FLEAY'S BARRED FROG (*MIXOPHYES FLEAYI*) BASELINE SURVEY APRIL 2017

SCENIC RIM TRAIL

Prepared for
Gainsdale Pty Ltd



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FLEAY'S BARRED FROG (*Mixophyes fleayi*) BASELINE SURVEY

SCENIC RIM TRAIL, MAIN RANGE

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Table of Abbreviations

BAAM	Biodiversity Assessment and Management Pty Ltd
DPEMP	Development Proposal and Environmental Management Plan
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
NC Act	Queensland Nature Conservation Act 1992

1.0 INTRODUCTION

The Scenic Rim Trail – Thornton Trailhead to Spicers Peak Nature Refuge Development Proposal and Environmental Management Plan (DPEMP) committed to monitoring stream condition, threatened frogs, and the occurrence of chytrid fungus (*Batrachochytrium dendrobatidis*) at locations where new sections of trail cross perennial watercourses within Main Range National Park. This monitoring is to include a baseline survey (in summer or early autumn) to establish the baseline condition and status of populations of Fleay's Barred Frog (*Mixophyes fleayi*) listed as an endangered species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Furthermore, the Commonwealth Department of Environment and Energy (DoEE) request for further information dated 30 March 2017 requested that preliminary documentation for the project include:

- map/s of all Fleay's Barred Frog habitat, and a calculation of the area of Fleay's Frog habitat, within and adjacent to the entire project site; maps and area of habitat calculations are to be based on field surveys conducted by a suitably qualified ecologist in accordance with appropriate methodologies;
- an estimate of the abundance of Fleay's Barred Frogs in the habitat identified, based on field surveys conducted in accordance with appropriate methodologies by a suitably qualified ecologist;
- an assessment of the quality of Fleay's Barred Frog habitat based on field surveys conducted in accordance with appropriate methodologies by a suitably qualified ecologist; and
- an assessment of the extent, nature, and severity of current threats (including the presence of chytrid fungal disease and feral pigs) to Fleay's Barred Frog across the extent of mapped habitat, based on field surveys conducted in accordance with appropriate methodologies by a suitably qualified ecologist, and with consideration of the *Recovery plan for stream frogs of south-east Queensland 2001-2005* (Hines and the South-east Queensland Threatened Frogs Recovery Team 2002).

The proposed new sections of walking trail generally follow ridges along the edges of the mountain range, but descend to cross perennial streams that provide potentially suitable breeding habitat for Fleay's Barred Frog at two locations in Main Range National Park:

- A proposed shortcut between the Winder management track and the Mt Castle West Fire-line track will cross a headwater tributary of Blackfellow Creek; and
- The proposed crossing point of a headwater tributary of Dalrymple Creek to link with the existing Cascades Trail.

The baseline survey for Fleay's Barred Frog is therefore focussed on these two locations.

2.0 FIELD SURVEY APPROACH

2.1 SURVEY METHODS BACKGROUND

Fleay's Barred Frog breeding males are known to call actively within the period September to March; therefore, any survey based on detecting the advertisement calls of males of this species should be conducted within this time period, but not during heavy rainfall or strong stream flow (Commonwealth of Australia 2010), since stream-breeding frogs do not generally call during heavy rainfall or strong stream flow conditions. The Commonwealth survey guidelines recommend that survey methods include call playback and spotlighting while walking transects along the stream (minimum transect length of 200 m) for a minimum of two nights under conditions when the ground is wet following recent rainfall (Commonwealth of Australia 2010).

Chytrid fungus (*Batrachochytrium dendrobatidis*) has been proposed as the primary cause of decline or extinction in a number of frogs in Australia, particularly species associated with cooler, higher-altitude habitats (Hero *et al.* 2006). Chytrid fungus has been detected in a variety of frogs at several locations in Main Range National Park, and chytrid fungus is now expected to be endemic in in the upper headwater streams in Main Range National Park (Dr Harry Hines, personal communication).

