KINGS FOREST

STAGE 1 PROJECT APPLICATION

PRECINCT 1 & 5
THREATENED SPECIES MANAGEMENT PLAN

JUNE 2011

A REPORT PREPARED FOR PROJECT 28 PTY LTD
## TABLE OF CONTENTS

1 Introduction ........................................................................................................ 2
   1.1 Background .................................................................................................. 2
   1.2 Proposed Development ................................................................................. 2
       1.2.1 Kings Forest Stage 1 Project Application ........................................... 2
       1.2.2 Precincts 1 & 5 .................................................................................. 3
   1.3 Aim & Objectives ........................................................................................ 3
   1.4 Plan Requirements ....................................................................................... 3
   1.5 Relationship to other Management Plans .................................................... 4

2 Summary of Significant Values ................................................................. 5
   2.1 Background .................................................................................................. 5
   2.2 Endangered Ecological Communities ......................................................... 5
   2.3 Threatened Species .................................................................................... 5
       2.3.1 Flora ................................................................................................. 5
       2.3.2 Fauna .............................................................................................. 5
   2.4 SEPP 14 Wetlands ....................................................................................... 6
   2.5 Cudgen Nature Reserve ............................................................................. 6

3 Threats, Recovery Strategies and Management Actions .......... 7
   3.1 Introduction .................................................................................................. 7
   3.2 Threatened flora species ............................................................................. 7
       3.2.1 Green-leaved rose walnut ................................................................. 7
       3.2.2 Southern swamp orchid ................................................................... 8
       3.2.3 Stinking cryptocarya ....................................................................... 9
       3.2.4 White laceflower .......................................................................... 11
   3.3 Fauna .......................................................................................................... 13
       3.3.1 Black bittern .................................................................................... 13
       3.3.2 Black-necked stork ......................................................................... 14
       3.3.3 Bush stone-curlew .......................................................................... 15
       3.3.4 Common planigale ........................................................................ 16
       3.3.5 Grass Owl ....................................................................................... 17
       3.3.6 Grey-headed Flying-fox ................................................................. 18
       3.3.7 Koala .............................................................................................. 19
       3.3.8 Masked Owl .................................................................................. 19
       3.3.9 Microchiropteran Bats ................................................................... 20
       3.3.10 Rose-crowned fruit-dove ............................................................... 22
       3.3.11 Wallum froglet & Wallum sedge frog (Acid frogs) ......................... 22

4 Monitoring and Reporting ............................................................... 25
   4.1 Background .................................................................................................. 25
   4.2 Flora monitoring ........................................................................................ 25
   4.3 Fauna monitoring ....................................................................................... 25
   4.4 Performance Criteria ................................................................................ 26
   4.5 Monitoring Reports ..................................................................................... 26

References ......................................................................................................... 27

Appendix 1 - Acid Frog Compensatory Habitat ......................... 29
1 INTRODUCTION

1.1 Background

The NSW Minister for Planning approved a Concept Plan for the proposed residential community at Kings Forest on the 19th August 2010. The approved documents included a Revised Threatened Species Management Plan (LandPartners 2009), which proposed the principles upon which the management of Threatened species at the Kings Forest site would be based.

Subsequently, the Director General issued modified Environmental Assessment Requirements (DGR’s) on the 22nd December 2010. James Warren & Associates (JWA) were engaged by Project 28 Pty Ltd to complete a Kings Forest Stage 1 Project Application Threatened Species Management Plan (TSMP) for Precincts 1 & 5 in accordance with requirements of 9.4 of these DGR’s and Clause C2 of the modified Concept Approval.

1.2 Proposed Development

1.2.1 Kings Forest Stage 1 Project Application

The Kings Forest site consists of 872 hectares of land located at Cudgen between Bogangar to the south-east and Kingscliff to the north in Northern New South Wales (NSW). The concept plan for the Kings Forest site is shown in FIGURE 1.

The scope of the Stage 1 Project Application works is as follows:

- Construction of the entrance road to the site and associated intersection works on Tweed Coast Road.
- Alignment and construction details of two lanes of Kings Forest Parkway, from Tweed Coast Road via Precincts 2, 3, 4 and 5 through to the roundabout in the western part of the site from which access to the southern part of the site is to be gained.
- Alignment and construction details for the civil works of the two proposed roads through the east-west SEPP 14 area to access the southern part of the site.
- Rural retail development in Precinct 1 to the east of Tweed Coast Road.
- Subdivision and construction of residential Precinct 5.
- Bulk earthworks across the site in Precincts 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13 & 14.

The scope of works is illustrated in FIGURE 2.
1.2.2 Precincts 1 & 5

This TSMP has been prepared for the proposed Precincts 1 & 5 of the Kings Forest Stage 1 Project Application. Precincts 1 & 5 occur in the most north-east portion of the Kings Forest site and will be comprised of the following:

- Precinct 1 - a rural retail development (FIGURE 3); and
- Precinct 5 - residential subdivision (FIGURE 4).

1.3 Aim & Objectives

The aim of this TSMP is to provide guidelines, strategies and methods for the management of the Threatened flora and fauna species recorded within the vicinity of Precincts 1 & 5, such that species continue to persist and reproduce.

Specific objectives of the Precinct 1 & 5 TSMP include:

- provide a summary of the threatened flora and fauna species occurring within the vicinity of Precincts 1 & 5;
- provide a profile for each threatened species occurring which includes:
  - a list of overall threats to the species;
  - potential threats from the development of Precincts 1 & 5;
  - recovery strategies for the species including details of Approved Recovery Plans and/or Priority Actions;
- devise management strategies to be implemented including:
  - strategies for the protection of threatened species during the construction and operation stage of the development;
  - weed control measures specific to areas containing listed threatened flora and fauna;
  - guidelines for the control of human and animal access to areas containing threatened species;
  - strategies for the embellishment of threatened species habitat through revegetation works and/or the creation of compensatory habitat areas where required.

1.4 Plan Requirements

As discussed above, this TSMP has been prepared in accordance with DGR 9.4 which states:

“Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals, weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies..."
do not conflict and that each plan can be implemented without negatively impacting on the objectives of another.”

This TSMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

**Threatened Species Management Plan**

“Each Threatened Species Management Plan update is to provide further details on specific habitat management measures to safeguard existing populations of the two threatened Wallum frog species that occur within the Environmental Protection zones, Ecological buffers and the golf course. These measures are to be determined with reference to contemporary scientific literature and current best practice.”

### 1.5 Relationship to other Management Plans

The Kings Forest Stage 1 Project Application includes numerous Management Plans that have been prepared for specific areas of the site. Additional to this TSMP, the following Management Plans relevant to Precincts 1 & 5 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this TSMP:

- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Vegetation Management Plan (Precinct 1 & 5 VMP) (JWA 2011a);
- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Buffer Management Plan (Precinct 1 & 5 BMP) (JWA 2011b); and
- Kings Forest Stage 1 Project Application: Precinct 1 & 5 Weed Management Plan (Precinct 1 & 5 WMP) (JWA 2011c).

A Kings Forest Stage 1 Project Application Feral Animal Management Plan (Stage 1 FAMP) (JWA 2011d) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 1 & 5.

Furthermore, a Kings Forest Stage 1 Project Application Koala Plan of Management (Stage 1 KPoM) (JWA 2011e) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 1 & 5.

