Transport for New South Wales

Warrell Creek to Nambucca Heads

Green-thighed frog monitoring report – survey #four 2025

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Pacific Highway upgrade: Warrell Creek to Nambucca Heads (WC2NH)

Green-thighed frog monitoring report – survey #4 2025

Sandpiper Ecological Surveys

Final Report

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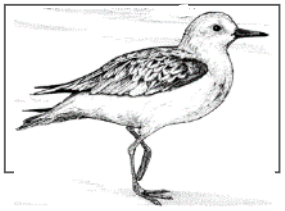

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1 Introduction

In 2015, Transport for NSW (TfNSW), in conjunction with the Acciona Ferrovial Joint Venture (AFJV), commenced upgrading the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH). The WC2NH project was opened to traffic in two stages:

- Stage 2a - 13.5km section from Lower Warrell Creek Bridge to Nambucca Heads opened on 18 December 2017; and
- Stage 2b - 6.25km section from the southern end of the project to the Lower Warrell Creek bridge opened on 29 June 2018.

1.1 Background

During pre-construction surveys along the WC2NH alignment, green-thighed frogs (*Litoria brevipalmata*) were recorded at two sites, albeit in low numbers (Lewis 2013). Specifically, two male frogs were found at chainage 60065 within the road corridor, and one male frog was recorded at chainage 60865 on the eastern side. Additionally, a low-lying forest area, susceptible to periodic inundation between chainages 57365 and 59365, was identified as potential green-thighed frog habitat (Lewis 2013). The green-thighed frog is listed as vulnerable under the New South Wales Biodiversity Conservation Act (BC Act) 2016.

To mitigate potential impacts on the small population of green-thighed frogs and to comply with the conditions of approval, a threatened species management plan was developed (Lewis 2013). In accordance with the conditions of approval and the recommendations within the management plan, twenty breeding ponds were constructed at four sites along the WC2NH upgrade, and frog exclusion fences were installed adjacent to each pond cluster.

As per the management plan, monitoring of the green-thighed frog ponds was scheduled to occur annually over five years, commencing in year one of the operational phase (i.e. August 2018–August 2019). The purpose of the monitoring program is to confirm use of the constructed ponds by the target species, with the following performance indicators used to assess the success of the mitigation measures:

· 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.

1.2 Monitoring

Monitoring was contingent on vegetation cover around the constructed ponds exceeding 20% and a rainfall trigger being met at the Bellwood weather station, either 75 mm within 24 hours or 150 mm over 72 hours (Lewis 2013). Additionally, surveys were required to be spaced at least 10 to 12 months apart unless otherwise approved by the Department of Planning, Industry and Environment (DPIE) in consultation with the Environmental Protection Agency (EPA) (Lewis 2013; RMS 2018). If sufficient rainfall did not occur during the scheduled monitoring season, surveys for that period were not required.

Green-thighed frog surveys were conducted on three occasions during the prescribed ecological monitoring

period, Year 1 to 5 (August 2018 to August 2023). These surveys took place in Year 2 (February 2020), Year 3 (December 2020), and Year 4 (February/March 2022), following rainfall events meeting the trigger values (Sandpiper Ecological 2020, 2021, 2022).

In Year 1, the rainfall trigger was met on October 17, 2018. However, vegetation cover around the ponds was below the 20% threshold stipulated in the management plan (Lewis 2013), and surveys were therefore not conducted. In Year 5, sufficient rainfall occurred during September and October 2022. However, the Year 4 survey had taken place only seven months earlier, in March 2022. As the management plan requires at least 10 to 12 months between surveys, the Year 5 survey could not proceed (Lewis 2013). Furthermore, the high rainfall typically expected between February and April did not occur in 2023 due to drought conditions.

The management plan requires monitoring to occur over five sessions, with only three sessions completed to date (Sandpiper 2020, 2021, 2022). The first survey was missed due to inadequate vegetation cover around the constructed ponds, and rainfall events in 2022 and 2023 that occurred less than 10 months apart. As a result, two additional surveys are required once the rainfall trigger is met, in line with recommendations from the Biodiversity, Conservation and Science (BCS) Group within the NSW Department of Climate Change, Energy, the Environment and Water (DECCEW), formerly DPIE.

