



**Transport**  
Roads & Maritime  
Services

# **GREEN THIGHED FROG MANAGEMENT PLAN**

## **Warrell Creek to Urunga upgrade**

**MARCH 2013**



# PACIFIC HIGHWAY UPGRADE:

## WARRELL CREEK TO URUNGA

### GREEN-THIGHED FROG MANAGEMENT STRATEGY



MARCH 2013



PREPARED FOR THE ROADS AND MARITIME SERVICES BY:

LEWIS ECOLOGICAL SURVEYS

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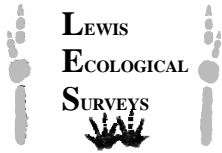
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**Belinda Bock (Roads and Maritime Services)** – Project management, background data and review.

**Brett Hoffman (Roads and Maritime Services)** – Project manager and logistics.

**Photography** - Lewis Ecological Surveys © else stated

**Top** – The vulnerable Green-thighed Frog (*Litoria brevipalmata*) from ch. 60065 Nambucca State Forest

**Left to Right** – Staged construction of Green-thighed Frog ponds on the Kempsey Bypass Project (Fill 6).

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# ABBREVIATIONS

Abbreviation	Description
WC2U	Warrell Creek to Urunga Pacific Highway Upgrade
WC2N	Warrell Creek to Nambucca Heads Staged Construction of the WC2U Approval
N2U	Nambucca Heads to Urunga (northern section of WC2U Pacific Highway Upgrade)
MCoA	Ministers Condition of Approval
EPA	Environmental Protection Authority
RMS	Roads and Maritime Services
LES	Lewis Ecological Surveys
Vulnerable	Species listed as vulnerable under schedule two of the NSW <i>Threatened Species Conservation Act (1995)</i>

## 1.0 INTRODUCTION

### 1.1 Background

Lewis Ecological Surveys (LES) has been contracted by Roads and Maritime Services (RMS) to prepare a management strategy for a population of Green-thighed Frog (*Litoria brevipalmata*) recorded during targeted frog surveys for the Warrell Creek to Urunga Pacific Highway Upgrade project (Lewis in prep). This species is currently listed as 'vulnerable' pursuant to the NSW *Threatened Species Conservation Act* (1995). Factors implicated in the decline of *L. brevipalmata* include habitat destruction and modification particularly the coastal lowlands which apparently form important breeding habitats (Ehmann 1997; Lemckert *et al.* 1997; Lemckert 1999).

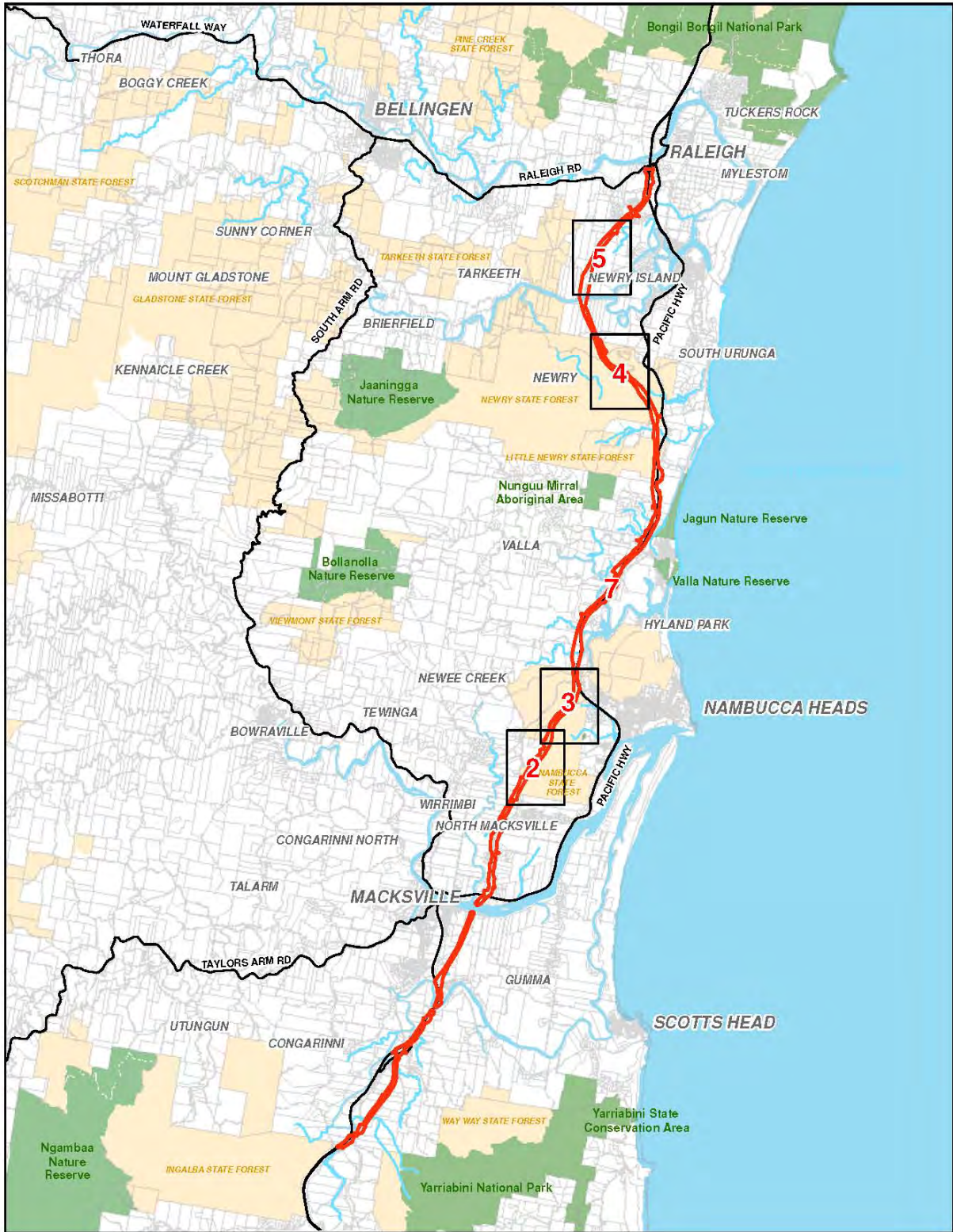
The Environmental Assessment (EA) prepared for the Warrell Creek to Urunga Pacific Highway Upgrade project did not record Green-thighed Frog despite there being four records around Nambucca Heads and suitable habitat within neighbouring state forests and private lands (SKM 2010; Figure 1-1 and 1-2). The historic records span a time period over the past 15 years and occur on either side of the carriageway between ch.59265 and ch.61765. To address this, a test of significance has been prepared and provided in Appendix A.



Figure 1-1. Location of documented Green-thighed Frog records.

### 1.2 The Subject Species –Green-thighed Frog (*Litoria brevipalmata*)

The Green-thighed Frog is a small to medium sized (max. 47 mm) hylid frog found in coastal and sub coastal areas from near Bundaberg (Cordalba) in the north to Ourimbah (i.e. central coast NSW) in the south (Mahony 1993; Barker *et al.* 1995; Cogger 1995; Lemckert *et al.* 1997; Lemckert 1999; Murphy and Turnbull 1999; Lewis 2000). It is a relatively distinct species with a prominent white upper lip, armpits and groin marked in lime green with black markings (Barker *et al.* 1995; Cogger 1995; Lemckert 1999). Despite these distinct markings and relatively wide distribution, it is known from few areas (Mahony 1993; see Ehmann 1997; Lemckert *et al.* 1997; Murphy & Turnbull 1999). Its cryptic habits ensured it remained



— Boundary of Proposed Highway Upgrade

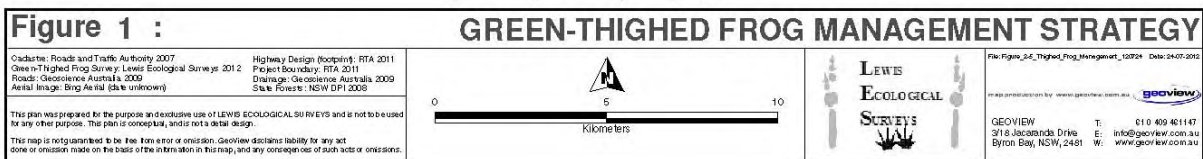


Figure 1-2. Overall of the Warrell Creek to Urunga Project.



unknown to science until 1972 (Tyler *et al.* 1972). The main habitat requirement of *L. brevipalmata* is warm temperate lowland forest (Tyler 1992). More recent records have indicated other habitat types used e.g. dry sclerophyll forest in the northern part of its range (Nattrass and Ingram 1993; Lemckert 1999; Murphy and Turnbill 1999) and coastal swamp forests and wet heath associations (Lewis 2005).

