and golden bell frog habitat could contain pollutants from the application of biocides in the catchment, excess sediments and nutrients. These can all adversely influence the presence and movement of the frog. Accordingly, efforts should be made to ensure the water quality entering the frog's habitat is as unpolluted as possible.

Green and golden bell frogs require unpolluted water but can tolerate a low level of salt. If water in your pond looks oily, is very turbid or has been inundated by salt water, remove the water and replace it with clean, fresh water.

If there is evidence of frog chytrid infection (frogs may exhibit lesions or sloughing skin and be lethargic):

- Place the frog into a container without directly touching it.
- If the frog is still alive, make sure the container is escape-proof and has a few small air holes and a small amount of water. Ring the Frogwatch Helpline on 0419 249 728 for an opinion on whether the frog is sick or whether it is likely to survive transportation. The Helpline will advise you where and how to transport the frog.
- If the frog is dead, put the container into a plastic bag and into your freezer as soon as possible then call the DECC Environment Line on 131 555 for further advice.
- Consult the frog hygiene protocol – see www.environment.nsw.gov.au/resources/nature/hyprfrog.pdf (PDF- 1.6MB).
- Clean out the pond and disinfect it thoroughly.

6.4 Fire management

Fire and fire management can adversely affect frogs by destroying vegetation used for refuge, foraging or shelter. In conducting fire management practices, burning in low lying areas and wetlands dominated by sedge and emergent growth should be restricted. These areas form important shelter and foraging habitat for the frog and generally pose a limited fire risk. The use of chemical fire suppressants may also have negative impacts on the frog, and their use should be avoided on and near known or potential breeding sites.

Photo: G Muir, Australian Museum Business Services

Figure 25: Green and golden bell frog

6.5 Monitoring tadpoles, frogs and habitat

DECC encourages systematic monitoring of key green and golden bell frog sites, and low key monitoring at other sites, in collaboration with local interest groups, private landholders and public authorities. This more opportunistic monitoring is required to ascertain the presence or absence of the species at historic locations, and on other sites where occasional or sporadic sightings have been reported.

Report any observations of green and golden bell frogs or their tadpoles to DECC. Send these observations to the NSW Wildlife Atlas online (www.wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp) or report them to DECC online at www.environment.nsw.gov.au/surveys/BellFrogOnlineForm2.htm or by phoning Environment Line on 131 555.

7 Further information

Australian Museum:

- green and golden bell frog information page – www.livingharbour.net/frogs/bell.htm
- cane toad information – www.austmus.gov.au/factsheets/canetoad.htm

Australian Reptile Park website – www.bluemts.com.au/reptilepark/ animals.asp?catID=5&ID=147

Commonwealth Department of Environment Water Heritage and Arts:

- green and golden bell frog profile – www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1870
- frog chytrid fungus information – www.environment.gov.au/biodiversity/threatened/publications/tap/chytrid/index.html

Department of Environment and Climate Change:

- frog resources page – www.environment.nsw.gov.au/plantsanimals/ UsefulLinksAndFrogResources.htm
- green and golden bell frog profile – www.threatenedspecies. environment.nsw.gov.au/tsprofile/profile.aspx?id=10483
- cane toad information pages – www.environment.nsw.gov.au/pestsweeds/ CaneToads.htm
- frog chytrid fungus information – www.environment.nsw.gov.au/plantsanimals/ FrogChytridFungus.htm
- plague minnow information – www.threatenedspecies.environment.nsw.gov.au/tsprofile/pas_profile_geo.aspx?id=20016

Frog and Tadpole Study Group:

- habitat creation information – www.fats.org.au/Publications.html

Frogs of Australia website – http://frogs.org.au/frogs

Frogs Australia Network website – www.frogsaustralia.net.au

James Cook University:

- frog diseases information – www.jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm

Queensland Environment Protection Agency:

- frog pond information – www.epa.qld.gov.au/nature_conservation/wildlife/ caring_for_wildlife/frog_ponds/
- making your dam wildlife friendly – www.epa.qld.gov.au/publications?id=195

8 Further reading

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