2 Methods

2.1 Study area

The WC2NH project covers a total length of 19.75km and extends from Warrell Creek in the south to Nambucca Heads in the north. The alignment bypasses the town of Macksville and the northern section traverses Nambucca State Forest. Green-thighed frog breeding ponds are situated at the northern end of the alignment, adjoining Nambucca State Forest (Figure 1).

Low-lying, periodically inundated forest between chainages 57365 and 59365 was identified as potential habitat (Lewis 2013). Based on this information, Lewis (2013) recommended that breeding ponds be constructed at five locations within the WC2NH section (Table 1, Figure 1). Each location was to contain five (approximately) 4 x 3 m ponds with a maximum depth of 400 mm, and a 250 m section of permanent frog exclusion fence was to be installed between the ponds and carriageway. Site 2N was initially situated on the north side of the alignment at chainage 60065 but was moved to chainage 59440 due to concern about vehicle strike on Old Coast Road.

Table 1: Location and features of frog ponds. * green-thighed frog recorded during pre-construction surveys.

Site	Chainage	Easting	Northing	No. ponds	Retention period (days)	Topographic position (as per Lewis 2013)
1E	58015	495912	6607879	5	60-80	Adjacent to drainage line; staggered upslope
1W	58165	495921	6608056	5	60-70	Upper slope/ridgeline
2S	60065*	496795	6609634	5	60-70	Open area
2N	59440	496465	6609092	5	Not specified	Not specified
3	60865*	497383	6610179	5	60-70	Ridge

