



Newcastle Coal
INFRASTRUCTURE GROUP

Ecological and Land

Management Plan



DOCUMENT NO:	HSEC.MPLN.12.06
NEXT REVIEW DATE:	15-04-2028
REVIEW FREQUENCY:	3 years
DOCUMENT OWNER:	Wade Covey
DOCUMENT APPROVER:	Manager Sustainability

KEY ELEMENTS



The Key Elements provide an overview of this Management Plan. If you are required to complete work in relation to this procedure, it is essential that you familiarise yourself with the contents of the whole management plan.

- Stop work and notify the Sustainability Department if a Green and Golden Bell Frog is observed in a work area
- Green and Golden Bell Frogs are not to be handled without Hygiene Management Training
- A **Vegetation Clearance Permit** is required when disturbing vegetation onsite
- All mobile plant is to be free of soil and organic matter before entering site
- Any changes the permanent operational lighting are to follow the change management assessment process to ensure these comply with Project Approval conditions and do not create obtrusive impacts.

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1. CONTEXT

Newcastle Coal Infrastructure Group (NCIG) is the operator of a Coal Export Terminal (CET) located in the industrial area of Kooragang Island in the Port of Newcastle. NCIG has approval to construct and operate a 79 Million Tonnes per Annum (Mtpa) CET, including associated rail and coal handling infrastructure and wharf/ship loading facilities.

NCIG's activities have the potential to impact biodiversity in and around the Terminal. This can be from a number of activities, including operational activities, water usage, waste management, use and storage of chemicals, ground disturbance and erosion.

This management plan outlines NCIG's land management practices and the ways in which NCIG plans, implements and monitors its activities to mitigate impacts on the local ecology. This Plan is specifically developed to meet the needs and expectations of NCIG's stakeholders, as provided for in the overarching NCIG Operation Environmental Management Plan (HSEC.MPLN.12.01).

1.1 Purpose

The Ecological and Land Management Plan (ELMP) has been developed in order to document the way in which NCIG manages activities that have the potential to impact on ecology in and around the Terminal. It outlines the system that identifies and assesses ecology and land management risks including statutory and approval requirements, the controls and procedures that manage these risks, and measures to review the system, including its effectiveness. Critical to this approach is business leadership and involvement, particularly at the planning and review stage to ensure that clear objectives and targets are established, and adequate resources are provided in order to achieve these.

The system outlined in this document is consistent with the framework established by the business and contained within the NCIG *Sustainable Operations Management Plan (HSEC.MPLN.01)*. This framework (Plan-Do-Check-Act) is shown in more detail in the overarching NCIG *Operation Environmental Management Plan (HSEC.MPLN.12.01)*.

1.2 Scope

This ELMP applies to the operation of the NCIG CET up to the maximum 79 Mtpa capacity (in accordance with Condition 1.1 of the CET Project Approval (06_0009)). It applies specifically to activities undertaken to operate the CET, including general operations, maintenance and administration activities. It does not apply to construction activities, as they are outlined within the NCIG Environmental Assessment and Project Approval (06_0009) and subsequent modification, or construction and maintenance activities undertaken within the NCIG Compensatory Habitat areas. These activities fall within a different set of management plans, which cover specific environmental risks. Despite this, management measures and controls are consistent between all areas under NCIG's operational control wherever practicable.

The ELMP also subsumes the previous Green and Golden Bell Frog Management Plan (GGBFMP) for operational purposes.

The NCIG CET operation is located on the south arm of the Hunter River. The following three major activities are undertaken during operations:

- Train Unloading – trains enter the NCIG site from the Kooragang mainline, travel along the rail spur and empty their coal wagons into one of two dump stations. Empty trains travel around the rail loop then rejoin the mainline.
- Coal Handling and Stockpiling – coal is transferred from the dump station, via a series of conveyors, to the stockyard for stockpiling. One of four stacker/reclaimers is used to stack coal onto the stockpile and reclaim coal via a bucket-wheel. Coal is reclaimed from the stockpile and sent to the wharf via an outbound series of conveyors.
- Ship Loading – Two ship loaders are available to transfer coal onto ships at berth, drawing from the buffer bins. There are three berths at the NCIG wharf, taking three ships at any one time.

The CET Operational site is shown on Figure 1 based on the maximum allowable coal throughput of 79 Mtpa.

Other key features of the NCIG CET include the water management system (including containment and reuse of water onsite), Administration, Store and Workshop Buildings, access roads and internal roads, utilities including electricity, water and sewer infrastructure, and site security features.

1.3 Structure

This ELMP is structured as follows:

Section 2 – Leadership and Commitment.

Section 3 – Planning and System Support, including existing environment and environmental assessment, risk management, legislative requirements and compliance obligations, and standards for fauna management.

Section 4 – Operation and Implementation, including key operational controls and impact management.

Section 5 – Performance Evaluation and Improvement, including ecological monitoring and reporting.

NCIG was granted Project Approval (06_0009) on 13 April 2007. This ELMP has been prepared in accordance with all conditions relating to ecology and land management in the Project Approval (06_0009).

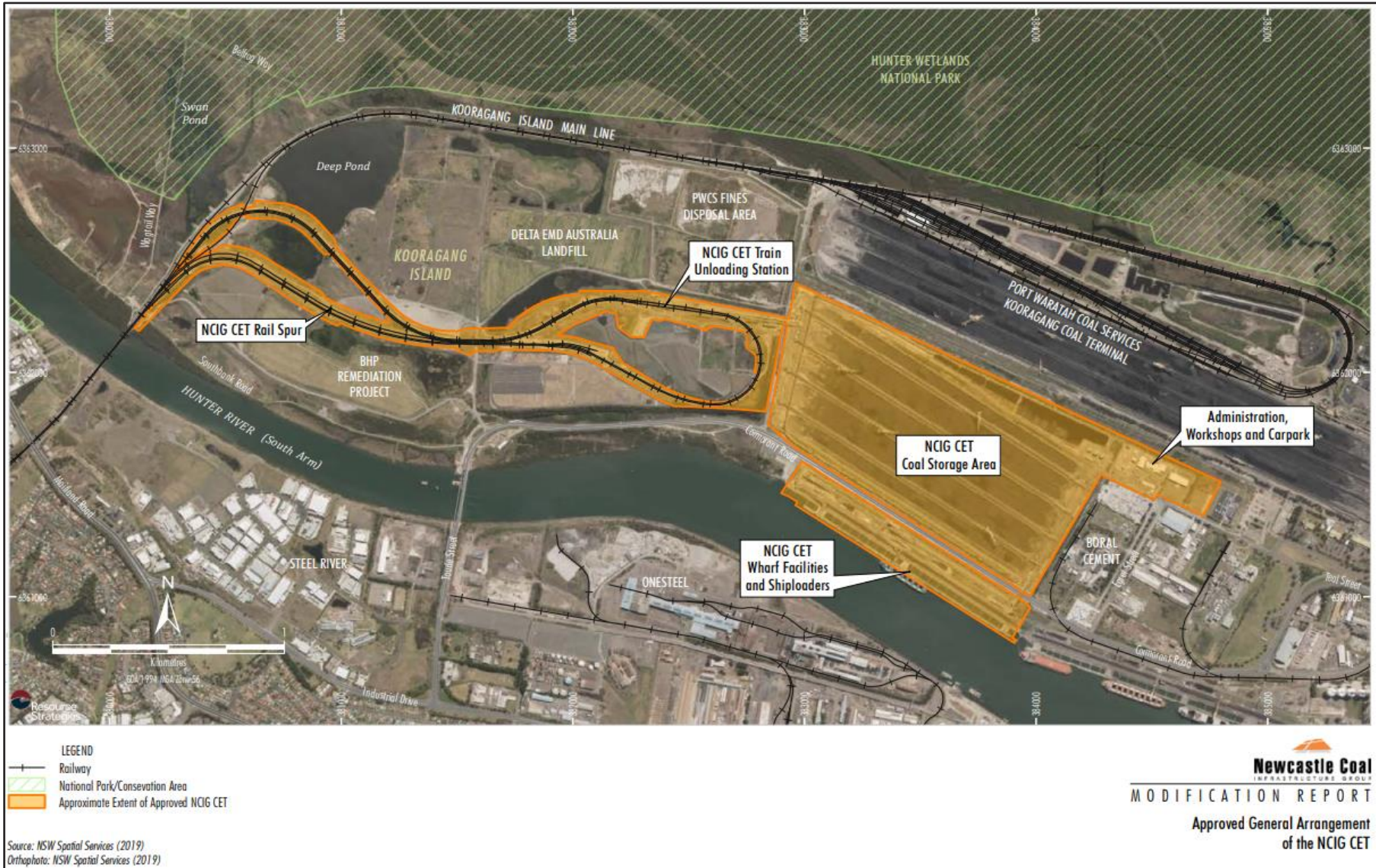


Figure 1. NCIG Project general arrangement

2. LEADERSHIP AND COMMITMENT

2.1 NCIG Sustainable Operations Management Approach

NCIG's leadership commitment is provided in more detail in the NCIG *Operation Environmental Management Plan* (HSEC.MPLN.12.01). Beyond this, NCIG management provides support for the effective management of environmental issues by:

- providing adequate resources for the management of ecological aspects;
- ensuring integration of ecological management requirements throughout business processes, e.g. risk assessment, procurement and acquisition;
- communication of ecological performance and conformance with environmental requirements, e.g. Quarterly HSEC Board Reports, CEO presentations at Business-wide Communication Days; and
- ensuring that ecological management is reflected across departmental objectives, through the development of objectives and targets during the annual business planning process – see Section 3.3.

NCIG strives to achieve best practice for environmental management, including ecological and land management. For this reason, the NCIG SDMP, which includes this ELMP, aims to comply with the provisions of ISO 14001:2015, which is supported and actively assisted by the Executive Leadership Team.

2.2 Roles, Responsibilities and Functions

Management of ecological issues is regarded as the responsibility of all NCIG employees and contractors. As well as this, key environmental accountabilities fall with senior and environmental-specific roles within the organisation. Key accountabilities are outlined in the following sections.

2.2.1 Chief Executive Officer (CEO)

- Actively promote and support the effective implementation of this plan
- Ensure adequate resources are provided to manage ecological aspects and impacts of the business

2.2.2 Manager – Sustainability

- Ensure the adequacy of this plan to meet relevant approval and licence conditions, legislative requirements and other compliance obligations
- Ensure that the Sustainable Operations Management Plan, which includes this management plan, complies with ISO 14001:2015.
- Ensure the plan is aligned with relevant NCIG policy and kept up to date with industry best practice
- Ensure ecological risks are covered in Broad Brush Risk Assessments (BBRAs)
- Develop the plan in consultation with other NCIG Departments and, where relevant, other stakeholders, e.g. government regulators
- Monitor the effective implementation of this plan
- Ensure adequate levels of ecological management training for all levels of personnel
- Accountable for the timely and effective response of community enquiries, including complaints related to ecology, in accordance with Condition 6.2, Schedule 2 of the Project Approval (06_0009)
- Principal point of contact for environmental regulators
- Ensure environmental performance is reported regularly to the ELT and Board of Directors through appropriate means, e.g. Quarterly Sustainable Operations Report.
- Fulfil the role of Department of Planning and Environment (DoPE)-approved Environmental Representative for the NCIG Project (see Appendix B), including taking reasonable steps to avoid or minimise unintended or adverse ecological impacts, and failing the effectiveness

of such steps, to direct that relevant actions be ceased immediately should an adverse impact on local ecology be likely to occur.

2.2.3 Executive Leadership Team (ELT)

- Ensure this management plan is implemented in their area of accountability
- All direct reports adhere to the requirements of this plan
- All direct reports have sufficient resources to adequately comply with and continuously improve this plan

2.2.4 Sustainability Department

- Ensure that this plan is developed to meet or exceed the requirements of relevant approval and licence conditions, legislative requirements and other compliance obligations
- Ensure that this plan is developed to address potentially significant ecological impacts resulting from NCIG's operational activities
- Assist other departments in the implementation of controls outlined in this management plan, including provision of ecological management training
- Organise ecological monitoring as it is identified in this plan and maintain ecological records including ecological monitoring data and ecology incident reports
- Prepare reports required by approvals and relevant conditions, e.g. Regular Shorebird reporting to the Commonwealth Department of Environment and Heritage.
- Monitor and review compliance of this plan, including auditing and compliance tracking required in Project Approval (06_0009)
- Any non-conformance of the plan is appropriately addressed through corrective actions, e.g. incident or hazard reporting, review of action.

