

7th Working Paper

Targeted Frog Survey

PROPOSED PACIFIC HIGHWAY UPGRADE BETWEEN SAPPHIRE AND ARRAWARRA: TARGETED FROG SURVEY

PREPARED BY:

LEWIS ECOLOGICAL SURVEYS

FOR:

CONNELL WAGNER



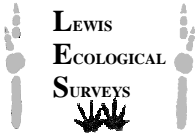
IMPORTANT DISCLAIMER

This ecological report has been prepared for *Connell Wagner Pty Ltd (CW)*: Principal Representative (Lachlan Sweeney). This report relies upon data, surveys, measurements and results based on a short-term objective study in response to a brief provided by the client (CW). Although conclusions have been based on the available data at the time, some professional judgement has been applied in reaching the conclusions. Every attempt has been made to ensure the accuracy and objectivity of the reports findings, conclusions and recommendations. *Lewis Ecological Surveys* does not accept responsibility for its use by other parties.



Author
Ben Lewis (principal)
(B. App. Sc – Hons)

Date: 2nd March 2006



6 Blue Gum Ave
Wingham NSW
Ph/Fax: 0249977448
Mob: 0413 019279
Email: lewisecological@optusnet.com.au

Relevant Licence's: DEC - No.S10524;
NSW Primary Industries Animal Care and Ethics – No: AW2001/040;
DEC Data Licence CONO1022

Report to be cited as: Lewis, B.D (2006). Proposed Pacific Highway Upgrade Between Sapphire and Arrawarra: Targeted Frog Survey. Report prepared for Connell Wagner (Sydney) by Lewis Ecological Surveys.

Acknowledgements:

Field Personnel: Ben Lewis, Sally Stennett.

Connell Wagner: Lachlan Sweeney (logistical support, project management), Anna McConville (logistic support and initial discussions).

Photography & Cover Design: Ben Lewis

Top – Lake Russell (Site 12) adjacent to the existing alignment provides potential habitat for the Green and Golden Bell Frog (*Litoria aurea*)

Bottom – Little Arrawarra Gully (Site 26) in Wedding Bells State Forest provide suitable habitat for Green-thighed Frog (*Litoria brevipalmata*)

Inset – Green-thighed Frog recorded at Skinners Creek (site 11) 1 km west of the proposed alignment.

TABLE OF CONTENTS

LIST OF TABLES	III
LIST OF FIGURES	III
EXECUTIVE SUMMARY	IV
1.0 INTRODUCTION	1
1.1 OVERVIEW AND BACKGROUND.....	1
2.0 STUDY AREA	1
2.1 STUDY AREA AND EXISTING LANDSCAPE.....	1
3.0 METHODS	1
3.1 SITE SELECTION.....	1
3.2 FIELD METHODS.....	1
3.2.1 <i>Habitat Assessment</i>	1
i. Aquatic Attributes.....	1
ii. Vegetation.....	1
iii. Disturbance.....	3
3.2.2 <i>Surveying Stream Habitats</i>	3
3.2.3 <i>Surveying Dam and Lagoon Habitats</i>	3
3.2.4 <i>Surveying Wetland Habitats</i>	3
3.2.5 <i>Surveying Ephemeral Habitats</i>	3
4.0 RESULTS AND DISCUSSION	4
4.1 GREEN-THIGHED FROG (<i>LITORIA BREVIPALMATA</i>).....	4
4.2 UNDESCRIBED WHIRRING TREE FROG (<i>LITORIA REVELATA SP</i>).....	4
4.3 STREAM SITES.....	4
4.3.1 <i>Conservation Significance Species</i>	5
4.4 DAM/LAGOON SITES.....	5
4.4.1 <i>Conservation Significant Species</i>	5
4.5 WETLAND SITES.....	5
4.5.1 <i>Conservation Significant Species</i>	5
4.6 EPHEMERAL SITES.....	5
4.6.1 <i>Conservation Significant Species</i>	5
5.0 CONSERVATION VALUE	5
6.0 RECOMENDATIONS	6
6.1 MINIMISE HABITAT REMOVAL.....	6
6.2 TIMING OF CONSTRUCTION ACTIVITIES.....	6
6.3 FROG UNDERPASSES AND CULVERTS.....	6
6.4 MAINTENCE OF EXISTING HYDROLOGICAL REGIMES.....	6
6.5 PRE-CLEARING SURVEYS.....	6
7.0 CONCLUSIONS	6
8.0 REFERENCES	7
APPENDIX ONE - SITE DESCRIPTIONS	8
APPENDIX TWO- ABIOTIC VARIABLES DURING THE SURVEY PERIOD	27

LIST OF TABLES

		Page No.
TABLE 1	NUMBER OF SITES SURVEYED IN EACH HABITAT TYPE, SURVEY EFFORT AND TARGET SPECIES	3
TABLE 2	FROG SPECIES AND THE HABITAT TYPE THEY WERE RECORDED IN	4

LIST OF FIGURES

		Page No.
FIGURE 1	LOCATION AND DISTRIBUTION OF SURVEY SITES AND HABITAT TYPE	2
FIGURE 2	LOCATION OF KNOWN AND POTENTIAL HABITAT FOR SIGNIFICANT FROG SPECIES	2

EXECUTIVE SUMMARY

The NSW *Roads and Traffic Authority* (RTA) have identified a preferred upgrade route of the Pacific Highway between Sapphire and Arrawarra in northeastern New South Wales. In order to adequately assess the ecological impacts of the proposal a specialist frog survey was conducted between the 7th and 28th January 2006 which followed several pronounced rainfall events (>50 mm in 24 hrs) triggering an optimal survey period for target species including the Green-thighed Frog (*Litoria brevipalmata*), Giant Barred Frog (*Mixophyes iteratus*), Wallum Froglet (*Crinia tinnula*) and Green and Golden Bell Frog (*Litoria aurea*). Field surveys used a multidisciplinary approach of active search and call imitation/broadcast for set time periods of four main aquatic habitats: streams, dams/lagoons, wetlands and ephemeral habitats.

Twenty species of frog were recorded during the survey and comprise nine Myobatrachid (ground dwelling) and 11 Hylid (Tree Frogs) species. Two of these species are considered ‘conservation significant’ with the Green-thighed Frog (*Litoria brevipalmata*) currently listed as ‘vulnerable’ under the New South Wales *Threatened Species Conservation Act* 1995 and the undescribed Whirring Tree Frog (*Litoria revelata* sp) awaiting formal identification. The Green-thighed Frog was recorded at Skinners Creek located ~ 1km west of the proposed footprint (~chainage 14100¹) in Orara East State Forest and represents the first record of this species in the study area. The undescribed Whirring Tree Frog was recorded in the southern study area 500m east of the proposed alignment (~ chainage 10900) and has been previously recorded from paperbark wetlands further to the south east.

Although no conservation significant frog fauna were recorded in close proximity to the proposed footprint several locations provide suitable habitat. They include:

- Green-thighed Frog habitat on the eastern side of the proposed footprint at ~chainage 10900 (south of Moonee township), Yellow Waterholes (~chainage 14000) and in Wedding Bells State Forest between ~chainages 30000-32000;
- Giant Barred Frog habitat at ~chainages 25350 (Woolgoolga Creek), 26800 (Poundyard Creek), 30350 (Arrawarra Gully) and 31050 (Arrawarra Creek);
- Green and Golden Bell Frog at ~chainage 16600 (Lake Russell);
- Wallum Froglet east of the proposed alignment at ~chainage 19000 (Emerald Beach Heathland) and on the western side of the alignment at ~chainage 32000.

Among the recommendations outlined in this report are the need to install frog friendly mitigation devices (culverts and bridges) where the footprint crosses prominent drainage lines (i.e. Woolgoolga Creek) and a need to maintain existing hydrological regimes in order to avoid altering local frog diversity and abundance, particularly in areas which provide potential Green-thighed Frog and Wallum Froglet habitat because of their specialised habitat/breeding requirements. Other recommendations include the exclusion of site office complexes, staging areas and batching plants from areas identified as providing known or potential habitat for conservation significant frog fauna.

¹ Chainage values supplied 7.8.2007. Footnote previously read “Due to difficulties in obtaining mapping files the chainage markers are derived approximates”.

1.0 INTRODUCTION

1.1 OVERVIEW AND BACKGROUND

The NSW *Roads and Traffic Authority* (RTA) has identified a preferred upgrade route of the Pacific Highway between Sapphire and Arrawarra in northeastern New South Wales (Figure 1). The route follows the existing carriageway from Sapphire northward to the southern outskirts of Woolgoolga (Double Crossing Creek) before deviating west through a mosaic of forested, agricultural and rural residential land and rejoining the existing alignment at Arrawarra Creek. In order to adequately assess the ecological impacts of the proposal *Connell Wagner* (principal contractor) have commissioned *Lewis Ecological Surveys* to conduct a specialist frog survey. The primary objectives of the frog survey were to:

- Identify potential target species of conservation significance within the study area;
- Implement a series of standardised surveys to identify and quantify the status of these target species; and
- Provide recommendations to mitigate against impacts arising from the proposal.

2.0 STUDY AREA

2.1 STUDY AREA AND EXISTING LANDSCAPE

The study area incorporates all lands within 1 km of the proposed alignment (Figure 1). The topography is generally flat coastal lands (<10m asl) rising to undulating and steep hills (<150m asl). Major drainage lines include Sugar Mill, Cunninghams, Skinners, Moonee, Double Crossing, Woolgoolga and Arrawarra Creeks with several large artificial (i.e. Lake Russell) and natural (Hearn's Lake) lake/wetland systems. Cunninghams and Double Crossing Creeks are both intertidal in the immediate vicinity of the proposed footprint and do not provide suitable frog habitat whilst Moonee Creek is in a highly degraded state in the vicinity of the proposed alignment and does not represent suitable habitat for target species.

Substantial tracts of vegetation have been modified in pursuit of pastoral (cattle) and horticultural (banana) development, and more recently a mosaic of rural and residential development providing satellite townships north of Coffs Harbour (i.e. Moonee, Safety Beach). Despite this, the study area comprises several large tracts of vegetation including Orara East and Wedding Bells State Forests, Moonee Beach and Arrawarra Nature Reserves and Coffs Coast Regional Parks. Collectively they support a diverse range of vegetation types from estuarine habitats (i.e. saltmarsh and mangroves), freshwater lakes, coastal heathlands, paperbark wetlands, swamp sclerophyll, dry sclerophyll, wet sclerophyll and sub tropical forests.

3.0 METHODS

Field surveys were conducted between the 7th and 28th January 2006 which followed several pronounced rainfall events (>50 mm in 24 hrs) resulting in excess of 200 mm falling in the study area over a few days (BOM 2006). This triggered an optimal survey period for target species including the Green-thighed Frog (*Litoria brevipalmata*), Giant Barred Frog (*Mixophyes iteratus*), undescribed Whirring Tree Frog (*Litoria revelata sp.*), Wallum Froglet (*Crinia tinnula*), Wallum Sedge Frog (*Litoria olongburensis*) and Green and Golden Bell Frog (*Litoria aurea*). Although species such as the Marsupial Frog (*Assa darlingtoni*), Mountain Frog (*Philoria sphagnicollis*) Southern Barred Frog (*Mixophyes balbus*) and New England Tree Frog (*Litoria subglandulosa*) occur in the Coffs Harbour region they were not considered in this current assessment as they are upland species generally associated with the Dorrigo Plateau in the Coffs Harbour region (Lemckert and Morse 1999; Lemckert 1999; DEC 2006; pers. obs).

3.1 SITE SELECTION

Sites were initially selected remotely from 1:25000 topographic maps with the primary objective being to select a broad range of sites covering the four main aquatic habitats: streams, dams/lagoons, wetlands and ephemeral depressions and watercourses that were likely to provide habitat for the target species. Field recognisance was then used at the commencement of the field survey to refine the site selection process. Subsequently, some sites were omitted due to poor habitat condition (transformed into residential estate or cleared land) and/or logistic constraints (i.e. access denied) in preference to neighbouring sites with improved habitat quality and access.