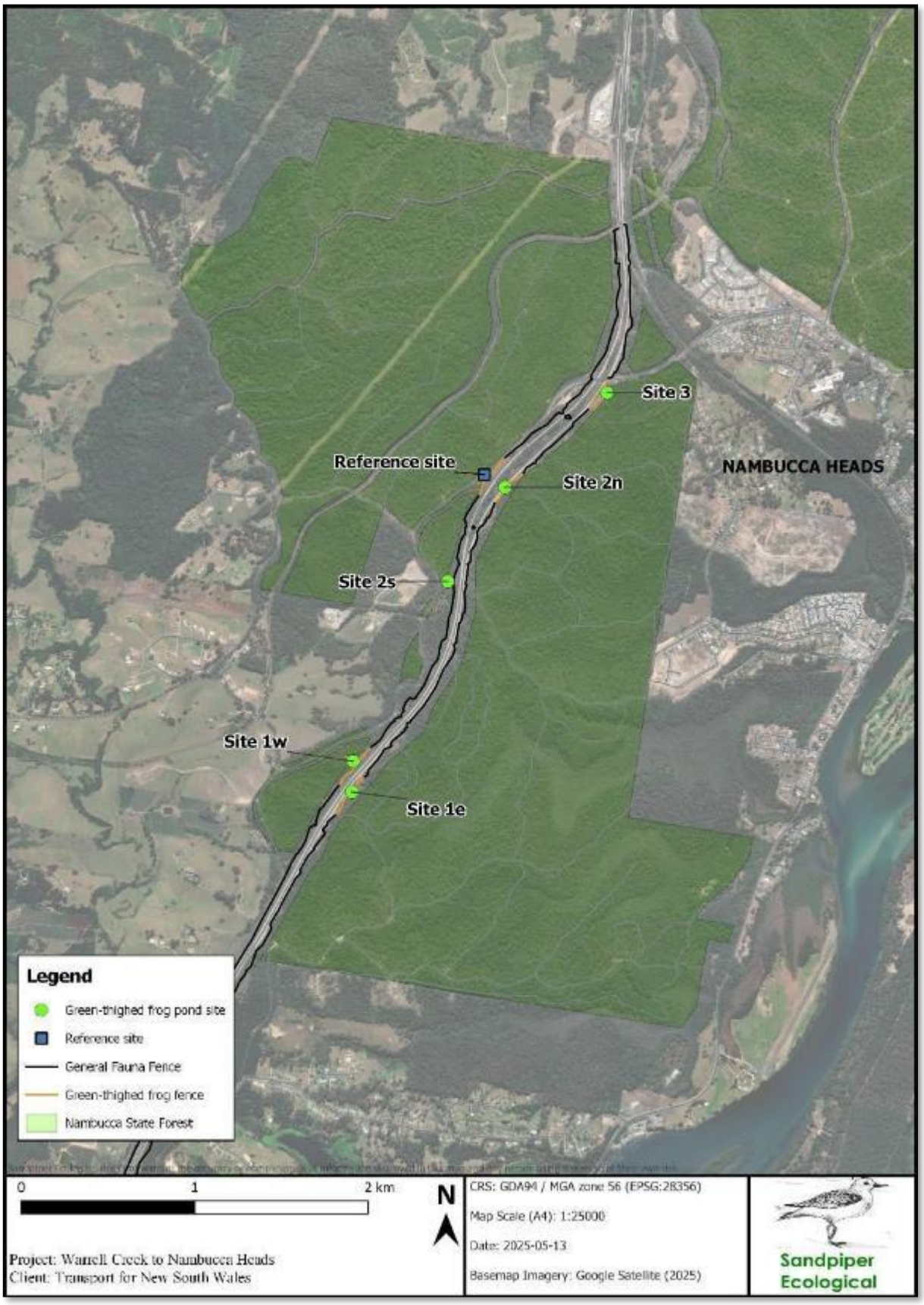

Figure 1: Location of green-thighed frog ponds and exclusion fence.

2.2 Timing, methods and weather conditions

Targeted green-thighed frog surveys were conducted in two stages to assess breeding activity and success in accordance with the species management plan.

2.2.1 Stage 1 – Targeted frog surveys

Stage 1 surveys were carried out on 10 March 2025 between 2000 and 0000 hrs. Surveys were conducted by two personnel. Upon arrival at each site, observers spent five minutes listening for calling frogs, followed by a 25-minute active search. Searches included the littoral zone of each pond and adjacent habitats within 100 m. As per the year 2 monitoring report (Sandpiper Ecological 2020) the reference site survey was expanded to include the ridgeline east and west of the alignment at 2S, and the ridge north of site 3. These surveys included a slow traverse of management trails by two ecologists searching flooded wheel ruts and depressions.

Rainfall data from the Bellwood weather station (059150) was unavailable. Consequently, rainfall data from the nearest available station (within 15km), Kalang (Spicketts Creek, 059148) was used to determine whether rainfall thresholds were met to conduct the surveys. Between 3 and 9 March, Kalang recorded 413.6 mm of rainfall. This included 132.6 mm within 24 hours on 8 March, exceeding the 75 mm 24-hour threshold, and 281.2 mm between 6 and 8 March, exceeding the 150 mm 72-hour threshold required to trigger the survey. Given the broad spatial extent of the rainfall event across the east coast, the use of an alternative weather station is likely to be indicative of rainfall totals recorded onsite.

Standing water was present in all constructed ponds, as well as in tyre ruts and roadside table drains. Surveys were conducted under wet and humid conditions, with intermittent light rain and heavy showers. Air temperatures ranged from 21.7°C to 22.9°C, relative humidity was 96%, and cloud cover was complete. These conditions were considered favourable for green-thighed frog breeding.

Table 2: On-site weather conditions and rainfall data for stage 1 green-thighed frog surveys conducted on 10 March 2025.