2.2.5 Superintendents / Team Leaders

- Ensure all direct reports are trained and adhere to the applicable requirements of this management plan
- Ensure that all ecological matters are brought to the attention of the Sustainability Department.

2.2.6 All Workers

- Actively apply and participate in the application of this procedure.

It is noted that, where relevant, these accountabilities have been formalised by NCIG management in the various Position Descriptions for NCIG personnel.

3. PLANNING AND SYSTEM SUPPORT

3.1 Existing Environment

3.1.1 Visual Amenity

The most sensitive visual settings in the vicinity of NCIG are the elevated residential areas of Mayfield, Mayfield West and Fern Bay. In addition, commuters travelling along Cormorant Road have close views of the terminal.

Visual Impacts are mainly associated with site structures. The level of visual modification is a function of the contrast between the Terminal and the existing visual landscape. The degree of visual modification generally decreases with distance and the degree of visual modification is considered negligible if the infrastructure is distant and relates to a small proportion of the overall landscape.

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from surrounding areas, and is a function of both landuse and duration of exposure shown by:

- Low visual sensitivity – industrial areas and local roads.
- Moderate visual sensitivity – tourist roads and major roads (e.g. Cormorant Road).
- High visual sensitivity – residential areas and natural/recreation areas (e.g. Kooragang Nature Reserve).

Visual Landscape Alteration includes:

- Elements of the Terminal considered to have the potential to impact on the visual landscape include:
 - rail spurs, rail sidings rail loops, rail overpass, train unloading stations and connecting conveyors;
 - coal storage area including coal stockpiles, conveyors, transfer points and combined stacker/reclaimers;
 - wharf facilities and shiploaders, conveyors and buffer bins;
 - administration and workshop buildings; and
 - night lighting.

In addition, night lighting would emanate from two main sources:

- overhead lighting of the coal storage area, stacker/reclaimer, train unloading station, wharf facilities and shiploaders; and
- mobile vehicle-mounted lights (e.g. trains and work vehicles on site).

The scale and nature of night lighting for the Terminal are similar in intensity to the existing night lighting at the PWCS Kooragang Coal Terminal. Potential night lighting impacts on the local and sub-regional settings are generally restricted to the production of a glow above operational areas that contrast with the night sky. This effect decreases with distance however the glow would be visible at nearby residential areas and along the local road network (i.e. Cormorant Road). The potential impact of night lighting on sensitive visual settings would be negligible given the presence of numerous light emitting sources in the local, sub-regional and regional settings.

The visual setting is generally well lit as a consequence of the existing industrial and port facilities which operate 24 hours per day. Numerous light emitting sources exist in the local, sub-regional and regional settings including fixed lighting associated with industrial developments and vehicular lights associated with traffic on the road network (e.g. Cormorant Road). Night Lighting complies with AS 4282-1997 Control of Obtrusive Effects of Outdoor Lighting. Night lighting is restricted to the minimum required for operational and safety requirements and is directed away from roads and sensitive viewpoints, where practicable. Light shields are also used to limit the spill of lighting where practicable.

Administration and workshop areas have been appropriately landscaped with selective tree planting, formal gardens and grassed areas in keeping with the “shop front” location on Egret Street. Terminal infrastructure has been designed and constructed in a manner that minimises visual contrasts (e.g. suitable coloured cladding for buildings and the integration and rationalisation of signage) in accordance with the requirements of the Newcastle DCP.

An earth bund (barrier) approximately 1,500 m in length is constructed on the northern side of Cormorant Road to act as a visual screen for the stockpile site. The barrier is located east of Windmill Road between the coal storage area and Cormorant Road. The barrier is essentially an extension of, and of a similar height to, the existing southern embankment of the KIWEF site and has been planted with trees to enhance the screening effect. Tree plantings have also been placed along the Wharf site Cormorant Road frontage and the Stockyard Windmill Road frontage.

3.1.2 Flora

Vegetation communities located in the Project site consist of Terrestrial and Wetland habitats as identified in the Project Environmental Assessment and Appendix E of the Assessment. Terrestrial habitat is characterised by grassland (dominated by landscape and pasture species) and landscape plantings (Connell-Hatch, 2006). The majority of the KIWEF site (i.e. including the rail infrastructure corridor) is dominated by introduced grasses and herbaceous weeds (ibid.). The wharf and shiploader facilities area consists of modified grassland and plantings of native species (Umwelt, 2003). There are several scattered juvenile mangrove trees along the shoreline in this area (Umwelt, 2003). Wetland habitat types in the Project site vary from semi-natural to highly disturbed (Connell-Hatch, 2006). The site includes ephemeral and semi-permanent wetlands which are subject to seasonal changes in vegetation and water levels. The three main wetland types identified in the Project site are:

- ephemeral freshwater wetlands dominated by Common Reed (*Phragmites australis*) and Cumbungi (*Typha orientalis*);
- ephemeral sedge swamps dominated by Marsh Clubrush (*Bulboschoenus fluvialis*); and
- estuarine wetlands dominated by Samphire (*Sarcocornia quinqueflora*) and Sand Couch (*Sporobolus virginicus*) (Connell-Hatch, 2006a).

Very few native flora species were recorded in the Project site apart from native aquatic vegetation and landscape (amenity) plantings (Connell-Hatch, 2006). A total of 96 plant taxa were recorded by the vegetation survey and of these, 42 were native and 54 were exotic species (Connell-Hatch, 2006).

3.1.3 Fauna

Specific details regarding fauna associated with the Terminal site have been identified through the process of the Environmental Assessment. Fauna associated with the Project site include common birds, migratory birds, threatened species such as the Green and Golden Bell Frog (*Litoria aurea*) and Australasian Bitten (*Botaurus poiciloptilus*), marine species, and feral mammals. Previous studies have attributed that the low diversity of native invertebrates and vertebrates recorded in the area to the historically disturbed nature of the site, lack of refuge sites and poor vegetation structure.

NCIG is committed to the sustainability of flora and fauna on the project site and in support of this commitment have implemented measures such as wetland culverts to assist pond migratory movement and connectivity. NCIG have also committed to the creation of compensatory habitat as a requirement of project approval (detailed in the Compensatory Habitat and Ecological Monitoring Program (CHEMP)).

Potential exists for introduced fauna species to be attracted to the Project site through increased refuge and scavenging areas. These factors could increase the concentration of introduced fauna in and around the Project site. Predation by feral animals such as foxes is thought to be a threat to the Green and Golden Bell Frog. Relevant mitigation measures are presented in feral animal controls in section 4.

3.1.4 Green and Golden Bell Frog (*Litoria aurea*)

3.1.4.1 Key Identifying Features

The Green and Golden Bell frog is a relatively large, muscular species with robust body form. Adult size ranges from approximately 45 millimetres (mm) to approximately 100 mm with most individuals being in the 60 to 80 mm size class (DEC, 2005). A white or cream stripe extends from above the nostril, over the eye and tympanum and continuing as a fold down the side (Robinson, 1998). There is usually a darker stripe below this one and another pale stripe from below the eye to the base of the forearm (ibid.). The belly is usually creamish white (DEC, 2005). The lower sides of the body are adorned with raised glandular creamish spots of irregular size. Legs are a variegated green and gold with the groin area and inside leg a brilliant electric blue, particularly in reproductive males (ibid.). The eye has a horizontally elliptical pupil and a golden yellow iris (ibid.). The toes are three-quarters to nearly fully webbed (Robinson, 1998).

Males are generally smaller than females (maximum size 70 to 75 mm) and, when mature, tend to have a yellowish darkening of the throat area (DEC, 2005). Males also develop nuptial pads on the inner finger and these can be observed as a brown pigmented patch (ibid.). Mature females by contrast are larger bodied (maximum size 90 to 100 mm) and become bulky when gravid (ibid.). The dorsal colouration is quite variable. Usually the background colour is green with irregular large spots and stripes of gold (Barker et al., 1995). Juveniles metamorphose at around 25 to 30 mm snout-vent length (SVL) (DEC, 2005).



Plate 1. Adult Green and Golden Bell Frog (*Litoria aurea*)

The tadpoles of the Green and Golden Bell Frog are relatively large reaching 65 to 100 mm at limb bud development stage (Stage 26 of Gosner, 1960 in DEC, 2005). They are deep bodied and possess long tails with a high fin that extends almost halfway along the body. Mouthparts consist of two upper and three lower labial rows (Martin, 1965; Courtice and Grigg, 1975; and Tyler and Davies, 1978 in DEC, 2005).



Plate 2. Tadpole Green and Golden Bell Frog (*Litoria aurea*)

This species can be distinguished from similar species by its wart-free skin, expanded finger and toe pads, and lack of spotting or marbling on the hind side of the thigh (Robinson, 1998). Its back colouration is also fairly distinctive (ibid.).

3.1.4.2 Ecology

The Green and Golden Bell Frog can be regarded as a 'colonising'/'pioneering' species as it is a habitat generalist, disperses widely and matures early (Hamer, 1998; 2002). These characteristics (also known as 'r'-selective characteristics) are an adaptation to living in an unpredictable environment (Begon et al., 1990).

The Green and Golden Bell Frog is frequently active by day and usually breeds in summer when conditions are warm and wet (Cogger, 1992). Males call while floating in water and females produce a floating raft of eggs which gradually settle to the bottom (Harrison, 1922 in NPWS, 1999). Tadpoles take around six weeks to develop depending on environmental conditions (e.g. temperature) (Pyke and White, 1996 in NPWS, 1999). Adult male Green and Golden Bell Frogs may only live for around two years in difficult terrain (Goldingay and Newell, 2005; White pers. comm., 2006) but life expectancy is likely to vary markedly according to the quality of the habitat (White pers. comm., 2006).

The Green and Golden Bell Frog forages at night on insects as well as other frogs (Cogger, 1992; NPWS, 1999; White, pers. comm., 2005). Tadpoles feed on algae and other vegetative matter (NPWS, 1999). The Green and Golden Bell Frog exhibits strong migration tendencies, including the ability to travel relatively significant distances (i.e. up to 1 to 1.5 kilometres [km]) in a single day/night (White pers. comm.; Pyke and White, 2001; and Wellington, 1998).

3.1.4.3 Conservation Status

The Green and Golden Bell Frog is listed as Endangered under the Biodiversity Conservation Act 2016 (BC Act) and Vulnerable under the EPBC Act. The Green and Golden Bell Frog is estimated to have disappeared from 90% of its former range within NSW (Pyke and White, 1996) although populations in Victoria are believed to be secure (Gillespie, 1996).

There are about 50 known populations of Green and Golden Bell Frog within NSW (NPWS, 1999), and of these, approximately 14 are situated within conservation reserves (viz.: Yuraygir National Park (NP), Hat Head NP, Lake Innes Nature Reserve (NR), Myall Lakes NP, Kooragang NR, Seven Mile Beach NR, Meroo NP, Towra Point NR, Jervis Bay NR, Narawallee NR, Ben Boyd

NP, Nadgee NR, Booderee NP and Department of Defence land at Jervis Bay [NPWS, undated in DEC, 2005]).

The Green and Golden Bell Frog is not considered to be adequately protected within the reserve system because in only 25% of cases does the major portion of the population habitat actually occur within the reserve – the majority of the Green and Golden Bell Frog habitat occurs on other tenures (NPWS, undated in DEC, 2005).

The Green and Golden Bell Frog was historically widespread across much of the Hunter Valley, commonly associated with floodplain wetlands of the Hunter River and its tributaries (DEC, 2005). In the Hunter region, the Green and Golden Bell Frog is now believed to be restricted to four key populations (ibid.), viz.:

- a large population on Kooragang Island;
- small, isolated populations at Sandgate on the margins of Hexham Swamp;
- a metapopulation in the Gillieston Heights/East Maitland, Ravensdale areas (also including Wentworth Swamp); and
- a metapopulation in the Ravensworth/Liddell/Bayswater area.