*Litoria brevipalmata* is uncommon in north-eastern NSW with <20 records in north-east NSW. It is often only seen during breeding events between October to April after local flooding (Mahony 1993; Barker *et al.* 1995; Ehmann 1997; Lemckert *et al.* 1997; Lemckert 1999). Males are frequently found perched on fallen tree branches above or close to still water (Barker *et al.* 1995; White 1995; Ehmann 1997; Lemckert *et al.* 1997).

### **1.3 Objectives**

The objective of this report is to provide a systematic and justifiable process for the development of management strategies, associated designs and where applicable which can be monitored to assess their effectiveness.

## 2.0 MANAGEMENT & MONITORING STRATEGIES

Seven management strategies have been proposed as a means to avoid, minimise, mitigate and monitor impacts to Green-thighed Frog. They include:

1. **Identification of Green-thighed Frog habitat**
2. **Protection of existing habitat**
3. **Pre-clearing surveys**
4. **Creation of breeding ponds**
5. **Design and installation of permanent frog fencing**
6. **Unexpected finds procedure linking to strategies 2-5 and 7**
7. **Monitoring of the breeding pond areas**

A summary of these actions and the associated technique is shown in Table 2-1.

### 2.1 Identification of Green-thighed Frog Habitat

A targeted Green-thighed Frog survey was undertaken by Lewis Ecological Surveys between January-March 2012 and within the Nambucca Floodplain Investigation area during October 2012. This survey confirmed the presence of Green-thighed Frog in Nambucca State Forest at:

- Ch.60065 within the road corridor where 2 male frogs were recorded; and
- Ch.60865 eastern side of RMS corridor where 1 male frog was recorded (Figure 2-1).

The northern part of the study area did not receive the required rainfall during the field survey period. It was still subject to field surveys between January and March 2012 to look for frogs and to identify suitable areas of breeding habitat. Based on the existing habitat the following areas are suspected as providing habitat for Green-thighed Frog:

#### Warrell Creek to Nambucca Heads

1. Associated low lying and flooded areas between ch.57365 and ch.59365 (Figure 2-2);

#### Nambucca Heads to Urunga

2. The low flat area that supports wet forest with swamp forest associations between ch.74665 and ch.74965 – Newry State Forest between Cut 20 and Martells Road (Cryptic Orchid habitat) shown in Figure 2-3.
3. The low lying area between ch.78765 and ch.78965 – north of the Kalang River and local access road 6 (Figure 2-4).
4. The two low lying drainages between ch.79765 and ch.80765 – Riddel property (Figure 2-4).

The above areas should be identified as sensitive environmental areas of 'moderate' and 'high' ecological value and delineated accordingly within the Construction Environmental Management Plan (CEMP). In this context, clearing of vegetation should be kept to a minimum in accordance with MCoA C1 and C27 (see below).

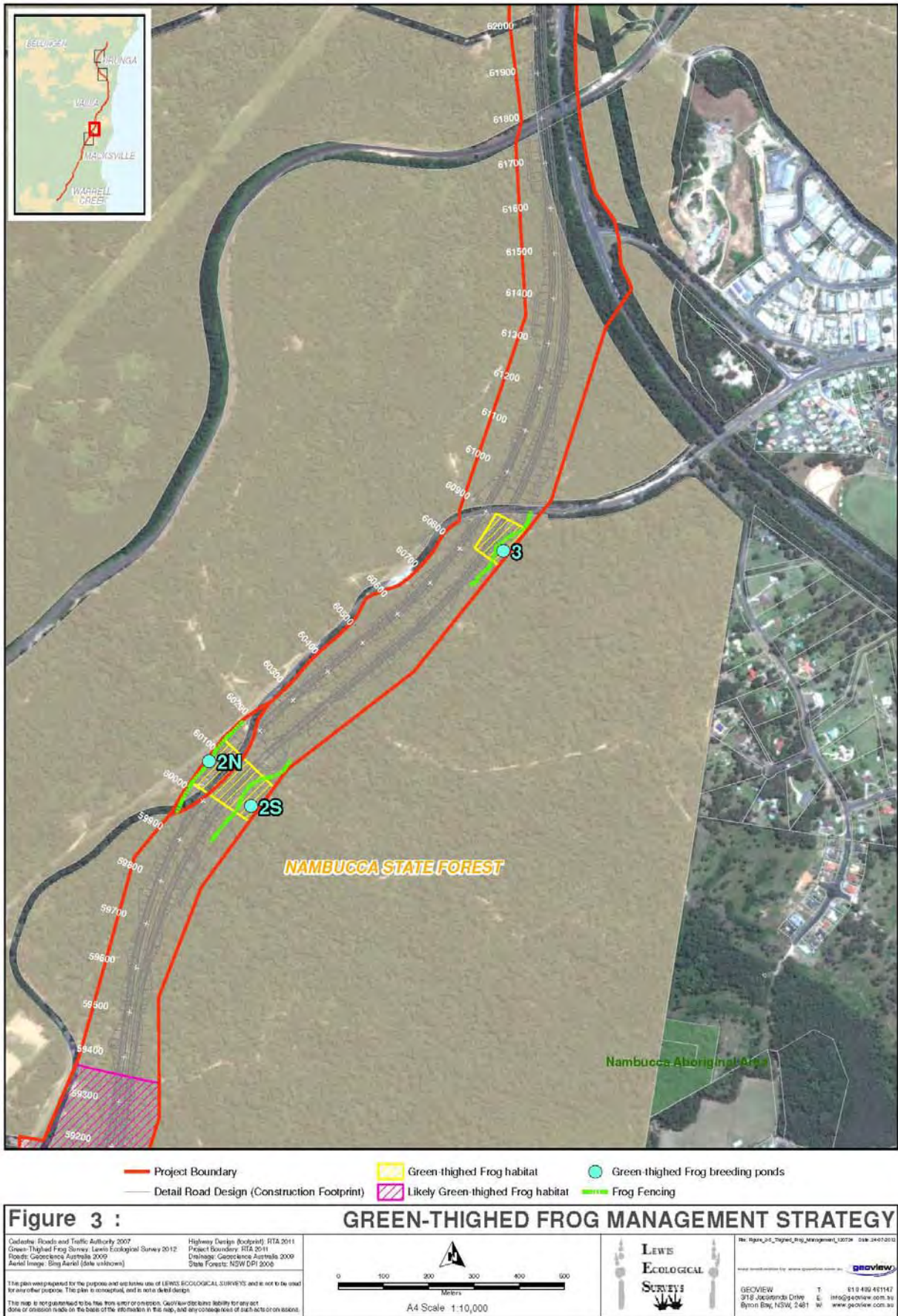
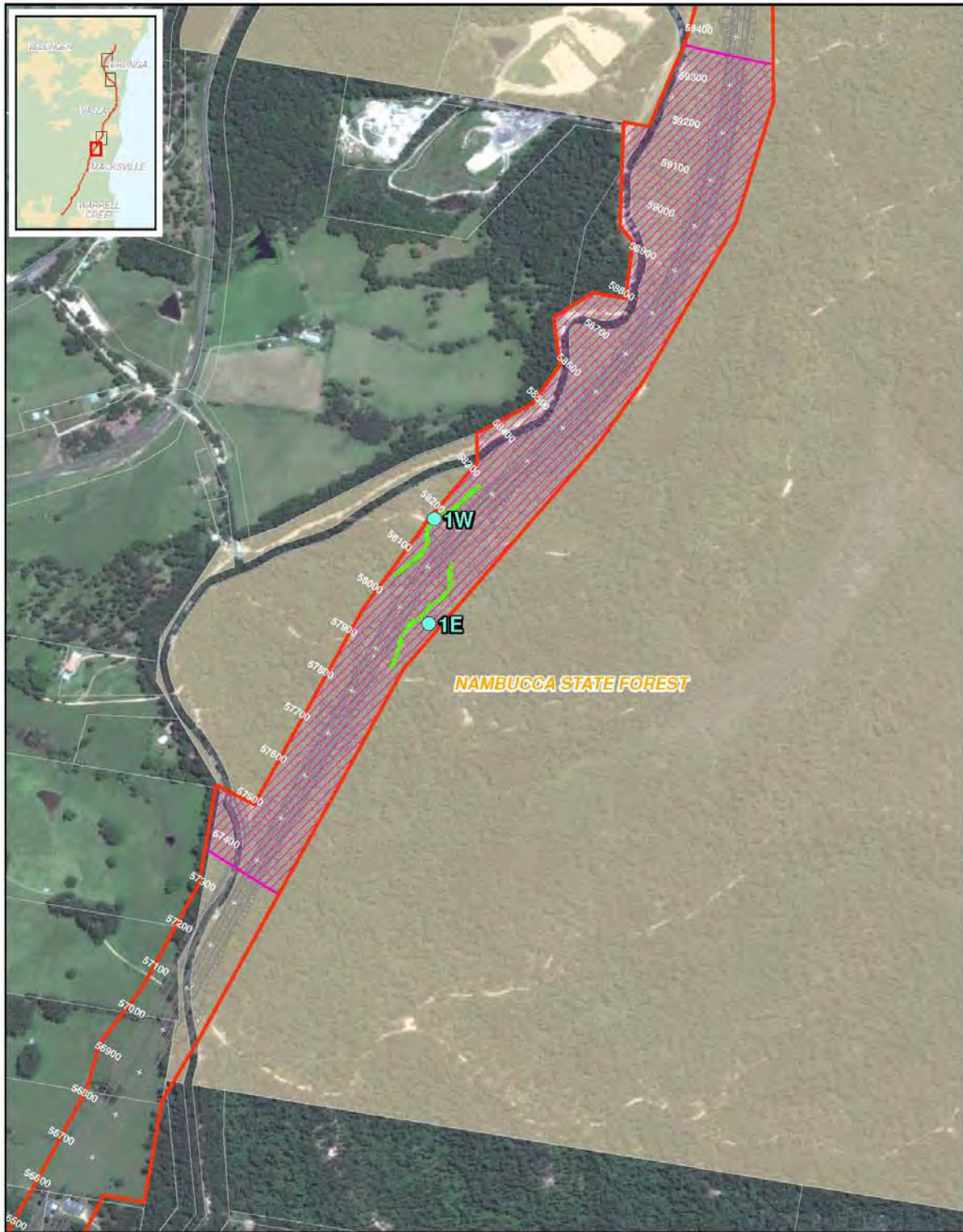
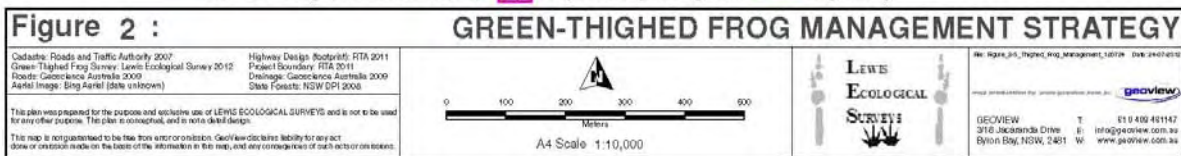