Site	Conditions	Temperature (°C)	Relative humidity (%)	Cloud cover (%)
Site 3	Light rain	22.9	96	100
Site 2S	Light rain	22.9	96	100
Site 2N	Light rain	21.7	96	100
Site 1E	Heavy	21.7	96	100
Reference Site	Heavy	21.7	96	100
Iron Bark Trail	Light rain	21.7	96	100
Poplar Trail	Heavy	21.7	96	100
Wirrimbirri Road	Light rain	22.9	96	100

2.2.2 Stage 2 - Tadpole and habitat assessment surveys

Stage 2 surveys were conducted on 2 May 2025, approximately 50 days after Stage 1, to assess breeding success and pond conditions. Dip-netting was conducted at each pond (10 scoops per pond) to detect tadpoles and aquatic predators. Captured tadpoles were transferred to an aquarium for identification using Anstis (2017). Fish were identified using Allen et al. (2002), and dytiscid larvae were identified using the Centre for Freshwater Ecosystems (undated) and CSIRO (2004). All captured fauna were released at the point of capture, and all sampling equipment was disinfected between sites.

A visual assessment of each pond was also conducted to evaluate habitat condition. This included inspection of water levels, pond edges, and surrounding vegetation. Frog exclusion fences were checked for gaps, damage, or signs of deterioration

3. Results

3.1 Frog surveys

No green-thighed frogs were recorded during the survey conducted on 10 March 2025. Across all survey locations, nine frog species were detected (Table 3). Species richness ranged from six species at Sites 2N and 2S to one species at the reference site. Sites 1E and 3 each recorded five species, while the expanded forest trail surveys yielded only two species, the red-backed toadlet (*Pseudophryne coriacea*) and striped marsh frog (*Limnodynastes peronii).* Forest trail surveys included Iron bark trail, Poplar trail and Wirrimbiri Road.

Red-backed toadlet (*Pseudophryne coriacea*) was recorded at five sites and was the most widespread species. Eastern dwarf tree frog (*Litoria fallax*) and striped marsh frog (*Limnodynastes peronii*) each appeared at four sites. Tusked frog (*Adelotus brevis*) and common eastern froglet (*Crinia signifera*) were recorded at three sites, graceful tree frog (*Litoria gracilenta*) and Tyler's tree frog (*Litoria tyleri*) at two, and both dusky toadlet (*Uperoleia fusca*) and a probable Bibron's toadlet (*Pseudophryne bibronii*) at one site each (2N).

Table 3: Frogs recorded during surveys of constructed breeding ponds adjoining the WC2NH upgrade. Prob = Probable record. Forest trails included

Species	Site 1E	Site 2N	Site 2S	Site 3	Reference site	Forest trails
Litoria fallax	X	X	X	X		
Litoria gracilenta		X	X			
Litoria tyleri	X			X		
Crinia signifera		X	X	X		
Pseudophryne coriacea	X	X	X		X	X
Pseudophryne bibroni		X (prob)				
Adelotus brevis	X	X		X		
Uperoleia fusca			X			
Limnodynastes peronii	X		X	X		X
Total	**5**	**6**	**6**	**5**	**1**	2

Plate 1: *Litoria fallax* recorded at site 3 (Left). *Litoria gracilenta* recorded at 2S.

3.2 Tadpole survey

Tadpole surveys were conducted across all constructed ponds retaining water, with tadpoles recorded at only two locations (Table 4). Probable *C. signifera* tadpoles were observed at Site 1E, and *Lim. peronii* was recorded at Site 3 (Plate 2). No tadpoles were detected at the remaining sites, and there were no records of green-thighed frog tadpoles (Table 3). No fish species or dytiscid larvae were recorded.

Table 4: Results of tadpole survey conducted on 2 May2025 .

Species	Site 1E	Site 2N	Site 2S	Site 3
Crinia signifera	X	X	X	X
Limnodynastes peronii			X	X

Plate 2. Striped marsh frog tadpole recorded at Site 3 (left). Probable common eastern froglet recorded at Site 1E.

3.3 Pond condition and habitat assessment

Overall, suitability of the ponds for green-thighed frogs varied both within and between sites. Of the 20 ponds, ten (50%) were rated as good, three (15%) as fair and seven (35%) as poor (Table 5). Thirteen ponds (65%) retained pooling water after 50 days, with depths ranging from 0 to 200 mm. Littoral-zone cover ranged from 15% to 100% and eighteen ponds (90%) exceeded the 20% cover threshold considered sufficient for emergent habitat and successful breeding (Lewis 2013).