The Green and Golden Bell Frog has been recorded in numerous studies of Kooragang Island. Further information regarding the distribution of the Green and Golden Bell Frog on Kooragang Island is provided in below.

3.1.4.4 Distribution

The Green and Golden Bell Frog inhabits marshes, dams and stream sides and appears to prefer those waterbodies where bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.) grow (NPWS, 1999). Optimum habitat for the Green and Golden Bell Frog is considered to be waterbodies which are unshaded, free of *Gambusia holbrooki* (an introduced predatory fish), have a grassy area nearby and diurnal sheltering sites (e.g. vegetation and/or rocks) (ibid.). Consistent with what has been observed at the Project site, some Green and Golden Bell Frog populations, especially in the Greater Sydney region, exist in highly disturbed areas such as disused industrial sites, landfill areas and cleared land (ibid.). The Green and Golden Bell Frog also occasionally inhabit farm dams and ornamental ponds (Robinson, 1998).

The Atlas of NSW Wildlife (DEC, 2006) indicates the Green and Golden Bell Frog has been recorded at 229 locations in the region (i.e. Newcastle and Port Stephens 1:100,000 map sheets), including within NCIG's site.

Known and potential Green and Golden Bell Frog habitat was originally located across the Terminal site prior to constructions works. Habitat continues to exist in surrounding areas (Figure 4). Disturbance of habitat due to the Project included Big Pond which was fully infilled and Ponds K49A, K102 and K116, which were partially disturbed. Deep Pond (K105A&B) was also disturbed as part of the Rail Flyover embankment. Most of the known and potential Green and Golden Bell Frog habitat recorded across the site and surrounds has not been directly disturbed by the Project.

The distribution of Green and Golden Bell Frogs in proximity to the Terminal site determined from monitoring is shown on Figure 4 and indicates known habitat for this species. During targeted surveys within the Project site and surrounds, the Green and Golden Bell Frog is regularly recorded at numerous locations across the industrial part of the survey area.

3.1.4.5 Potential Relocation Areas

Consistent with Project Approval (06_0009), Particular Manner Decision (2006/2987) and clarification letter dated 14 November 2006, Green and Golden Bell Frogs found on the Project site during construction would be relocated to one of the following potential relocation areas:

- identified Green and Golden Bell Frog habitat within the Kooragang Island Waste Emplacement Facility adjacent to the Terminal site (Figure 4) (in consultation with Hunter and Central Coast Development Corporation and the University of Newcastle); or
- identified Green and Golden Bell Frog habitat in Port of Newcastle (PoN) land adjacent to the Terminal site (Figure 4) (in consultation with PoN);

Frogs found on the NCIG operations site will also be relocated to one of the abovementioned locations, to avoid harm to individuals of the species. Relocation procedures for the Green and Golden Bell Frog are outlined in Section 4.1.4.

3.2 Legislation, Approvals and Licensing Requirements

There are a number of legislative and regulatory documents which apply to the way in which NCIG manages ecology from its terminal facility. These are primarily broken down into legislation and policies, and approvals and licences. These are administered by both federal and state government departments, including the Department of Planning, Industry and Environment (DPIE) and the Commonwealth Department of Agriculture, Water and the Environment (DAWE).

3.2.1 Legislation and Policies

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance.

Environmental Planning and Assessment Act 1979

The major development approval for the NCIG Coal Export Terminal is the Project Approval provided by DPIE (PA 06_0009), including subsequent modifications (MOD 1. MOD 2 and MOD 3). This approval was provided under the now repealed Part 3A (Major Projects) of the *Environmental Planning and Assessment Act 1979*. The approval contains a number of conditions related to ecology and land management which are explained in more detail in Section 3.2.2.

Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 repeals the Threatened Species Conservation Act 1995. This Act provides for the conservation of threatened species and ecological communities of animals and plants. The Act lists the key threatening processes that are likely to adversely affect threatened species or ecological communities and sets out a number of specific objects relating to the conservation of biological diversity and the promotion of ecologically sustainable development. This legislation relates to how threatened species are assessed within the *Environmental Planning and Assessment Act 1979*.

National Parks and Wildlife Act 1974

The Act is a broad piece of legislation that covers a number of different areas including reserving lands, managing certain reserved lands and the protection of Aboriginal objects and places.

Local Land Services Act 2013

The amended Local Land Services Act repeals the Native Vegetation Act 2003. The Act provides a new regulatory framework for native vegetation and land management activities in NSW. The Act creates the Land Management (Native Vegetation) Code 2018, which categorises NSW land into different

categories to provide certainty to landholders and define options available for each category for native vegetation management.

Biosecurity Act 2015 (NSW)

The NSW Biosecurity Act 2015 replaces the Noxious Weeds Act 1993. The Act provides for the identification, classification and control of invasive weeds.

Biosecurity Act 2015 (Cth)

The Commonwealth Biosecurity Act 2015 is administered by the DAWE and replaces the Quarantine Act 1908. The Act provides the Commonwealth with powers to assess and manage the risk of pests and diseases entering Australian territory and causing harm to animal, plant and human health, the environment and the economy. Biosecurity risks are covered in NCIG's Biosecurity Incident Response Procedure (HSEC.PRO.13.05)

3.2.2 Approvals and Licences

Project Approval 06_0009, including subsequent Modifications

There are a number of conditions within the Project Approval pertaining to the management of ecology and land management at NCIG. Specifically, these are:

- Condition 2.16 – employing an ecologist to conduct a pre-construction survey of the site, development of a Green and Golden Bell Frog management and relocate animals that will be affected to an alternate location.
- Condition 2.17 – Design and construction of rail infrastructure to allow movement of Green and Golden Bell Frogs.
- Condition 2.18 – Workers involved in construction and operation of the terminal are to be trained in hygiene management protocols.
- Condition 2.19 – Employment of a qualified ecologist to advise on the mitigation and management of impacts to listed threatened species.
- Condition 2.58 – Installation of a bund along the Southern side of the Stockyard, Cormorant Road frontage.
- Condition 2.59 – Managing site lighting impacts, including meeting the requirements of AS 4282-1997.
- Condition 2.60 – planting of local native species along the bund required in Condition 2.58 to screen visual impacts for receptors to the south.
- Condition 7.5 c) iv) – Retention of native vegetation onsite, including monitoring and management.

EPBC Act Particular Manner Decision 2006/2987

A referral was made to the federal environmental regulator for the Terminal development. A decision was made by the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC), now DAWE, that the development would not have a significant impact on Bell Frogs and Migratory Shorebirds if conducted in a particular manner. This decision was pending the implementation of appropriate conditions. Those which are relevant to this management plan are:

- Condition 1 – relocation of Green and Golden Bell Frogs from the Project site where in an area of disturbance.
- Condition 2 – measures to manage Chytrid Fungus, including training of site personnel in hygiene management and inspection of all mobile plant for free soil/organic matter and disinfection of tyres and wheels.
- Condition 3 – the construction of a rail culvert in the NCIG Rail Loop.
- Condition 4 – planting of preferred vegetation and establishment of ponds for Green and Golden Bell Frogs at ends of frog underpasses (culverts).
- Condition 6 – annual monitoring of Bell Frogs during the breeding season in and around the Terminal site until 2020, and then three yearly until 2030. If monitoring indicates a

decline in the population then measures will be implemented in consultation with the Dept of Environment and Heritage to arrest this decline.

- Condition 7 – screens to be along rail infrastructure to minimise lighting impacts on shorebirds using Deep Pond.
- Condition 8 – annual monitoring of Australasian Bittern and shorebird populations utilising Deep Pond to be undertaken during summer until 2020, with three yearly monitoring until 2030.
- Condition 9 – Provision of the above monitoring results to the Department of Environment and Heritage (now DAWE) by 31 March in the relevant reporting time period, including summary and analysis of results every three years addressing utilisation patterns of migratory shorebirds at Deep Pond. Measures to be implemented to enhance existing habitat or provide additional habitat, where monitoring indicates a decline attributable to the operation of the Terminal. Provision of new habitat to be undertaken in consultation with a shorebird specialist.

3.3 Management/Recovery Plans

The Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*) (Draft Recovery Plan) (DEC, 2005) identifies 43 key populations known or considered likely to exist throughout the species range within NSW. The Draft Recovery Plan considers the conservation requirements of the species across its known range and identifies future actions to be taken to ensure the long-term viability of the Green and Golden Bell Frog.

The Draft Management Plan for the Green and Golden Bell Frog Key Population in the Lower Hunter (Lower Hunter Management Plan) (DECC, 2007) has been prepared (to satisfy Action 11.3.4 of the Draft Recovery Plan) to “ensure that the Lower Hunter population is successfully managed and monitored such that the species continues to persist in the Lower Hunter and that ‘measures’ of the two populations’ viability are maintained or improved over time”. The Lower Hunter Management Plan recognises two key populations within the Lower Hunter: Kooragang/Ash Island and Sandgate/Hexham Swamp populations (ibid.).

4. OPERATION AND IMPLEMENTATION

NCIG manages ecology within and adjacent to its terminal site. This focusses primarily on the management of habitat/flora and pest species, but may also include the relocation of native fauna where it is deemed to be in danger.

4.1 Green and Golden Bell Frog

4.1.1 Green and Golden Bell Frog Management Procedures

The following management procedures will be implemented to minimise impacts on the Green and Golden Bell Frog:

- HSEC induction training, including Green and Golden Bell Frog awareness;
- site hygiene management;
- pre-clearance surveys; and
- Green and Golden Bell Frog relocation procedures.

These procedures are discussed in the subsections below.

4.1.2 Site Hygiene Management

The accidental introduction or spread of pathogens has the potential to adversely affect frog populations. A water-borne fungal pathogen *Batrachochytrium dendrobatidis*, commonly known as the amphibian or frog chytrid fungus, is responsible for the disease Chytridiomycosis (Berger et al., 1999; NPWS, 2001., NSW Government SOS, 2020). In Australia, *Batrachochytrium* has been found in frogs since 1989 and has been observed in various regions, including rainforests of southern, central and northern Queensland and northern NSW, montane and foothill forests of Victoria, and suburban/semi-rural populated areas of Brisbane, Adelaide and Perth (Berger et al., 1999).

Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Werkman, 2001), including the Genus *Litoria* (Berger et al., 1999). Infection occurs through waterborne zoospores released from an infected amphibian in water (NPWS, 2001) and the fungus infects both frogs and tadpoles (Berger et al., 1999). Typical clinical signs of frogs with Chytridiomycosis include lethargy, inappetence, skin discoloration, presence of excessive sloughed skin, and sitting unprotected during the day with hind legs held loosely to the body (ibid.).

4.1.2.1 Training

To reduce the likelihood of spreading potential infection, all site workers are informed of the conservation status of the Green and Golden Bell Frog and the importance of not touching bell frogs without hygiene management training. NCIG Sustainability Department representatives are appropriately trained and aware of the hygiene management protocols. The NPWS Hygiene Protocol for the Control of Disease in Frogs is presented in Appendix A.

4.1.3 Pre-clearance Surveys (Vegetation Clearance Protocol)

Pre-clearance surveys will include targeted active searches of potential Green and Golden Bell Frog habitat located within areas to be disturbed. For large areas of clearance, pre-clearance surveys will be undertaken by a suitably qualified ecologist. An NCIG environmental representative will undertake a pre-clearance check for the removal of small areas of vegetation in low-risk habitats (e.g. tree removal or vegetation trimming). Pre-clearance surveys will be conducted in accordance with the relevant measures outlined in the Hygiene Protocol.

The pre-clearance surveys (and if applicable relocation activities) will be conducted to minimise disruption to breeding activities and the need to relocate tadpoles or metamorphs, where practicable.

Habitat resources typically associated with the lifecycle components of the Green and Golden Bell Frog (e.g. ponded areas and rocks, logs, tussock forming vegetation and other cover) will be searched during a diurnal visual inspection where relevant.

Additionally, following diurnal habitat searches, a nocturnal habitat search may be conducted to assess nocturnal usage (i.e. breeding/calling) in the habitat area if relevant to the type of vegetation clearance (e.g. in water bodies or areas of potential frog habitat). The nocturnal habitat searches may include:

- searching of habitat features which were searched during the day;
- spotlighting; and/or
- call play-back.