Figure 2-1. Known Green-thighed Frog locations within the RMS corridor and proposed mitigation strategies.



- Project Boundary
- Green-thighed Frog habitat
- Green-thighed Frog breeding ponds
- Detail Road Design (Construction Footprint)
- Likely Green-thighed Frog habitat
- Frog Fencing



**Figure 2-2.** Likely Green-thighed Frog habitat within the RMS corridor and proposed mitigation strategies for the southern construction stage Warrell Creek to Nambucca Heads.

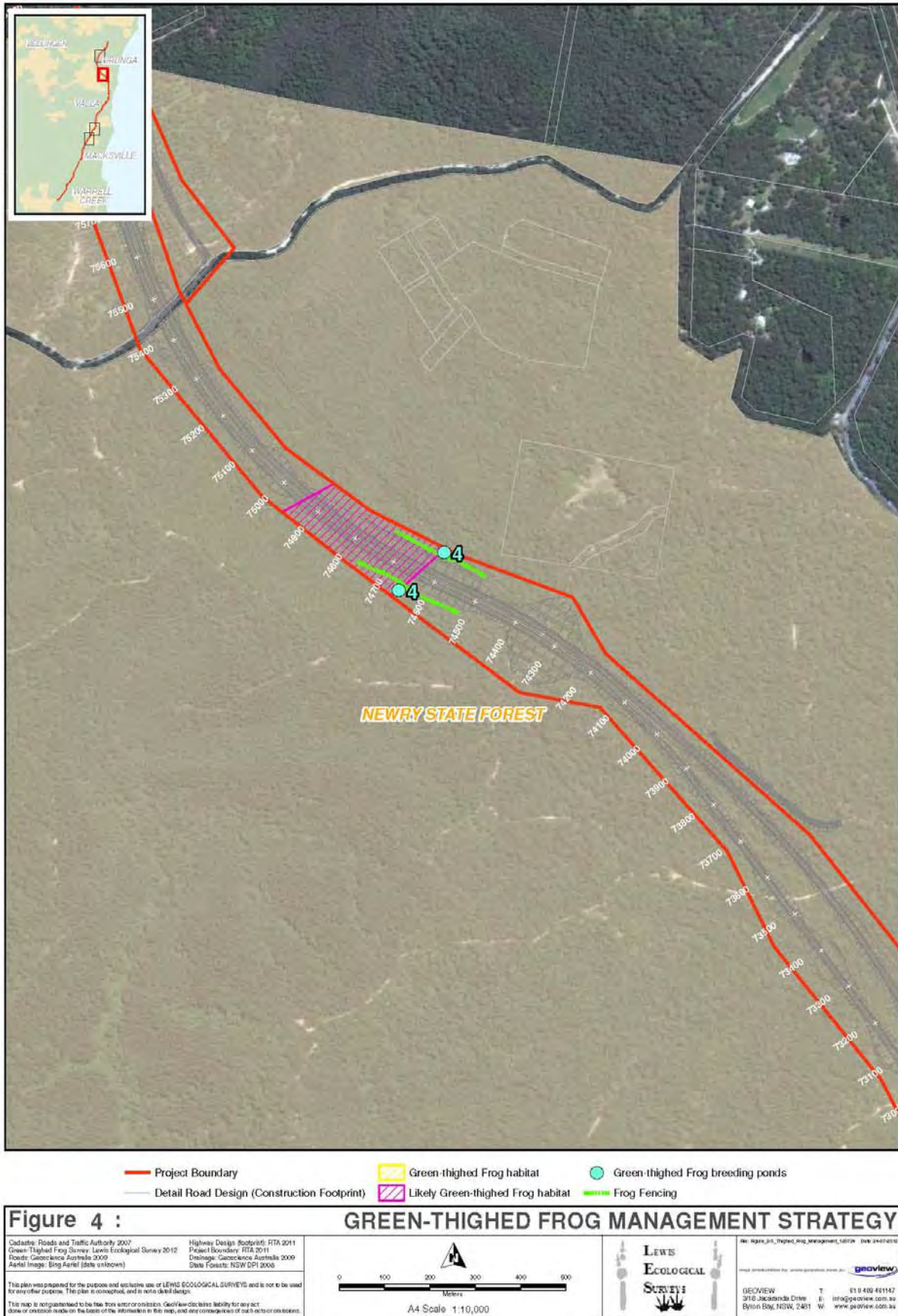
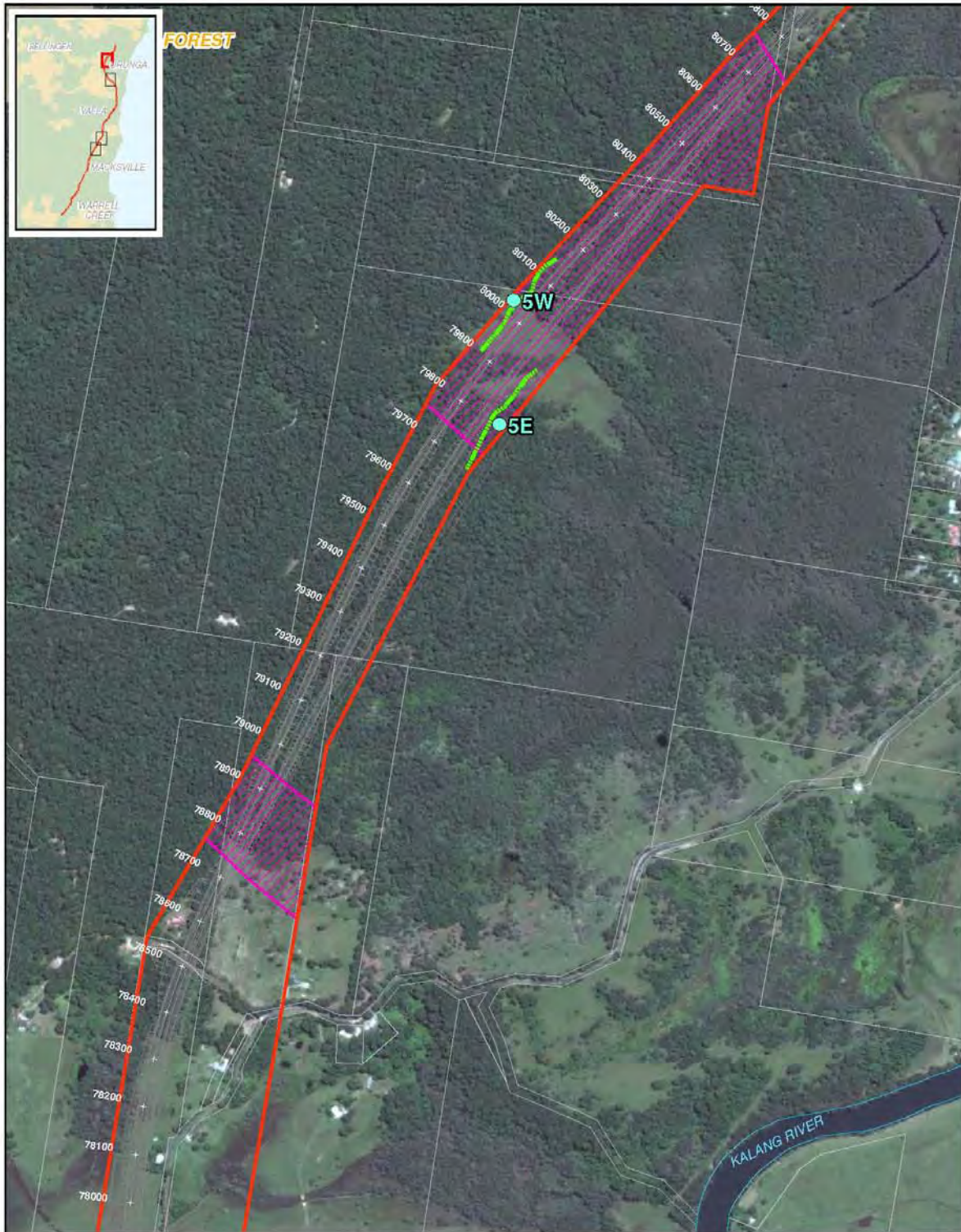