This TSMP should also be read in conjunction with the Site Based Management Plan (Gilbert & Sutherland 2011a) which details further protection measures for Threatened species during the following phases of development across the entire Kings Forest site:

1. Bulk earthworks
2. Landform stabilisation
3. Civil construction
4. On maintenance
5. Operational
2 SUMMARY OF SIGNIFICANT VALUES

2.1 Background

Kings Forest has been comprehensively studied. A summary of the significant values relevant to the development of Precincts 1 & 5 is provided in the following sections.

2.2 Endangered Ecological Communities

Three (3) Endangered Ecological Communities (EEC’s)\(^1\) occur within the vicinity of Precincts 1 & 5 (FIGURE 5):

- Swamp sclerophyll forest on coastal floodplain;
- Freshwater wetlands; and
- Subtropical coastal floodplain forest.

2.3 Threatened Species

2.3.1 Flora

Four (4) Threatened flora species occur within the vicinity of Precincts 1 & 5 (FIGURE 6):

- Green-leaved rose walnut (*Endiandra muelleri subsp. bracteata*);
- Southern swamp orchid (*Phaius australis*);
- Stinking laurel (*Cryptocarya foetida*); and
- White laceflower (*Archidendron hendersonii*).

2.3.2 Fauna

Thirteen (13) Threatened fauna species have been recorded (FIGURE 7), or are considered to be provided with potential habitat, within the vicinity of Precincts 1 & 5. These species are as follows:

- Black bittern (*Ixobrychus flavicollis*);
- Black-necked stork (*Ephippiorhynchus asiaticus*);
- Bush stone-curlew (*Burhinus grallarius*);
- Common planigale (*Planigale maculata*).
- Grass owl (*Tyto capensis*);
- Grey-headed flying fox (*Pteropus poliocephalus*);
- Koala (*Phascolarctos cinereus*).

\(^1\) As listed within schedules of the TSC Act (1995).
• Little bent-wing bat (*Miniopterus australis*);
• Masked owl (*Tyto novaehollandiae*);
• Rose-crowned fruit-dove (*Ptilinopus regina*);
• Wallum froglet (*Crinia tinnula*);
• Wallum sedge frog (*Litoria olongburensis*); and
• Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).

2.4 SEPP 14 Wetlands

SEPP 14 - Coastal Wetlands are mapped over large areas of the Kings Forest site, including areas adjacent to Precincts 1 & 5 (FIGURE 8). These wetlands are protected by State Environmental Planning Policy No. 14 - Coastal Wetlands (SEPP 14).

2.5 Cudgen Nature Reserve

Cudgen Nature Reserve occurs immediately adjacent to the eastern and southern boundaries of the Kings Forest site (FIGURE 9).
3 THREATS, RECOVERY STRATEGIES AND MANAGEMENT ACTIONS

3.1 Introduction

The existing and potential threats, recovery strategies and management actions for all listed species that occur within the vicinity of Precincts 1 & 5 are discussed below. For each listed species, management actions are based on those set out in the Revised Threatened Species Management Plan (LandPartners 2009) which accompanied the Concept Plan Application, the Draft or Approved Recovery Plan and the Priority Action Statement.

3.2 Threatened flora species

3.2.1 Green-leaved rose walnut

3.2.1.1 Threats

There is a historic record of a single stem of the Threatened species Green-leaved rose walnut within the road reserve of Tweed Coast Road (FIGURE 6). However, this tree has not been located despite several surveys since 2006 and could not be located during recent site investigations. It is considered likely that it has been removed during roadside maintenance works.

3.2.1.2 Recovery of the species

An Approved Recovery Plan outlines specific objectives to facilitate the recovery of the Green-leaved Rose Walnut in the wild. Objectives of this plan are as follows:

- To co-ordinate the recovery of the Green-leaved Rose Walnut;
- To resolve taxonomic difficulties in the separation of the Green-leaved Rose Walnut and Rusty Rose Walnut and other closely related taxa and conduct field surveys where necessary to fill information gaps;
- To re-assess background information for the newly resolved taxa;
- To improve the consideration of the Green-leaved Rose Walnut in environmental impact assessments for developments and activities;
- To manage and protect the Green-leaved Rose Walnut and associated habitat from threatening processes;
- Fire-planning and management;
- To improve knowledge of distribution, regeneration and genetics;
- To integrate the recovery of the Green-leaved Rose Walnut with the recovery of other biota; and
- To involve the community in the recovery of the Green-leaved Rose Walnut.
3.2.1.3 **Management Actions**

1. As site inspections have failed to find the recorded specimen of the Green-leaved Rose Walnut, the most appropriate objective, at this stage, is to manage and protect potential habitat for this species. The restoration and management of suitable habitat will provide potential areas for the chance regeneration of this species. Restoration and management strategies are outlined in the Precinct 1 & 5 VMP (JWA 2011a).

2. A monitoring program has been devised to search for and record any individuals of this species occurring within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.2.2 **Southern swamp orchid**

3.2.2.1 **Threats**

The Southern swamp orchid was originally recorded within Paperbark forest in the mid-eastern portion of the Kings Forest site. A separate colony of several individuals was recorded within Paperbark forest north-east of Precinct 5 within the Environmental Protection Zone (FIGURE 6). Further searches have failed to find any current occurrence of this species. It has been suggested that this species is browsed by Swamp wallabies and plants have been reduced to bulbs or small leaves which are not easily seen (LandPartners 2009). Large areas of potential habitat for this species (i.e. *Melaleuca quinquenervia* swamp and sclerophyll forest) will remain unaffected by the development enabling the potential regeneration of the species.

3.2.2.2 **Recovery of the species**

No recovery plan or Priority Action Statement (PAS) has been prepared for this species. The following list of recovery strategies is derived from the Revised Threatened Species Management Plan (LandPartners 2009) and the Threatened Species Website (DECCW 2011):

- View, photograph, catalogue and monitor any present populations.
- Report any records to the DECCW.
- Propagate and replant keeping meticulous records of origins and planting locations.
- Protect areas of habitat from clearing, draining or development.
- Provide further habitat opportunities.
- Protect areas of habitat from frequent fire. Consideration of the potential occurrence of this species in any Fire Management Plan (i.e. exclusion of area from fire regime).
- Fence swampy areas to exclude stock and if population(s) regenerate and maintain fencing.
- Protect areas of habitat from pollution.
Kings Forest (Stage 1) - Precinct 1 & 5 Threatened Species Management Plan

- Provide weed control.
- Annual monitoring.
- Buy plants only from licensed nurseries.
- Assist with the control of feral pigs.
- Involve local residents by education; facilitation of Landcare or community groups.

3.2.2.3 Management Actions

1. As site inspections have failed to find the recorded specimens of the Southern swamp orchid, the most appropriate objective, at this stage, is to manage and protect potential habitat for this species. The restoration and management of suitable habitat will provide potential areas for the chance regeneration of this species. Restoration and management strategies for suitable plant communities (e.g. Swamp sclerophyll forest) are outlined in the Precinct 1 & 5 VMP (JWA 2011a).

2. The areas where the Southern swamp orchid was recorded will be fenced, preventing any further browsing by Wallabies. The area will then be closely monitored for any regeneration in accordance with monitoring criteria within the Precinct 1 & 5 VMP (2011a).