In the event that any Green and Golden Bell Frogs are observed during the diurnal or nocturnal searches for the pre-clearance surveys, the relocation procedures (Section 4.1.4) will be initiated prior to the commencement of construction works.

Where relevant, the results of the pre-clearance surveys will be recorded and reported in the Annual Environmental Management Report (AEMR).

4.1.4 Green and Golden Bell Frog Relocation Procedures

4.1.4.1 Relocation Procedure during Pre-Clearance Surveys

In the event a Green and Golden Bell Frog is identified within the Terminal site during Vegetation Clearance surveys, the following relocation procedure will be initiated:

1. The frog will be captured in accordance with the Hygiene Protocol for the Control of Disease in Frogs (Appendix A)
2.
 - a. If the frog appears to be healthy, it will be released in a location as described in Section 3.1.4.5. Where practicable, relocation will be timed to coincide with periods of recent rainfall or ponds with available water, to optimise chances of survival of the frog.
 - b. If the frog appears to be sick, or is dead, the procedures outlined in Section 4.1.4.3 will be followed.

Details of Green and Golden Bell Frog relocations (e.g. lifecycle stage and sex of individual [if possible], location where found and location of release) conducted during pre-clearance surveys will be recorded in NCIG's Green and Golden Bell Frog Register. The University of Newcastle will be notified for the purposes of their records.

4.1.4.2 Relocation Procedure outside Pre-Clearance Surveys

In the event a frog is observed within the Project site outside pre-clearance surveys (e.g. within an area already disturbed) and is thought to be a Green and Golden Bell Frog, the following relocation procedure will be initiated if the frog is likely to be harmed by works:

1. The observer will notify an Environmental Representative of the frog's location.
2. The Environmental Representative will determine whether the frog is likely to be harmed by works.
3. If the frog is likely to be harmed by works, the Environmental Representative will capture the frog in accordance with the Hygiene Protocol for the Control of Disease in Frogs (Appendix A).
4.
 - a. If the frog appears to be healthy, it will be released in a location as described in Section 3.1.4.5. Where possible, frogs will be relocated to a pond with available water, to optimise chances of survival.
 - b. If the frog appears to be sick or is dead, the procedures outlined in Section 4.1.4.3 will be followed.

Details of Green and Golden Bell Frog relocations (e.g. lifecycle stage and sex of individual [if possible], location where found and location of release) will be recorded in NCIG's Green and Golden Bell Frog Register. The University of Newcastle will be notified for the purposes of their records.

4.1.4.3 Procedures for Handling Sick or Dead Green and Golden Bell Frogs

Table 1 details the range of symptoms that may be exhibited by sick or dying frogs, while Table 2 provides diagnostic behaviour tests which can be used to determine if a frog is sick (e.g. infected with chytrid fungus).

Table 1 – Symptoms of Sick and Dying Frogs

APPEARANCE	BEHAVIOUR
<ul style="list-style-type: none"> • Darker or blotchy upper (dorsal) surface. • Reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes. • Swollen hind limbs. • Very thin or emaciated. • Skin lesions (sores, lumps). • Infected eyes. • Obvious asymmetric appearance. 	<ul style="list-style-type: none"> • Lethargic limb movements, especially hind limbs. • Abnormal behaviour (e.g. a nocturnal burrowing frog sitting in the open during the day and making no vigorous attempt to escape when approached). • Little or no movement when touched.

Table 2 – Diagnostic Behaviour Tests

Sick frogs will fail one or more of the following tests:

TEST	HEALTHY	SICK
Gently touch with finger.	Frog will blink.	Frog will not blink.
Turn frog on its back.	Frog will flip back over.	Frog will remain on its back.
Hold frog gently by its mouth.	Frog will use its forelimbs to try to remove grip.	No response from frog.

Source: after NPWS (2001)

In the event a Green and Golden Bell Frog appears to be sick, or is dead, the procedures outlined below will be followed:

- Disposable gloves will be worn when handling sick or dead frogs.
- To prevent cross-contamination, new gloves and a clean plastic bag will be used for each frog specimen.
- Frogs exhibiting one or more of the symptoms for sick frogs listed in Table 1 or Table 2 and considered unlikely to survive transportation will be euthanised as follows: The terminally ill frog will be placed into a container with the bottom covered with 3% chloral hydrate (NPWS, 2001).
- Sick frogs likely to survive transportation will be placed into either a moistened cloth bag with some damp leaf litter or into a partially inflated plastic bag with damp leaf litter and before sealing. All frogs will be kept separate during transportation.
- The recipient of the sick or dead frog will be contacted to confirm the appropriate procedure prior to transport.
- Containers will be labelled and will provide the following details: date, location and species (if known).
- A standardised collection form will be filled out and a copy sent with the specimen.
- Individual containers will be used for each specimen.

4.2 Fauna Management (General)

The fauna management strategies described below have been developed to minimise impacts on fauna. The practicality of implementing each management strategy will be dependent on the characteristics of the habitat area in question and will be determined by the NCIG Environmental Representative or their representative.

Appropriate licences for the implementation of fauna management strategies will be obtained in consultation with DPIE or the relevant authority.

Fauna Management Strategies

The general fauna management strategies to be implemented should an animal be required to be relocated will include (but not necessarily be limited to):

- If fauna is identified in an area to be cleared, the following may be utilised selectively to minimise disturbance to fauna:
 - delay clearing of vegetation until fauna has moved to an alternative location;
 - fell/clear surrounding non-habitat trees/areas to encourage the colony/individuals in the habitat tree/area to move to an alternative location;
 - cause sufficient physical disturbance to the tree/area to encourage fauna to relocate;
 - capture existing fauna for later release at a suitable time;
 - relocate moveable habitat features to within proximal suitable habitat (e.g. KIWEF) in consultation with the relevant land manager; or
 - block the entrance to habitat features to prevent re-entry prior to felling.

4.2.1 Threatened Species Management Protocol

A Threatened Species Management Protocol (TSMP) has been developed to facilitate implementation of threatened species management strategies to minimise the potential impacts on threatened flora and fauna species. Table 3 lists the threatened fauna species that have been observed on site and threatened species that have the potential to be on site, as they have been observed nearby. The key components of the TSMP are outlined below and include site observations/surveys and threatened species management strategies.

4.2.1.1 Site Observations/Surveys

In the event a threatened species listed under the Biodiversity Conservation (BC) Act, 2016 or the Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) is identified within areas delineated for vegetation clearance, the Threatened Species Management Strategies phase (Section 4.2.1.2) of the TSMP will be initiated.

4.2.1.2 Threatened Species Management Strategy

Although the risk of impact to threatened species is unlikely during the operational phase of the terminal, the below management strategies have been developed for use where relevant. Management strategies include threat abatement measures, capture and release and relocation. The management strategies will be determined on a case-by-case basis. Some examples of possible management strategies are provided below. Management strategies to minimise Project-related impacts on the Green and Golden Bell Frog should be implemented in accordance with Section 4.1.

Threat Abatement

Threat abatement is the implementation of management strategies at the site to alleviate threatening processes. Actions may include the scheduling of vegetation clearance activities to occur at a particular time (e.g. when the hollow is not being utilised as a nesting/roosting resource by the threatened fauna species), or relocation (see below). Such strategies will be largely dependent on the degree of flexibility provided in conducting the disturbance work.

Capture and Release

This option involves the capture and release of threatened fauna within proximal suitable habitat (e.g. KIWEF) in consultation with the relevant land manager. Where threatened fauna is observed using a particular habitat feature, an attempt will be made utilising accepted trapping techniques by a qualified ecologist, to capture the particular animal for the purpose of later release in suitable habitat.

Relocation

This option involves the relocation of roosting/nesting resources to proximal suitable habitat (e.g. KIWEF) in consultation with the relevant land manager.

Table 3 – Threatened Species that have been observed on site or have the potential to be on site

Threatened species observed on site	- Green and Golden Bell Frog (observed frequently around site in various locations)
Threatened species that have the potential to be on site	- Australasian Bittern (observed in BHP Pond) - Black-necked Storks (observed in Deep Pond) - Black-tailed Godwit (observed in Deep Pond) - Blue-billed Duck (observed in Deep Pond and Blue-billed Duck Pond) - Curlew Sandpiper (observed in Deep Pond) - Eastern Curlew (observed over Deep Pond) - Freckled Duck (observed in Deep Pond) - Little Eagle (observed over Deep Pond) - Magpie Goose (observed in Deep Pond) - Spotted Harrier (observed over Deep Pond) - White-bellied Sea-Eagles (observed over Deep Pond) - White-fronted Chat (observed in Deep Pond)

4.3 Vegetation Clearance Activities (General)

A Vegetation Clearance Protocol (VCP) will be implemented to minimise impacts on threatened flora and fauna species within the Project area. The key components of the VCP are outlined below and include:

- delineation of areas to be cleared of existing vegetation;
- pre-clearance surveys;
- managing impacts on fauna; and
- vegetation clearance procedures.

4.3.1 Delineation of Areas for Vegetation Clearance

This component involves the delineation of areas that are to be cleared of existing vegetation. Vegetation adjoining the proposed clearance areas will be clearly marked to prevent accidental damage during vegetation clearance.

4.3.2 Pre-clearance Surveys (General Fauna)

Pre-clearance surveys include habitat assessments which involve the inspection of potential habitat features located within areas requiring vegetation clearance.

The NCIG site contains limited mature native vegetation that has the potential for habitat features, however a pre-clearance survey will be undertaken to identify any features with the potential to provide roosting and/or nesting resources for birds and/or arboreal mammals (e.g. grass tussocks and hollow openings) or shelter and/or breeding resources for frogs and/or reptiles (e.g. grass swales, grass tussocks and rock crevices).

Areas containing features with the potential to provide resources for birds, arboreal mammals, frogs or reptiles are referred to as potential habitat areas. Following the identification of potential habitat areas, preliminary and secondary habitat assessments will be undertaken by an ecologist to determine appropriate fauna management strategies.

Parameters recorded at each potential habitat area during the preliminary habitat assessment may include:

- living status of the tree;
- habitat features (e.g. hollow, opening, crack, loose bark, bird nest/form, grass swale, etc.);
- whether the habitat feature is considered to provide potential habitat for birds, arboreal mammals, frogs and/or reptiles (by assessing the feature in terms of location, height, size and aspect);
- fauna observed in the area and surrounds, particularly bird activity at hollows and nests; and
- evidence of fauna in the area and surrounds (e.g. scats, tracks, scratches, remains of prey, etc.).

Following the preliminary habitat assessment, a secondary habitat assessment will be conducted to assess the usage of habitat features by fauna. The secondary habitat assessment may include:

- active searches and/or spotlighting for arboreal mammals, frogs and or reptiles; and/or
- observation of hollows and nests/roosts for usage by bird species.

Habitat features such as large hollows identified during the pre-clearance surveys will be relocated within proximal suitable habitat (e.g. Kooragang Island Waste Emplacement Facility [KIWEF]) in consultation with the relevant land manager, except where the habitat feature cannot be relocated (e.g. the dimensions preclude moving or the feature is damaged during felling).

In the event that any threatened flora or fauna species are observed during the habitat assessment for the pre-clearance surveys, the TSMP (Section 4.2.1.2) will be initiated. Following pre-clearance surveys and assessment of potential habitat trees/areas, fauna management strategies (Section 4.2) will be implemented if necessary, or vegetation clearance procedures (Section 4.3) will commence.