3.2 FIELD METHODS

3.2.1 Habitat Assessment

Habitat attributes thought to influence frog distribution and a broad habitat description were recorded at each site. They included an assessment on aquatic attributes, vegetation, disturbance and substrate type. General information was also collected and included location (AMG's), land tenure and site topography (upper slope, stream, wetland).

i. Aquatic Attributes

Information collected for aquatic attributes included the type of water body present, its dimensions, substrate and whether the water was flowing or still, and a measure of its visibility/turbidity. At stream sites the stream flow type was recorded as pools, pool/riffles or riffles along with the average stream width.

ii. Vegetation

Information collected on vegetation attributes included a broad description of the surrounding and adjacent (100m) vegetation type. The dominant species in each stratum present (i.e. overstorey, midstorey, understorey, shrub layer, ground cover) was also recorded. At stream sites the width of the perceived riparian zone was also recorded as an average of both sides.



Figure 1. Location of survey sites and broad aquatic habitat type.



Figure 2. Significant frog locations and areas of potential habitat.

iii. Disturbance

Information was collected on the level of disturbance at each site. A subjective scaling system was used to assign each site a relative rating from nil for no obvious signs of anthropogenic events (i.e. under scrubbing, clearing, logging, grazing, refuse, roads, weed infestation, fragmentation, erosion) to severe where multiple (>3) types of disturbance were evident. A site assigned a low rating generally had evidence of at least one anthropogenic practise whilst a moderate rating was assigned to a site if there was evidence of at least two anthropogenic practices.

3.2.2 Surveying Stream Habitats

The primary target species likely to be found at stream sites was the Giant Barred Frog (*Mixophyes iteratus*). A total of 12 streams were surveyed using a 500m transect or 60 min search time (Table 1). During the survey period active search techniques were employed by two people using 50 watt hand held spotlight, call imitation at regular intervals and illumination of the water column to identify and capture tadpoles. The objective of this approach was to obtain a higher degree of accuracy arising from a single visit although transects of reduced length and time have been effective in the detection of this species elsewhere in north eastern NSW (see Lewis and Rohweder 2005). In this study 87% of their frog records were obtained during the first survey.

3.2.3 Surveying Dam and Lagoon Habitats

The primary target species likely to be found in dams and lagoons was the Green and Golden Bell Frog (*Litoria aurea*) and an undescribed species of Whirring Tree Frog (*Litoria revelata sp.*). Six dams and lagoons were surveyed for 30 min at night by two observers using 50 watt spotlights (Table 1). During this time active search techniques were employed along with call imitation. In addition, a 20 min survey was undertaken during the day to survey for basking individuals and to identify tadpoles, an approach which has proved an effective technique in the past (Goldingay and Lewis 1999; Lewis and Goldingay 1997).

3.2.4 Surveying Wetland Habitats

The principal target species likely to be found in wetland habitats included the Wallum Froglet (*Crinia tinnula*), Green and Golden Bell Frog, undescribed species of Whirring Tree Frog and to a lesser extent Wallum Sedge Frog (*Litoria olongburensis*). Four wetlands were surveyed by two observers for 30 min at night using a 50 watt spotlight (Table 1). During this time active search techniques were employed along with call imitation for the Green and Golden Bell Frog and call broadcast using a 12 watt megaphone for Wallum Froglet and Wallum Sedge Frog in wallum type habitats (sites 2, 13-15, 17, 31).

3.2.5 Surveying Ephemeral Habitats

The primary target species likely to be found in ephemeral habitats was the Green-thighed Frog (*Litoria brevipalmata*), undescribed Whirring Tree Frog and to a lesser extent Wallum Froglet in Swamp Sclerophyll and Wallum related habitats. A total of 19 ephemeral sites were surveyed by two observers using a 20 min active search technique (Table 1).

Table 1. Number of sites surveyed in each habitat type, survey effort and target species. Numbers in parentheses represent person survey effort (i.e. survey between 2100-2130 by 2 people is 30 (60). Und. = Undescribed.

Aquatic Habitat	No. Sites Surveyed	Active Search Time	Total Effort	Target Species
Stream	12	60	720 (1440)	Giant Barred Frog
Dam/Lagoon	6	30	180 (360)	Green and Golden Bell Frog, Und. Whirring Tree Frog
Wetland	4	20	80 (160)	Wallum Froglet, Wallum Sedge Frog, Green & Golden Bell Frog, Und. Whirring Tree Frog
Ephemeral	19	20	380 (760)	Green-thighed Frog, Und. Whirring Tree Frog, Wallum Froglet

4.0 RESULTS AND DISCUSSION

Twenty species of frog were recorded during the survey (Table 2). They comprise nine species from the Myobatrachid family (ground dwelling frogs) and 11 from the Hylid family (tree frogs). Two species of conservation significance were recorded: Green-thighed Frog (*Litoria brevipalmata*) and an undescribed species of Whirring Tree Frog (*Litoria revelata sp.*).

4.1 GREEN-THIGHED FROG (*LITORIA BREVIPALMATA*)

Green-thighed Frog was recorded at Skinners Creek located ~ 1km west of the proposed footprint (~chainage 14100) in Orara East State Forest (Figure 2; Appendix 1). Three males were heard calling from a flooded oxbow lagoon section of Skinners Creek in wet sclerophyll forest (Flooded Gum, Grey Gum overstorey with Lilly Pilly understorey). This observation followed localised flooding of the Coffs Harbour region which received in excess of 200 mm leading up to the survey (Appendix 2). This represents the first record of this species in the study area with the nearest historic records occurring to the north west at Ramornie (50 km west of Grafton) and south west in the Thora area near Bellingen (DEC 2006). This is consistent with its patchy distribution northward of Ourimbah where it is known from relatively few records (Lewis 2000).

Despite being recorded at only one location potential habitat for this cryptic species exists in several areas including:

- Areas to the east of ~chainage 10900 (South Moonee Township)
- Yellow Water Holes on the western side of existing highway at Central Bucca intersection (~chainage 14000); and

- Drainage lines and depressions in Wedding Bells State Forest between chainages 30000-32000 (Figure 2).

4.2 UNDESCRIBED WHIRRING TREE FROG (*LITORIA*

REVELATA SP)

The undescribed Whirring Tree Frog was recorded in the southern study area south of Moonee township (Figure 2). Five males were heard calling from a flooded depression in Swamp Sclerophyll Forest 500m east of the proposed alignment (~10900). It is at present difficult to determine its relative status in the Coffs Harbour region given it may often be confused with either the Jervis Bay Tree Frog (*Litoria jervisensis*) or the Whirring Tree Frog (*Litoria revelata*), however it is known to occupy a broad range of habitats from coastal paperbark wetlands near sea level to montane (i.e. mountainous, upland) wet eucalypt and temperate rainforests at almost 1000m above sea level (unpublished data). Within the study area the Whirring Tree Frog has been previously recorded in an adjacent paperbark wetland 700 m to the southeast (pers. obs; Figure 2).

The following is a general account of species recorded during the survey according to broad habitat type.

4.3 STREAM SITES

Twelve species of frog were recorded at stream sites (Table 2). Species often recorded in this habitat included the Tusked Frog (*Adelotus brevis*), Great Barred Frog (*Mixophyes fasciolatus*), Eastern Dwarf Frog (*Litoria fallax*) and Red-backed Toadlet (*Pseudophyrne coriacea*). The latter two species were recorded at more intermittent stream sites.

Table 2. Frog species and the habitat type they were recorded in. Numbers represent the number of sites in each habitat type. Numbers in parentheses represent percentage of total number of sites for each habitat type. C = Common, V = Vulnerable, U = Unknown.

Common Name/Group	Scientific Name	Status	Habitat				No. Sites
			Stream	Dam/Lagoon	Wetland	Ephemeral	
MYOBATRACHIDAE							
Tusked Frog	<i>Adelotus brevis</i>	C	8 (67)	1 (17)	1 (25)	1 (5)	11 (27)
Eastern Sign-bearing Froglet	<i>Crinia parinsignifera</i>	C	-	-	2 (50)	7 (37)	9 (22)
Common Eastern Froglet	<i>Crinia signifera</i>	C	3 (25)	1 (17)	2 (50)	12 (63)	18 (44)
Striped Marsh Frog	<i>Limnodynastes peroni</i>	C	3 (25)	-	4 (100)	13 (68)	20 (45)
Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	C	-	-	-	1 (5)	1 (2)
Pobblebonk	<i>Limnodynastes sp</i>	C	-	1 (17)	-	-	1 (2)
Great Barred Frog	<i>Mixophyes fasciolatus</i>	C	7 (58)	-	1 (25)	3 (16)	11 (27)
Red-backed Toadlet	<i>Pseudophyrne coriacea</i>	C	10 (83)	1 (17)	1 (25)	10 (53)	22 (54)
Smooth Toadlet	<i>Uperoleia laevigata</i>	C	1 (8)	-	3 (75)	7 (37)	11 (27)
HYLIDAE							
Green-thighed Frog	<i>Litoria brevipalmata</i>	V	1* (8)	-	-	-	1 (2)
Common Green Tree Frog	<i>Litoria caerulea</i>	C	-	1 (17)	-	3 (16)	4 (10)
Bleating Tree Frog	<i>Litoria dentata</i>	C	-	2 (33)	-	5 (26)	7 (17)
Eastern Dwarf Frog	<i>Litoria fallax</i>	C	4 (33)	4 (67)	3 (75)	13 (68)	24 (59)
Graceful Tree Frog	<i>Litoria gracilentia</i>	C	2 (17)	1 (17)	1 (25)	6 (32)	10 (24)
Broad-palmed Frog	<i>Litoria latopalmata</i>	C	-	1 (17)	-	-	1 (2)
Stony Creek Frog	<i>Litoria lesueurii</i>	C	1 (8)	1 (17)	-	-	2 (5)
Rocket Frog	<i>Litoria nasuta</i>	C	-	4 (67)	-	2 (11)	6 (15)
Peron's Tree Frog	<i>Litoria peronii</i>	C	1 (8)	2 (33)	-	-	3 (7)
Undescribed Whirring Tree Frog	<i>Litoria revelata sp.</i>	U	-	-	-	1 (5)	1 (2)
Tyler's Tree Frog	<i>Litoria tyleri</i>	C	1 (8)	3 (50)	3 (75)	9 (47)	16 (39)

4.3.1 Conservation Significant Species

The record of the Green-thighed Frog has been assigned to this category given it was observed in an oxbow lagoon system of Skinners Creek. Potential habitat was also identified at this site for the endangered Giant Barred Frog. Other potential locations for the Giant Barred Frog include the southern tributary of Poundyard Creek (~Chainage 26800), Woolgoolga and Arrawarra Creeks which provide suitable habitat in the form of adequate riparian vegetation, steep sided stream banks and pool-riffles. These characteristics were identified as principal habitat components during a detailed study of this species in northeastern NSW (Lewis and Rohweder 2005). The fragmented nature of the Poundyard Creek site may indicate less optimal habitat for Giant Barred Frog given it normally requires large tracts of unfragmented riparian forest. Historic records of the Giant Barred Frog exist several kilometres further to the west of the proposed alignment in Sherwood Nature Reserve, Central Bucca and west of Emerald Beach (DEC 2006). This includes the headwaters and upper reaches of several creeks surveyed during the current survey (i.e. Woolgoolga Creek), however, much of the footprint occurs in or near the intertidal zone and therefore considered sub optimal habitat.

4.4 DAM/LAGOON SITES

Thirteen species of frog were recorded at dam and lagoon sites with most of these species (77%) being members of the hylid family (Table 2). Species regularly encountered in this habitat included the Bleating Tree Frog (*Litoria dentata*), Eastern Dwarf Frog, Rocket Frog (*Litoria nasuta*), Peron's Tree Frog (*Litoria peronii*) and Tyler's Tree Frog (*Litoria tyleri*).

4.4.1 Conservation Significant Species

No conservation significant species were recorded in this habitat type. Although potential habitat does exist for the Green and Golden Bell Frog (*Litoria aurea*) at Lake Russell there are no historic records to substantiate its existence in the study area. This is despite several detailed studies of this species across its range (White and Pyke 1996) and more locally (Lewis and Goldingay 1999). The nearest records for this species occur ~12km to the north at Blue Lake (Yuraygir National Park) or over 60 km further south in Hat Head National Park (DEC 2006; pers. obs).