3. A monitoring program has been devised to search for and record any individuals of this species occurring within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.2.3 Stinking cryptocarya

3.2.3.1 Threats

A single Stinking cryptocarya approximately 10 metres high occurs south of Precinct 5 within an Environmental Protection Zone (FIGURE 6). This tree occurs in the company of a single Beach acronychia (*Acronychia imperforata*) and a mature Corkwood (*Duboisia myoporoides*) within a narrow strip of vegetation adjacent to Swamp mahogany/Paperbark swamp forest. A vehicle access track occurs approximately 5 metres from the subject tree. There are very few weed species within a 10 metres perimeter of this tree, although a single Happy plant (*Dracaena sp.*) occurs, and Slash pine wildings occur on the north side of the access track. Some dumped rubbish occurs immediately adjacent.

Potential threats to this tree include fire (and fire control methods), weeds and clearing as a result of road widening or maintenance.
3.2.3.2 Recovery of the species

No recovery plan exists for this species however a PAS has been prepared. The following list of recovery strategies is derived from the PAS and includes strategies that are relevant to the proposed Precinct 1 & 5 development:

- Ensure that land managers and other stakeholders are aware of populations and habitat, identify information and resource needs.
- Encourage community awareness to assist in detecting new locations, and with habitat rehabilitation projects.
- Ensure that managers are aware of populations and habitat and that fire plans, pest management plans take account of requirements for the recovery of Stinking Cryptocarya.
- Develop and implement site management plans for important Stinking Cryptocarya sites.
- Ensure regional fire plans, hazard reduction burn guidelines include protocols for protecting rainforest habitats
- Protect rainforest habitats from fire.
- Protect areas of rainforest habitat from clearing, degradation and fragmentation.
- Survey before road and track maintenance in the habitat of the species, protect road and trackside plants.
- Assess weed threats to populations, manage as necessary. Implement Bitou bush control as described in the approved TAP.
- Monitor populations at key sites and address threats.
- Undertake habitat assessments at known sites and ascertain threats.
- Determine current population size and demography.

3.2.3.3 Management Actions

Management of the Stinking cryptocarya will include the following:

1. Protective and high visibility temporary fencing (i.e. star pickets and high visibility mesh fencing) will be erected along the edge of the track during harvesting of Slash pine and general rehabilitation works.

2. Removal of the Happy plant located nearby.


4. This tree is within an area that will be rehabilitated and protected in the long term, so it may not be necessary to erect a permanent protective fence. However, a buffer of suitable fast growing rainforest species (e.g. Brown kurrajong, Common lilly pilly, Corkwood) must be planted. Permanent fencing should be considered as an adaptive management strategy.
5. Any personnel involved in removal/control of nearby Slash pine wildings are to be made aware of the location of the tree and the need to protect it and limit spray drift within its vicinity.

6. The existence of the threatened species must be considered in the development of any Fire Management Plan (i.e. fire should be excluded from the area immediately adjacent to the tree).

7. A monitoring program has been devised to monitor the health and continued persistence of this tree and to search for and record any additional individuals of this species occurring within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.2.4 White laceflower

3.2.4.1 Threats

Two (2) mature White laceflower of approximately 10 and 12 metres high have been recorded north east of Precinct 5 within the Environmental Protection Zone (FIGURE 6). One of the trees is smothered by native vines (Mucuna gigantea - Native burny vine, Cissus antarctica - Native water vine), and has a dense thicket of Lantana around the base.

Potential threats to these trees include:

- competition from weeds and native vines;
- fire and fire control methods;
- grazing; and
- disturbance by cattle.

3.2.4.2 Recovery of the species

No recovery plan exists for this species however a PAS has been prepared. The following list of recovery strategies is derived from the PAS and includes strategies that are relevant to the proposed Precinct 1 & 5 development:

- Facilitate community and land-holder liaison, awareness and education programmes.
- Encourage the community to participate in the detection of White Lace Flower at new locations, and encourage their participation in habitat rehabilitation projects.
- Protect areas of habitat from frequent fire. Consideration of the potential occurrence of this species in any Fire Management Plan (i.e. exclusion of area from fire regime).
- Ensure that managers are aware of populations and habitat and that fire plans, pest management plans take account of requirements for the recovery of White Lace Flower.
3.2.4.3 Management Actions

1. Prior to any rehabilitation works the White laceflower trees will be identified and clearly marked. A temporary high visibility fence (i.e. star pickets and high visibility mesh fencing) will be constructed around both trees to limit disturbance.

2. Seeds and/or cuttings will be collected and grown for use in rehabilitation plantings.

3. Weed control in the vicinity of these plants must be undertaken strictly adhering to the following strategies:
   a. Any personnel involved in restoration/weed control works in the vicinity of the trees must be made aware of the location of the trees.
   b. Areas immediately adjacent to the trees must be hand weeded.
   c. Vines and Lantana must be carefully removed by hand.
   d. Extreme care should be taken when spraying herbicides in the area to ensure drift does not adversely affect the trees.

4. These trees are within an area that will be rehabilitated in the long term, so it may not be necessary to erect a permanent fence around them. However, a buffer of suitable fast growing rainforest species (e.g. Brown kurrajong, Common lilly pilly, Corkwood) will be planted around the two trees. Permanent fencing should be considered as an adaptive management strategy.

5. The existence of the threatened species must be considered in the development of any Fire Management Plan (i.e. fire should be excluded from the area immediately adjacent to the trees).

8. A monitoring program has been devised to monitor the health and continued persistence of these trees and to search for and record any additional individuals of this species occurring within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.
3.3 Fauna

3.3.1 Black bittern

3.3.1.1 Threats
There are two (2) records of the Black bittern at the south of Precinct 5 and within Environmental Protection Zone (FIGURE 7).

Potential threats to this species are as follows:

- Clearing of riparian vegetation.
- Predation by foxes and feral cats on eggs and juveniles.
- Grazing and trampling of riparian vegetation by stock.

No habitat suitable for this species will be cleared for the Precinct 1 & 5 developments. However, foxes and feral cats have been recorded on the site and may threaten the wellbeing and/or survival of this species.

3.3.1.2 Recovery of the species
No recovery plan exists for this species however a Priority Action Statement (PAS) has been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- In areas of suitable breeding habitat, seek to retain and manage riparian vegetation.
- Enhance knowledge of the breeding locations of this species. Survey suitable habitat e.g. vegetated wetlands during the breeding season. Investigate habitat usage particularly in Swamp Oak Forest.

3.3.1.3 Management Actions
Although the Black bittern was sighted outside the proposed Precinct 1 & 5 development footprints (i.e. within adjoining Environmental Protection Zones), the species will benefit from the extensive rehabilitation works planned for the Precinct 1 & 5 development areas (in accordance with the Precinct 1 & 5 VMP).

This species inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. The bio-retention swales proposed within the Precinct 5 ecological buffers will be revegetated (in accordance with the Precinct 1 & 5 VMP) and will provide potential additional habitat for this species.

The following additional management actions will benefit the Black bittern:

1. In addition to the creation of potential habitat, extensive areas currently weed infested and supporting pine plantations will be rehabilitated to extend forage areas (in accordance with the Precinct 1 & 5 VMP).
2. The Stage 1 FAMP (JWA 2011d) will ensure predators such as the Red fox are controlled in areas of known habitat.
3. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.2 Black-necked stork

3.3.2.1 Threats

Black-necked storks have been recorded in conjunction with constructed dams in the far west of the Kings Forest site. The species may also utilise periodically inundated areas of pasture adjacent or within wetland environments.