VEGETATION CLEARANCE PROTOCOL

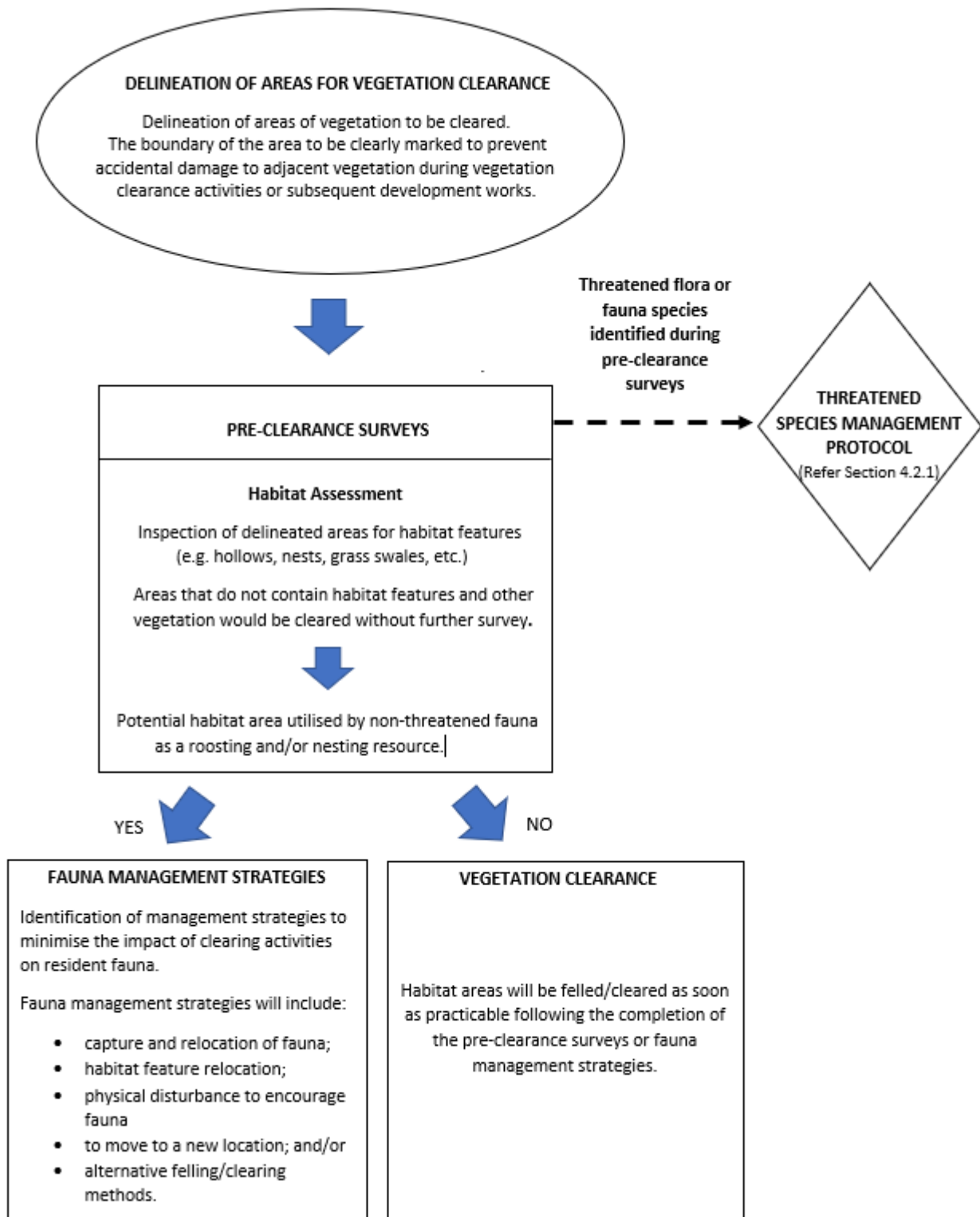


Figure 2. Vegetation Clearance Protocol.

4.4 Shorebird Habitat Management

NCIG retains habitat features within and adjacent to the site boundary that are suitable for use by migratory shorebirds. This is a key feature of the mitigating impacts to migratory shorebirds from construction of the Terminal.

In particular, the habitat adjacent to the NCIG Rail Flyover embankment through Deep Pond remains suitable for migratory waders. In particular the north embankments into the pond, which becomes increasingly suitable for migratory waders when water levels drop, and a greater surface area is exposed. For this reason, NCIG manages vegetation along this embankment toe alignment to maintain suitability for wader species (Figure 5). Specifically, this refers to brushcutting or spraying emergent vegetation to keep it low, i.e. approximately less than 20cm in height. Emergent vegetation is unsuitable for migratory waders as it has the potential to harbour predators, and waders unlikely to utilise this habitat.

4.5 Pest Management

Pests identified in proximity to the NCIG site include foxes, rabbits, feral cats and pigs. NCIG does not undertake routine management of these animals. However, in circumstances where these animals are observed to be in concerning numbers or, in the case of foxes and pigs, are becoming increasingly bold in their behaviour towards humans, then these will be managed appropriately by a licenced vermin management contractor.

4.6 Weed Management

There are several weed species present across the NCIG site. Of particular note are Pampas Grass and Bitou Bush. NCIG actively manages individuals of these species where they are observed. This is typically through chemical spraying, and in some cases physical removal of vegetation matter. Weed spraying activities are included in regular scheduled land management activities, which cover the entire NCIG site – refer to Section 4.7.

In addition to nuisance terrestrial weed species, NCIG will manage wetland weed species, including emergent vegetation that causes water management issues across site. In particular, excessive growth of species such as *Typha orientalis* or *Phragmites australis* in operational water management areas are removed or actively managed to keep vegetation growth to a minimum. These activities are conducted on an as-needs basis. However, in consultation with the University of Newcastle, a portion of emergent vegetation may remain in WT01 as this vegetation may provide habitat for Green and Golden Bell Frogs during periods of dry weather. The extent of emergent vegetation that may be maintained in WT01 can be seen in Figure 3.



Figure 3: Extent of emergent vegetation that may be maintained in WT01 for GGBF habitat

4.7 Landscape/Visual Management

NCIG undertakes general landscape and vegetation management activities on a regular basis. This includes managing of lawns, grass, trees and shrubs across site to ensure they remain healthy. Activities include mowing, brushcutting, trimming and planting. Trees, shrubs or lawns that die or perish will be replaced ongoing. These activities are completed on a set schedule. Activities are scheduled within the maintenance scheduling system.

Vegetation along the NCIG site boundaries, including the visual berm along the Stockyard/ Cormorant Road frontage is maintained with a specific objective of visual impact management. These areas include trees and other emergent species what provide coverage from Cormorant Road. Trees along these alignments have been chosen to provide high, dense coverage. Where required, mulching activities will be completed at appropriate times throughout the year to encourage growth and maintain plant health.

Irrigation systems have been installed in some locations around site where plant health is critical. These irrigation systems are set according to timers and will activate at set frequencies and times during the week. These settings are adjusted depending on the time of year.

5. PERFORMANCE EVALUATION AND IMPROVEMENT

5.1 Green and Golden Bell Frog Performance

5.1.1 Green and Golden Bell Frog Monitoring

The overall objective of Green and Golden Bell Frog monitoring across Kooragang Island is to monitor the dynamics of the Green and Golden Bell Frog within habitat areas adjacent to the NCIG Terminal site and within the Kooragang Island Waste Emplacement Facility, and any other locations where captured frogs have been relocated. Table 4 details the monitoring programme components. The results of the monitoring programme will be recorded and reported in the AEMR.

Table 4. Green and Golden Bell Frog Monitoring Program

MONITORING COMPONENT	DETAILS
Timing	<p>Surveys will be conducted during favourable seasonal and climatic conditions (e.g. typically between September and February, after heavy rain). Where logistically practicable, diurnal and nocturnal monitoring surveys will be conducted and generally covering the locations identified in Figure 4 and will include locations where captured frogs have been released.</p> <p>In accordance with NCIG's EPBC Particular Management Decision (2006/2987), monitoring will be conducted annually during breeding season until 2020. Thereafter, monitoring will be undertaken on a minimum three-yearly basis until 2030. The requirement to monitor beyond 2030 will be determined at that time in consultation with the DAWE.</p>
Locations	<p>Monitoring locations will include Green and Golden Bell Frog habitat within the Kooragang Island Waste Emplacement Facility and any other locations where captured frogs have been relocated</p>
Methodology	<p>Monitoring methodology may include, however not necessarily be limited to, frog call recording, active searches, spotlighting and call playback. The monitoring programme will be conducted in accordance with Threatened Species Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC, 2004).</p>

Parameters

Monitoring parameters will include, but not necessarily be limited to:

- Green and Golden Bell Frog presence/absence, distribution, habitat utilisation, behaviour and abnormalities.
- Observations of other frog species distribution, relative abundance and abnormalities.
- Observations of other threatened frog species (listed under the BC Act and/or the EPBC Act).
- Water quality (i.e. salinity and pH) and habitat condition.

Additional general information recorded during monitoring surveys may include:

- date;
- time of day;
- rainfall (mm);
- site location (GPS co-ordinates and map location);
- survey methodology utilised;
- sampling effort;
- habitats surveyed;
- weather conditions (including temperature);
- number of observers;
- photographs taken; and
- any other relevant information.

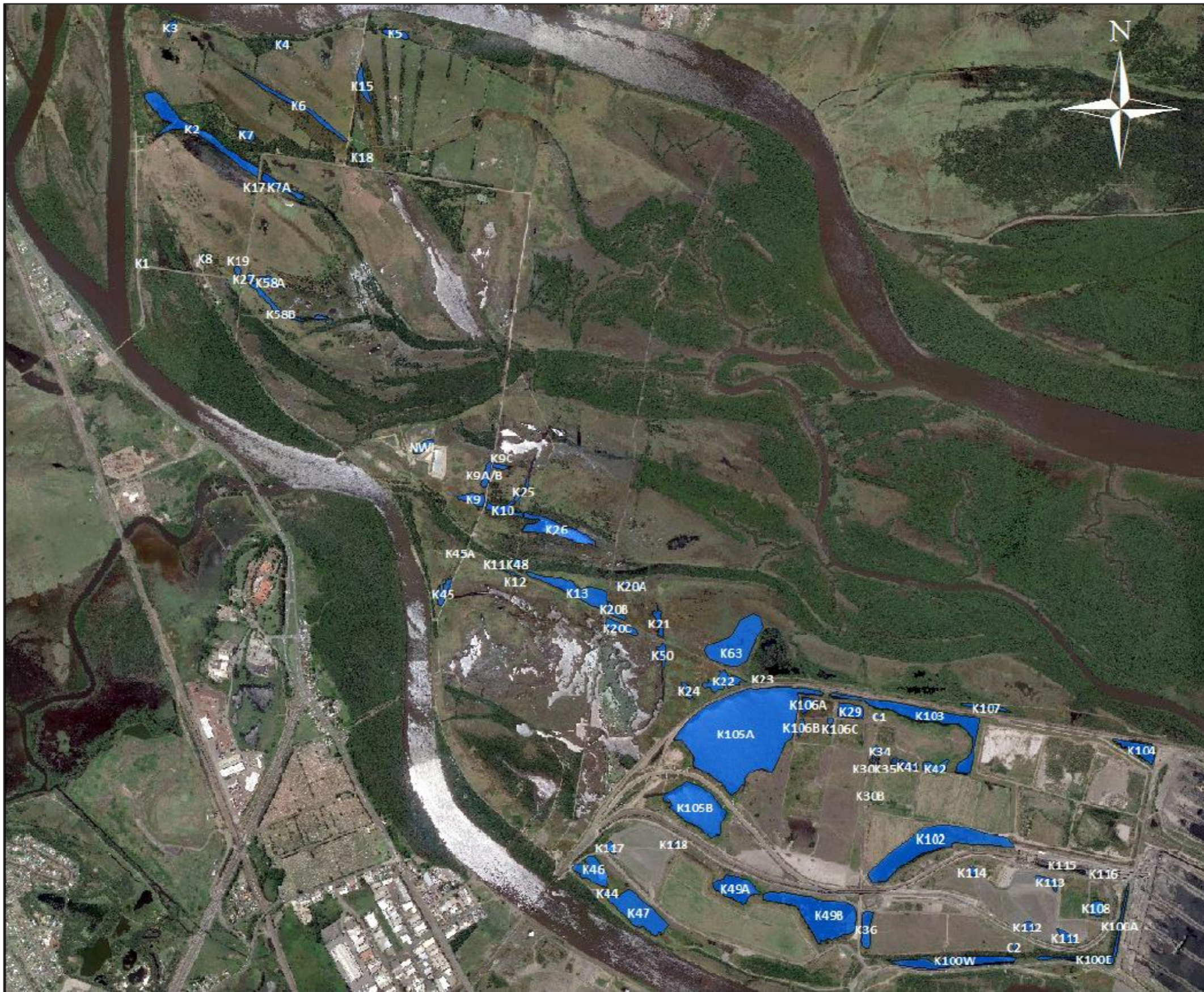


Figure 4. Green and Golden Bell Frog Monitoring Sites

5.2 Green and Golden Bell Frog Response Criteria and Additional Mitigation/Management Measures

If in the event the results of the monitoring programme indicate that Green and Golden Bell Frog populations may be declining as a direct influence of the Terminal, specific response criteria will be developed by NCIG, in consultation with DAWE and DPIE, to determine whether declining populations (if evident from the monitoring program) are attributable to the Terminal site or activities.