4.5 WETLAND SITES

Ten species of frog were recorded at wetland sites with most of the species (70%) representing the Myobatrachid family (Table 2). Species commonly encountered in this habitat include the Eastern Sign-bearing Froglet (*Crinia parinsignifera*), Common Eastern Froglet (*Crinia signifera*), Striped Marsh Frog (*Limnodynastes peroni*), Red-backed Toadlet, Smooth Toadlet (*Uperoleia laevigata*), Eastern Dwarf Frog and Tyler's Tree Frog.

4.5.1 Conservation Significant Species

Although no conservation significant species were recorded in this habitat the undescribed Whirring Tree Frog has been previously recorded at wetlands south of Moonee (pers. obs., Figure 2). This site was resurveyed as part of the current assessment (site 2) although no individuals were recorded. Potential habitat was identified for the Wallum Froglet at two locations: heathland north of Emerald Beach (~chainage 19000) and west of Arrawarra on the western verge of the Pacific Highway (~chainage 32000). A single historic record occurs in the Hearn's Lake area ~1.5 km east of the proposed footprint (DEC 2006; Figure 2).

4.6 EPHEMERAL SITES

Fifteen species of frog were recorded from ephemeral habitats (Table 2). Species regularly encountered in this habitat included the Common Eastern Froglet, Striped Marsh Frog, Red-backed Toadlet, Eastern Dwarf Frog, and Tyler's Tree Frog.

4.6.1 Conservation Significant Species

The undescribed Whirring Tree Frog was recorded at one location south of Moonee and ~ 500m east of the proposed alignment (~chainage 10900). Potential habitat for the Green-thighed Frog exists at several sites including Yellow Waterholes (~chainage 14000) and throughout the ephemeral gully and depressions within Wedding Bells State Forest.

5.0 CONSERVATION VALUE

The study area is considered to provide moderate conservation value to frog fauna for three reasons. Firstly, it provides known habitat for conservation significant frogs, and secondly it provides potential habitat for Wallum Froglet and Giant Barred Frog at several discreet locations. The third reason is the high diversity which suggests frogs perform an important ecological function in the local area. In order to maintain these ecological values the recommendations outlined in section six should be adopted.

6.0 RECOMMENDATIONS

Although no rare frog fauna were recorded on or in close proximity to the proposed footprint a series of recommendations have been outlined below to reduce impacts on frog sensitive habitats. They are designed to confirm with best management practices (BMP's) and include:

- Minimal habitat removal;
- Timing of habitat removal and construction activities;
- Installation of frog friendly underpasses;
- Maintenance of existing hydrological values; and
- Pre-clearing surveys for target species at select sites.

6.1 MINIMISE HABITAT REMOVAL

The proposal will remove substantial areas of vegetated lands particularly in the northern part of the study area. Where possible the development footprint should be reduced to a minimum but still within safe working guidelines for the construction and eventual operational phase of the project. Construction site offices, equipment and material staging areas and batching plants should not be constructed on or in close proximity to the areas identified in figure two because they contain known or potential habitat for conservation significant frog fauna.

6.2 TIMING OF CONSTRUCTION ACTIVITIES

Where feasible the removal of habitat along drainage lines should avoid periods of wet weather. Its objective is to minimise direct impacts to frogs which may have selected areas within the development footprint as aestivation (i.e. hibernation) or breeding sites, and will also reduce the risk of potential secondary impacts such as sedimentation in adjoining habitats.

6.3 FROG UNDERPASSES AND CULVERTS

Frog friendly underpasses and culverts are recommended at six strategic points along the proposed footprint. They include:

- Bridge or culvert structure at Sugar Mill Creek;
- Culvert linking Lake Russell to lands further to the east including Moonee Nature Reserve;
- Bridge across Woolgoolga Creek;
- Bridge or an adequate culvert across the main tributary of Poundyard Creek (on Newman's Road);
- Bridge or an adequate culvert across Little Arrawarra Gully; and
- Bridge across Arrawarra Creek.

The bridge design should incorporate sufficient terrestrial habitats on either side of the creek and seek to maximise the opportunity for vegetation (sedges and rushes such as *Lomandra* and *Gahnia*) to grow either side and possibly under the bridge by maximising light levels. Attempts should be made to install culverts in a similar manner.

Whilst it could be argued that there is little justification for the installation of these structures one must consider that potential habitat was identified at both Woolgoolga, Poundyard and Arrawarra Creeks for the Giant Barred Frog and these structures will also facilitate east west movements for other vertebrate fauna.

6.4 MAINTENCE OF EXISTING HYDROLOGICAL REGIMES

Where the footprint traverses across or near lands identified as having suitable habitat for rare frog fauna the existing hydrological regime should be maintained. This will ensure the proposal reduces the likelihood of altering local species diversity and abundance. For example, the hydrological features at Yellow Waterholes (~chainage 14000) and Little Arrawarra Gully (~chainage 30350) should be maintained in an ephemeral state for Green-thighed Frog. In order to maintain the hydrological features of wallum habitats (low p H waters) north of Emerald Beach (~chainage 19000) and near Arrawarra (~chainage 31500) sedimentation ponds should be installed and the water should not be treated with neutralising agents such as lime.

6.5 PRE-CLEARING SURVEYS

Pre-clearing surveys should be conducted prior to the removal of habitat at several key sites. They include a survey of Woolgoolga, Poundyard and Arrawarra Creeks and Little Arrawarra Gully for the Giant Barred Frog. Should individuals be detected within the development footprint permission from relevant agencies should be sought for translocation into immediate habitat. Targeted surveys should also be undertaken for Wallum Froglet in the paperbark wetland (~chainage 32000) in a similar manner. The timing of these surveys should occur as close as possible to the clearing event taking into account the target species ecology.

7.0 CONCLUSIONS

The current study found high frog diversity occurs in the Sapphire to Arrawarra study area with 20 species recorded including two species of conservation significance. Both the Green-thighed Frog and undescribed Whirring Tree Frog were recorded a considerable distance (>500m) from the proposed development footprint and as such the impacts associated with the proposal in these two cases should be considered insignificant. A further two species, the Giant Barred Frog and Wallum Froglet may also occur at several discreet locations in close proximity to the proposed alignment. Provided the recommendations outlined in section six are adopted in conjunction with best management practices it is likely that impacts on these and other species would be negligible.

8.0 REFERENCES

Bureau of Meteorology (BOM). (2006). Rain and River Data. www.bom.gov.au

Department of Environment and Conservation (DEC). (2006). Threatened Species Web Search. www.npws.gov.au/wildlife/species.

Goldingay, R.L. and Lewis, B.D. (1999). Development of a conservation strategy for the green and golden bell frog (*Litoria aurea*) in the Illawarra region of New South Wales. *Australian Zoologist* **31** (2): 376-87.

Lemckert, F. (1999). Impacts of selective logging on frogs in a forested area of northern New South Wales. *Biological Conservation* **89**: 321-328.

Lemckert, F. and Morse, R. (1999). Frogs in the Timber Production Forests of the Dorrigo Escarpment in Northern NSW: An inventory of Species Present and the Conservation of Threatened Species. Pages 72-80 in *Declines and Disappearances of Australian Frogs* (ed) A. Campbell, Environment Australia -Canberra.

Lewis, B.D and Goldingay, R.L. (1999). A preliminary assessment of the status of the green and golden bell frog in north-eastern New South Wales. Pages 94-8 in *Declines and Disappearances of Australian Frogs* (ed) A. Campbell, Environment Australia -Canberra.

Lewis, B.D. (2000). Record of the green-thighed frog (*Litoria brevipalmata*) from north-east New South Wales. *Herpetofauna* **30** (2): 7-9.

Lewis, B.D. and Rohweder, D.A. (2005) Distribution, habitat, and conservation status of the giant barred frog (*Mixophyes iteratus*) in the Bungawalbin Catchment. *Pacific Conservation Biology* **11**(3): 189-197.

White, A.W. and Pyke, G.H. (1996). Distribution and conservation status of the green and golden bell frog (*Litoria aurea*) in New South Wales. *Australian Zoologist*. **30** (2): 177-189.

APPENDIX ONE - SITE DESCRIPTIONS



Site No: 1 (Western side Pacific Highway – 200m north of Headlands Road)

Picture Orientation: 245°

E: 514221 **N:** 6655641

Land Tenure: Private

Waterbody Type: Dam

Dimensions: 0.04ha

Hydrological Features: Permanent artificial dam

Water Visibility: 0.3m

Substrate: Soil

Fringing Vegetation: Sedges (Typha), Grass (Molasses, Bladey, Tall Paspalum), Ferns (Blechnum)

Riparian Zone Width: n/a

Aquatic Vegetation Cover: 75% (Typha and Lilies)

Site Disturbance: Severe (Plantation, Clearing, Roads, Pollution)

Surrounding Vegetation Type: Banana Plantation

Dominant Species

- Overstorey: Camphor Laurel, Radiata Pine
- Midstorey: Absent
- Understorey: Absent
- Shrublayer: Senna, Lantana
- Ground Cover: Molasses Grass, Bladey Grass, Tall Paspalum, Typha, Blechnum

Adjacent Vegetation Type: Dry Sclerophyll Forest, Agriculture

Survey Results

Survey Results

- Tusked Frog (*Adelotus brevis*) – 6 (w)
- Eastern Dwarf Frog (*Litoria fallax*) – 13 (ob, w)
- Rocket Frog (*Litoria nasuta*) – 7 (w)
- Peron's Tree Frog (*Litoria peronii*) – 1 (w)

Suitability For Target Species

- Green and Golden Bell Frog (*Litoria aurea*): low
- Green-thighed Frog (*Litoria brevipalmata*): nil
- Wallum Froglet (*Crinia tinnula*): nil
- Whirring Tree Frog (*Litoria revelata sp*): low
- Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Site has limited value for pond dwelling frog fauna.



Site No: 2 (Moonee South – 750m east of Highway)

Picture Orientation: 180°

E: 514728 **N:** 6656729

Land Tenure: Private

Waterbody Type: Paperbark Wetland

Dimensions: 6 ha

Hydrological Features: Natural semi permanent wetland

Water Visibility: 0.3m

Substrate: Soil

Fringing Vegetation: Sedges (Gahnia), Ferns (Blechnum), Vines (Monkey Rope)

Riparian Zone Width: n/a

Aquatic Vegetation Cover: 75%

Site Disturbance: Low (Drainage, grazing)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

- Overstorey: Broad-leaved Paperbark, Swamp Mahogany
- Midstorey: Broad-leaved Paperbark, Swamp Mahogany
- Understorey: Broad-leaved Paperbark, Swamp Mahogany
- Shrublayer: Walking Stick Palm, Senna
- Ground Cover: Gahnia, Blechnum, Monkey Rope

Adjacent Vegetation Type: Dry Sclerophyll Forest, Agriculture

Survey Results

- Striped Marsh Frog (*Limnodynastes peroni*) - >100 (ob, w)
- Smooth Toadlet (*Uperoleia laevis*) – 1 (w)
- Great Barred Frog (*Mixophyes fasciolatus*) – 3 (w)
- Tusked Frog (*Adelotus brevis*) – 3 (w)
- Eastern Dwarf Frog (*Litoria fallax*) – 20 (ob, w)
- Tyler's Tree Frog (*Litoria tyleri*) – 50 (ob, w)

Suitability For Target Species

- Green and Golden Bell Frog (*Litoria aurea*): low
- Green-thighed Frog (*Litoria brevipalmata*): low
- Wallum Froglet (*Crinia tinnula*): low
- Whirring Tree Frog (*Litoria revelata sp*): known
- Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Potential habitat value for most of target species.