2.2 SURVEY APPROACH

The survey methods proposed to be undertaken during the threatened frog survey were as follows:

- timing the frog survey to occur within one week of rainfall;
- conducting frog and tadpole surveys on 200 m long transects along each of the two focal streams, including one transect downstream of each proposed crossing point and one to two transects upstream of each proposed crossing point;
- surveying calling male frogs by walking slowly along the banks of creeks at night, searching for the reflected eye-shine of frogs using head-mounted spotlights, pausing to conduct call-playback for Fleay's Barred Frog and other frog species approximately every 25 m, and recording the locations of all calling males frogs or other frog observations using a hand-held GPS;
- surveying the presence and relative abundance of Fleay's Barred Frog tadpoles during the day, using dip-netting in pools to capture tadpoles for species identification, collecting swabs from the skin of tadpoles for testing for the occurrence of chytrid fungus, and recording the total number of tadpoles rising to the surface of pools per 10 minute survey;
- assessing stream bank condition and water quality via a rapid assessment for habitat attributes using field sheets based on the State of the Rivers survey methods (Parsons *et al.* 2002). Water quality (pH, temperature and electrical conductivity) was measured just below the surface using Oakton waterproof testing pens (Eutech instruments), which had been calibrated on the day of testing. Dissolved oxygen was measured using a CHEMets® Kit-7512 and compared to a standard scale on site.

2.3 TESTING FOR THE PRESENCE OF CHYTRID FUNGUS

Swab samples were collected from five Fleay's Barred Frog tadpoles in each of the two streams surveyed. These samples were sent to Cesar Laboratories for testing for the presence of chytrid fungus spores. DNA was extracted from each swab sample and then tested in triplicate as per the real-time Taqman PCR assay method of Boyle *et al*. (2004), with total amounts of zoospores within a swab extraction estimated using a known zoospore standard. There are three results possible: Positive for chytrid (all 3 replicates test positive), Negative for chytrid (all 3 replicates test negative) and Equivocal (1 or 2 positives out of 3 replicates).

2.4 LITERATURE REVIEW

The published literature relating to the ecology and conservation of Fleay's Barred Frog was reviewed to inform the field survey methodology and assessment of conservation status and current and emerging threats.

3.0 RESULTS AND DISCUSSION

3.1 SPECIES PROFILE FOR FLEAY'S BARRED FROG

Status: EPBC Act: Endangered; NC Act: Endangered.

Distribution: Fleay's Barred Frog is narrowly distributed from the Conondale Range in south-east Queensland south to Yabba Scrub in north-eastern New South Wales (Hines *et al.* 1999). Populations in the Conondale Ranges declined in the 1970's and the species was thought to be lost from the area since 1990-91 (Ingram and McDonald 1993). However, more recent surveys have located the species in the upper reaches of neighbouring streams but it appears to still be absent from lower reaches (Hines *et al.* 1999). Populations from Mount Tamborine and the Bunya Mountains now seem to be extinct (Curtis *et al*. 2012), but population densities in the Border Ranges have recovered following initial declines due to chrytrid fungus infection (Newell *et al*. 2013, Quick *et al.* 2015).

Habitat and Ecology: Inhabits montane rainforest and adjoining tall open forests along lotic streams in which the species breeds (Curtis *et al*. 2012). Most records occur above 400 m, but they can be located in streams as low as 200 m (Goldingay *et al.* 1999).Typically found close to its breeding habitat along rainforests streams, but individuals, particularly adult females, can sometimes be located several hundred metres from breeding habitat, including along ridge tops in rainforest (Doak 2005).

Males call while perched on emergent rocks or on the nearby bank. Breeding occurs between July and April. Eggs are deposited in "nests" constructed in the shallow riffle zone of gently flowing streams. The nest consists of a shallow excavation in the stream bed or eggs are pasted directly onto bed rock. Unlike many frogs, *M. fleayi* does not appear to breed during and immediately after heavy rain. Rather the species breeds shortly after stream flow has slowed. This is presumably to avoid the threat of nests and tadpoles being washed downstream during high flow events (Stratford *et al*. 2010, Knowles *et al.* 2014).