The response criteria will initially include comparison of results from the monitoring program with the baseline monitoring and the predicted impacts in the Project Environmental Assessment (NCIG, 2006).

The response criteria will be used to determine if additional mitigation/management measures are required to reverse any decline.

Mitigation/management measures will be determined by the Environmental Representative (or delegate), in consultation with DAWE and DPIE. Such mitigation/management measures may include creation or enhancement of frog habitat and dispersal pathways, establishment of new populations and/or control of Mosquito Fish (*Gambusia holbrooki*) populations.

5.3 Migratory Shorebird and Waterbird Monitoring

Monitoring, typically monthly, of migratory shorebirds and other waterbird species is conducted on and around the NCIG site. This includes recording of observations of the Australasian Bittern. This is completed primarily in the ponds around the NCIG rail facility, such as Deep Pond, Blue-billed Duck Pond and BHP Pond (Figure 5), and is completed as a simple count, i.e. behaviour such as foraging, roosting etc not recorded. These surveys are conducted to understand potential impacts on wader birds from the NCIG Terminal site and to take appropriate management action to reduce impacts on these species. In accordance with NCIG's EPBC Particular Manner Decision (2006/2987), monitoring of the Australasian Bittern and shorebird populations utilising Deep Pond will be undertaken during the peak season (summer) until 2020. Thereafter, monitoring is required on a three yearly basis. This monitoring will be provided to DAWE on an annual basis, including a summary and analysis of the results each three years.



Figure 5. Shorebird Monitoring and Vegetation Management Locations

5.4 Internal Auditing

The Sustainability Department will undertake regular auditing of ecological and land management within the SDMP, including this Ecological and Land Management Plan. This auditing is conducted in accordance with the NCIG *Audit and Inspection Procedure* (HSEC.PRO.15.01) and the annual Audit and Inspection Schedule. Non-conformances will be recorded, and appropriate actions taken to remedy.

5.5 Coordination

The monitoring and management of ecology at the NCIG site will be undertaken in a coordinated approach with the adjacent coal terminal operated by PWCS. The manner in which the coordination will be conducted is outlined by the Coordinated Environmental Monitoring and Management Procedure.

5.6 Incident Review

Environmental incidents relating to ecology and land management of the NCIG site are to be managed in accordance with NCIG *Hazard and Incident Management Procedure* (HSEC.PRO.13.01), including the Trigger Action Response Procedure. This includes recording the incident on the NCIG HSEC System, which is then forwarded to the Manager – Sustainability and Environment and Sustainability Lead for action.

5.7 Corrective Action

If corrective actions are identified as a result of ecological monitoring assessment, ELMP audit and inspection results, compliance tracking or community complaints about ecology (see Operation Environmental Management Plan), the Sustainability Department or Manager – Sustainability will determine appropriate management strategies and implementation of contingency measures in consultation with other departments. This same process is applied as an outcome of management review of environmental management measures, as discussed in Section 5.8. These will be in addition to those implemented as part of normal operational activities.

Corrective actions are also identified for environmental incidents. This process will be implemented in accordance with the NCIG *Hazard and Incident Management Procedure* (HSEC.PRO.13.01) including the Trigger Action Response Procedure.

5.8 Reporting

For reporting commitments, refer to Section 5.9 of the NCIG *Operation Environmental Management Plan* (HSEC.MP.12.01).

5.9 General Review

Ongoing review and attainment of feedback in regard to environmental measures is undertaken to ensure that the SDMP is meeting its targets and objectives. Any improvements deemed necessary will be identified and SDMP documentation will be updated to reflect this.

5.10 Management Review

The ELT reviews progress and health of environmental management measures on a quarterly basis in line with the Quarterly Sustainable Operations Report prepared for the NCIG Board. In addition, Key Result Areas (KRAs) and objectives are set during the business planning process (see Section 3.3), to ensure that statements within the NCIG Sustainability Policy are being achieved. Information used to develop KRAs, and objectives include:

- Legislative requirements;
- Performance against environmental objectives and targets in the HSEC Plan;
- Compliance assessment;
- Environmental monitoring results;
- Results of environmental auditing and trends of non-conformance;
- Monitoring of environmental statistics;
- Environmental incidents
- Corrective actions;

- Community complaints;
- Other current environmental issues and concerns;

The above is consistent with the NCIG *Management Planning, Monitoring and Review Procedure* (HSEC.15.02). As with general review of environmental management measures, improvements deemed necessary by management will be identified and SDMP documentation will be updated to reflect this.

6. REVISION HISTORY

DATE	REVISION NO	GENERAL DESCRIPTION OF CHANGE	PERSONS INVOLVED
16/06/16	Draft	First Draft	Phil Reid
25/07/16	1	Final	Nathan Juchau Phil Reid
23/11/18	2	Update to include Shorebird Monitoring Location Plan, update of legislation and update of general information.	Hayley Ardagh Phil Reid
25/02/22	3	General update. Update to legislation. Deletion of information related to terminal construction/early development.	Hayley Ardagh Wade Covey
16/04/25	4	General update. Minor administrative changes. Updates to roles and responsibilities.	Wade Covey

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8. APPENDIX A HYGEINE PROTOCOL FOR THE CONTROL OF DISEASED IN FROGS (NPWS, 2001)



Threatened Species Management
Information Circular No. 6

hygiene protocol for the
control of disease in
frogs

August 2001

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

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This document can be sourced from the NPWS website:
www.npws.nsw.gov.au/wildlife/licence/frog.html

This document should be cited as:
NSW National Parks and Wildlife Service (2001). Hygiene protocol for the control of disease in frogs. Information Circular Number 6. NSW NPWS, Hurstville NSW.

ISBN 0 7313 6372 8

Acknowledgments

NSW National Parks and Wildlife Service Declining Frog Working Group who recommended the preparation and provided input into the development of this strategy.

Ross Wellington and Ron Haering (both NPWS) the authors of this document.

Thanks to Jack Baker, Lee Berger, Mark Endersby, Jeff Hardy, Frances Hulst, Alex Hyatt, Keith McDougall, Diana Mendez, Deborah Pergolotti, Graham Pyke, Marjo Rauhala, Julie Ravallion, Karrie Rose, Lothar Voigt and Arthur White for their advice and/or technical review.

This hygiene protocol is an adaptation of the Declining Amphibian Population Task Force (DAPTF) Fieldwork Code of Practice and the recommendations of Speare et al. (1999) and has drawn on recommendations from earlier guidelines prepared by Environment ACT.

Foundation for National Parks and Wildlife funded the printing of this protocol.



hygiene protocol for the control of disease in

frogs

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1 introduction

This information circular outlines measures to:

- Prevent or reduce disease causing pathogens being transferred within and between wild populations of frogs.
- Ensure captive frogs are not infected prior to release.
- Deal safely with unintentionally transported frogs.
- Assist with the proper identification and management of sick and dead frogs in the wild.

1.1 Who should read this document?

This protocol is intended for use by all researchers, wildlife consultants, fauna surveyors and students undertaking frog field-work. In addition, the protocol should be read by National Parks and Wildlife Service (NPWS) personnel, frog keepers, wildlife rescue and carer organisations, herpetological/frog interest groups/societies, fauna park/zoo operators/workers and other individuals who regularly deal with or are likely to encounter frogs.

This protocol outlines the expectations of the NPWS regarding precautionary procedures to be employed when working with frog populations. The intention is to promote implementation of hygiene procedures by all individuals working with frogs. New licences and licence renewals will be conditional upon incorporation of the protocol. The NPWS recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation proposals should accompany any licence application or renewal to the NPWS.

1.2 Background

1.2.1 Amphibian Chytrid Fungus

The apparent decline of frogs, including extinctions of species and local populations, has attracted increased international and national concern. Many

potential causes for frog declines have been proposed (eg see Pechmann et al., 1991; Ferrero and Bergin, 1993; Pechmann and Wilbur, 1994; Pounds and Crump, 1994; Pounds et al., 1997). However, the patterns of decline at many locations suggest that epidemic disease maybe the cause (Richards et al., 1993; Laurance et al., 1996; Alford and Richards, 1997). Recent research has implicated a water-borne fungal pathogen *Batrachochytrium dendrobatidis* as the likely specific causative agent in many of these declines both in Australia and elsewhere (Berger et al., 1998; 1999). This agent is commonly known as the amphibian or frog chytrid fungus and is responsible for the disease Chytridiomycosis (Berger et al., 1999).

B. dendrobatidis is a form of fungus belonging to the phylum Chytridiomycota. Most species within this phylum occur as free-living saprophytic fungi in water and soil and have been found in almost every type of environment including deserts, arctic tundra and rainforest and are considered important primary biodegraders (Powell 1993). *B. dendrobatidis* is a unique parasitic form of Chytridiomycete fungi, in that it invades the skin of amphibians, including tadpoles, often causing sporadic deaths with up to 100% mortality in some populations. Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Wekman 2000). However, it is not currently known whether the fungus is endemic or exotic to Australia.

The infective stage of *B. dendrobatidis* is the zoospore and transmission requires water (Berger et al., 1999). Zoospores released from an infected amphibian can potentially infect other amphibians in the same water. More research is needed on the dynamics of infection in the wild.

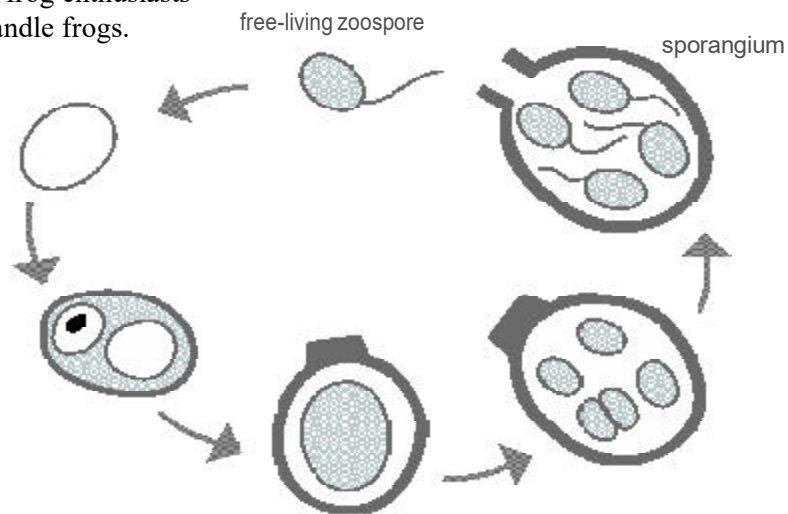
B. dendrobatidis is known to be susceptible to seasonal temperature changes, dehydration, salinity, water pH, light, nutrition and dissolved oxygen (Berger et al., 1999).

1.3 Objectives

The objectives of the hygiene protocol are to:

- Recommend best-practice procedures for NPWS personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs.

- Suggest workable strategies for those regularly working in the field with frogs or conducting fieldwork activities in wetlands and other aquatic environments where there is the potential for spreading pathogens such as the frog chytrid fungus.
- Provide background information and guidance to people who provide advice or supervise frog related activities.
- Provide standard licence conditions for workers engaged in frog related activities.
- Inform Animal Care and Ethics Committees (ACEC) for their consideration when granting research approvals.



Life cycle of frog chytrid fungus from infective free-living zoospore stage to sporangium (adapted from L. Berger).

2 site hygiene management

A checklist of risk management procedures and recommended standard hygiene kit is provided in Appendix 1. Please note Footnote 1 on page 4.

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Some frog populations can be particularly sensitive to the introduction of infectious pathogens such as the frog chytrid fungus. Also, the arrangement of populations in the landscape may make frogs particularly vulnerable to transmission of infectious pathogens. Therefore, it is important that frog workers recognise the boundaries between sites and undertake measures which reduce the likelihood of spreading infection.