Site No: 3 (Moonee South – 550m east of Highway)

Picture Orientation: 070°

E: 514691 **N:** 6657315

Land Tenure: Private

Waterbody Type: Ephemeral Depression

Dimensions: 1.3 ha

Hydrological Features: Natural ephemeral depression

Water Visibility: 0.5m

Substrate: Soil

Fringing Vegetation: Rushes (*Lomandra*), Ferns (*Blechnum*), Tussocks (*Carax* sp), Grass (*Basket*), Herbs (*Hydrocotyle*), Vines (*Smilax*)

Riparian Zone Width: n/a

Aquatic Vegetation Cover: n/a

Site Disturbance: Low (Vehicle Trails, Rubbish)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

Overstorey: Swamp Mahogany, Swamp Oak, Coastal Blackbutt, Broad-leaved paperbark

Midstorey: Weeping Bottlebrush, Broad-leaved Paperbark, Swamp Oak

Understorey: Cheese Tree, Weeping Bottlebrush

Shrublayer: Senna, Walking Stick Palm

Ground Cover: *Lomandra*, *Blechnum*, *Carax* sp, *Basket* Grass, *Smilax*, *Hydrocotyle*

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results

Great Barred Frog (*Mixophyes fasciolatus*) – 15 (ob, w)

Tyler's Tree Frog (*Litoria tyleri*) – >100 (ob, w)

Undescribed Whirring Tree Frog (*Litoria revelata* sp) – 5 (ob, w)

Smooth Toadlet (*Uperoleia laevis*) - >100 (ob, w)

Common Eastern Froglet (*Crinia signifera*) – 20 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – 10 (ob, w)

Eastern Dwarf Frog (*Litoria fallax*) – 4 (ob, w)

Bleating Tree Frog (*Litoria dentata*) – 4 (ob, w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil

Green-thighed Frog (*Litoria brevipalmata*): moderate

Wallum Froglet (*Crinia tinnula*): nil

Whirring Tree Frog (*Litoria revelata* sp): known

Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Suitable site for ephemeral frog species.



Site No: 4 (Moonee South – 350m east of Highway)

Picture Orientation: 200°

E: 514457 **N:** 6657325

Land Tenure: Private

Waterbody Type: Permanent Creek

Dimensions: Pools (10-30m in length and 3-6m wide)

Hydrological Features: Natural permanent creek

Water Visibility: 0.4m

Substrate: Gravel, Soil

Fringing Vegetation: Rushes (*Lomandra*), Ferns (*Blechnum*), Tussocks (*Carax* sp)

Riparian Zone Width: 5m

Aquatic Vegetation Cover: 0%

Site Disturbance: Severe (Roads, Clearing, Grazing, Rubbish, Fragmentation, Pollution, Erosion)

Surrounding Vegetation Type: Wet Sclerophyll Forest

Dominant Species

Overstorey: Flooded Gum

Midstorey: Weeping Bottlebrush, Cheese Tree

Understorey: Senna, Lantana

Shrublayer: Lantana, Senna

Ground Cover: *Lomandra*, *Blechnum*, *Carax* sp

Adjacent Vegetation Type: Dry Sclerophyll Forest, Agriculture

Survey Results:

Eastern Dwarf Frog (*Litoria fallax*) – 14 (ob, w)

Red Backed Toadlet (*Pseudophyrne coriacea*) – 3 (ob, w)

Smooth Toadlet (*Uperoleia laevis*) - 7 (w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil

Green-thighed Frog (*Litoria brevipalmata*): low

Wallum Froglet (*Crinia tinnula*): nil

Whirring Tree Frog (*Litoria revelata* sp): moderate

Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Limited habitat value to target species.



Site No: 5 (Fairview Drive – 300m west of Highway)
Picture Orientation: 080°
E: 513792 **N:** 6657400
Land Tenure: Private
Waterbody Type: Ephemeral Watercourse intermittent pools
Dimensions: Pools (1-5m in length and 0.5-2m wide)
Hydrological Features: Natural Ephemeral Watercourse
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia), Grass (Broad-leaved Paspalum), Tussocks (Carax sp), Vines (Monkey Rope)
Riparian Zone Width: 20m
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (Fragmentation, roads, pollution, underscrubbing)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Flooded Gum
 Midstorey: Flooded Gum, Grey Gum, Swamp Mahogany, Weeping Bottlebrush
 Understorey: Weeping Bottlebrush, Cheese Tree
 Shrublayer: Coffee Bush, Lantana, Walking Stick Palm
 Ground Cover: Gahnia, Broad-leaved Paspalum, Carax sp, Monkey Rope
Adjacent Vegetation Type: Plantation, Dry Sclerophyll Forest
Survey Results:
 Eastern Dwarf Frog (*Litoria fallax*) – 17 (ob, w)
 Great Barred Frog (*Mixophyes fasciolatus*) – 1 (w)
 Tusked Frog (*Adelotus brevis*) – 2 (w)
 Tyler’s Tree Frog (*Litoria tyleri*) – 14 (ob, w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Site has limited value for Green-thighed Frog



Site No: 6 (Moonee South – Eastern Side of Highway)
Picture Orientation: 200°
E: 514146 **N:** 6657625
Land Tenure: RTA Road Reserve
Waterbody Type: Ephemeral depression
Dimensions: numerous 0.002 ha
Hydrological Features: Artificial ephemeral depression
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia, Lomandra), Grass (Basket Grass, Whiskey Grass), Vines (Glocyene), Tussocks (Carax sp)
Riparian Zone Width: n/a
Aquatic Vegetation Cover: 0%
Site Disturbance: Severe (Roads, Rubbish Dumping, Fragmentation, Pollution)
Surrounding Vegetation Type: Dry Sclerophyll Forest
Dominant Species
 Overstorey: Coastal Blackbutt, Flooded Gum, Pink Bloodwood
 Midstorey: Coastal Blackbutt, Red Mahogany, Pink Bloodwood
 Understorey: Weeping Bottlebrush, Cheese Tree, Black She-oak
 Shrublayer: Lantana, Doodenea, Weeping Bottlebrush
 Ground Cover: Gahnia, Lomandra, Basket Grass, Whiskey Grass
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Eastern Dwarf Frog (*Litoria fallax*) – 7 (ob, w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 4 (ob, w)
 Great Barred Frog (*Mixophyes fasciolatus*) – 1 (w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 1 (w)
 Graceful Tree Frog (*Litoria gracilentia*) – 1 (w)
 Tyler’s Tree Frog (*Litoria tyleri*) – 2 (ob, w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Generally unsuitable for target species.



Site No: 7 (Moonee Beach South – eastern side of highway)
Picture Orientation: 100°
E: 514352 **N:** 6657692
Land Tenure: Private
Waterbody Type: Ephemeral depression
Dimensions: 0.002ha
Hydrological Features: Natural ephemeral watercourse
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia), Grass (Basket Grass, Bladey, Broad-leaved Paspalum), Herbs (Hydrocotyle), Ferns (Bracken)
Riparian Zone Width: n/a
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (Logging, Vehicle Trails, Rubbish dumping)
Surrounding Vegetation Type: Dry Sclerophyll Forest
Dominant Species
 Overstorey: Red Mahogany, Coastal Blackbutt, Tallowwood
 Midstorey: Turpentine
 Understorey: Turpentine, Geebung, Cheese Tree, Weeping Bottlebrush
 Shrublayer: Walking Stick Palm, Weeping Bottlebrush, Cheese Tree
 Ground Cover: Gahnia, Basket Grass, Bladey Grass, Broad-leaved Paspalum, Hydrocotyle, Bracken
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Striped Marsh Frog (*Limnodynastes peroni*) – 3 (ob)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 25 (w)
 Common Eastern Froglet (*Crinia signifera*) – 5 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Marginal habitat for Green-thighed Frog.

Site No: 8 (Moonee South - Western Side of Highway)
Picture Orientation: 280°
E: 514095 **N:** 6657910
Land Tenure: RTA Road Reserve & Private
Waterbody Type: Semi Permanent Creek
Dimensions: Pools (10-30m in length and 1.5-2m wide)
Hydrological Features: Natural semi permanent creek
Water Visibility: 0.3m
Substrate: Gravel, Soil
Fringing Vegetation: Sedges (Lomandra), Grass (Basket Grass, Broad-leaved Paspalum), Ferns (Maiden Hair, Blechnum, Tree Fern), Vines (Monkey Rope, Native Grape), Tussocks (Carax sp)
Riparian Zone Width: 20m
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (Roads, Utility Easements, Fragmentation, Plantation)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Flooded Gum
 Midstorey: Flooded Gum, Brush Box
 Understorey: Brush Box, Bangalow Palm, *Acacia melonoxlyn*, Sandpaper Fig
 Shrublayer: Lantana, Senna, Rainforest sp
 Ground Cover: Lomandra, Basket Grass, Broad-leaved Paspalum, Maiden Hair Fern, Blechnum, Tree Fern, Monkey Rope, Native Grape, Carax sp
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 7 (w)
 Peron’s Tree Frog (*Litoria peronii*) – 1 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): low
General Comments: Generally unsuitable for target species



Site No: 9 (Southern side of Lower Bucca Road- western side of highway)
Picture Orientation: 180°
E: 514212 N: 6660349
Land Tenure: Crown
Waterbody Type: Ephemeral depression
Dimensions: numerous 0.0001 ha areas
Hydrological Features: Natural ephemeral depression
Water Visibility: 0.1m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia), Grass (Basket Grass, Bladey Grass, Eragrostis)
Riparian Zone Width: n/a
Aquatic Vegetation Cover: 0%
Site Disturbance: Low (Roads, Rubbish Dumping)
Surrounding Vegetation Type: Swamp Sclerophyll Forest
Dominant Species
 Overstorey: Forest Red Gum
 Midstorey: Swamp Box, Broad-leaved Paperbark, Swamp Mahogany
 Understorey: Weeping Bottlebrush, Cheese Tree, Broad-leaved Paperbark, Swamp Box
 Shrublayer: *Pultenea villosa*, *Melaleuca styphelioides*, Groundsel, Swamp Box
 Ground Cover: Gahnia, Basket Grass, Paspalum
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Tyler's Tree Frog (*Litoria tyleri*) – 2 (w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 4 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – 15 (ob, w)
 Bleating Tree Frog (*Litoria dentata*) – 7 (ob, w)
 Spotted Marsh Frog (*Limnodynastes tasmaniensis*) – 3 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): moderate
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): low
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Suitable habitat for Green-thighed Frog.



Site No: 10 (Lower Skinners Creek – western side of highway adjacent powerline easement)
Picture Orientation: 240°
E: 514312 N: 6660453
Land Tenure: Private
Waterbody Type: Permanent Creek
Dimensions: Pools (2-15m in length and 1-2m wide)
Hydrological Features: Natural permanent creek
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia, Lomandra), Grass (Basket Grass), Ferns (False Bracken), Vines (Monkey Rope)
Riparian Zone Width: 5m
Aquatic Vegetation Cover: 0%
Site Disturbance: Moderate (Logging, Vehicle Trails, Powerline easement)
Surrounding Vegetation Type: Swamp Sclerophyll Forest
Dominant Species
 Overstorey: Red Mahogany, Coastal Blackbutt, Tallowwood
 Midstorey: Red Mahogany, Turpentine, Swamp Box, Weeping Bottlebrush
 Understorey: Turpentine, Weeping Bottlebrush
 Shrublayer: Walking Stick Palm, Lilly Pilly, Weeping Bottlebrush
 Ground Cover: Gahnia, Lomandra, Basket Grass, False Bracken, Monkey Rope
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Common Eastern Froglet (*Crinia signifera*) – 15 (w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – >100 (w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 1 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – 1 (obs)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): moderate
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): moderate
 Giant Barred Frog (*Mixophyes iteratus*): low
General Comments: Suitable habitat for Green-thighed Frog.



Site No: 11 (Upper Skinners Creek – western side of highway on Eastern Boundary Road)
Picture Orientation: 025°
E: 513525 **N:** 6661051
Land Tenure: State Forest
Waterbody Type: Oxbow Lagoon adjacent Skinners Creek
Dimensions: 0.01ha
Hydrological Features: Natural ephemeral oxbow
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Tussocks (*Carax* sp), Sedges (*Gahnia*), Ferns (Maiden Hair, *Blechnum*)
Riparian Zone Width: 25m
Aquatic Vegetation Cover: 0%
Site Disturbance: Low (Logging, Vehicle Trails)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Flooded Gum, Grey Gum
 Midstorey: Flooded Gum, Grey Gum, *Waterhousia floribunda*
 Understorey: Lilly Pilly, Rainforest sp
 Shrublayer: Sandpaper Fig, Rainforest sp.
 Ground Cover: *Carax*, *Gahnia*, *Blechnum*, Maiden Hair Fern
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results
 Green-thighed Frog (*Litoria brevipalmata*) – 3 (ob, w)
 Great Barred Frog (*Mixophyes fasciolatus*) – 6 (ob, w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 5 (w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 60 (w)
 Tusked Frog (*Adelotus brevis*) – 3 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): known
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): moderate
 Giant Barred Frog (*Mixophyes iteratus*): moderate
General Comments: Green-thighed Frog recorded and site has potential for both the Whirring Tree Frog and Giant Barred Frog.