Threats: Unclear, although the following possible processes have been suggested (Eyre *et al.* 1997; Hines *et al.* 1999, Curtis *et al*. 2012):

- Increased mortality due to the exotic pathogen, *Batrachochytrium* (chytrid fungus) is a strongly suspected cause of the population decline of Fleay's Barred Frog. *M. fleayi* suffering from chytrid fungus have been located at various locations (Berger *et al.* 1999).
- Loss and fragmentation of habitat;
- Habitat degradation, particularly of breeding sites due to disturbance by cattle and pigs leading to increased sedimentation of breeding habitat;
- Weed invasion (e.g. Mist Weed *Agerata riparia*) of riparian habitat potentially degrading breeding sites; and
- Predation by feral animals.

3.2 SURVEY CONDITIONS

The nocturnal survey of upper Blackfellow Creek was undertaken over a period of 2.5 hours from 18:20 to 20:50 on the evening of 20th March 2017. Steady rainfall was experienced from around 15:00 and throughout the survey period, with rainfall intensity increasing for a short period in the half hour before the survey started, which precipitated a rapid temporary rise in the flow of water in the creek itself. Despite the rainfall, the air temperature was relatively warm due to the cloud cover, leading to warm, wet and humid conditions that were ideal for a nocturnal survey of frogs.

The nocturnal survey of upper Dalrymple Creek was undertaken over a period of 2 hours from 18:20 to 20:30 on the evening of 21st March 2017 in heavily overcast conditions with an occasional light shower and relatively warm, humid conditions that were ideal for a nocturnal survey of frogs.

Rainfall preceding the survey included 48 mm recorded over the two days 13-14 March and approximately 100 mm recorded over 24 hours on 20-21 March at the Mount Castle rain-gauge.

3.3 STREAM HABITAT CONDITION

There was little disturbance at any of the stream condition assessment sites (see **Appendix A** for details), and vegetation cover was high, including beds of *Elatostema reticulatum* and *Pollia*

crispata along the stream banks that are indicative of perennially damp soils. There were no weed species detected along the length of the creeks surveyed at both crossing points, which occur within remnant rainforest habitat characterised as Regional Ecosystem (RE) 12.8.4 (Complex notophyll vine forest with *Araucaria* spp. on Cainozoic igneous rocks). Water levels and flows were relatively high during the survey, due to recent high rainfall. In-stream substrate consisted mainly of bedrock and large boulders and cobbles.

The water quality measured in both creeks (see **Table 3.1**) was considered normal for the location and time of the survey. pH was near neutral, and temperature between 17.6 and 18.1 C. The low electrical conductivity and high concentration of dissolved oxygen are indicative of high rainfall and flow conditions.

Table 3.1. Water quality measured in Dalrymple and Blackfellow Creeks, both upstream and downstream of the proposed new trail crossing points, on 21 March 2017

Parameter	Site			
	Dalrymple Upstream (DUS4)	**Dalrymple Downstream (DDS4)**	**Blackfellow Upstream (BCUS4)**	**Blackfellow Downstream (BCDS4)**
pH	7.3	7.2	7.1	7.5
Temperature °C	17.8	18.1	17.6	17.6
Electrical Conductivity (µS)	80	80	50	50
Dissolved oxygen (mg/L)	10	10	8 – 10	7 – 8

The proposed crossing point of Blackfellow Creek is on a narrow, shallow, run and riffle section of the creek with gently sloping banks on either side vegetated with *Elatostema reticulatum* (see **Photos 3.1** and **3.2**). The upper reaches of this Creek in the vicinity of the proposed crossing point have small, shallow pools (see **Photo 3.1** for example) interspersed with run-and-riffle sections that provide ideal breeding habitat for Fleay's Barred Frog. There was no evidence of feral pig diggings along Blackfellow Creek, but there were abundant fresh feral pig diggings along the Winder Track above the proposed new trail section and ranger staff had installed a pig trap further down the Winder Track. There had been no evidence of feral pigs in this area during the 2016 survey, illustrating the ongoing influx of feral pigs into Main Range National Park from the eastern escarpment edge.