Figure 2-3. Likely Green-thighed Frog habitat within the RMS corridor and proposed mitigation strategies for the northern construction stage Nambucca Heads to Urunga.



**Figure 5 :** GREEN-THIGED FROG MANAGEMENT STRATEGY

<p>Cadastre: Roads and Traffic Authority 2007                  Green Thighed Frog Survey: Lewis Ecological Survey 2012                  Project: Geoscience Australia 2009                  Aerial Image: Bing Aerial (date unknown)</p>	<p>Highway Design (footprint): RTA 2011                  Project Boundary: RTA 2011                  Drainage: Geoscience Australia 2009                  State Forests: NSW DPI 2008</p>	<p>0 100 200 300 400 500                  Meters</p> <p>A4 Scale 1:10,000</p>	<p>LEWIS                  ECOLOGICAL                  SURVEYS</p>	<p>File: Rpts_2-5_Thiged_Frog_Management_120726.docx 2/16/2016 10:17:20 AM</p> <p>www.geoview.com.au</p> <p>geoview</p> <p>GEOVUEW 1 016 406 41147                  318 E. Spicersbridge Drive E info@geoview.com.au                  Byron Bay, NSW, 2481 W www.geoview.com.au</p>
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**Figure 2-4.** Likely Green-thighed Frog habitat within the RMS corridor and proposed mitigation strategies for the northern construction stage Nambucca Heads to Urunga.

## 2.2 Protection of Existing Habitat

Following the identification of Green-thighed Frog habitat these areas must be protected from construction related works other than what is considered essential. The locating of access tracks, utilities redistribution, car parking facilities and other ancillary works including topsoil stock piles, lay down areas, wash down bays, site shedding and compound sites must not be located in these areas. This approach will be in accordance with MCoA:

*C1. The Proponent shall employ all feasible and reasonable measures to minimise the clearing of native vegetation to the greatest extent practicable during the construction of the project*

*C27 Unless otherwise approved by the Director General in accordance with this condition, the sites for ancillary facilities associated with the construction of the project shall (c) be located in areas of low ecological significance and require minimal clearing of native vegetation (not beyond that already required by the project).*

The protection of the identified areas should include the demarcation of clearing limits and signage identifying these areas as 'no go' zones.

Due consideration is required for drainage works and the design given that road projects of this nature normally improve drainage rather than impede it for Green-thighed Frog. Where this cannot be achieved the provision of frog breeding ponds should provide an adequate mitigation tool provided they are constructed correctly (*see* Section 2.4).

## 2.3 Pre-clearing Surveys

Frog surveys will be limited to active searches set at 15 minutes per hectare of suitable microhabitats immediately prior (<2 hrs) to commencing clearing operations. Active searches will involve the use of a small wrecking bar to actively turn rocks, logs, rake debris and search within low dense vegetation around depressions and drainage lines. The requirement for nocturnal surveys will be made at the discretion of the Project Ecologist performing the pre clearing surveys.

Captured frogs will be held temporarily in a plastic bag with a small amount of water (1 frog per bag) and relocated in areas of suitable habitat adjacent to the clearing footprint and not more than 200 m from the capture site. This is consistent with Department of Environment and Climate Change (DECC) Hygiene protocol for the control of disease in frogs.

## 2.4 Creation of Breeding Ponds

Five locations have been identified as suitable recipient sites for frog breeding ponds with three located in the Warrell Creek to Nambucca Heads Upgrade section and two in the Nambucca Heads to Urunga section (Table 2-1; Figure 2-1 to 2-5).

The key element with designing a breeding site for Green-thighed Frog is to ensure the water body periodically dries out. This provides two important advantages for this species, firstly, it reduces competitive interactions with pond dwelling frogs (i.e. Tyler's Tree Frog, *Litoria tyleri*) which are common in the study area, and secondly, it reduces predatory interactions associated with the exotic Mosquito Fish (*Gambusia holbrooki*). Based on site specific data and surveys of breeding sites on the mid north coast, a temporary water body should hold surface water for between 40-50 days at sunny exposed sites and for between 60-80 days at shaded locations following a suitable summer rainfall event of 100-150 mm in 24-36 hours.

Another key message in the design of the breeding ponds is to not over design the pond and replicate features from other known breeding locations on the mid north coast and thus provide the best opportunity for a successful breeding event. Essentially, a simple shallow excavation that will hold water for the required period is all that is needed as this species has been regularly encountered breeding in inundated motor vehicle wheel ruts, disused logging dumps, roadside culverts and eroded gully lines (B. Lewis unpublished data). Where possible a number of options should be proposed and can include *in situ* habitat if it is deemed suitable. The design and construction of breeding ponds will be supervised by the Project Ecologist.

**Table 2-1.** Summary of proposed Green-thighed Frog breeding pond locations. Ponds constructed as per Figure 2-5.

Site No.	Side of Carriageway	Chainage (north from Kempsey)	Design (see Figure 2-5)	Landscaping	Substrate	Action
<b>Warrell Creek to Nambucca Heads</b>						
1E	Eastern side of carriageway	58015	<ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Open swale vegetated with grass or sedges (i.e. <i>Carax sp.</i>, <i>Fimbristylis</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at or near to the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate adjacent to drainage line (southern side) within RMS corridor (i.e. Flooded Gum/Blackbutt overstorey).</li> <li>• Ponds to support water for up to 60-80 days.</li> <li>• Ponds staggered upslope to allow for variability in rainfall/flooding and hence drying out.</li> </ul>
1W	Western side of carriageway	58165	<ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Open swale vegetated with grass or sedges (i.e. <i>Carax sp.</i>, <i>Fimbristylis</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at or near to the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate in open area within RMS corridor on upper slopes/ridge line (i.e. Blackbutt Forest).</li> <li>• Ponds to support water for up to 60-70 days.</li> </ul>
2S	Southern side of carriageway	60065	<ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Open swale vegetated with grass or sedges (i.e. <i>Carax sp.</i>, <i>Fimbristylis</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at or near to the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate in open area within RMS corridor.</li> <li>• Ponds to support water for up to 60-70 days.</li> </ul>