Site No: 12 (Lake Russel – western side of highway)
Picture Orientation: 000°
E: 516150 **N:** 6661940
Land Tenure: Private
Waterbody Type: Lagoon/Lake
Dimensions: 7.5ha
Hydrological Features: Artificial permanent lake
Water Visibility: 1.2m
Substrate: Soil
Fringing Vegetation: Grass (*Paspalum*, *Bladey*), Herbs (*Hydrocotyle*), Ferns (*Bracken*), Vines (*Monkey Rope*)
Riparian Zone Width: n/a
Aquatic Vegetation Cover: 35% (Common Spike Rush, Lillies)
Site Disturbance: Severe (Artificial construction, fragmentation, roads, grazing, clearing)
Surrounding Vegetation Type: Mixed (Agricultural, Plantation, Paperbark Wetland)
Dominant Species
 Overstorey: Broad-leaved Paperbark, Swamp Oak, Coastal Blackbutt
 Midstorey: Broad-leaved Paperbark, Swamp Oak
 Understorey: Absent
 Shrublayer: Senna, Cheese Tree, Lantana, Coastal Wattle
 Ground Cover: *Paspalum*, *Bladey* Grass, *Hydrocotyle*, *Bracken*
Adjacent Vegetation Type: Mixed (Swamp Sclerophyll Forest, Agriculture, Dry Sclerophyll)
Survey Results
 Tyler's Tree Frog (*Litoria tylei*) – 2 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – >200 (ob, w)
 Common Eastern Froglet (*Crinia signifera*) – 1 (w)
 Rocket Frog (*Litoria nasuta*) – 7 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): moderate
 Green-thighed Frog (*Litoria brevipalmata*): nil
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Suitable site for bell frogs.



Site No: 13 (500m North Emerald Beach)
Picture Orientation: 040°
E: 518188 **N:** 6662999
Land Tenure: Crown-Coffs Harbour Council
Waterbody Type: Ephemeral wetland
Dimensions: numerous small depression 0.001ha
Hydrological Features: Natural ephemeral wetland
Water Visibility: 0.1m
Substrate: Sand
Fringing Vegetation: Various sedges and grass trees
Riparian Zone Width: n/a
Aquatic Vegetation Cover: n/a
Site Disturbance: Low (Vehicle trails)
Surrounding Vegetation Type: Coastal Heathland
Dominant Species
 Overstorey: Coastal Wattle
 Midstorey: absent
 Understorey: absent
 Shrublayer: *Banksia oblongifolia*
 Ground Cover: sedges and wallum epacrids
Adjacent Vegetation Type: Swamp Sclerophyll Forest
Survey Results
 Striped Marsh Frog (*Limnodynastes peroni*) – 2 (w)
 Common Eastern Froglet (*Crinia signifera*) – 2 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): nil
 Wallum Sedge Frog (*Litoria olongburensis*): low
 Wallum Froglet (*Crinia tinnula*): moderate
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Suitable site for Wallum Froglet.



Site No: 14 (500m north of Emerald Beach – eastern side of highway)
Picture Orientation: 040°
E: 518111 **N:** 6663105
Land Tenure: Crown – Coffs Harbour Council
Waterbody Type: Paperbark Wetland
Dimensions: 0.75ha
Hydrological Features: Natural permanent wetland
Water Visibility: 0.4m
Substrate: Soil
Fringing Vegetation: Various sedges (Baumea), Ferns (False Bracken), Grass (Whiskey Grass)
Riparian Zone Width: n/a
Aquatic Vegetation Cover: 80%
Site Disturbance: Low (Vehicle Trails, Altered Drainage, Fragmentation)
Surrounding Vegetation Type: Paperbark Wetland
Dominant Species
 Overstorey: Broad-leaved Paperbark, Swamp Oak
 Midstorey: Broad-leaved Paperbark, Swamp Oak
 Understorey: Broad-leaved Paperbark
 Shrublayer: Broad-leaved Paperbark, Groundsel
 Ground Cover: *Baumea sp.*
Adjacent Vegetation Type: Heathland
Survey Results:
 Striped Marsh Frog (*Limnodynastes peroni*) – >100 (ob, w)
 Common Eastern Froglet (*Crinia signifera*) – 6 (w)
 Smooth Toadlet (*Uperoleia laevigata*) – 1 (w)
 Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 10 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): low
 Green-thighed Frog (*Litoria brevipalmata*): nil
 Wallum Froglet (*Crinia tinnula*): low
 Whirring Tree Frog (*Litoria revelata sp*): low
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Generally has low potential for most target species.



Site No: 15 (Moonee Nature Reserve opposite Graham Drive – eastern side of highway)

Picture Orientation: 100°

E: N:

Land Tenure: Nature Reserve

Waterbody Type: Paperbark Wetland

Dimensions: ~9ha

Hydrological Features: Natural permanent wetland

Water Visibility: 0.9m

Substrate: Soil

Fringing Vegetation: Various sedges, Ferns (Blechnum), Grass (Bladey, Carpet Grass)

Riparian Zone Width: n/a

Aquatic Vegetation Cover: 40%

Site Disturbance: None

Surrounding Vegetation Type: Paperbark Wetland

Dominant Species

Overstorey: Broad-leaved Paperbark

Midstorey: Broad-leaved Paperbark

Understorey: Broad-leaved Paperbark

Shrublayer: absent

Ground Cover: Bladey Grass, Blechnum, Sedges

Adjacent Vegetation Type: Swamp Sclerophyll Forest

Survey Results:

Tyler's Tree Frog (*Litoria tyleri*) – 50 (ob, w)

Eastern Dwarf Frog (*Litoria fallax*) – 30 (ob, w)

Striped Marsh Frog (*Limnodynastes peroni*) – >100 (ob, w)

Common Eastern Froglet (*Crinia signifera*) – 8 (w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): low

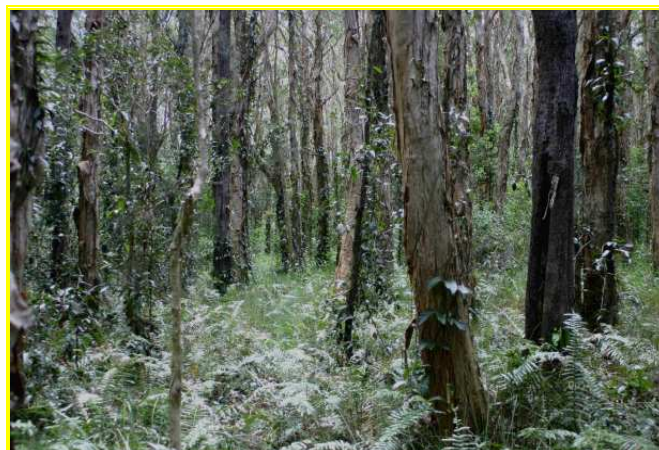
Green-thighed Frog (*Litoria brevipalmata*): low

Wallum Froglet (*Crinia tinnula*): low

Whirring Tree Frog (*Litoria revelata sp*): low

Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Generally has low potential for most target species.



Site No: 16 (0.4 km north of Graham Drive Pacific Highway Intersection – western side of highway)

Picture Orientation: 320°

E: 518511 **N:** 6664395

Land Tenure: Private

Waterbody Type: Ephemeral Depression

Dimensions: 0.09ha

Hydrological Features: Natural with ephemeral depressions

Water Visibility: 0.1m

Substrate: Soil

Fringing Vegetation: Various sedges, Ferns (Blechnum), Vines (Monkey Rope), Grass (Bladey Grass)

Riparian Zone Width: n/a

Aquatic Vegetation Cover: n/a

Site Disturbance: Low (roads, fragmentation)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

Overstorey: Broad-leaved Paperbark, Swamp Oak

Midstorey: Broad-leaved Paperbark, Swamp Oak

Understorey: Broad-leaved Paperbark, Swamp Oak, Swamp Box, Senna

Shrublayer: Senna, Groundsel

Ground Cover: Bladey Grass, Blechnum, Sedges

Adjacent Vegetation Type: Agriculture and Rural Residential

Survey Results

Tyler's Tree Frog (*Litoria tyleri*) – 4 (w)

Smooth Toadlet (*Uperoleia laevigata*) – 30 (w)

Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 3 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – 28 (w)

Eastern Dwarf Frog (*Litoria fallax*) – 13 (ob, w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil

Green-thighed Frog (*Litoria brevipalmata*): low

Wallum Froglet (*Crinia tinnula*): low

Whirring Tree Frog (*Litoria revelata sp*): nil

Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Generally unlikely to have target species.



Site No: 17 (0.5 km south of Double Crossing Creek western side of Pacific Highway)

Picture Orientation: 200°

E: 518541 **N:** 6665471

Land Tenure: RTA Road Reserve and Private

Waterbody Type: Ephemeral Depression

Dimensions: 2.5 ha

Hydrological Features: Natural with ephemeral

Water Visibility: 0.2m

Substrate: Soil

Fringing Vegetation: Various sedges, paspalum, bladey grass, Rhodes grass

Riparian Zone Width: n/a

Aquatic Vegetation Cover: 85%

Site Disturbance: Severe (roads, pollution, clearing, fragmentation)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

- Overstorey: Broad-leaved Paperbark, Swamp Oak
- Midstorey: Broad-leaved Paperbark, Swamp Oak, Swamp Box
- Understorey: Broad-leaved Paperbark, Swamp Oak, *Leptospermum sp.*
- Shrublayer: Callistemon sp, Groundsel, Swamp Oak
- Ground Cover: Bladey Grass, Paspalum, Rhodes Grass, *Schoenus sp.*

Adjacent Vegetation Type: Agricultural

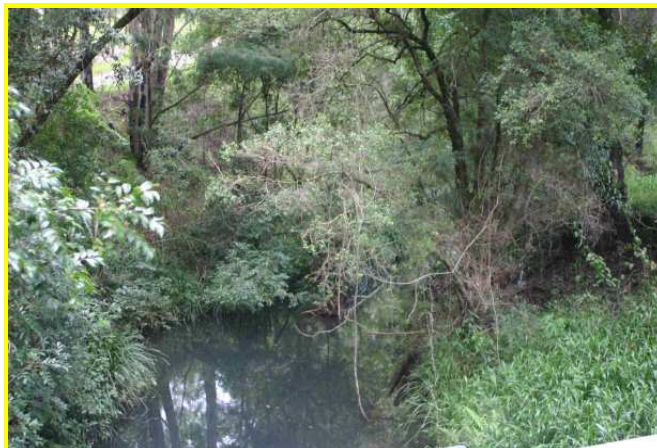
Survey Results:

- Tyler's Tree Frog (*Litoria tyleri*) – 5 (w)
- Eastern Dwarf Frog (*Litoria fallax*) – 20 (ob, w)
- Bleating Tree Frog (*Litoria dentata*) – 15 (ob, w)
- Smooth Toadlet (*Uperoleia laevis*) – 50 (w)
- Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – >100 (w)
- Common Eastern Froglet (*Crinia signifera*) – 10 (w)
- Common Green Tree Frog (*Litoria caerulea*) – 3 (w)
- Rocket Frog (*Litoria nasuta*) - >100 (ob, w)

Suitability For Target Species

- Green and Golden Bell Frog (*Litoria aurea*): nil
- Green-thighed Frog (*Litoria brevipalmata*): low
- Wallum Froglet (*Crinia tinnula*): low
- Whirring Tree Frog (*Litoria revelata sp*): nil
- Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Generally unlikely to have target species.