Vegetation type and cover varied across sites. Grasses dominated most littoral zones, with perennial grass species common at sites 2N and 1E (Plate 3). Several ponds at sites 2N and 3N were dominated by branching rush (*Juncus prismatocarpus*) and appeared suitable for the subject species. Stands of bulrush (*Typha orientalis*) were recorded in three ponds, one each at sites 1E, 2S and 3, suggesting semi-permanent water. Vegetation surrounding the ponds has matured over the monitoring period and at the time of this survey included several medium sized *Eucalyptus*, *Acacia* and *Allocasuarina* trees exceeding 100 mm diameter at breast height (Plate 3).

At site 1E, one of the five ponds was rated as good, two as fair and two as poor (Table 5). Water depths ranged from 0 to 100 mm and littoral cover ranged from 40% to 100%. At site 2N, all five ponds were rated as good with depths between 50 and 200 mm and uniform 100% littoral cover. At site 2S, all five ponds were rated as poor and were completely dry (Plate 3). Cover ranged from 15% to 100% although only three ponds exceeded 20%. At site 3, four ponds were rated as good and one as fair with depths between 150 and 200 mm and 100% vegetation cover in all ponds.

Table 5: Summary of pond condition during 2025 survey, WC2NH.

Site	Pond	Depth (mm)	Littoral % veg cover	Condition
1E	1	50	70	Poor
1E	2	100	50	Fair
1E	3	0	40	Poor
1E	4	120	100	Good
1E	5	0	100	Poor
2N	1	150	100	Good
2N	2	200	100	Good
2N	3	150	100	Good
2N	4	150	100	Good
2N	5	50	100	Good
2S	1	0	20	Poor
2S	2	0	15	Poor
2S	3	0	25	Poor
2S	4	0	60	Poor
2S	5	0	100	Poor
3	1	150	100	Good
3	2	200	100	Good
3	3	200	100	Good
3	4	200	100	Fair
3	5	150	100	Good

Plate 3: Variation in habitat condition among constructed ponds at WC2NH. Top left: Pond in good condition with branching rush and water retention exceeding 50 mm at site 3. Top right: Overgrowth of perennial grasses at site 3. Bottom left: A dry pond at site 2S with sparse littoral vegetation. Bottom right: Dense perennial grass and Acacia growth around the pond periphery at site 1e.

3.3 Fence condition

The frog exclusion fence was generally in good condition, with only minor lifting of the frog mesh recorded. However, vegetation is beginning to overgrow the fence, with thick perennial grasses growing through the mesh (Plate 4).

Plate 4: Grass growing through frog fence at site 3.

4 Discussion

4.1 Performance indicators

4.1.1 Continued presence of green-thighed frogs at breeding ponds

No green-thighed frogs were recorded during monitoring in the vicinity of the breeding ponds, reference sites, or within the broader Nambucca State Forest area in March 2025. The absence of frogs is consistent with previous surveys despite suitable rainfall and pond conditions (Sandpiper 2020, 2021, 2022, and 2024). Given these findings, the absence of green-thighed frogs using the breeding ponds is likely due to the absence of a viable population in the surrounding area.

The absence of records likely reflects both the historically low baseline population around the WC2NH alignment and the extended drought that limited breeding events prior to 2020. Green-thighed frogs in this region exhibit boom-and-bust dynamics tied to episodic heavy rains (Lewis 2013). Several successive wet seasons may be required before individuals reoccupy the Nambucca State Forest and constructed ponds. The past three to four years have included numerous episodic heavy rain events, yet no frogs have been recorded. This further suggests that either very few individuals remain near the highway or the population is absent.