Where critically endangered species or populations of particular risk are known to occur, this protocol should be applied over very short distances ie a single site may need to be subdivided and treated as separate sites.

When planning to survey multiple sites, always start at a site where frog chytrid fungus is not known to be present before entering other infected areas.

2.1 Defining a site

Defining the boundary of a site may be problematic. In some places, the boundary between sites will be obvious but in others, less so. 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. It may be that a natural or constructed feature forms a logical indicator of a site boundary eg a road/ track, a large body of water such as a river or the sea, a marked habitat change or a catchment boundary.

As a guiding principle, each individual water body should be considered as a separate site.

When working along a river or stream or around a wetland or a series of interconnecting ponds it is reasonable, in most instances, to treat such examples as a single site for the purposes of this protocol. Such a case would occur in areas where frogs are known to have free interchange between ponds.

Where a stream consists of a series of distinctive tributaries or sub-catchments or where there is an obvious break or division then they should be treated as separate sites, particularly if there is no known interchange of frogs between sites.

2.2 On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be undertaken to minimise the transfer of disease from footwear, equipment and/or vehicles.

Footwear

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 that contains *benzalkonium chloride* as the active ingredient. Disinfecting solutions should be prevented from entering any water bodies.

Rubber boots such as 'gum boots' or 'Wellingtons' are recommended because of the ease with which they can be cleaned and disinfected.

Several changes of footwear bagged between sites might be a practical alternative to cleaning.

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 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 in 2.4 below.

Vehicles

Where necessary, vehicle tyres should be sprayed/flushed with a disinfecting solution in high-risk areas.

Transmission of disease from vehicles is unlikely to be a problem. However, if a vehicle is used to traverse a known frog site, which could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should undergo cleaning and disinfection. This should be carried out at a safe distance from water bodies, so that the disinfecting solution can infiltrate soil rather than run-off into a nearby water body.

Spraying with 'toilet duck' (active ingredient *benzalkonium chloride*) is recommended to disinfect car wheels and tyres.

Cleaning of footwear before getting back into the car will prevent the transfer of pathogens from/to vehicle floor and control pedals.

2.3 Handling of frogs in the field

The spread of pathogenic organisms, such as the frog chytrid fungus, may occur as a result of handling frogs.

Frogs should only be handled when necessary.

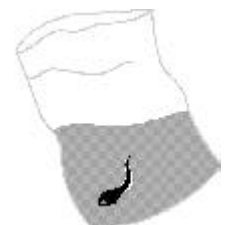
Where handling of frogs is necessary the risk of pathogen transfer should be minimised as follows:

- Hands should be either cleaned and disinfected between samples or a new pair of disposable gloves used for each sample¹. This may be achieved by commencing with a work area that has a dish containing a disinfecting solution and paper towels.
- A 'one bag – one frog' approach to frog handling should be used especially where several people are working together with one person processing frogs and others doing the collecting. Bags should not be reused.
- A 'one bag – one sample' approach to tadpole sampling should be used. Bags should not be reused.

Researchers who use toe clipping or Passive Integrated Transponder (PIT) tagging are likely to increase the risk of transmitting disease between frogs due to the possibility of directly introducing pathogens into the frogs' system. This can be minimised by using:

- Disposable sterile instruments
- Instruments disinfected previously and used once
- Instruments disinfected in between each frog

Disinfecting solutions containing *benzalkonium chloride* are readily available from local supermarkets. Some brands include Toilet Duck, Sanpic, New Clenz and Pine Clean.



¹ As a principle, this protocol assumes that not all frogs in an infected pond will be contaminated by the frog chytrid fungus. The infective load of a body of water may not be high enough to cause cross contamination of individual frogs in the same pond. Therefore care should be taken to use separate gloves and bags and clean hands for each sample, to avoid transmission of high infective loads between individuals.

Open wounds from toe clipping and PIT tagging should be sealed with a cyanoacrylate compound such as *Vetbond*® to reduce the likelihood of entry of pathogens. The NPWS ACEC further recommends the application of topical anaesthetic *Xylocaine*® cream and *Betadine*® disinfectant (1% solution) before and after any surgical procedure. This should then be followed by the wound sealant.

All used disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed 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

2.4 Disinfection Methods

Disinfecting agents for hands and equipment must be effective against bacteria and both the vegetative and spore stages of fungi. The following agents are recommended:

- Chloramine and Chlorhexidine based products such as *Halamid*®, *Halasept*®

or *Hexifoam*® are effective against both bacteria and fungi. These products are suitable for use on hands, footwear, instruments and other equipment. The manufacturers instructions should be followed when preparing these solutions.

- Bleach and alcohol (ethanol or methanol), diluted to appropriate concentrations can be effective against bacteria and fungi. However, these substances may be less practical because of their corrosive and hazardous nature.

When using methanol either:

- immerse in 70% methanol for 30 minutes or
- dip in 100% methanol then flame for 10 seconds or boil in water for 10 minutes

Fresh bleach (5% concentration) may be also effective against other frog pathogens such as Rana Virus.

Some equipment not easily disinfected in these ways can be effectively cleaned using medical standard 70% isopropyl alcohol wipes – *Isowipes*®.



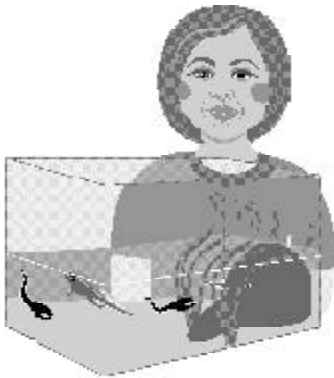
3 captive frog . hygiene management

3.1 Housing frogs and tadpoles

Frogs and tadpoles should only be removed from a site when absolutely necessary.

When it is necessary for frogs or tadpoles to be collected and held for a period of time, the following measures should be undertaken:

- Animals obtained at different sites should be kept isolated from each other and from other captive animals.
- 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.
- Prior to housing frogs or tadpoles, ensure that tanks, aquaria and any associated equipment are disinfected.
- Tanks and equipment should be cleaned, disinfected and dried immediately after frogs/tadpoles are removed.

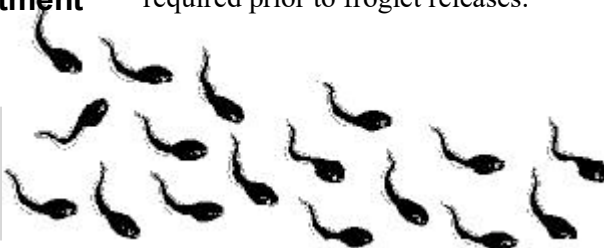


Careful maintenance of your enclosures will ensure a safe and hygienic environment for captive frogs and tadpoles.

3.2 Tadpole treatment

In most instances:

Release to the wild of tadpoles held or bred in captivity should be avoided.



When contemplating a release of captive bred tadpoles for conservation purposes a Translocation Proposal should be submitted to the NPWS and pathological screening for disease should be undertaken (see also NPWS Draft Translocation Policy). Tadpoles can be tested by randomly removing 10 individuals at 6 weeks and again at 2 weeks before anticipated release. Testing could be undertaken by the pathology section at Taronga Zoo, Newcastle University, CSIRO Australian Animal Health Laboratories at Geelong and James Cook University at Townsville. Such an arrangement would need to be negotiated by contacting one of these institutions well before the anticipated release date. (see Appendix 2 for contact details)

The NPWS will licence the NSW Department of Education and Training (DET) to allow school students and/or teachers to remove tadpoles for classroom life cycle studies. They will be authorised to remove a maximum of 20 individuals from only one location and each school will also require endorsement from DET Animal Care and Ethics Committee and comply with this protocol.

Tadpoles collected for these purposes are to be obtained from the local area of the school and are not to be obtained from NPWS Reserves. As soon as tadpoles have transformed, froglets must be returned to the exact point of capture. Tadpoles from different locations are not to be mixed.

Antifungal cleansing treatments to clear tadpoles of the frog chytrid fungus are currently being trialed. In the future, such a treatment may be an added procedure required prior to froglet releases.

Detailed information on safely maintaining frogs in captivity is provided in Voigt (2001).

3.3 Frog treatment

The rigour with which frogs must be treated to ensure pathogens are not introduced to native populations means that any proposal for the removal of adult frogs (particularly threatened species) from wild populations should be given careful consideration.

When it is essential for frogs to be removed from the wild, the following should apply.

Individuals to be released should be quarantined for a period of 2 months and monitored for any signs of illness or disease.

Frogs must not be released if any evidence of illness or infection is detected. If illness is suspected, further advice must be sought from a designated frog recipient (Appendix 2) as soon as possible to determine the nature of the problem. Chytridiomycosis can be diagnosed in live frogs by microscopical examination of preserved toe clips or from shedding skin samples. Research is still in progress on the development of a simple technique for the detection of Chytridiomycosis and a treatment for infected frogs.

Current methods which may be used include:

- A technique for the treatment of potentially infected frogs is to place the frogs individually in a 1mg/L benzalkonium chloride solution for 1 hour on days 1, 3, 5, 9, 11 and 13 of the treatment period. Frogs are then isolated/quarantined for two months. This and other possible treatments are documented in Berger and Speare (1998)
- *Betadine*® and *Bactone*® treatments have also been used on adult frogs with some success (M. Mahony, Newcastle University pers. comm.)

- *Itraconazole*® is an expensive drug which has been used successfully (Lee Berger CSIRO Australian Animal Health Laboratory pers. comm.). Information on this method is available on the Website <http://www.jcu.edu.au/school/PHTM/frogs/adms/attach6.pdf>.

Frogs undergoing treatment should be housed individually and kept separate from non-infected individuals.

3.4 Displaced frogs

Displaced frogs are those native frog species and introduced Cane Toads (*Bufo marinus*) which have been unintentionally transported around the country with fresh produce, transported produce and landscaping supplies. Procedures to be undertaken when encountering introduced/displaced native frog species (as well as Cane Toads) are as follows.

3.4.1 Banana box frogs

'Banana Box' frog is the term used to describe several native frog species (usually *Litoria gracilentia*, *L. infrafrenata*, *L. bicolor* and *L. caerulea*) commonly transported in fruit and vegetable shipments and landscaping supplies. In the past, well meaning individuals have attempted to return these frogs to their place of origin but this is usually impossible to do accurately. There is risk of spread of disease if these frogs are transferred from place to place.

It is strongly recommended that:

Displaced Banana Box frogs should be treated as if they are infected and should not be freighted anywhere for release to the wild unless specifically approved by NPWS.

When encountering a displaced frog:

- Contact a licensed wildlife carer organisation to collect the animal. The frog should then undergo a quarantine period of 2 months along with an approved disinfection treatment.
- Post-quarantine, the frog (if one of the species identified above) may be transferred to a licensed frog keeper. All other species require the permission from NPWS Wildlife Licensing (WLU) prior to transfer. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Licensed Frog Keepers are to list these frogs in their annual licence returns to NPWS.

Frogs held by licensed Frog Keepers are not to be released to the wild except with specific NPWS approval.

Displaced frogs may be made available to recognised institutions for research projects, display purposes or perhaps offered to the Australian Museum as scientific specimens once approval has been provided by the NPWS WLU.



Frogs are often unintentionally transported with fresh produce and landscaping supplies. They are collectively known as 'banana box' or displaced frogs.

3.4.2 Cane toads

Cane toads are known carriers of the Frog chytrid fungus and should not be knowingly transported or released to the wild.

If a cane toad is discovered outside of its normal range, it should be humanely euthanased in accordance with the recommended NSW Animal Welfare Advisory Council procedure (see Appendix 3). Care should be taken to avoid euthanasia of native species due to mistaken identity.

3.4.3 Local frog species

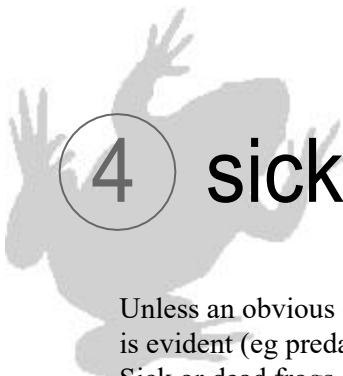
Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs.

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.