Site No: 18 (Upper Woolgoolga Creek)

Picture Orientation: 250°

E: 515912 **N:** 6668265

Land Tenure: Crown – RTA Road Reserve

Waterbody Type: Permanent Creek

Dimensions: Pools (20-80m in length and 3-4m wide)

Hydrological Features: Natural with permanent pools

Water Visibility: 1.2m

Substrate: Gravel, Rock

Fringing Vegetation: Rushes (Lomandra), Ferns (Maiden Hair Fern, Whirled Fern), Vines (Native Grape), Grasses (Basket Grass, Broad-leaved Paspalum)

Riparian Zone Width: 10m

Aquatic Vegetation Cover: n/a

Site Disturbance: Moderate (grazing, roads, fragmentation)

Surrounding Vegetation Type: Wet Sclerophyll Forest

Dominant Species

- Overstorey: Grey Gum, Tallowwood
- Midstorey: Brush Box, White Mahogany, Forest Oak, *Waterhousia floribunda*
- Understorey: Lilly Pilly, *Waterhousia floribunda*
- Shrublayer: Rainforest sp, Lantana
- Ground Cover: Lomandra, Basket Grass, Maiden Hair Fern, Whirled Fern, Native Grape, Lantana

Adjacent Vegetation Type: Agriculture

Survey Results:

- Great Barred Frog (*Mixophyes fasciolatus*) – 2 (w)
- Stony Creek Frog (*Litoria lesueurii*) – 1 (ob)
- Red-backed Toadlet (*Pseudophyrne coriacea*) – 2 (w)

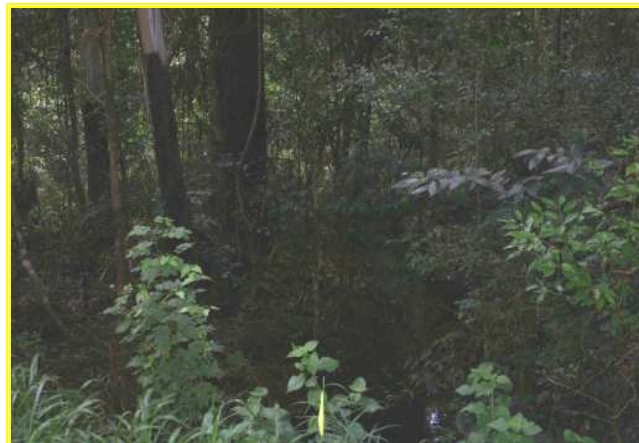
Suitability For Target Species

- Green and Golden Bell Frog (*Litoria aurea*): nil
- Green-thighed Frog (*Litoria brevipalmata*): nil
- Wallum Froglet (*Crinia tinnula*): nil
- Whirring Tree Frog (*Litoria revelata sp*): nil
- Giant Barred Frog (*Mixophyes iteratus*): moderate

General Comments: Suitable habitat for creek dwelling species such as Giant Barred Frog.



Site No: 19 (Upper Woolgoolga Creek Road)
Picture Orientation: 90°
E: 515544 **N:** 6668283
Land Tenure: Private
Waterbody Type: Ephemeral Depression
Dimensions: 0.06 ha
Hydrological Features: Natural with ephemeral depression
Water Visibility: 0.1m
Substrate: Soil
Fringing Vegetation: Grass (Broad-leaved Paspalum), Sedges (Juncus), Ferns (False Bracken), Vines (Native Grape)
Aquatic Vegetation Cover: 0%
Site Disturbance: Severe (fragmentation, agriculture, grazing, clearing)
Surrounding Vegetation Type: Fragmented Wet Sclerophyll Forest
Dominant Species
 Overstorey: Flooded Gum
 Midstorey: Lilly Pilly, Sandpaper Fig, Red Ash, Red Cedar
 Understorey: Lilly Pilly, Sandpaper Fig, Red Ash, Red Cedar
 Shrublayer: Senna, Lilly Pilly
 Ground Cover: BL Paspalum, Juncus, False Bracken, Native Grape
Adjacent Vegetation Type: Riparian Rainforest
Survey Results:
 Striped Marsh Frog (*Limnodynastes peroni*) – 30 (w)
 Graceful Tree Frog (*Litoria gracilentata*) – 10 (w)
 Tyler’s Tree Frog (*Litoria tyleri*) – 4 (ob, w)
 Bleating Tree Frog (*Litoria dentata*) – 5 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – 2 (w)
 Common Eastern Froglet (*Crinia signifera*) – 3 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): moderate
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): low
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Suitable habitat for ephemeral species such as Green-thighed Frog.



Site No: 20 (1.45 km along Woolgoolga Creek Road near alignment)
Picture Orientation: 330°
E: 517055 **N:** 6668395
Land Tenure: State Forest
Waterbody Type: Ephemeral Creek
Dimensions: Pools (2-5m in length and 0.5-2m wide)
Hydrological Features: Natural with semi permanent pools
Water Visibility: 0.3m
Substrate: Gravel, Rock, Soil
Fringing Vegetation: Lichen, Moss, Basket Grass, Ferns (Maiden Hair Fern, Blechnum, Tree Fern), Vines (Native Grape)
Riparian Zone Width: 15m
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (roads, pollution, fragmentation)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Grey Gum, Flooded Gum, Grey Ironbark
 Midstorey: Grey Gum, Pink Bloodwood, Lilly Pilly
 Understorey: Lilly Pilly, various rainforest species
 Shrublayer: Lantana, native grape, rainforest species
 Ground Cover: Basket Grass, Maiden Hair Fern, Blechnum, Native Grape, Lantana
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 15 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): low
General Comments: Generally unlikely to have target species.



Site No: 21 (Woolgoolga Creek on the proposed alignment)
Picture Orientation: 010°
E: 516605 N: 6668683
Land Tenure: State Forest
Waterbody Type: Permanent Creek
Dimensions: Pools (10-80m in length and 2-5m wide)
Hydrological Features: Natural with permanent pools
Water Visibility: 1.0m
Substrate: Gravel, Soil
Fringing Vegetation: Rushes (Lomandra), Ferns (Blechnum, Maiden Hair Fern), Vines (Native Grape), Lantana
Riparian Zone Width: 10-40m
Aquatic Vegetation Cover: n/a
Site Disturbance: Low (weeds, fragmentation)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Flooded Gum
 Midstorey: Brush Box, Lilly Pilly, Sandpaper Fig
 Understorey: Sandpaper Fig, Brush Box, Waterhousia
 Shrublayer: Sandpaper Fig, Native Grape, Lantana, Walking Stick Palm
 Ground Cover: Lomandra, Blechnum, Lantana
Adjacent Vegetation Type: Agriculture, Mixed Plantation
Survey Results:
 Tyler's Tree Frog (*Litoria tyleri*) – 30 (ob, w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 4 (w)
 Tusked Frog (*Adelotus brevis*) – 3 (w)
 Great Barred Frog (*Mixophyes fasciolatus*) – 8 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): nil
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): moderate
General Comments: Suitable habitat for creek dwelling species such as Giant Barred Frog.



Site No: 22 (Poundyard Creek - End of Newman's Road on alignment)
Picture Orientation: 300°
E: 516358 N: 6669986
Land Tenure: Private
Waterbody Type: Permanent Spring Fed Creek
Dimensions: Pools (1-15m in length and 1-3m wide)
Hydrological Features: Natural with permanent pools
Water Visibility: 2.0m
Substrate: Rock, gravel, sand and soil
Fringing Vegetation: Rushes (Lomandra), Ferns (Maiden Hair, Blechnum), Vines (Monkey Rope, Wait-A-While, Lawler, Native Grape)
Riparian Zone Width: 15m
Aquatic Vegetation Cover: n/a
Site Disturbance: Low (fragmentation)
Surrounding Vegetation Type: Rainforest
Dominant Species
 Overstorey: Strangler Fig, *Syzygium sp.*
 Midstorey: *Syzygium sp.*
 Understorey: Bangalow Palm, Sandpaper Figs, Rainforest Plants
 Shrublayer: Pittosporum, Walking Stick Palm
 Ground Cover: Lomandra, Monkey Rope, Lawler Vine, Wait-a-while, Native Grape
Adjacent Vegetation Type: Wet Sclerophyll Forest
Survey Results:
 Great Barred Frog (*Mixophyes fasciolatus*) – 9 (w)
 Tusked Frog (*Adelotus brevis*) – 4 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – 26 (ob, w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 2 (w)
 At neighbouring farm dam Tyler's Tree Frog (*Litoria tyleri*) was also recorded.
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): low
 Giant Barred Frog (*Mixophyes iteratus*): moderate
General Comments: Limiting factor at this site for Giant Barred Frog may be fragmentation.



Site No: 23 (Palmer Road North)
Picture Orientation: 250°
E: 516472 **N:** 6670533
Land Tenure: Private
Waterbody Type: Dam
Dimensions: 0.06 ha
Hydrological Features: Artificial construction, permanent water
Water Visibility: 0.5m
Substrate: Soil
Fringing Vegetation: Cumbungi (Typha) and Lillies
Aquatic Vegetation Cover: 90%
Site Disturbance: Severe (Land clearing, roads, urban, fragmentation, banana plantation)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Grey Gum, Tallowwood, Pink Bloodwood
 Midstorey: Grey Gum, Tallowwood
 Understorey: Brush Box, Lilly Pilly, Cheese Tree
 Shrublayer: *Acacia sp.*, Lantana
 Ground Cover: Bladley Grass, Kangaroo Grass, Lomandra
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Eastern Dwarf Frog (*Litoria fallax*) - >50 (ob, w)
 Tyler's Tree Frog (*Litoria tyleri*) - 3 (w)
 Bleating Tree Frog (*Litoria dentata*) - 2 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): low
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): moderate
General Comments: Site suitable for pond dwelling frogs.



Site No: 24 (Upper Little Arrawarra Gully)
Picture Orientation: 310°
E: 516376 **N:** 6672064
Land Tenure: State Forest
Waterbody Type: Semi Permanent Creek
Dimensions: Pools (2-7m in length and 0.3-3m wide)
Hydrological Features: Natural with semi permanent pools
Water Visibility: 1.2m
Substrate: Soil
Fringing Vegetation: Rushes (Lomandra), Grasses (Bladley Grass, Broad-leaved Paspalum), Ferns (Small Fishbone), Vines (Glocyene).
Riparian Zone Width: 5m
Aquatic Vegetation Cover: n/a
Site Disturbance: Low (Logging, vehicle trails)
Surrounding Vegetation Type: Dry Sclerophyll Forest
Dominant Species
 Overstorey: Grey Gum, Grey Ironbark, Tallowwood
 Midstorey: Brush Box, Tallowwood
 Understorey: Cheese Tree
 Shrublayer: Lantana, Cheese Tree
 Ground Cover: Lomandra, Bladley Grass, Broad-leaved Paspalum, Small Fishbone, Glocyene.
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Graceful Tree Frog (*Litoria gracilentia*) - 2 (w)
 Common Eastern Froglet (*Crinia signifera*) - 15 (ob, w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) - >100 (w)
 Tusked Frog (*Adelotus brevis*) - 1 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): low
 Giant Barred Frog (*Mixophyes iteratus*): nil
General Comments: Most suitable habitat for Green-thighed and Whirring Tree Frogs.



Site No: 25 (Northern tributary of Little Arrarwarra Gully off Embankment Road)

Picture Orientation: 110°

E: 516490 **N:** 6672835

Land Tenure: State Forest

Waterbody Type: Ephemeral Drainage Line

Dimensions: Pools (1-5m in length and 0.5-2m wide)

Hydrological Features: Natural with semi permanent pools

Water Visibility: 0.2m

Substrate: Soil

Fringing Vegetation: Rushes (Juncus, Lomandra), Ferns (Bracken), Vines (Hard Leaf Creeper, Monkey Rope), Grasses (Basket Grass, Bladey Grass)

Riparian Zone Width: 5m

Aquatic Vegetation Cover: n/a

Site Disturbance: Low (logging, vehicle trails)

Surrounding Vegetation Type: Dry Sclerophyll Forest

Dominant Species

Overstorey: Grey Gum, Red Mahogany, Pink Bloodwood
 Midstorey: Grey Gum, Red Mahogany, Pink Bloodwood
 Understorey: Forest Oak, Brush Box, Swamp Box, Cheese Tree, Acacia
 Shrublayer: Cheese Tree, Lantana, Eucalypts
 Ground Cover: Lomandra, Juncus, Basket Grass, Bladey Grass, Bracken

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results:

Graceful Tree Frog (*Litoria gracilentata*) – 2 (w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) - >100 (ob, w)
 Tusked Frog (*Adelotus brevis*) – 1 (w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): nil
 Giant Barred Frog (*Mixophyes iteratus*): nil

General Comments: Suitable habitat for ephemeral species such as Green-thighed Frog in the flood out depressions.