Site No.	Side of Carriageway	Chainage (north from Kempsey)	Design (see Figure 2-5)	Landscaping	Substrate	Action
2N	Northern side of carriageway	60065	<ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Open swale vegetated with grass or sedges (i.e. <i>Carax sp.</i>, <i>Fimbristylis</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at or near to the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate the suitability of ponds between new carriageway and Old Coast Road once final design is completed. <b>Note</b> – need to avoid locating ponds in areas where it may increase road strike. May need to position on northern side of Old Coast Road or alternatively reposition ponds at ch. 59715.</li> </ul>
3	Eastern side of carriageway	60865	<ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Pond and verges to include native grasses or sedges (i.e. <i>Fimbristylis</i> or <i>Carax sp.</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate on high point (i.e. ridge) in dry sclerophyll forest where Scribbly Gum is present.</li> <li>• Ponds to support water for up to 60-70 days.</li> <li>• Position southern side of Old Coast Road.</li> </ul>
<b>Nambucca Heads to Urunga</b>						
4	Both sides of carriageway	74665	<p>On each side construct:</p> <ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Pond and verges to include native grasses or sedges (i.e. <i>Fimbristylis</i> or <i>Carax sp.</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate ponds adjacent to drainage line to adjust for various hydrological regimes associated with flooding (i.e. stepping ponds away from creek line).</li> <li>• Ponds to support water for up to 60-80 days.</li> </ul>
5E	Eastern side of carriageway	79845	<p>On each side construct:</p> <ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Pond and verges to include native grasses or sedges (i.e. <i>Fimbristylis</i> or <i>Carax sp.</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate ponds on edge of forest in open pasture.</li> <li>• Ponds to support water for ~60 days.</li> </ul>
5W	Western side of carriageway	80015	<p>On each side construct:</p> <ul style="list-style-type: none"> <li>• Five 4x3 m (12m<sup>2</sup>).</li> <li>• Maximum depth 400 mm.</li> <li>• No steeper than a 1:4 battered slope.</li> <li>• Install a water staff.</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetated after construction</li> <li>• Pond and verges to include native grasses or sedges (i.e. <i>Fimbristylis</i> or <i>Carax sp.</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• In situ soil/clay obtained at the site.</li> </ul>	<ul style="list-style-type: none"> <li>• Locate ponds on edge of forest in open pasture at toe of slope.</li> <li>• Ponds to support water for 60-80 days.</li> </ul>



a. September 2011                      b. September 2011                      c. March 2012  
**Figure 2-5.** Construction of Green-thighed Frog ponds at Fill 6 Kempsey Bypass project (September 2011-March 2012).

## 2.5 Design and Installation of Permanent Frog Fencing

### 2.5.1 Temporary Frog Fencing

Temporary frog fencing will be installed at all known Green-thighed Frog locations currently limited to Ch.60065 and Ch.60865. At both of these locations, temporary frog fencing is to extend for 100-150 m with the upper and lower limits to be finalised following consultation with the Project Ecologist. The temporary frog fence should have the following design considerations:

- a) Fence height of at least 500 mm<sup>1</sup> and buried to a depth of at least 50-100 mm;
- b) Return wing of 3-5 metres to reduce the opportunity for frogs to breach the fence;
- c) The installed fence will be inspected/signed off by an ecologist with sufficient frog expertise. This procedure should form part of the pre clearing/ground disturbance checklist/permit.
- d) Fencing will be installed within 72 hrs of the clearing of the construction footprint<sup>2</sup>.

### 2.5.2 Permanent Frog Fencing

Frog fencing will be installed in areas where Green-thighed Frog ponds have been constructed. The fence will span a minimum of 125 m on either side of the frog ponds to reduce the incidence of road strike. Further frog fencing may be required by the Project Ecologist after further surveys have been undertaken (i.e. following the results of pre-clearing surveys). As a minimum the following chainages require frog fencing:

- Eastern side of ch. 57890-58140;
- Western side of ch. 58040-58290;
- Both sides of ch. 59940-60190;
- Eastern side of ch. 60740-60990 (noting abutment works associated with Old Coast Road may alleviate need for frog fencing);
- Both sides of ch. 74540-74790;
- Eastern side of ch. 79720-79970; and
- Western side of ch. 79890-80140.

Design wise, the frog fencing must be a standalone fence positioned between the floppy top fauna fence and the carriageway (i.e. toe of the batter). From a design perspective, the fence will stand 500 mm in height and comprise neoprene rubber sheeting including a small rubber return of not less 100 mm on the ground. The fence hot dip galvanized pressed sheet metal or powder coated aluminum pressed sheet mounted on a galvanized star picket (Figure 2-6).

<sup>1</sup> This height is considered sufficient to avoid the need to have a return lip at the top of the fence given its temporary nature and the objective of discouraging frog movement into the construction zone.

<sup>2</sup> It is not considered practical to install a frog fence prior to clearing as it will be damaged during the clearing operation. The pre-clearing survey performed by the Project Ecologist has the objective of capturing frogs within the clearing zone immediately prior to clearing.

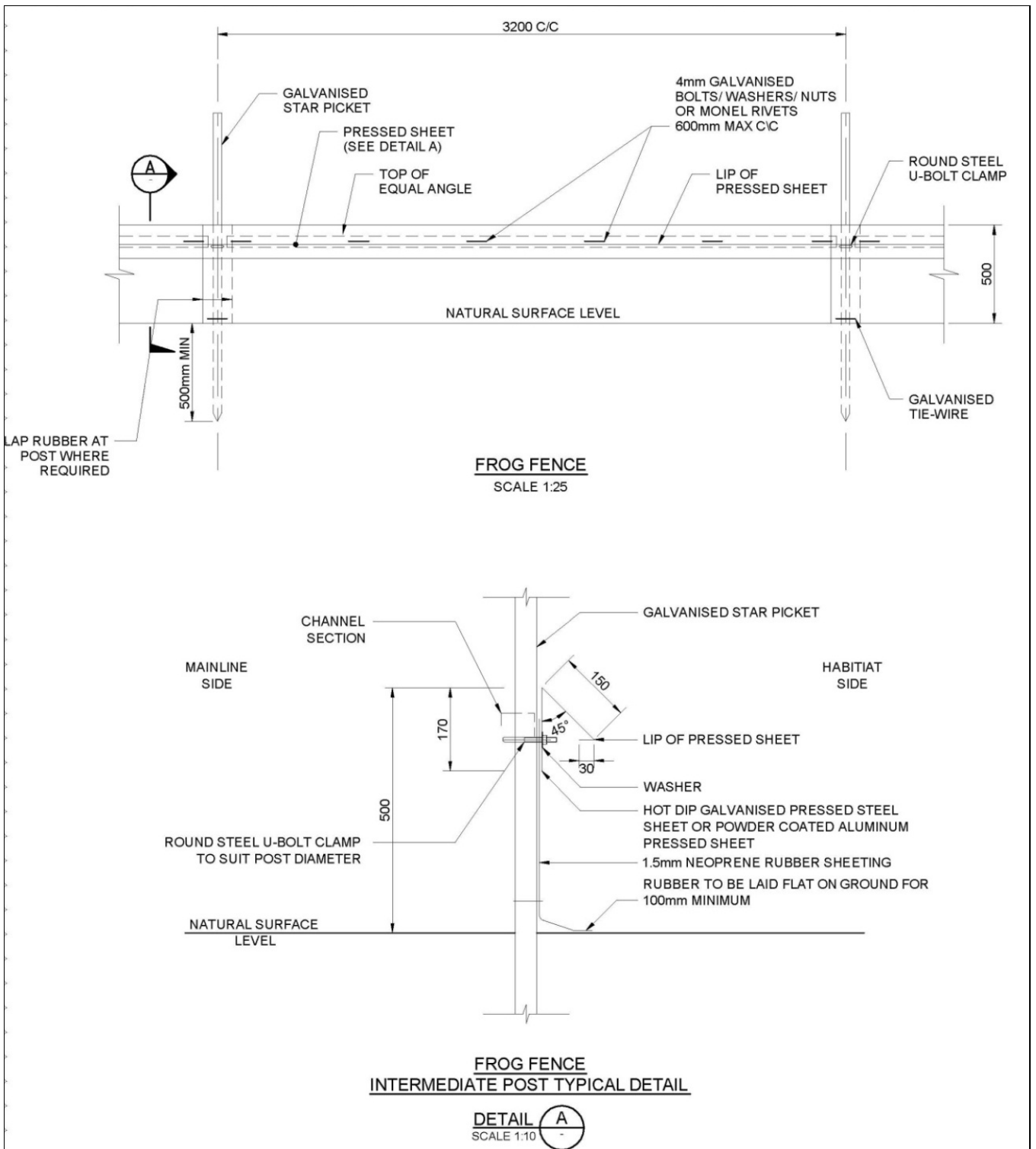


Figure 2-6. An example of frog fence design that could be used for Warrell Creek to Urunga.