Incidences of frogs spawning or tadpoles appearing in swimming pools should be referred to a wildlife carer/rescue organisation for assistance (see Appendix 4).

Contact the Frogwatch Helpline if you are unsure whether a frog is a local species or displaced.

An NPWS information brochure titled 'Cane Toads in NSW' provides further information on cane toads and assistance with identification of some of the commonly misidentified native species. This information is also available on the NPWS website.



4 sick or dead frogs

Unless an obvious cause of illness or death is evident (eg predation or road mortality): Sick or dead frogs encountered in the wild should be collected and disposed of in accordance with the procedures described in section 4.2 below.

4.1 Symptoms of sick and dying frogs

Sick and dying frogs exhibit a range of symptoms characteristic of chytrid infection. Symptoms may be expressed in the external appearance or behaviour of the animal. A summary of these symptoms are described below. More detailed information can be found in Berger et al., (1999) or at the James Cook University Amphibian Disease website at: <http://www/jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm>. A directory of other useful websites is provided in NPWS (2001).



Appearance (one or more symptoms)

- darker or blotchy upper (dorsal) surface
- reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes
- swollen hind limbs
- very thin or emaciated
- skin lesions (sores, lumps)
- infected eyes
- obvious asymmetric appearance

Behaviour (one or more symptoms)

- lethargic limb movements, especially hind limbs
- abnormal behaviour (eg a nocturnal, burrowing or arboreal frog sitting in the open during the day and making no vigorous attempt to escape when approached)
- little or no movement when touched

Great barred frog (*Mixophyes fasciolatus*) with severe Chytrid infection — note lethargic attitude and sloughing skin. Photo: L. Berger

Diagnostic behaviour tests

Sick frogs will fail one or more of the following tests:

test	healthy	sick
Gently touch with finger	Frog will blink	Frog will not blink above the eye
Turn frog on its back	Frog will flip back over	Frog will remain on its back
Hold frog gently by its mouth	Frog will use its forelimbs to try to remove grip	No response from frog

4.2 What to do with sick or dead frogs

A procedure for the preparation and transport of a sick or dead frog is given below². Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist the NPWS and researchers to determine the extent of the disease and the number of species affected.

- Disposable gloves should be worn when handling sick or dead frogs. Avoid handling food and touching your mouth or eyes as this could transfer pathogens and toxic skin secretions from some frog species.
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination. When gloves are unavailable, use an implement to transfer the frog to a container rather than using bare hands.
- If the frog is dead, keep the specimen cool and preserve as soon as possible (as frogs decompose quickly after death making examination difficult). Specimens can be fixed/preserved in 70% ethanol or 10% buffered formalin.

Cut open the belly and place the frog in about 10 times its own volume of preservative. Alternatively, specimens can be frozen (although this makes tissues unsuitable for some tests). If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can be sent for analysis eg a preserved foot, leg or a portion of abdominal skin.

- The container should be labelled showing at least the species, date and location. A standardised collection form is provided in Appendix 5.
- If the frog is alive but unlikely to survive transportation (death appears imminent), euthanase the frog (see Appendix 3) and place the specimen in a freezer. Once frozen, the specimen is ready for shipment to the address provided below.
- 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.
- 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 (available from BOC/CIG Gas outlets).
- Place live or frozen specimens into a small styrafoam esky (available from K-Mart/Big W for approximately \$2.50).
- Seal esky with packaging tape and address to one of the laboratories listed in Appendix 4.
- Send the package by courier (NPWS use TNT Express Overnight).
- Keep all receipts for esky, ice, cooler bricks and courier for reimbursement from NPWS Threatened Species Unit Northern Directorate (Appendix 3).

Further information on sick and dying frogs is available on the Amphibian Disease Home Page at <http://www.jcu.edu.au/dept/PHTM/frogs/ampidis.htm>—in particular refer to 'What to do with dead or ill frogs'.

² The measures described below are standard procedures and may vary slightly depending on the distance and time required to reach the intended recipient. Contact the intended recipient of the sick or dead frog prior to sending to confirm the appropriate procedure.



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.appendix 1

.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.

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 taken into account 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 (consider both vehicle wheels/tyres and control pedals) and 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 NPWS Hygiene Protocol for the Control of Disease in 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 this protocol. Recommended contents of a field hygiene kit would include:

- Small styrofoam eski
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle
- Disinfecting solutions
- Wash bottle
- Scraper or scrubbing brush
- Small bucket
- Plastic bags large and small
- Container for waste disposal
- Materials for dealing with sick and dead frogs (see section 4.2)



. appendix 2

. designated sick and dead frog recipients

Always contact the relevant specialist prior to sending a

sick or dead frog. In some cases, only wild frogs will be assessed for disease. Analysis may also attract a small fee per sample.

Contact one of the following specialists to arrange receipt and analyse sick and dead frogs. Make contact prior to dispatching package:

Karrie Rose
Pathology Taronga Zoo
PO Box 20
MOSMAN NSW 2088

Phone: 02 9978 4749
Fax: 02 9978 4516
Krose@zoo.nsw.gov.au

Diana Mendez
School of Public Health
and Tropical Medicine
JCU House — Suite 11
57 Mitchell Street
North Ward
TOWNSVILLE QLD 4810

Phone: 07 4722 5771 or 07 4781 4181
Fax: 07 4722 5788
Diana.Mendez@jcu.edu.au

for all skin or toe-clip samples:

Rick Speare
School of Public Health
and Tropical Medicine
JCU House — Suite 13
57 Mitchell Street
North Ward
TOWNSVILLE QLD 4810

Phone: 07 4722 5777
Fax: 07 4722 5788
Richard.Speare@jcu.edu.au

Michael Mahony
School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308

Phone: 02 4921 6014
Fax: 02 4921 6923
bimjm@cc.newcastle.edu.au

For reimbursement of costs associated with the transport of sick and dead frogs costs contact:

Nick Sheppard
Threatened Species Unit
NSW National Parks and Wildlife Service
(Northern Directorate)
Locked Bag 914
COFFS HARBOUR NSW 2450

Phone: 02 6659 8231
Fax: 02 6651 6187
nick.sheppard@npws.nsw.gov.au

For information on frog keeping licences and approvals to move some species of displaced frog contact:

The Manager
NPWS Wildlife Licensing
Biodiversity Research and
Management Division
PO Box 1967
Hurstville NSW 2220
Ph 02 9585 6481
Fax 02 9585 6401
jeff.hardy@npws.nsw.gov.au

For information on the possible identity of displaced frogs contact:

Frog and Tadpole Society (FATS)
Frogwatch Helpline
Ph: 0419 249 728

.appendix 3

.NSW Animal Welfare Advisory Council methodology

The NSW Animal Welfare Advisory Council Procedure for humanely euthanasing cane toads or terminally ill frogs is stated as follows:



- Using gloves, or some other implement, place cane toad or terminally ill frog into a plastic bag.
- Cool in the refrigerator to 4°C.
- Crush cranium with a swift blow using a blunt instrument.

Note: Before killing any frog presumed to be a cane toad, ensure that it has been correctly identified and if outside the normal range for cane toads in NSW (north coast) that local NPWS regional office is informed.

. appendix 4

. licensed wildlife carer and rescue organisations

Following is a list of wildlife rehabilitation groups licensed by
NSW National Parks and Wildlife Service⁴:

Northern NSW

ASR (Australian Seabird Rescue), 'Waverly',
Pacific Highway, WEST BALLINA 2478

FRIENDS OF THE KOALA,
PO Box 5034, EAST LISMORE 2477

KPSN (Koala Preservation Society of NSW),
PO BOX 236, PORT MACQUARIE 2444

NRWC (Northern Rivers Wildlife Carers),
PO Box 6432, LISMORE SOUTH 2480

NTWC (Northern Tablelands Wildlife
Carers), PO Box 550, ARMIDALE 2350

TVWC (Tweed Valley Wildlife Carers),
PO Box 898, MURWILLUMBAH 2484

WCGI (Wildlife Carers of Glen Innes),
PO Box 520, GLEN INNES 2370

Central Coast including Sydney

AWARE (Aust. Wildlife Ambulance Rescue
Service), PO Box 592, CARINGBAH 2229

AWH (Australian Wildlife Hospital),
PO Box 84, RAYMOND TERRACE 2324

CCFFC (Cabramatta Creek Flying-fox
Committee), PO Box 430 BONNYRIGG 2177

FAWNA (For Aust Wildlife Needing Aid),
PO Box 41, BEECHWOOD 2446

GLWR (Great Lakes Wildlife Rescue), c/-
Huntley, The Lakes Way, BUNGWAHL 2423

HKPS (Hunter Koala Preservation Society),
PO Box 544, RAYMOND TERRACE 2324

IFAW (International Fund for Animal Welfare
Aust P/L), 29 Georgina St, NEWTOWN 2042

KBCC (Ku-ring-gai Bat Colony Committee),
45 Highfield Road, LINDFIELD 2070

KPC (Kangaroo Protection Co-operative),
GPO Box 3719, SYDNEY 2001

NATF (Native Animal Trust Fund),
8 Conway St, TORONTO 2283

ORRCA (Org. for the Rescue and Research of
Cetaceans), PO Box 442, ARTARMON 2064

SMWS (Sydney Metropolitan Wildlife
Services), 31 Chiltern Rd, INGLESIDE 2101

WILD & FREE,
PO Box 268, GLOUCESTER 2422

WILDLIFE ARC (Wildlife - Animal Rescue &
Care), PO Box 2383, GOSFORD 2250

WIRES (Wildlife Information & Rescue
Service), PO Box 260, FORESTVILLE 2087
(Note: WIRES has 25 Branches – addresses
available separately)

Southern NSW

LAOKO (Looking After Our Kosciusko
Orphans), 18 Kurrajong St, JINDABYNE 2627

NANA (Native Animal Network Assoc.),
P.O. Box 780, ULLADULLA 2539

SWCG (Sunraysia Wildlife Carers Group),
PO Box 189, GOL GOL 2738

Western NSW

LWC (Lachland Wildlife Carers),
'Revenue', CONDOBOLIN 2877

WILDCARE QUEANBEYAN,
PO Box 1404, QUEANBEYAN 2620

RRANA (Rescue & Rehabilitation of
Australian Native Animals),
107 Boughtman St, BROKEN HILL 2880

RSPCA (ACT) Inc.
PO Box 3082
WESTON ACT 2611

WCN(CW) (Wildlife Carers Network
(Central West)), 'Grundy Fen',
RUNNING STREAM, NSW 2850

⁴ Note: some of these organisations may not care for frogs.

appendix 5 — sick or dead frog collection form

Sender details:

name: _____ address: _____ postcode: _____
 phone: (w) _____ (h) _____ fax: _____ email: _____

Collector details: (where different to sender)

name: _____ address: _____ postcode: _____
 phone: (w) _____ (h) _____ fax: _____ email: _____

Specimen details:

record no: _____ no. of specimens: _____ species name: _____ date collected: _____
day/month/year

time collected: _____ sex: _____ status at time of collection: _____ date sent: _____
male/female healthy(H)/ sick(S)/ dead(D) day/month/year

location: _____ map grid reference: _____
(easting) (northing)

reason for collection: _____

Batch details for multiple species collection:

species	no.	locality	(AMG)	date	sex	status (H/S/D)

habitat type: _____ vegetation type: _____ micro habitat: _____
eg creek, swamp, forest eg rainforest, sedgeland eg creek bank, under log, amongst emergent vegetation,
on ground in the open

unusual behaviour of sick frogs: _____
eg lethargic, convulsions, sitting in the open during the day, showing little or no movement when touched.

dead frogs appearance: _____
eg thin, reddening of skin on belly and/or toes, red spots, sore, lumps or discolouration on skin

deformed frogs: _____ dead/sick tadpoles: _____
eg limb(s) missing, abnormal shape or length eg numbers/behaviour

unusual appearance of egg masses: _____ recent use of agricultural chemicals in area: _____
eg grey or white eggs eg pesticides, herbicides, fertilisers

other potential causes of sickness/mortality/comments/additional information:



NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

General inquiries: PO Box 1967 Hurstville NSW 2220
Phone: 1300 36 1967
Fax: 02 9585 6555 Web site: www.npws.nsw.gov.au