Potential threats to the species from development of the site include:

- Minor loss of habitat within low-lying pasture;
- Human disturbance to areas of forage habitat; and
- Disturbance from straying domestic dogs.

3.3.2.2 Recovery of the species

No recovery plan exists for this species however a Priority Action Statement (PAS) has been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- Improve the protection of Black-necked stork habitat by excluding stock, reducing grazing pressure & controlling weed species at important sites.
- Reduce nutrient runoff into wetlands known to be used by the species. Avoid the use of pesticides and herbicides near or in wetlands.
- Restore & maintain natural hydrological regimes in freshwater wetlands.

3.3.2.3 Management Actions

1. The most effective measures to ensure that forage habitat for the Black-necked stork remains free from disturbance (from human visitation or from straying domestic dogs) is by fencing habitat areas to preclude human visitation. This will be achieved by the proposed Koala proof fences (JWA 2011e) in combination with enforcement of domestic dog control in accordance with the requirements of the Companion Animals Act 1998.

2. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.
3.3.3 Bush stone-curlew

3.3.3.1 Threats

A single record for the Bush stone-curlew occurs in the south-eastern portion of the Kings Forest site. Suitable habitat for this species is also considered to occur within the vicinity of Precincts 1 & 5.

Potential threats to the species from development of the site include:

- Injury/death from vehicle strike;
- Injury/death from domestic animals;
- Loss of habitat (either directly as a result of development, or indirectly as habitat becomes unsuitable due to regrowth of heathland in identified habitat areas); and
- Human disturbance.

3.3.3.2 Recovery of the species

An Approved Recovery Plan outlines specific objectives to facilitate the recovery of the Bush stone-curlew. The Recovery Plan for the Bush Stone-curlew lists the following proposed recovery objectives:

1. Expand existing Bush Stone-curlew community conservation programs;
2. Raise community recognition of the Bush Stone-curlew and interest in the recovery program;
3. Increase the total area of Bush Stone-curlew habitat protected and managed for conservation on public and private lands by 25% in each Catchment Management Area (CMA);
4. Support declining wild populations with a robust and well-funded captive-breeding and translocation program;
5. Ensure the conservation status of the Bush Stone-curlew is adequately recognised under NSW and Commonwealth legislation;
6. Ensure that impacts on Bush Stone-curlews and their habitat are accurately assessed during planning and environmental assessment processes;
7. Increase understanding of the ecology of the Bush Stone-curlew;
8. Increase understanding of threatening processes affecting Bush Stone-curlews;
9. Increase understanding of the significance of the Bush Stone-curlew to indigenous Australians;
10. Integrate the recovery plan with other conservation plans and programs to maximise the efficient use of resources and benefits to biodiversity; and
11. Implement a well-funded and co-ordinated recovery program across NSW.

A Priority Action Statement (PAS) has also been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- Undertake integrated predator & pest control programs in Bush stone-curlew habitat with particular emphasis around breeding sites & in the breeding season.
• Manage Bush stone-curlew habitat - predator control, fallen timber retention, ground cover length, weed control, stock access, application of insecticides, disturbance, regeneration, site security & viability.
• Undertake annual monitoring programs to determine breeding success, juvenile recruitment & the status of the population.
• Identify & map Bush Stone-curlew habitat on private land.

3.3.3.3 Management Actions

1. The most effective measures to ensure that forage habitat for the Bush stone-curlew remains free from disturbance (from human visitation or from straying domestic dogs) is by fencing habitat areas to preclude human visitation. This will be achieved by the proposed Koala proof fence (JWA 2011e) in combination with enforcement of domestic dog control in accordance with the requirements of the Companion Animals Act 1998.

2. Additionally, control of feral dogs, cats and foxes as per the Stage 1 FAMP (JWA 2011d) will also be implemented.

3. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.4 Common planigale

3.3.4.1 Threats
A single record of the Common planigale occurs in the south-eastern portion of the Kings Forest site. Suitable habitat for this species is also considered to occur within the vicinity of Precincts 1 & 5.

The most likely threats to the Common planigale from the development of Precincts 1 & 5 are:

• loss of habitat;
• mortality from vehicle strike; and
• predation by domestic cats.

3.3.4.2 Recovery of the species
No recovery plan exists for this species however a Priority Action Statement (PAS) has been prepared. In accordance with the PAS, foxes, cats & cane toads will be controlled in known & potential planigale habitat through implementation of the Stage 1 FAMP (JWA 2011d).

3.3.4.3 Management Actions
As cats will be prohibited from the site, risks to the Common planigale will be significantly reduced. Feral animal control in accordance with the Stage 1 FAMP (JWA 2011) will ensure the any stray feral cats are appropriately controlled, while
the Koala proof fences (JWA 2011e) will restrict domestic dogs as well as humans from entering habitat areas for the species.

### 3.3.5 Grass Owl

#### 3.3.5.1 Threats

There are four (4) recorded sightings of the Grass owl at Kings Forest (FIGURE 7). While Grass owls have been recorded within rank grassland within Environmental Protection Zones, they have also been recorded within urban zoned areas of the Kings Forest site, and are likely to forage widely.

Potential threats to this species from proposed development of Precincts 1 & 5 include:

- Fragmentation and loss of habitat;
- Alteration of habitat from weed invasion, colonisation by woody heathland species;
- Injury/death from vehicle strike;
- Fire;
- Human disturbance;
- Injury/death from domestic animals;
- Increased risk of fire;
- Disturbance from light spill from houses and roads; and
- Use of second-generation (single-dose) rodenticides based on brodifacoum (e.g. Talon).

#### 3.3.5.2 Recovery of the species

No recovery plan exists for the Grass owl however a Priority Action Statement (PAS) has been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- Secure sympathetic management of the Grass Owl, particularly in regard to minimising secondary poisoning from pesticides such as brodifacoum based rodenticides.
- Control pest animals throughout the species range where nesting is known or strongly suspected.
- Where Grass Owl records occur on private land encourage landholders to undertake management to conserve and actively manage habitat.
- Compile and assess opportunistically gathered records of the species in NSW toward developing a model of distribution, habitat use and management.

#### 3.3.5.3 Management Actions

1. The existence of this threatened species must be considered in the development of any Fire Management Plan (i.e. fire should be excluded from the areas of potential habitat);
2. The existence of the Grass owl must be considered in the development of any program using pesticides and herbicides for weed and/or mosquito and/or feral animal control.

3. The Stage 1 FAMP (JWA 2011d) will ensure predators such as the Red fox are controlled in areas of known habitat.

4. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.6 Grey-headed Flying-fox

3.3.6.1 Threats
There is one (1) record of the Grey-headed flying fox to the south of the Kings Forest site (FIGURE 7). The Grey-headed flying-fox is considered likely to utilise the Kings Forest site on a seasonal basis (i.e. when feed trees such as Swamp Mahogany, Swamp Box, Scribbly Gum, Broad-leaved Paperbark, Figs etc. are flowering).

Large areas or forage resources are retained within Environmental Protection Zones, and the development of the site will result in a very minor reduction of resources for this species.