As part of the monitoring procedures for measuring the effectiveness of the frog fencing some specific monitoring for frog fencing breaches must be undertaken by a suitable qualified zoologist at certain times of the year (i.e. when breeding pond monitoring occurs). Moreover, surveys for frogs will be undertaken on either side of the frog fence. The success of this design will be based on the absence of Green-thighed Frog fence breaches.

## 2.6 Unexpected Finds Process

An unexpected finds process has been developed to manage instances where Green-thighed Frog may be detected during pre-clearing surveys or during clearing operations for the upgrade. This is in response to field surveys not being undertaken at a suitable time in the northern part of the study area (ch. 66765-82765) and the cryptic nature of this species. For example the area between ch.78765 and ch.78965 is considered suitable for Green-thighed Frogs but there appears to be an adequate amount of breeding areas adjacent to the RMS corridor. Given this, it was not considered necessary to nominate this area in preference for other suitable habitat ~ 1 km to the north where ponds have been proposed (i.e. ch. 79845).

Where the above occurs, unexpected finds process requires the adoption and implementation of strategies outlined in this plan; specifically the provision for protection of existing habitat, creation of breeding ponds, installation of permanent fencing and the associated monitoring outlined in Section 2.8 of this strategy.

## 2.7 Updating the Management Strategy

This management strategy would be updated following the discovery of additional Green-thighed Frog locations/population and the need for additional measures including but not limited to frog fencing and breeding ponds. This is applicable for either the Warrell Creek to Nambucca Heads or Nambucca Heads to Urunga sections of the Warrell Creek to Urunga project.

## 2.8 Monitoring of Green-thighed Frogs

Two components have been identified for the monitoring of Green-thighed Frogs:

- 1) Monitoring of breeding ponds; and
- 2) Monitoring the integrity of the frog fences

### 2.8.1 Green-thighed Frog Breeding Ponds

All five breeding pond locations would be monitored; however, the monitoring would be staggered over two construction periods. The timing identified below aligns with the Nambucca to Urunga section of the Upgrade.

#### i. Timing

Monitoring will be undertaken on five occasions in Years 4-8 with each event at least 10-12 months apart but ultimately dependant on rainfall events (Table 2-2). On each occasion the site would be surveyed for 30 minutes during stage 1 and for 20 minutes during stage 2 (see below). Most of these monitoring events would occur during the operational phase of the project (Years 5-8). Monitoring would commence once the vegetation on the edges of the constructed ponds is considered sufficient (>20% groundcover). The timing would be staggered accordingly for the Warrell Creek to Nambucca Heads section of the upgrade.

#### ii. Monitoring Procedure

Monitoring of the constructed breeding ponds would be undertaken on a rainfall event basis when 24 hr rainfall totals exceed 75 mm or a cumulative total of 150 mm over a 72 hour period<sup>3</sup>. Such rainfall events would be monitored via 'on site' weather stations which are to be programmed to generate a sms message to the field survey team phone, and alternatively, the Bureau of Meteorology (BOM) website and specifically the Nambucca Heads Bowling Club (Station No. 059024). Surveys would be performed using a two stage process outlined below.

#### *Stage 1 – Determining Presence and Breeding Activity*

Upon the study area receiving the required rainfall, a reference site would be visited to determine the extent of Green-thighed Frog activity. At present, a site near ch. 60065 has been nominated given it is

<sup>3</sup> 50 mm is often proposed, however, it is rarely considered suitable; B Lewis unpub data.

readily accessible, however, efforts should be made to locate another site which is not going to be removed/disturbed by the upgrade. Sites to the north in Nambucca State Forest represent other suitable locations as reference sites. Regardless of the outcomes of this survey, the constructed ponds and their surrounds would also be surveyed.

The survey would comprise a 30 minute nocturnal active search at each of the three breeding pond areas using a hand held spotlight. Peripheral habitats (i.e. <100 m) would also be surveyed at this time. Upon the completion of Stage 1 surveys the next stage would be implemented.

### ***Stage 2 – Determining the Success of the Breeding Event***

All sites would be subject to follow-up surveys between 30-50 days after the initial census to assess the outcome of the breeding event. This follow up survey will comprise:

- A 20 minute active search for metamorphs and juvenile frogs around the pond edge and vegetation immediately adjacent to the pond (i.e. <10 m);
- Dip-netting of the constructed pond and subsequent tadpole identification. Specific attention will be given toward identifying the presence of fish (both native and exotic) along with predatory invertebrates such as dytiscid larvae;
- The depth of the ponds would be measured from the permanently installed water staff; and
- Photo taken from a designated photo point.

#### **iii. Performance Indicators**

Performance indicators of success will be based on either the:

- Continued presence of Green-thighed Frog at Sites 2S, 2N and 3;
- Green-thighed Frogs calling from the edge of the constructed ponds; or
- The presence of tadpoles, juveniles or metamorphs during follow up surveys.

Signs of the mitigation being unsuccessful will be based on the:

- Absence of Green-thighed Frogs from sites 2S, 2N and 3. The corrective action for this would be to firstly, implement additional surveys of adjacent areas to confirm Green-thighed Frogs remain in that general area, and secondly, undertake a review and if deemed necessary modify the ponds to improve an site suitability problems.
- Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis. The corrective action for this would involve a review and if deemed necessary, modify the ponds by placing a semi permeable layer or further excavation.
- Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).The corrective action for this would be to improve drainage to ensure the ponds dries out.
- Exotic fish fauna recorded in breeding ponds. The corrective action for this would be to improve drainage to ensure the pond dries out.

A summary of the timing, responsibilities and documentation requirements is outlined below in Table 2-2.

**Table 2-2.** Timing of key actions, responsibilities and documentation requirements.

Management Action/Year Number	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Responsibility	Documentation Requirements
<b>Pre Construction</b>										
Prepare Green-thighed Frog Management Strategy	√								RMS	Construction Environmental Management Plan
<b>Construction</b>										
Habitat Protection		√	√	√					Contractor	Ecological Monitoring Program
Pre-clearing Surveys		√	√						Contractor	Ecological Monitoring Program Post Clearing report Green-thighed Frog Management Strategy (updated)
Temporary Frog Fencing		√	√						Contractor	Construction Environmental Management Plan
Permanent Frog Fencing			√	√					Contractor	Ecological Monitoring Program
Breeding Ponds			√	√					Contractor	Ecological Monitoring Program
Unexpected Finds Procedure		√	√	√					Contractor	Green-thighed Frog Management Strategy (updated) Ecological Monitoring Program
<b>Post Construction/Operation</b>										
Monitoring effectiveness of mitigation				√	√	√	√	√	Contractor	Ecological Monitoring Program - Annual reporting

### 3.0 REFERENCES

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## 4.0 APPENDIX A – TEST OF SIGNIFICANCE

### Introduction

The following assessment of significance was conducted for the Green-thighed Frog in accordance with the *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Climate Change and Department of Primary Industries 2005). This was in response to Green-thighed Frog not being previously considered in the Environmental Assessment (SKM 2010) and its subsequent discovery at two locations and identification of others areas of suitable habitat during field surveys in February 2012 (Lewis in prep).

### How is the Proposal likely to affect the lifecycle of a threatened species and/or population?

The Green-thighed Frog inhabits rainforest, moist eucalypt forest, swamp forest, dry eucalypt forest and heath, typically within a few hundred metres of areas that gather surface water after rain (Mahony 1993; Barker *et al.* 1995; Cogger 1995; Lemckert *et al.* 1997; Lemckert 1999; Murphy and Turnbill 1999; Lewis 2000). Breeding is triggered following heavy rainfall (i.e. > 75 mm in 24 hrs or 150 mm in 72 hrs) in late spring, summer or autumn, with frogs aggregating around flooded ephemeral pools (Lewis 2012). The tadpole stage is relatively short lived with tadpoles undergoing metamorphosis normally in 35-50 days (B. Lewis unpub data).