Photo 3.1 Small pool immediately upstream of proposed crossing point on Blackfellow Creek.

Photo 3.2 Narrow run and riffle section at the proposed crossing point of Blackfellow Creek.

The proposed crossing point of a minor tributary of Dalrymple Creek is on a rock platform in shallow water below a small waterfall approximately 20 m above the junction of the tributary with Dalrymple Creek itself (see **Photos 3.3** and **3.4**). The banks on either side of the crossing point are composed of rock, and the proposed new trail approach from the eastern side would be via a relatively steep slope. The confluence of the tributary with Dalrymple Creek comprises a shared waterfall into a deep pool with vertical banks on either side. Due to these impediments to access immediately downstream of the confluence, the 'downstream' survey was undertaken on the section of Dalrymple Creek upstream of the confluence with the tributary.

Photo 3.3 View upstream from the proposed crossing point (rock platform at centre of photo) on Dalrymple Creek tributary.

Photo 3.4 View downstream from the proposed crossing point (at centre of photo) on Dalrymple Creek tributary, with the confluence with Dalrymple Creek in the distant background.

3.4 FROG SURVEY RESULTS

3.4.1 Blackfellow Creek Section

No frogs were heard calling or responded to call-playback during the nocturnal spotlighting survey. However, this survey was undertaken during steady rain and in conditions of strong stream flow; therefore frogs were not expected to be calling or responding to call-playback. Yet, the survey conditions were ideal for detecting frogs foraging, and a total of seven Fleay's Barred Frogs (**Photo 3.5**) were detected at several locations along upper Blackfellow Creek above the proposed crossing point (see **Figure 3.1** and **Appendix B** for location details). These frogs tended to be found on level, more open ground within 30 m of the creek banks and were all exhibiting foraging behaviour. No other frogs were detected in the vicinity of the creek, but a single Black-soled Frog (*Lechriodus fletcheri*) (**Photo 3.6**) was found on the lower Winder Track and several large Cane Toads (*Bufo marinus*) were detected along the upper Winder Track, particularly where the Winder Track passed through a eucalypt forest/rainforest ecotone near the Mount Castle lookout carpark. The abundance of Fleay's Barred Frog (frogs per hour survey effort) was measured as 4 frogs/hr along the creek itself (1.75 hrs survey effort) and 0 frogs/hr on the rainforest slopes and ridgeline (0.75 hrs survey effort).

The relatively turbid waters and strong stream flow did not provide suitable conditions to survey the relative abundance of *Mixophyes* tadpoles. However, dip-netting confirmed that *Mixophyes* tadpoles occurred relatively abundantly in all the small pools along the length of the creek surveyed, both above and below the proposed creek crossing point, confirming the suitability of the creek for Fleay's Barred Frog breeding.