3.3.6.2 Recovery of the species
No recovery plan exists for the Grey-headed flying-fox however a Priority Action Statement (PAS) has been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- Provide educational resources to improve public attitudes towards Grey-headed Flying Foxes.
- Protect & enhance priority foraging habitat.
- Protect roosting habitat critical to the survival of Grey-headed Flying Foxes.
- Increase the extent & viability of foraging habitat for Grey-headed Flying Foxes that is productive during winter and spring, including habitat.
- Set priorities for protecting foraging habitat critical to the survival of the species & generate maps of priority foraging habitat.

3.3.6.3 Management Actions
Although there are no camp sites within Kings Forest, this species forages widely, (i.e. up to 50km from camps) and is likely to benefit from the extensive rehabilitation works planned in accordance with the Precinct 1 & 5 VMP (JWA 2011a).

The development of Precincts 1 & 5 is likely to result in very few impacts to the Grey-headed flying-fox. The species is known to be adaptable to foraging in close proximity to urban environments, and the majority of suitable habitat for the
species is well-buffered from urban encroachment. The following management actions will benefit the Grey-headed flying-fox:

1. Forage areas, for the Grey headed flying fox, will be created by including feed trees such as Swamp Mahogany, Swamp Box, Scribbly Gum, Broad-leaved Paperbark and Figs in the enhancement planting programme.

2. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.7 Koala

A Kings Forest Stage 1 Koala Plan of Management (JWA 2011e) has been prepared and contains a detailed assessment of the potential threats and issues relating to the recovery of the species. Numerous management actions are recommended within the KPoM which should be read in conjunction with this TSMP.

3.3.8 Masked Owl

3.3.8.1 Threats

There is one record of the Masked owl south-west of Precinct 5 within the Environmental Protection Zone. Masked owls are likely to forage widely over the Kings Forest site as the mosaic of vegetation types provides habitat for a variety of prey species.

Some small areas of habitat (e.g. grassland and heathland) for potential prey species for the Masked owl (e.g. Black Rat, Bush Rat and Swamp Rat) will be lost during development of Precincts 1 & 5. However, retention of large areas within Environmental Protection Zones will continue to provide a variety of forage environments for Masked owls.

Masked Owls may also be at risk from use of second-generation (single-dose) rodenticides used for management of rodents.

3.3.8.2 Recovery of the species

An approved Recovery Plans has been prepared for the Masked Owl (as part of the ‘Recovery Plan for the Large Forest Owls’). The Recovery Plan lists the following relevant proposed recovery objectives:

- Assess the distribution and amount of high quality habitat for the Masked owl across public and private lands to get an estimate of the number and proportion of occupied territories that are/are not protected;
- To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the species and across different land tenures and disturbance histories;
To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success;

- Ensure the impacts on the species and its habitat are adequately assessed during planning and environmental assessment processes;

- Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites);

- To improve the recovery and management of the species based on an improved understanding of key areas of its biology and ecology;

- To raise awareness of the conservation requirements of the species amongst the broader community, to involve the community in owl conservation efforts and in doing so increase the information base about owl habitats and biology; and

- To co-ordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.

A Priority Action Statement (PAS) has also been prepared however none of the recovery strategies within the PAS are considered to be relevant to the proposed development of Precincts 1 & 5.

3.3.8.3 Management Actions

Habitat for the Masked owl will largely be protected by Environmental protection Zones. The following additional management actions will benefit the Masked owl:

1. The existence of the Masked owl must be considered in the development of any program using pesticides and herbicides for weed and/or mosquito and/or feral animal control.

2. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.9 Microchiropteran Bats

3.3.9.1 Threats

Several threatened species of microchiropteran bat have been recorded at the Kings Forest site and are likely to forage widely, depending on specific species requirements. Threatened species of microchiropteran bat recorded, or considered to be provided with suitable habitat, within the vicinity of Precincts 1 & 5 include:

- Little bent-wing bat; and
- Yellow-bellied sheathtail bat.
The most likely impacts to bats would be from urban disturbance (light spill, noise, vehicle movements) adjacent to foraging areas and the loss of foraging areas themselves in urban-zoned land. However, it is expected these impacts would be relatively low as some species of micro-bat are known to adapt to urban environments where street lighting provides greater opportunities for the capture of prey. Micro-bats will have large areas of foraging habitat retained within Environmental Protection Zones and associated ecological buffer areas. Potential roost habitat is best represented by consolidated vegetation within Environmental Protection Zones, and development of urban zoned land is likely to have little impact on available roost sites.

3.3.9.2 Recovery of the species

No recovery plan exists for the Little bent-wing bat or the Yellow-bellied sheathtail bat however Priority Action Statements (PAS) have been prepared. The following lists of recovery strategies relevant to the proposed development of Precincts 1 & 5 are derived from the PAS:

**Little bent-wing bat**
- Provide map of known occurrences to Rural Fire service and seek inclusion of mitigation measures on Bushfire Risk Management Plans.
- Identify types of winter roosts (suspected to be banana palms and tree hollows) used by the species.

**Yellow-bellied sheathtail bat**
- Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity.
- Give priority to largest hollow bearing trees.
- Ensure the largest hollow bearing trees (including dead trees & paddock trees) are given highest priority for retention in PVP assessments & other land assessment tools.
- Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal.
- Research the roosting ecology of tree-roosting bats.
- Use radio-tracking to identify important foraging range and help interpret density of records.

3.3.9.3 Management Actions

1. Impacts on micro-bat species are likely to be relatively low. Any hollow-bearing trees within the urban zoned land should be retained where possible (or included within buffers, open space etc) or if trees require removal, bat boxes should be installed within Environmental Protection Zones.

2. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.
3.3.10 Rose-crowned fruit-dove

3.3.10.1 Threats
Rose-crowned fruit-doves may be seasonal visitors to the Kings Forest site when suitable resources are available. The development of Precincts 1 & 5 is unlikely to result in the loss of any significant resources for the species. However, this species may have potential for increased mortality from window-strike within urban precincts in proximity to areas of retained vegetation.

3.3.10.2 Recovery of the species
No recovery plan exists for the Rose-crowned fruit-dove however a Priority Action Statement (PAS) has been prepared. The following list of recovery strategies relevant to the proposed development of Precincts 1 & 5 is derived from the PAS:

- Raise awareness of threats of window strike and ways to reduce threat.
- Ensure species ecological requirements are considered in fire planning & hazard reduction guidelines.
- Prevent rainforest loss & fragmentation & expand & reconnect habitat. Measures include excluding grazing & protecting paddock fig trees.

3.3.10.3 Management Actions
1. Retained habitat areas will be buffered from the development. Buffers are to consist of a minimum 30m inner zone vegetated with heath and Koala food tree species, in accordance with the Precinct 1 & 5 Vegetation Management Plan (JWA 2011a) and Precinct 1 & 5 Buffer Management Plan (JWA 2011b), and a maximum 20m outer zone containing roads, footpaths and cycle ways, an asset protection zone (APZ), stormwater management and passive recreation areas. It is considered that this significant buffer to potential Rose-crowned fruit-dove habitat will suitably reduce the risk of window-strike.

2. A monitoring program has been devised to monitor the presence of this species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.

3.3.11 Wallum froglet & Wallum sedge frog (Acid frogs)

3.3.11.1 Background
Wallum froglets have been recorded in association with constructed drainage lines within the development area as well as inhabiting depressions formed during Slash pine stump removal (FIGURE 7). Low lying wet heath and drainage line communities and adjacent areas prone to frequent inundation, within adjacent EPZ zoned land, are considered to provide core habitat for this species (FIGURE 10).