Site No: 26 (Middle Reaches of Little Arrarwarra Gully)

Picture Orientation: 185°

E: 517299 **N:** 6672944

Land Tenure: State Forest

Waterbody Type: Semi Permanent Creek

Dimensions: Pools (5-20m in length and 1-7m wide)

Hydrological Features: Natural with permanent pools

Water Visibility: 0.3m

Substrate: Soil

Fringing Vegetation: Rushes (Lomandra), Ferns (False Bracken), Vines (Monkey Rope), Grasses (Basket Grass)

Riparian Zone Width: 10m

Aquatic Vegetation Cover: n/a

Site Disturbance: Low (logging, vehicle trails)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

Overstorey: Coastal Blackbutt, Red Mahogany
 Midstorey: Forest Red Gum, Weeping Bottlebrush
 Understorey: Weeping Bottlebrush, Lilly Pilly, Cheese Tree
 Shrublayer: Cheese Tree, Lantana, Lilly Pilly
 Ground Cover: Lomandra, Basket Grass, False Bracken

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results:

Common Eastern Froglet (*Crinia signifera*) – 13 (ob, w)
 Tusked Frog (*Adelotus brevis*) – 4 (w)
 Great Barred Frog (*Mixophyes fasciolatus*) – 8 (ob, w)
 Eastern Dwarf Frog (*Litoria fallax*) – 1 (w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 25 (w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 3 (ob, w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): moderate
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp*): moderate
 Giant Barred Frog (*Mixophyes iteratus*): low

General Comments: Suitable habitat for ephemeral species such as Green-thighed Frog in the flood out depressions.



Site No: 27 (Lower Little Arrawarra Gully)
Picture Orientation: 270°
E: 517495 **N:** 6673211
Land Tenure: State Forest
Waterbody Type: Permanent Creek
Dimensions: Pools (10-20m in length and 1.5-6m wide)
Hydrological Features: Natural with permanent pools
Water Visibility: 0.5m
Substrate: Soil
Fringing Vegetation: Sedges (Gahnia), Rushes (Lomandra), Ferns (Blechnum type), Vines (Monkey Rope), Grasses (Basket Grass)
Riparian Zone Width: 10m
Aquatic Vegetation Cover: n/a
Site Disturbance: Low (logging, vehicle trails)
Surrounding Vegetation Type: Swamp Sclerophyll Forest
Dominant Species
 Overstorey: Coastal Blackbutt, Red Mahogany
 Midstorey: Broad-leaved Paperbark, *Melaleuca styphelioides*, Red Bloodwood, Turpentine
 Understorey: Broad-leaved Paperbark, Cheese Tree, *Leptospermum sp.*
 Shrublayer: Cheese Tree, Doodenana, Lantana, Eucalypts, Sandpaper Fig
 Ground Cover: Lomandra, Baskett Grass, Blechnum Fern,
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Great Barred Frog (*Mixophyes fasciolatus*) – 4 (ob, w)
 Tusked Frog (*Adelotus brevis*) – 2 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp.*): low
 Giant Barred Frog (*Mixophyes iteratus*): low
General Comments: Suitable habitat for ephemeral and creek dwelling species such as Green-thighed and Giant Barred Frog.



Site No: 28 (Arrawarra Creek west side of Pacific Highway)
Picture Orientation: 280°
E: 517582 **N:** 6673909
Land Tenure: State Forest
Waterbody Type: Permanent Creek
Dimensions: Pool (20-50m in length and 1-3.5m wide)
Hydrological Features: Natural with permanent water
Water Visibility: 0.3m
Substrate: Soil
Fringing Vegetation: Rushes (Lomandra, Juncus)
Riparian Zone Width: 15m
Aquatic Vegetation Cover: 5% (Eel Grass)
Site Disturbance: Low (Logging, erosion)
Surrounding Vegetation Type: Wet Sclerophyll Forest
Dominant Species
 Overstorey: Coastal Blackbutt, Flooded Gum
 Midstorey: Turpentine, Coastal Blackbutt, Cheese Tree, Lilly Pilly
 Understorey: Water Gum, Lantana, Cheese Tree, Pittosporum, Eucalypts
 Shrublayer: Lantana, Water Gum, *Acacia sp.*, Monkey Rope
 Ground Cover: Lomandra, Basket Grass, Gahnia, Juncus
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Great Barred Frog (*Mixophyes fasciolatus*) – 8 (ob, w)
 Tusked Frog (*Adelotus brevis*) – 6 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): nil
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp.*): nil
 Giant Barred Frog (*Mixophyes iteratus*): low
General Comments: Most suitable habitat for Giant Barred Frog.



Site No: 29 (West Side of Pacific Highway 50m along Nash's Road)
Picture Orientation: 020°
E: 517590 N: 6674063
Land Tenure: State Forest
Waterbody Type: Ephemeral Depression
Dimensions: 0.0015 ha
Hydrological Features: Artificial construction from gravel road with ephemeral water body
Water Visibility: 0.1m
Substrate: Soil
Fringing Vegetation: Grass (Bladey, Paspalum, Giant Parramatta Grass)
Aquatic Vegetation Cover: n/a
Site Disturbance: Severe (recent logging, fragmentation, roads)
Surrounding Vegetation Type: Dry Sclerophyll Forest (Plantation)
Dominant Species
 Overstorey: Coastal Blackbutt
 Midstorey: Coastal Blackbutt, Grey Ironbark
 Understorey: Grey Ironbark, *Acacia sp.*, *Leptospermum sp.*
 Shrublayer: Lantana, Eucalypt regrowth, *Acacia sp.*
 Ground Cover: Bladey Grass, Paspalum, Giant Parramatta Grass
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Common Eastern Froglet (*Crinia signifera*) – 8 (w)
 Striped Marsh Frog (*Limnodynastes peroni*) – 2 (ob, w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp.*): nil
General Comments: Suitable only for Green-thighed Frog.



Site No: 30 (Lagoon 300m east of highway)
Picture Orientation: 150°
E: 517980 N: 6674204
Land Tenure: Crown
Waterbody Type: Lagoon
Dimensions: 0.18 ha
Hydrological Features: Natural permanent
Water Visibility: 0.6m
Substrate: Soil
Fringing Vegetation: Sedges (*Eleocharis*) and Lillies
Aquatic Vegetation Cover: 35%
Site Disturbance: Low (logging & vandalism)
Surrounding Vegetation Type: Dry Sclerophyll Forest
Dominant Species
 Overstorey: Coastal Blackbutt
 Midstorey: Coastal Blackbutt, Broad-leaved Paperbark
 Understorey: *Acacia sp.*, Geebung, Swamp Oak
 Shrublayer: *Leptospermum sp.*, Monkey Rope
 Ground Cover: Bladey Grass, Lomandra, Bracken Fern,
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results
 Eastern Dwarf Frog (*Litoria fallax*) – 120 (ob, w)
 Tyler's Tree Frog (*Litoria tyleri*) – 25 (ob, w)
 Peron's Tree Frog (*Litoria peronii*) – 10 (ob, w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): low
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp.*): moderate
General Comments: Aquatic vegetation considered too sparse for bell frogs. Nearby ephemeral areas may be used by Green-thighed Frog.



Site No: 31 (250m north Nash’s Road on West Side of Pacific Highway)

Picture Orientation: 300°

E: 517671 **N:** 6674270

Land Tenure: State Forest – RTA Road Reserve

Waterbody Type: Paperbark Wetland

Dimensions: 0.4 ha

Hydrological Features: Natural with ephemeral water body

Water Visibility: 0.5m

Substrate: Soil

Fringing Vegetation: Sedges (*Eleocharis acuta*, *Baumea teretifolia*)

Aquatic Vegetation Cover: 85%

Site Disturbance: Low (Road, Pollution)

Surrounding Vegetation Type: Paperbark

Dominant Species

- Overstorey: Broad-leaved Paperbark
- Midstorey: Broad-leaved Paperbark, Swamp Box
- Understorey: Broad-leaved Paperbark, Swamp Box
- Shrublayer: Broad-leaved Paperbark, Swamp Box
- Ground Cover: Spikerush, *Baumea sp*, Kangaroo Grass, Paspalum

Adjacent Vegetation Type: Dry Sclerophyll Forest

- Eastern Dwarf Frog (*Litoria fallax*) – 5 (w)
- Graceful Tree Frog (*Litoria gracilentata*) – 12 (ob, w)
- Smooth Toadlet (*Uperoleia laevisgata*) – 1 (w)
- Red-backed Toadlet (*Pseudophyrne coriacea*) – 5 (w)
- Striped Marsh Frog (*Limnodynastes peroni*) – 2 (ob, w)
- Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 7 (w)
- Tyler’s Tree Frog (*Litoria tyleri*) – 15 (w)

Suitability For Target Species

- Green and Golden Bell Frog (*Litoria aurea*): nil
- Green-thighed Frog (*Litoria brevipalmata*): low
- Wallum Froglet (*Crinia tinnula*): low
- Whirring Tree Frog (*Litoria revelata sp*): low

General Comments: Most suitable habitat for Wallum Froglet along the proposed alignment.



Site No: 32 (250m south of Arrawarra Beach Road)

Picture Orientation: 280°

E: 517810 **N:** 6674335

Land Tenure: RTA Road Reserve

Waterbody Type: Ephemeral Drainage Line

Dimensions: 0.02 ha

Hydrological Features: Natural with ephemeral water body

Water Visibility: 0.2m

Substrate: Soil

Fringing Vegetation: Sedges (*Baumea rubiginosa*), Ferns, Grass (Kangaroo, Bladey)

Aquatic Vegetation Cover: n/a

Site Disturbance: Moderate (road, fragmentation, clearing, pollution)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

- Overstorey: Forest Red Gum, Coastal Blackbutt
- Midstorey: Forest Red Gum, Broad-leaved Paperbark, Swamp Box
- Understorey: Cheese Tree, Swamp Box, *Melaleuca styloides*
- Shrublayer: Cheese Tree, Broad-leaved Paperbark, Coffee Bush
- Ground Cover: Bladey Grass, Kangaroo Grass, Lomandra

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results:

- Eastern Dwarf Frog (*Litoria fallax*) – 2 (w)
- Graceful Tree Frog (*Litoria gracilentata*) – 6 (ob, w)
- Common Eastern Froglet (*Crinia signifera*) – 15 (w)
- Smooth Toadlet (*Uperoleia laevisgata*) – 3 (w)
- Red-backed Toadlet (*Pseudophyrne coriacea*) – 20 (w)
- Striped Marsh Frog (*Limnodynastes peroni*) – >50 (ob, w)
- Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 20 (w)
- Tyler’s Tree Frog (*Litoria tyleri*) – 1 (w)

Suitability For Target Species

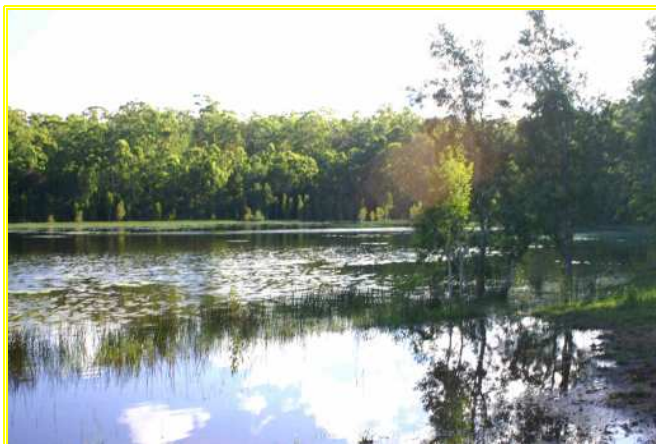
- Green and Golden Bell Frog (*Litoria aurea*): nil
- Green-thighed Frog (*Litoria brevipalmata*): moderate
- Wallum Froglet (*Crinia tinnula*): low
- Whirring Tree Frog (*Litoria revelata sp*): nil

General Comments: Suitable for Green-thighed Frog.



Site No: 33 (100m north of Arrawarra Beach Road)
Picture Orientation: 355°
E: 517981 **N:** 6674698
Land Tenure: RTA Road Reserve
Waterbody Type: Ephemeral Depression
Dimensions: 0.03 ha
Hydrological Features: Artificial construction with ephemeral water body
Water Visibility: 0.2m
Substrate: Soil
Fringing Vegetation: Grass (Paspalum, Carpet)
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (road, fragmentation, clearing, pollution)
Surrounding Vegetation Type: Dry Sclerophyll Forest
Dominant Species
 Overstorey: Coastal Blackbutt
 Midstorey: Coastal Blackbutt, Broad-leaved Paperbark, Black She-oak
 Understorey: Black She-oak, Swamp Box
 Shrublayer: *Leptospermum sp.*, *Acacia sp.*, Swamp Box, *Pultanea villosa*
 Ground Cover: Carpet Grass, Paspalum, Bladey Grass, Lomandra
Adjacent Vegetation Type: Swamp Sclerophyll Forest
Survey Results:
 Graceful Tree Frog (*Litoria gracilentata*) – 2 (w)
 Eastern Dwarf Frog (*Litoria fallax*) – 3 (ob, w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 2 (w)
 Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 20 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): low
 Wallum Froglet (*Crinia tinnula*): nil
 Whirring Tree Frog (*Litoria revelata sp.*): nil
General Comments: Unlikely for target species.