### Green-thighed Frog Habitat in the study area

Green-thighed Frog is known from Nambucca State Forest at ch.60065 and ch.60865 with historic records occurring in areas adjacent to these chainages (Figure A-1). A small number of male frogs were recorded calling at these locations and subsequent follow up surveys were unable to locate any metamorphs to confirm the success of the summer 2012 breeding event. It was concluded that these sites would require more prolonged rainfall events to enable successful breeding.

This species is considered likely to occur further to the south in Nambucca State Forest, particularly the low lying habitats between ch.57365 and ch.59365. Further north in the Nambucca to Urunga area, Green-thighed Frog is considered likely to inhabit the following areas:

5. The low flat area that supports wet forest with swamp forest associations between ch.74665 and ch.74965 – Newry State Forest between Cut 20 and Martells Road (Cryptic Orchid habitat).
6. The low lying area between ch.78765 and ch.78965 – north of the Kalang River and local access road 6.
7. The two low lying drainages between ch.79765 and ch.80765 – Riddel property.

### Potential impacts of the Upgrade on this species

The Upgrade has the potential to affect the lifecycle of the Green-thighed Frog in a number of ways during the construction and operational phases of the project. During the construction stage the impacts will largely be centred on the removal of refuge and breeding habitat and interim changes to hydrological processes as the clearing and bulk earthworks progress. These interim changes may remove some breeding locations, alter others with altered overland flows and create new breeding areas. With regard to the removal of habitat the current clearing estimates for construction show the removal of 255 ha of native vegetation which consisting of dry sclerophyll forest (144.11 ha), moist sclerophyll forest (63.16 ha), swamp forest (45.54 ha), rainforest (0.58 ha) with the residual areas comprised of mangroves and wetlands. An estimated 50 ha of either



known or suitable habitat for Green-thighed Frog would be removed to accommodate the carriageway with some residual and secondary impacts associated with changes to local hydrological processes. These impacts will be linear in their nature and are unlikely to remove complete home ranges or territories which tend to extend over a few hundred metres.



**Figure A-1.** Location of documented Green-thighed Frog records.

During the operational phase of the project there is some potential for populations to be severed by a paved carriageway or dramatically increase the risk of road strike. There will also be an incremental risk of pollutants entering these areas as a result of a motor vehicle accident thereby reducing overall habitat quality. Specific measures will reduce these risks with the current concept design providing for culvert structures (i.e. ch. 57650, 58395, 58970, 60280, 61115, 32075, 78670, 79715, 80095), protection of water courses, frog exclusion fencing and the provision of breeding ponds on either side of the carriageway. These later measures have been outlined in this management strategy for the Green-thighed Frog.

**How is the Proposal likely to affect the habitat of a threatened species, population or ecological community?**

The Upgrade will affect the habitat of Green-thighed Frog via habitat removal, habitat modification and potentially the creation of barriers to habitat connectivity.

**Habitat Removal**

The Upgrade will remove an estimated 255 ha of native vegetation of which 50 ha is considered either known or potential habitat for the Green-thighed Frog. This impact will be linear in nature

and seldom exceed 125 m in width, indicating it is unlikely to remove the entirety of a home range or territory which extends over a few hundred metres. The locating of access tracks, utilities redistribution, car parking facilities and other ancillary works including topsoil stock piles, lay down areas, wash down bays, site shedding and compound sites will avoid areas of known or potential Green-thighed Frog habitat. This approach will be in accordance with MCoA:

*C1. The Proponent shall employ all feasible and reasonable measures to minimise the clearing of native vegetation to the greatest extent practicable during the construction of the project*

*C27 Unless otherwise approved by the Director General in accordance with this condition, the sites for ancillary facilities associated with the construction of the project shall (c) be located in areas of low ecological significance and require minimal clearing of native vegetation (not beyond that already required by the project).*

### **Habitat Modification**

Changes in the local hydrological processes are expected to occur during the construction of the Upgrade. At this time, some areas previously used as breeding sites may receive altered flow regimes and during heavy rainfall events (>50 mm in 24 hrs) increased sediment loads. The overall magnitude of these impacts are considered relatively benign for Green-thighed Frog which tends to display generalised habits in its selection of ephemeral breeding sites. Often roads, wheel ruts on seldom used tracks, earth bunds and borrow pits are selected as breeding sites on the mid north coast of NSW. The amount of vegetation surrounding these ponds does not appear to influence breeding site selection (B. Lewis unpub data).

Habitat pollution arising from hydrocarbons, chemical spills and other contaminants have the potential to reduce overall habitat suitability as breeding sites may become contaminated. Standard construction environmental management practices will reduce this risk during the construction phase of the project whilst the locating of multiple breeding ponds on either side of the carriageway at known locations will reduce the overall risk to any given frog population.

With respect to forecasting edge effects, the Upgrade is estimated to impact on 126 ha of vegetation with the most profound effects occurring in the moist forest types. Around 30 ha would be relevant to Green-thighed Frog habitat and the resultant changes in vegetation species composition and floristic structure will probably have little effect on the way Green-thighed Frogs use the residual habitat.

### **Summary**

An estimated 50 ha of known and potential Green-thighed Frog habitat will be impacted by the Upgrade. These habitats are recognised as being widespread in the Nambucca, Newry and Kalang areas and shouldn't be considered significant at a local or regional scale. For example, the known records of Green-thighed Frog in the coastal lowlands and foothills around Nambucca Heads suggest a somewhat widespread distribution and this is consistent with the distribution of this species 30 km to the south at Eungai, Clybucca and Tambaran.

<p><b>Does the Proposal affect any threatened species or populations that are at the limit of its known distribution?</b></p>
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The Green-thighed Frog is not at its distributional limit in the Warrell Creek to Urunga study area. This species inhabits coastal and sub coastal areas from near Bundaberg (Cordalba) in the north (Queensland) to Ourimbah (i.e. central coast NSW) in the south (Mahony 1993; Barker *et al.* 1995; Cogger 1995; Lemckert *et al.* 1997; Lemckert 1999; Murphy and Turnbill 1999; Lewis 2000).

### How is the Proposal likely to affect current disturbance regimes?

A number of disturbance regimes are currently recognised in the study area and include:

- the loss of mature forest and tree hollows;
- weed invasion;
- inappropriate fire regimes;
- draining of wetlands;
- increased nutrient loads in aquatic habitats; and
- the presence of introduced predators.

The creation of a new road has the potential to affect the current disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process sought to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The Upgrade is considered unlikely to significantly affect these current disturbance regimes.

### How is the Proposal likely to affect habitat connectivity?

The coastal foothills and plains between Warrell Creek and Urunga support a mosaic of vegetation with numerous small patches in the 1-10 ha range occurring on private lands and larger contiguous patches (i.e. >100 ha) generally being confined to public lands of Nambucca and Newry State Forests and private lands to the north of the Kalang River. It is these patches that are recognised as providing habitat for the Green-thighed Frog.

The Upgrade would result in an increase of these smaller patches and a decrease in overall patch size. Assuming that populations or meta populations of Green-thighed Frog show some form of site fidelity to an area of breeding sites, then impacts may remain relatively benign provided the new carriageway doesn't isolate known sites to isolated patches of <20 ha. Based on the current design and known occurrences of Green-thighed Frog this is unlikely to occur.

It is conceivable that the Upgrade will affect habitat connectivity as the newly constructed carriageway will have paved surfaces exceeding 50 m and accommodate high volumes of traffic, day and night. The use of frog fencing and culvert and bridge structures in areas of known and potential Green-thighed Frog habitat will increase the permeability of the carriageway with the current concept design providing suitable structures at ch. 57650, 58395, 58970, 60280, 61115, 32075, 78670, 79715, 80095. This should enable existing populations to remain as a single population, genetically unaffected by the Upgrade. Monitoring of these fauna underpasses combined with the monitoring of frog breeding ponds and frog fencing will determine the success of these as mitigation tools at maintaining habitat connectivity.