Many of the Wallum froglet records within the Kings Forest site occur in forage habitat (i.e. land inundated after heavy rain) rather than core habitat.
Wallum sedge frogs have been recorded within regenerating heath communities to the north and east of Precinct 5, and within the adjacent Cudgen Nature Reserve (FIGURE 7).

3.3.11.2 Threats

Potential threats to these species from development of Precincts 1 & 5 include:

- Loss of habitat from habitat removal and fragmentation;
- Changes in hydrology;
- Water pollution;
- Injury/death from vehicle strike; and
- Contamination of habitat by herbicides, pesticides and fertiliser as part of landscaping maintenance.

3.3.11.3 Recovery of the species

An approved Recovery Plan has been prepared for the Wallum froglet and the Wallum sedge frog (as part of the ‘National recovery plan for the wallum sedgefrog and other wallum-dependent frog species’ [Meyer et al. 2006]). The Recovery Plan lists the following relevant proposed recovery objectives:

- Identify and assess essential habitat.
- Protect wallum frog populations and manage habitat.
- Acquire information on threats to inform management.
- Engage stakeholders and the broader community in recovery of wallum frog species.
- Rehabilitate degraded wallum frog habitat.
- Monitor frog numbers and distribution.

3.3.11.4 Management Actions

Long-term management of these species will be tied to the maintenance of existing suitable habitat within EPZ’s and the creation of additional compensatory habitat areas within EPZ’s and ecological buffers to offset unavoidable losses of habitat. Maintenance of hydrology (particularly acidity), stormwater and run-off (including herbicides, pesticides, fuel etc.) in constructed habitat areas is critical in determining whether these areas are capable of supporting the species in the long term.

The following management actions have considered the appropriate objectives of the National Recovery plan:

1. Compensatory habitat areas will be created within EPZ’s and ecological buffers and will include core breeding habitat and forage habitat areas. Constructed ponds for the Wallum froglet and Wallum sedge frog have been completed as part of the Tugun Bypass, with successful results. Details of the proposed Acid Frog Compensatory habitat strategy at Kings Forest are provided in APPENDIX 1.

2. Additionally, forage habitat will be created for the Acid frogs with the construction of bio-filtration swales within ecological buffers.
3. In addition to the creation of new habitat, extensive areas currently weed infested and supporting pine plantations will be rehabilitated to extend habitat areas in accordance with the Precinct 1 & 5 VMP (JWA 2011a) and Precinct 1 & 5 WMP (2011c).

4. A detailed water quality monitoring regime is included in the Overall Water Management Plan (Gilbert & Sutherland 2011b) and will ensure that significant impacts on Acid frog habitats are avoided.

5. The Stage 1 FAMP (JWA 2011d) will ensure Cane toads are controlled in areas of known habitat. Core habitat areas will be densely planted with sedges etc. to deter Cane toads from entering these areas.

6. The existence of the Acid frogs must be considered in the development of any Fire Management Plan (i.e. fire should be excluded from swamps and areas immediately adjacent to Wallum froglet habitat).

7. To minimise the spread of the disease chytridiomycosis to and between habitats, all contractors undertaking work in both wetland construction and vegetation rehabilitation must follow the protocol set out within the publication *Hygiene protocol for the control of disease in frogs* (DECCW & NPWS 2008).

8. The existence of the Acid frogs must be considered in the development of any program using pesticides and herbicides for weed and/or mosquito and/or feral animal control.

9. A monitoring program has been devised to monitor the presence of these species within the vicinity of Precincts 1 & 5 (SECTION 4). Furthermore, monitoring programs are included within the Precinct 1 & 5 VMP (2011a) and Precinct 1 & 5 WMP (2011c) to ensure suitable habitat remains viable.
4 Monitoring and Reporting

4.1 Background

A well-designed monitoring program will allow project managers to detect results months, years, or decades following implementation of a plan. This section outlines the monitoring requirements for the Precinct 1 & 5 TSMP.

Populations of Threatened flora & fauna within the EPZ’s adjoining Precincts 1 & 5 will be monitored on an annual basis for a period of five (5) years.

4.2 Flora monitoring

All threatened plant species will be monitored as follows:

- Survival
- Height
- Flowering
- Fruiting
- Signs of natural recruitment
- Potential threats (i.e. weeds)

4.3 Fauna monitoring

A baseline survey will be completed within the Precinct 1 & 5 EPZ’s prior to commencement of construction to determine species presence. The fauna surveys will target Threatened species recorded, or predicted to occur, within the vicinity of Precincts 1 & 5 and will include the following methodology (where appropriate):

- Elliott trapping;
- Cage trapping;
- Pitfall trapping;
- Arboreal Elliott trapping;
- Spotlighting/stag watching;
- Call playback;
- Dawn & dusk bird surveys;
- Hair tubes; and
- Active searching.
4.4 Performance Criteria

The success of the TSMP will be regularly evaluated (i.e. as above). A number of criteria will indicate successful management of threatened species. The overall performance criteria for this plan are that:

- Management actions for each threatened species as listed within the TSMP are completed;
- All recorded threatened flora species survive and flourish during the construction and operation phases of the proposed development;
- Where revegetation is proposed in accordance with this TSMP (i.e. buffer plantings, compensatory habitat etc.), survival of 95% of stems planted;
- Within revegetation areas, establishment of a 70% native ground cover after 2-3 years;
- Within revegetation areas, average percentage cover of 90% native ground cover at the 5\textsuperscript{th} year;
- Within revegetation areas, noxious weeds are to be eradicated and environmental weeds less than 1% of the area;
- Within revegetation areas, maintenance of 100% of planted diversity;
- All appropriate exclusion fencing is in place and operational, and existing habitat to be retained for each threatened flora and fauna species remains unaffected; and
- Feral animal monitoring is completed in accordance with the FAMP (JWA 2011c).

4.5 Monitoring Reports

A report will be prepared after each annual survey period and will include the following:

- Results of the flora and fauna surveys;
- A comparison of results with previous years;
- Discussion regarding the absence of previous species/occurrence of new species;
- Any habitat maintenance recommendations (i.e. additional nest boxes etc.);
- Discussion regarding the occurrence of any weed/pest species;
- Recommendations for controlling weed/pest species (if required); and
- Performance against performance criteria (Section 4.4).
REFERENCES


APPENDIX 1 - ACID FROG COMPENSATORY HABITAT

1. Background

Two (2) Threatened species of ‘Acid fog’ have been recorded from the vicinity of Precincts 1 & 5 (FIGURE 7):

- Wallum froglet (*Crinia tinnula*); and
- Wallum sedge frog (*Litoria olongburensis*).

The Wallum froglet is listed as Vulnerable within schedules of the NSW Threatened Species Conservation Act (1995). Wallum froglets inhabit acid paperbark swamps and sedge swamps of the coastal ‘wallum’ country.

The Wallum sedge frog is listed as Vulnerable within schedules of the NSW Threatened Species Conservation Act (1995) and the Commonwealth Environment Protection & Biodiversity Conservation Act (1999).