Site No: 34 (West Side of Pacific Highway Opposite Arrawarra Beach Road)
Picture Orientation: 200°
E: 517690 **N:** 6674727
Land Tenure: State Forest- Utilities
Waterbody Type: Ephemeral Drainage Line
Dimensions: 1.0 ha
Hydrological Features: Natural with ephemeral water body
Water Visibility: 0.6m
Substrate: Soil
Fringing Vegetation: Sedges (Lomandra), Grasses (Bladey Grass, *Entolasia stricta*)
Aquatic Vegetation Cover: n/a
Site Disturbance: Moderate (powerline, logging, fragmentation)
Surrounding Vegetation Type: Swamp Sclerophyll Forest
Dominant Species
 Overstorey: Red Mahogany
 Midstorey: Broad-leaved Paperbark
 Understorey: Black She-oak, Swamp Box, Broad-leaved Paperbark
 Shrublayer: *Leptospermum sp.*, Cheese Tree, Broad-leaved Paperbark
 Ground Cover: Bladey Grass, *Entolasia stricta*, Lomandra, various sedges and herbs
Adjacent Vegetation Type: Dry Sclerophyll Forest
Survey Results:
 Graceful Tree Frog (*Litoria gracilentata*) – 12 (ob,w)
 Common Eastern Froglet (*Crinia signifera*) – 30 (w)
 Rocket Frog (*Litoria nasuta*) – 2 (ob,w)
 Red-backed Toadlet (*Pseudophyrne coriacea*) – 5 (w)
 Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 10 (w)
Suitability For Target Species
 Green and Golden Bell Frog (*Litoria aurea*): nil
 Green-thighed Frog (*Litoria brevipalmata*): moderate
 Wallum Froglet (*Crinia tinnula*): low
 Whirring Tree Frog (*Litoria revelata sp.*): low
General Comments: One of the better sites for Green-thighed Frog.



Site No: 35 (Lagoon 1 km along Farm Trail in Wedding Bells State Forest)

Picture Orientation: 245°

E: 517065 **N:** 6675028

Land Tenure: State Forest

Waterbody Type: Lagoon

Dimensions: 3.6 ha

Hydrological Features: Natural permanent

Water Visibility: 0.8m

Substrate: Soil

Fringing Vegetation: Sedges (*Eleocharis sphacelata*) and Lillies

Aquatic Vegetation Cover: 15%

Site Disturbance: Low (erosion & vehicle trails)

Surrounding Vegetation Type: Dry Sclerophyll Forest

Dominant Species

Overstorey: Coastal Blackbutt, Red Mahogany

Midstorey: Coastal Blackbutt, Red Mahogany

Understorey: *Acacia* sp, Broad-leaved Paperbark

Shrublayer: *Leptospermum* sp, *Acacia* sp., Lantana

Ground Cover: Bladey Grass, Kangaroo Grass, Lomandra

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results

Stony Creek Frog (*Litoria lesueurii*) – 1 (ob)

Rocket Frog (*Litoria nasuta*) - >100 (ob,w)

Red Backed Toadlet (*Pseudophyrne coriacea*) – 1 (w)

Eastern Dwarf Frog (*Litoria fallax*) – 35 (ob, w)

Broad-palmed Frog (*Litoria latopal mata*) – 15 (w)

Pobblebonk (*Limnodynastes* sp) - >5 (w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): moderate

Green-thighed Frog (*Litoria brevipalmata*): moderate

Wallum Froglet (*Crinia tinnula*): nil

Whirring Tree Frog (*Litoria revelata* sp): moderate

General Comments: Aquatic vegetation considered too sparse for bell frogs. Nearby ephemeral areas may be used by Green-thighed Frog.



Site No: 36 (West Side of Pacific Highway Opposite Darlington Park)

Picture Orientation: 010°

E: 517752 **N:** 6675079

Land Tenure: State Forest- Utilities

Waterbody Type: Ephemeral Drainage Line

Dimensions: 0.6 ha

Hydrological Features: Natural with ephemeral water body

Water Visibility: 0.5m

Substrate: Soil

Fringing Vegetation: Sedges (*Gahnia*, *Lomandra*)

Aquatic Vegetation Cover: n/a

Site Disturbance: Moderate (powerline, logging, fragmentation)

Surrounding Vegetation Type: Swamp Sclerophyll Forest

Dominant Species

Overstorey: Forest Red Gum, Coastal Blackbutt, Broad-leaved Paperbark

Midstorey: Broad-leaved Paperbark, White Mahogany, Swamp Box

Understorey: Cheese Tree, Swamp Box, Broad-leaved Paperbark

Shrublayer: *Leptospermum* sp, Broad-leaved Paperbark

Ground Cover: Bladey Grass, Kangaroo Grass, *Gahnia*

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results:

Graceful Tree Frog (*Litoria gracilent a*) – 7 (ob, w)

Common Eastern Froglet (*Crinia signifera*) – 40 (ob, w)

Red-backed Toadlet (*Pseudophyrne coriacea*) – >50 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – 6 (ob, w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): nil

Green-thighed Frog (*Litoria brevipalmata*): moderate

Wallum Froglet (*Crinia tinnula*): low

Whirring Tree Frog (*Litoria revelata* sp): nil

General Comments: Suitable for Green-thighed Frog.



Site No: 37 (East Side of Pacific Highway Opposite Darlington Park)

Picture Orientation: 130°

E: 517964 **N:** 6675541

Land Tenure: Private

Waterbody Type: Series of Dams

Dimensions: 0.5 ha

Hydrological Features: Artificial construction with permanent water

Water Visibility: 0.7m

Substrate: Soil

Fringing Vegetation: Grasses (Paspalum and Carpet)

Aquatic Vegetation Cover: 35%

Site Disturbance: Severe (clearing, fragmentation, grazing)

Surrounding Vegetation Type: Agricultural

Dominant Species

Overstorey: Swamp Oak

Midstorey: Broad-leaved Paperbark

Understorey: Cabbage Palms, Callistemon sp.

Shrublayer: Swamp Oak

Ground Cover: Carpet Grass, Paspalum

Adjacent Vegetation Type: Dry Sclerophyll Forest

Survey Results:

Eastern Dwarf Frog (*Litoria fallax*) – 25 (ob, w)

Bleating Tree Frog (*Litoria dentata*) – 10 (w)

Rocket Frog (*Litoria nasuta*) – 3 (w)

Suitability For Target Species

Green and Golden Bell Frog (*Litoria aurea*): low

Green-thighed Frog (*Litoria brevipalmata*): low

Wallum Froglet (*Crinia tinnula*): nil

Whirring Tree Frog (*Litoria revelata* sp): low

General Comments: Generally unsuitable for target species.

BLANK

Supplementary Site One

Opposite Emerald Beach Turnoff

E: 517313 **N:** 6662885

Survey Results:

Common Eastern Froglet (*Crinia signifera*) – 10 (w)

Red-backed Toadlet (*Pseudophyrne coriacea*) – 15 (w)

Eastern Dwarf Frog (*Litoria fallax*) – 8 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – 25 (w)

Supplementary Site Two

1 km South of Double Crossing Creek

E: 518560 **N:** 6665221

Survey Results:

Tyler's Tree Frog (*Litoria tyleri*) – 4 (w)

Eastern Dwarf Frog (*Litoria fallax*) – 25 (ob, w)

Striped Marsh Frog (*Limnodynastes peroni*) – 30 (ob, w)

Bleating Tree Frog (*Litoria dentata*) – 10 (w)

Smooth Toadlet (*Uperoleia laevis*) – 20 (w)

Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 1 (w)

Common Green Tree Frog (*Litoria caerulea*) – 2 (w)

Great Barred Frog (*Mixophyes fasciolatus*) – 2 (w)

Supplementary Site Three

0.2 km South of Double Crossing Creek

E: 518657 **N:** 6665765

Survey Results:

Graceful Tree Frog (*Litoria gracilentia*) – 3 (w)

Common Eastern Froglet (*Crinia signifera*) – 5 (w)

Smooth Toadlet (*Uperoleia laevis*) – 10 (w)

Red-backed Toadlet (*Pseudophyrne coriacea*) – 1 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – >50 (ob, w)

Smooth Toadlet (*Uperoleia laevis*) – 20 (w)

Eastern Sign Bearing Froglet (*Crinia parinsignifera*) – 1 (w)

Common Green Tree Frog (*Litoria caerulea*) – 4 (w)

Supplementary Site Four

Powerline Easement 200m north of Embankment Road

E: 517622 **N:** 6673487

Survey Results:

Graceful Tree Frog (*Litoria gracilentia*) – 2 (w)

Common Eastern Froglet (*Crinia signifera*) – 50 (ob, w)

Smooth Toadlet (*Uperoleia laevis*) – 3 (w)

Red-backed Toadlet (*Pseudophyrne coriacea*) – >100 (w)

Striped Marsh Frog (*Limnodynastes peroni*) – 20 (ob, w)

APPENDIX TWO- ABIOTIC VARIABLES DURING THE SURVEY PERIOD

Table A. Abiotic variables recorded throughout the month of January 2006. Light shading denotes survey period. Data obtained from weather station 059040. Source: Bureau of Meteorology (2006).

Date	Minimum temperature (°C)	Maximum temperature (°C)	Rainfall (mm)	Direction of maximum wind gust	Speed of maximum wind gust (km/h)	3pm relative humidity (%)	3pm cloud amount (oktas)	3pm MSL pressure (hPa)
1/01/06	22.5	32.2	0	NNE	63	57	0	1012.3
2/01/06	20.5	27.6	0	S	54	63	7	1012.6
3/01/06	20.6	29	0			89	3	1005.4
4/01/06	22.7	24.8	2	S	37	65	7	1014.7
5/01/06	20.6	21.9	0	E	37	96	8	1013.2
6/01/06	19.9	22.9	118.8	SW	39	96	8	1009.8
7/01/06	20.8	25.6	72.8	SE	44	79	7	1013.2
8/01/06	20.4	26.1	29.2	ESE	50	77	7	1013.9
9/01/06	20.3	26.4	26.6	SW	37	88	6	1010.8
10/01/06	22.5	28	33	NE	41	80	4	1014.4
11/01/06	24.1	31	3.6	NNE	57	73	1	1011.2
12/01/06	22.8	27.7	13.4	NNE	26	84	1	1012.4
13/01/06	24	27.9	0	NE	28	83	8	1013
14/01/06	21.7	27.4	3.2	NNE	41	68	7	1012.6
15/01/06	20.9	28.7	0	ENE	31	69	5	1015
16/01/06	21.1	28.4	0.8	NE	37	68	5	1015.4
17/01/06	20.4	31	0	NNE	56	67	5	1009.5
18/01/06	22.1	25.6	3.8	S	39	74	7	1012.8
19/01/06	20.6	22.6	20.6	ESE	35	81	8	1018.2
20/01/06	20	26.5	40.2			73	7	1016.8
21/01/06	19.3	27.5	13.2	ENE	26	68	2	1013.8
22/01/06	18.8	27.8	0	E	26	64	2	1011.7
23/01/06	19.7	29.2	0	NE	48	71	1	1007.3
24/01/06	23.9	30.7	0	NE	39	74	1	1006.8
25/01/06	22	26.3	5.2	SSW	33	83	8	1015.6
26/01/06	20.2	28.6	0.2	E	26	62	1	1014
27/01/06	21.3	27.9	2.4	ENE	30	62	7	1011.4
28/01/06	19.2	27.8	0	ENE	28	52	1	1012.1
29/01/06	19.4	27.2	1	SE	33	68	7	1011.6
30/01/06	18.7	27.8	0	SW	30	68	1	1007.3
31/01/06	21.1	28.7	0	SSE	33	69	5	1007.5