### How is the Proposal likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

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<b>Report name</b>	<b>Green-Thighed Frog Management Strategy (October 2012)</b>		
<b>Agency name</b>	<b>Department of Planning and Infrastructure</b>		
<b>Date</b>	<b>1 March 2013</b>		
<b>Comment number</b>	<b>Report section/ref</b>	<b>Comment</b>	<b>RMS Response</b>
1.	2.1 Identification of Green-thighed frog habitat	<p>Targeted survey was undertaken in the Nambucca Floodplain Investigation Area in October 2012 – please:</p> <ul style="list-style-type: none"> <li>• Identify the investigation area; and</li> <li>• Provide copy of the survey report.</li> </ul>	<p>No separate report was produced. The reference to Lewis in prep will be removed.</p> <p>The section now reads as <i>The northern part of the study area did not receive the required rainfall during the field survey period. It was still subject to field surveys between January and March 2012 to look for frogs and to identify suitable areas of breeding habitat.</i></p> <p>The GTF management strategy was updated with any relevant information once surveys had been completed within the Nambucca Floodplain Investigation area. Apart from some small properties within the Nambucca Investigation area (which could be viewed from the road or surveys performed nearby) the whole WC2U footprint was surveyed.</p>
2.		<p>The northern section of the study area was not surveyed due to insufficient rainfall. The area is suspected to provide frog habitat. The department recommends survey of the area be undertaken to confirm presence/absence of the frog and the determination of appropriate/additional mitigation measures (i.e, fencing/breeding ponds).</p>	<p>Based on field surveys performed between January and March 2012 those areas suspected as containing green-thighed frog have been identified for frog fencing, breeding ponds etc. Refer to figure 2-3 and 2-4. The identification of this habitat in the absence of the site receiving enough rainfall is based on the author's expert knowledge of this species.</p> <p>The areas identified in Figure 2-3 and 2-4 would be very difficult to access once the site received &gt;100 mm in 24 hrs. RMS has adopted the pre cautionary principal and accepted the advice of those areas as likely Green-thighed Frog habitat and proposes to install the appropriate frog mitigation measures (i.e. ponds + fencing)</p>

<b>Report name</b>	<b>Green-Thighed Frog Management Strategy (October 2012)</b>		
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<b>Comment number</b>	<b>Report section/ ref</b>	<b>Comment</b>	<b>RMS Response</b>
			The opportunity to undertake further addition surveys for this species has now lapsed. A suitable weather event occurred in the study area on the 26-27 <sup>th</sup> January and again on the 21 <sup>st</sup> February.
3.	Table 2-1	The Table refers to Figure 3-4, which is not included in the Strategy.	Amended to Figure 2-5
4.	Figure 2-6	The figure is hard to read – include a higher quality figure.	Figure quality presents fine in the word document. It might be a PDF formatting problem.
5.	2.6 Unexpected finds	This process is suitable for unexpected finds during construction. Additional targeted survey in the northern section should be undertaken following suitable rainfall and during the optimal season to determine the location of temporary fencing. The unexpected finds process would then be followed should frogs be encountered in the construction area.	See comments in relation to Comment 2 above
6.		Updating of the Strategy should be discussed in a separate section, and be considered when additional measures are required (fencing/breeding ponds) following unexpected finds or additional targeted surveys.	Amended and created section 2.7
7.	2.7.1 Stage 1	The reference site(s) should be identified in the relevant figure (2-1 – 2-4).	<p>The strategy refers to a reference site at ch. 60065 which has been identified in figure 2-1 as green thighed frog habitat; this is also the approximate areas of where green thighed frog breeding ponds are proposed to be installed.</p> <p>It should also be noted that reference sites often change in response to localised rainfall conditions and can even respond in relation to roadside maintenance works such as the grading of a gravel road. Rather than pin point an area on one of the figures it is best left to the ecologist implementing the program to find an appropriate</p>

<b>Report name</b>	Green-Thighed Frog Management Strategy (October 2012)		
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			reference location after taking into account the extent of rainfall and the localised site conditions. Past experience has shown that reference sites and their suitability may change over time or that multiple reference sites may be needed.
8.	Stage 2	The Strategy should include discussion of contingency measures should monitoring demonstrate the performance indicators of the mitigation measures are not being met.	<p>Amended to show the following:</p> <ul style="list-style-type: none"> <li>• Absence of Green-thighed Frogs from sites 2S, 2N and 3. The corrective action for this would be to firstly, implement additional surveys of adjacent areas to confirm Green-thighed Frogs remain in that general area, and secondly, undertake a review and if deemed necessary modify the ponds to improve an site suitability problems.</li> <li>• Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis. The corrective action for this would involve a review and if deemed necessary modify the ponds by placing a semi permeable layer or further excavation.</li> <li>• Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).The corrective action for this would be to improve drainage to ensure the ponds dries out.</li> <li>• Exotic fish fauna recorded in breeding ponds. The corrective action for this would be to improve drainage to ensure the pond dries out.</li> </ul>

Warrell Creek to Urunga

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1.	2.1 Identification of Green-thighed frog habitat	<p>Targeted survey was undertaken in the Nambucca Floodplain Investigation Area in October 2012 – please:</p> <ul style="list-style-type: none"> <li>• Identify the investigation area; and</li> <li>• Provide copy of the survey report.</li> </ul>	<p>No separate report was produced. The reference to Lewis in prep will be removed.</p> <p>The section now reads as <i>The northern part of the study area did not receive the required rainfall during the field survey period. It was still subject to field surveys between January and March 2012 to look for frogs and to identify suitable areas of breeding habitat.</i></p> <p>The GTF management strategy was updated with any relevant information once surveys had been completed within the Nambucca Floodplain Investigation area. Apart from some small properties within the Nambucca Investigation area (which could be viewed from the road or surveys performed nearby) the whole WC2U footprint was surveyed.</p>
2.		<p>The northern section of the study area was not surveyed due to insufficient rainfall. The area is suspected to provide frog habitat. The department recommends survey of the area be undertaken to confirm presence/absence of the frog and the determination of appropriate/additional mitigation measures (i.e, fencing/breeding ponds).</p>	<p>Based on field surveys performed between January and March 2012 those areas suspected as containing green-thighed frog have been identified for frog fencing, breeding ponds etc. Refer to figure 2-3 and 2-4. The identification of this habitat in the absence of the site receiving enough rainfall is based on the author's expert knowledge of this species.</p> <p>The areas identified in Figure 2-3 and 2-4 would be very difficult to access once the site received &gt;100 mm in 24 hrs. RMS has adopted the pre cautionary principal and accepted the advice of those areas as likely Green-thighed Frog habitat and proposes to install the appropriate frog mitigation measures (i.e. ponds + fencing)</p>



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			The opportunity to undertake further addition surveys for this species has now lapsed. A suitable weather event occurred in the study area on the 26-27 <sup>th</sup> January and again on the 21 <sup>st</sup> February.
3.	Table 2-1	The Table refers to Figure 3-4, which is not included in the Strategy.	Amended to Figure 2-5
4.	Figure 2-6	The figure is hard to read – include a higher quality figure.	Figure quality presents fine in the word document. It might be a PDF formatting problem.
5.	2.6 Unexpected finds	This process is suitable for unexpected finds during construction. Additional targeted survey in the northern section should be undertaken following suitable rainfall and during the optimal season to determine the location of temporary fencing. The unexpected finds process would then be followed should frogs be encountered in the construction area.	See comments in relation to Comment 2 above
6.		Updating of the Strategy should be discussed in a separate section, and be considered when additional measures are required (fencing/breeding ponds) following unexpected finds or additional targeted surveys.	Amended and created section 2.7
7.	2.7.1 Stage 1	The reference site(s) should be identified in the relevant figure (2-1 – 2-4).	<p>The strategy refers to a reference site at ch. 60065 which has been identified in figure 2-1 as green thighed frog habitat; this is also the approximate areas of where green thighed frog breeding ponds are proposed to be installed.</p> <p>It should also be noted that reference sites often change in response to localised rainfall conditions and can even respond in relation to roadside maintenance works such as the grading of a gravel road. Rather than pin point an area on one of the figures it is best left to the ecologist implementing the program to find an appropriate</p>

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			reference location after taking into account the extent of rainfall and the localised site conditions. Past experience has shown that reference sites and their suitability may change over time or that multiple reference sites may be needed.
8.	Stage 2	The Strategy should include discussion of contingency measures should monitoring demonstrate the performance indicators of the mitigation measures are not being met.	<p>Amended to show the following:</p> <ul style="list-style-type: none"> <li>• Absence of Green-thighed Frogs from sites 2S, 2N and 3. The corrective action for this would be to firstly, implement additional surveys of adjacent areas to confirm Green-thighed Frogs remain in that general area, and secondly, undertake a review and if deemed necessary modify the ponds to improve an site suitability problems.</li> <li>• Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis. The corrective action for this would involve a review and if deemed necessary modify the ponds by placing a semi permeable layer or further excavation.</li> <li>• Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).The corrective action for this would be to improve drainage to ensure the ponds dries out.</li> <li>• Exotic fish fauna recorded in breeding ponds. The corrective action for this would be to improve drainage to ensure the pond dries out.</li> </ul>