4.1.2 Presence of tadpoles, juveniles or metamorphs during follow-up surveys

Dip-netting in May 2025 (Stage 2) recorded only eastern froglet and striped marsh frog tadpoles, with no green-thighed frog tadpoles recorded. This outcome is consistent with the absence of calling adults and compliments results from previous surveys, where non-target tadpole species dominated captures. Overall pond condition was variable, all five ponds at Site 2N retained water and supported suitable littoral cover, and four of five ponds at Site 3 were deemed suitable for breeding. In contrast, Site 1E had only one pond in good condition and two in fair condition, while all ponds at Site 2S were dry and did not retain water for the minimum requirement of 50-60 days (Lewis 2013). Although 90 percent of ponds now exceed the 20 percent littoral-cover threshold, suboptimal hydroperiods <50 days at several sites would preclude successful green-thighed frog development to metamorphosis (Lewis 2013).

Nevertheless, the lack of green-thighed frog tadpoles, despite some ponds meeting habitat criteria, suggests that unsuitable pond conditions are a secondary issue. The primary constraint appears to be the absence of a breeding population within the broader study area.

5. Contingency and recommendations

Four of the five surveys recommended in the management plan (Lewis 2013) have been completed. Monitoring in March 2025 recorded no green-thighed frogs at the breeding ponds, reference sites, or within the adjoin Nambucca State Forest, despite suitable rainfall and pond conditions. This continued absence suggests the species is unlikely to be persisting locally at present. The fifth and final survey should be completed as required by the management plan before corrective actions are recommended (Table 6). No further pond modifications or remedial actions are recommended unless records are confirmed in the general area during survey five.

Table 6: Contingency table for green-thighed frog monitoring program at WC2NH.

Problem	Triggered	Corrective Action	Proposed Action
Absence of green-thighed frogs from constructed pond sites	Yes	Implement additional surveys of adjacent areas to confirm frogs remain in the general area, then review and, if necessary, modify pond design to address site-suitability problems	Since the 2021 surveys, monitoring has been expanded to include forest trails, roadside drains and other inundated habitats within a 2 km radius of the reference site. Despite these efforts, no green-thighed frogs have been detected, suggesting either an extremely low population density or local absence. Consequently, no further action is proposed at this stage and expanded surveys in these areas are to continue in survey 5.
Ponds not holding water long enough	Yes	Review pond performance and, if necessary, modify ponds by installing a semi-	The lack of green-thighed frog tadpoles, appears to be a result of an absence of a breeding population within the broader study

Problem	Triggered	Corrective Action	Proposed Action
to enable tadpole metamorphosis		permeable liner or undertaking further excavation	area. Pond suitability is a secondary issue and no further action is warranted at this stage unless a population is confirmed within the general area.
Ponds holding water for too long (becoming semi-permanent)	Yes	Improve drainage so that ponds dry out within the prescribed ephemeral window	Same as above
Exotic fish fauna recorded in breeding ponds	No	Improve drainage to ensure the pond dries out and prevents fish establishment	NA

6. References

Lewis, B. D. (2013). Pacific Highway Upgrade: Warrell Creek to Urunga green-thighed frog management strategy. Report prepared by Lewis Ecological Surveys for NSW Roads and Maritime Services.

RMS (2018). Warrell Creek to Nambucca Heads Operational Ecological and Water Quality Monitoring Brief. NSW Government.

Sandpiper Ecological (2020). Pacific Highway Upgrade, Warrell Creek to Nambucca Heads: Green-thighed Frog Monitoring Report, year two operational phase. Report prepared for Transport for NSW.

Sandpiper Ecological (2021). Pacific Highway Upgrade, Warrell Creek to Nambucca Heads: Green-thighed Frog Monitoring Report, year three operational phase. Report prepared for Transport for NSW.

Sandpiper Ecological (2022). Pacific Highway Upgrade, Warrell Creek to Nambucca Heads: Green-thighed Frog Monitoring Report, year four operational phase. Report prepared for Transport for NSW.

Sandpiper Ecological (2024). Pacific Highway Upgrade, Warrell Creek to Nambucca Heads: Green-thighed Frog Monitoring Report, year five operational phase. Report prepared for Transport for NSW.