Core habitat for Acid frog species within the vicinity of Precincts 1 & 5 is considered to be comprised of undisturbed and regenerating wet heathland (FIGURE 10, PLATE 1), whilst remaining habitats (i.e. adjoining areas of grassland and slashed areas) are considered to provide forage habitat when inundated during wet periods.

Wallum froglets in particular have been recorded in a number of locations within Precincts 1 & 5 particularly within constructed drainage line communities (PLATE 2). Whilst numerous records have occurred over a 10 year period in some areas of the site not mapped as core habitat, records of this species do not necessarily equate with breeding habitat. Breeding habitat must retain water for extended periods of time.

Furthermore, the Wallum froglet is known to move into adjacent habitats during rainfall events. During a study of the habitat and movements of the Wallum froglet by White & Pike (2006), froglets were often located away from breeding ponds in nearby heath and woodland and could be found up to 100m from a pond. Froglet movement between ponds and foraging sites nearby appeared to be directed by the occurrence of rainfall events.

The assessment of impacts on Acid frog habitat has considered the avoid, mitigate, offset approach as described in the Threatened Species Assessment Guidelines: The Assessment of Significance (DPI 2008). However, the proposed development will result in unavoidable impacts on some Core habitat areas. Core habitat in other areas of the site have been avoided and will be rehabilitated.
PLATE 1: Existing frog habitat (i.e. regenerating wet heath) within EPZ to the east of Precinct 5.

PLATE 2: Existing frog habitat within the Precinct 5 development area (i.e. constructed drainage line).
2. Literature Review

Few attempts to replicate or re-instate breeding areas for ‘Acid frogs’ have been undertaken and documented in Australia. It is well recognised however that the Wallum froglet will rapidly recolonise disturbed areas previously containing ‘Wallum’ vegetation. In these instances common attributes are shallow water bodies in sandy soils and of low pH and electrical conductivity (Ecosense Consulting Pty Ltd, 2005).

The creation of compensatory habitat was completed for ‘Acid frog’ species during the construction of the Tugun Bypass. The design requirements of the Tugun Bypass frog ponds were determined through consultation with a number of recognised authorities on ‘Acid frogs’.

A number of recommendations were provided by these experts based on observations made during field & laboratory work (Ecosense Consulting Pty Ltd, 2005):

- Ponds should be constructed in sandy substrates (which previously contained ‘Wallum’) with an underlying organic hardpan;
- Ponds should generally be shallow and constructed in areas of high groundwater;
- Water quality should exhibit the following characteristics:
  - pH <5 (as influenced by humic soils);
  - hardness < 100 p.p.m;
  - salinity < 350 uS.cm⁻¹;
- Ponds should be ephemeral to prevent habitation by fish but have a minimum hydro-period of 4-6 weeks for the Wallum froglet; and
- Pond fringes should be densely planted with emergent species to prevent predation by the Cane toad (*Bufo marinus*).

Four (4) frog ponds were constructed within compensatory habitat areas adjoining the Tugun Bypass. Both the Wallum froglet and the Wallum sedge frog (*Litoria olongburensis*) have been recorded within these constructed ponds. Furthermore, water treatment basins constructed around the bypass have had the added benefit of providing additional frog habitat. Wallum froglets have been recorded calling from several water treatment basins on numerous occasions during monitoring events (Pacific Alliance, 2010).
3. Kings Forest Proposal

It is proposed to create Core Acid frog habitat within Environmental Protection Zones (EPZ’s), ecological buffers and the golf course on the Kings Forest site (FIGURE 11). Areas requiring rehabilitation works within EPZ’s and buffers will be targeted for the creation of Core Acid Frog habitat. Site selection has also included consideration of the following:

- Proximity to existing Core habitat areas and Acid frog records (FIGURE 12);
- Distribution of suitable soils (i.e. Podsols) (FIGURE 13);
- Topography;
- Presence of Potential Acid Sulphate soils (FIGURE 14); and
- Existing vegetation values.

A typical section and plan view of the proposed compensatory acid frog habitat FIGURE 15. The compensatory core acid frog habitat will include:

- The creation of melon holes by either using an excavator bucket to form holes approximately 60cm deep by at least 1.8m long, or through the removal of Slash pine stumps which has been shown to create small breeding ponds elsewhere on the site (PLATE 3);
- These holes will be created to intercept the water table to ensure water is available for an extended period of time and allow for successful breeding;
- It would be expected that the water in these melon holes would evaporate during extended dry periods;
- ‘Tiles’ of suitable vegetation (i.e. from existing habitat areas to be removed) will be translocated to compensatory habitat areas. It is likely that some frogs will also be translocated with the tiles of vegetation;
- Additionally, dense plantings of Saw-sedge (Gahnia spp.), Curly sedge (Baloskion spp.) and Matrush (Lomandra spp.) will also occur around the margins of these melon holes (where required) to ensure almost complete coverage of the hole by the sedges;
- The narrow design of the melon holes, coupled with the dense planting of Saw-sedge, will assist in the prevention of mosquito breeding, protect tadpoles from predation and preclude the occurrence of Cane toads.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.
LEGEND

Proposed Broad leaf paperbark
- at 7m centres

Proposed Swamp mahogany
- at 7m centres (within identified Koala
  food tree planting areas only - refer to KPaM)

Proposed melanhole (0.6x1.8m TYP.)
surrounded by Saw sedges
Fourteen (14) suitable compensatory habitat areas have been identified on the Kings Forest site (FIGURE 11), covering a total area of approximately 59ha, and are described as follows:

- **Compensatory Habitat Area 1**
  - An area of approximately 1.44ha on the northern side of Depot Road in the north-eastern portion of the Kings Forest site (i.e. adjacent to Precinct 2);
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

- **Compensatory Habitat Area 2**
  - An area of approximately 2.41ha on the southern side of Depot Road in the north-eastern portion of the Kings Forest site (i.e. adjacent to the northern portion of Precinct 5);
  - Adjacent to existing areas of Core habitat (FIGURE 12, PLATE 1);
  - This area is to be dedicated to NPWS for inclusion in the Cudgen Nature Reserve (FIGURE 11);
  - Core habitat will be created through a combination of excavation of melon holes and removal of existing mature Slash pine (PLATE 4), and subsequent assisted regeneration/revegetation works where necessary.
PLATE 4: Slash pine to be removed from Compensatory Habitat Area 2.

- **Compensatory Habitat Area 3**
  - An area of approximately 2.47ha on the northern side of Depot Road in the north-eastern portion of the Kings Forest site (i.e. adjacent to Precinct 3);
  - Adjacent to existing areas of Core habitat (FIGURE 12);
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

- **Compensatory Habitat Area 4**
  - Areas totalling approximately 2.77ha within the inner ecological buffers to the south of Precinct 5 (PLATES 5 & 6);
  - Core habitat occurs within the adjacent SEPP 14 wetland;
  - Includes existing small areas of existing frog habitat. Wallum froglets were recorded within this Compensatory Habitat Area during recent site assessments;
  - Core habitat will be created through a combination of excavation of melon holes and removal of existing mature Slash pine (PLATE 5), and subsequent assisted regeneration/revegetation works where necessary.
PLATE 5: Compensatory Habitat Area 4.

PLATE 6: Compensatory Habitat Area 4 (existing frog habitat in centre of shot).
• **Compensatory Habitat Area 5**
  
  - An area of approximately 2.46ha in eastern portion of the Kings Forest site (i.e. south-east of Precinct 5) (PLATE 7);
  - Adjacent to existing areas of Core habitat (PLATE 8);
  - This area is to be dedicated to NPWS for inclusion in the Cudgen Nature Reserve (FIGURE 11);
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

PLATE 7: Compensatory Habitat Area 5.
PLATE 8: Existing Core habitat area to the east of Compensatory Habitat Area 5.
• **Compensatory Habitat Area 6**
  
  o An area of approximately 2.76ha in eastern portion of the Kings Forest site (i.e. south-east of Precinct 5) (**PLATE 9**);
  
  o Adjacent to existing areas of Core habitat (**PLATE 10**);
  
  o Includes existing small areas subject to inundation (**PLATE 11**). Wallum froglets were recorded within this Compensatory Habitat Area during recent site assessments;
  
  o This area is to be dedicated to NPWS for inclusion in the Cudgen Nature Reserve (**FIGURE 11**);
  
  o Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

**PLATE 9:** Compensatory Habitat Area 6.
PLATE 10: Existing Core habitat area to the south of Compensatory Habitat Area 6.
PLATE 11: Small areas or inundation within Compensatory Habitat Area 6. Wallum froglets were recorded within these pools during recent site assessments.

- **Compensatory Habitat Area 7**
  - An area of approximately 4.51ha in eastern portion of the Kings Forest site (i.e. south-east of Precinct 5) (PLATE 12);
  - This area is to be dedicated to NPWS for inclusion in the Cudgen Nature Reserve (FIGURE 11);
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.
PLATE 12: Compensatory Habitat Area 7.

- **Compensatory Habitat Area 8**
  - An area of approximately 3.9ha in eastern portion of the Kings Forest site (i.e. east of Precinct 13) (PLATE 13);
  - Adjacent to existing areas of Core habitat (PLATE 14);
  - Includes existing small areas subject to inundation (PLATE 15). Wallum froglets were recorded within this Compensatory Habitat Area during recent site assessments;
  - This area is to be dedicated to NPWS for inclusion in the Cudgen Nature Reserve (FIGURE 11);
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.
PLATE 13: Compensatory Habitat Area 8.

PLATE 14: Existing Core habitat area to the east of Compensatory Habitat Area 8.
• **Compensatory Habitat Area 9**
  o An total area of approximately 6.9ha within the proposed Golf Course in the southern portion of the Kings Forest site (**FIGURE 16**);
  o Core habitat will be created through revegetation of bio-retention swales and aquifer recharge ponds.

• **Compensatory Habitat Area 10**
  o An area of approximately 1.15ha within the EPZ to the south of Precinct 14;
  o Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

• **Compensatory Habitat Area 11**
  o An area of approximately 5.63ha within the inner ecological buffers to the south of Precincts 6 & 7 (**PLATES 16 & 17**);
  o Adjacent to Core habitat within the adjacent SEPP 14 wetland (**PLATE 18**);
  o Includes existing small areas of frog habitat (**PLATE 19**). Wallum froglets were recorded within this Compensatory Habitat Area during recent site assessments;

---

**PLATE 15:** Small areas or inundation within Compensatory Habitat Area 8. Wallum froglets were recorded within these pools during recent site assessments.
Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

PLATE 16: Compensatory Habitat Area 11.
PLATE 17: Compensatory Habitat Area 11.

PLATE 18: Existing Core habitat area within SEPP 14 wetland adjacent to Compensatory Habitat Area 11.
PLATE 19: Small area of existing frog habitat within Compensatory Habitat Area 11. Wallum froglets were recorded within these pools during recent site assessments.
• **Compensatory Habitat Area 12**
  o An area of approximately 13.96ha within the inner ecological buffers to the west of Precincts 9 & 10 and the east of Precinct 11;
  o Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

• **Compensatory Habitat Area 13**
  o An area of approximately 2.36ha within the inner ecological buffers to the east of Precincts 8 *(PLATE 20)*;
  o Includes existing small areas of frog habitat. Wallum froglets were recorded within this Compensatory Habitat Area during recent site assessments;
  o Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

*PLATE 20: Compensatory Habitat Area 13.*
• **Compensatory Habitat Area 14**
  - An area of approximately 6.32ha within an EPZ to the west of Precinct 8;
  - Core habitat will be created through excavation of melon holes and subsequent assisted regeneration/revegetation works where necessary.

A comparison of the compensatory habitat proposed at Kings Forest with the design criteria of the Tugun Bypass frog ponds is provided in **TABLE 1**.

**TABLE 1**

<table>
<thead>
<tr>
<th>TUGUN BYPASS FROG PONDS</th>
<th>PROPOSED KINGS FOREST COMPENSATORY HABITAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponds should be constructed in sandy substrates (which previously contained ‘Wallum’) with an underlying organic hardpan;</td>
<td>The proposed compensatory habitat areas occur on a sandy substrate which historically contained ‘Wallum’ vegetation. This area likely comprises an underlying organic hardpan. If necessary, topsoil/organic material will be stockpiled during initial earthworks and used to line constructed frog habitat areas.</td>
</tr>
<tr>
<td>Ponds should generally be shallow and constructed in areas of high groundwater;</td>
<td>Constructed melon holes will be a maximum of approximately 60cm deep and will be created to intercept the water table.</td>
</tr>
<tr>
<td>Water quality should exhibit the following characteristics:</td>
<td>Core habitat will be designed and located in areas with similar water quality characteristics.</td>
</tr>
<tr>
<td>- pH &lt;5 (as influenced by humic soils);</td>
<td>Proposed melon holes will be constructed to ensure water is available for an extended period of time and allow for successful breeding.</td>
</tr>
<tr>
<td>- hardness &lt; 100 p.p.m; and</td>
<td></td>
</tr>
<tr>
<td>- salinity &lt; 350 uS.cm⁻¹.</td>
<td></td>
</tr>
<tr>
<td>Ponds should be ephemeral to prevent habitation by fish but have a minimum hydro-period of 4-6 weeks for the Wallum froglet; and</td>
<td></td>
</tr>
<tr>
<td>Pond fringes should be densely planted with emergent species to prevent predation by the Cane toad (<em>Bufo marinus</em>).</td>
<td>Dense plantings of Saw-sedge (<em>Gahnia</em> spp.), Curly sedge (<em>Restio</em> spp.) and Matrush (<em>Lomandra</em> spp.) will occur around the margins of the melon holes.</td>
</tr>
</tbody>
</table>
Further to the comparison above, which shows the similarities between the two compensatory habitat proposals, it is noted that the configuration of the frog ponds at the Tugun Bypass comprised a small number or larger ponds, whereas the Kings Forest proposal provides a larger number of small ponds (melon holes). This design feature has been incorporated to discourage the use of the ponds by Mosquitoes. As the Tugun Bypass ponds are not immediately adjacent to a residential area, this would not likely have been a design consideration.

A Wallum Froglet Compensatory Habitat Plan (WFCHP) will be completed to guide the construction of the frog habitat on completion of earthworks. The plan will be prepared in accordance with the National recovery plan for the wallum sedgefrog and other wallum-dependent frog species (Queensland Environmental Protection Agency 2006). The WFCHP will include (but not be limited to) the following:

- detailed frog pond design criteria;
- performance criteria;
- a detailed habitat and population monitoring program; and
- contingencies in the event that constructed habitats perform poorly.