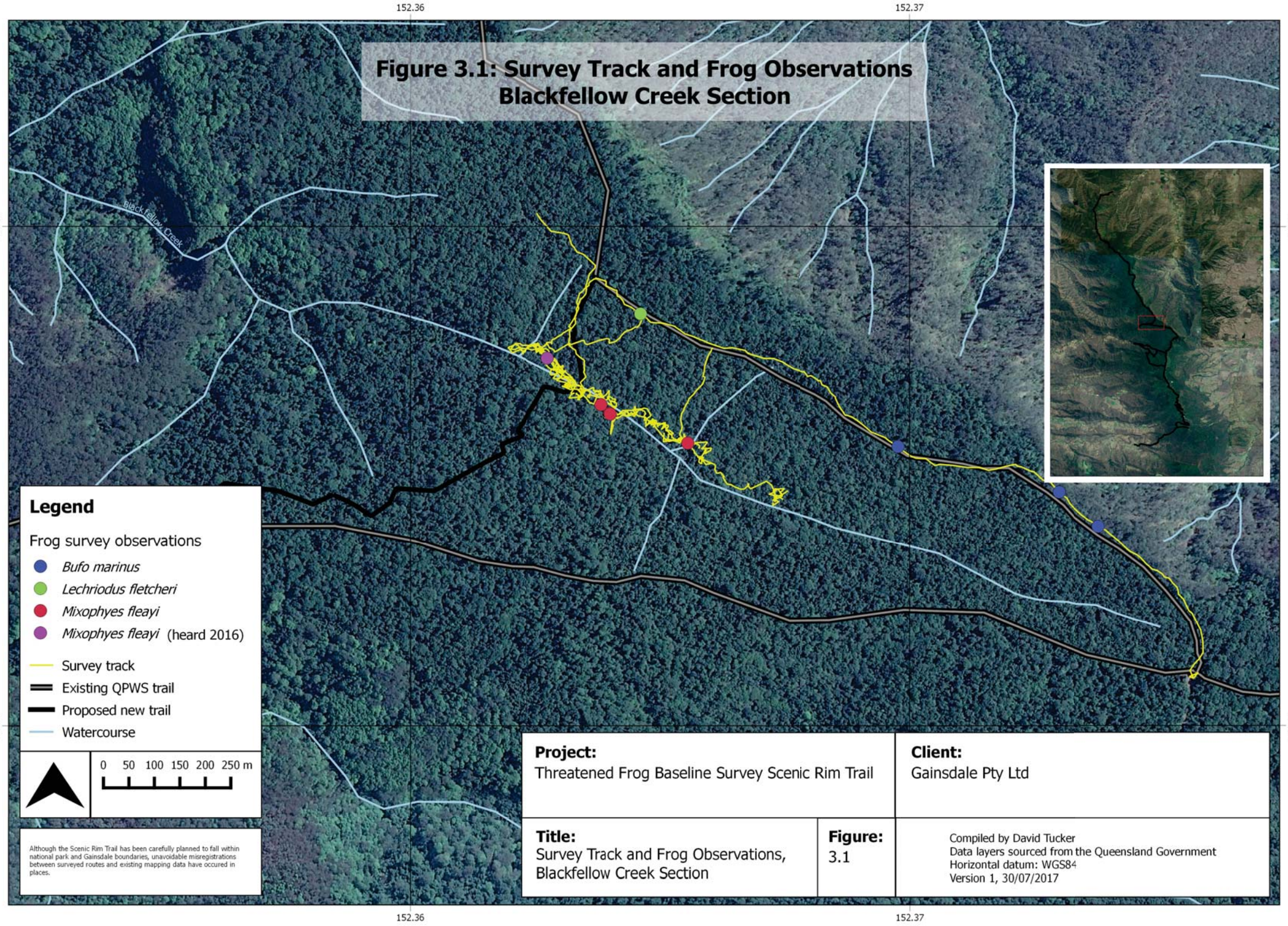
Figure 3.1: Survey Track and Frog Observations
Blackfellow Creek Section
152.36
152.37
-27.96
-27.97
Black Fellow Creek
Legend
Frog survey observations
Bufo marinus
Lechriodus fletcheri
Mixophyes fleayi
Mixophyes fleayi (heard 2016)
Survey track
Existing QPWS trail
Proposed new trail
Watercourse
0 50 100 150 200 250 m
Although the Scenic Rim Trail has been carefully planned to fall within national park and Gainsdale boundaries, unavoidable misregistrations between surveyed routes and existing mapping data have occured in places.
Project:
Threatened Frog Baseline Survey Scenic Rim Trail
Client:
Gainsdale Pty Ltd
Title:
Survey Track and Frog Observations, Blackfellow Creek Section
Figure:
3.1
Compiled by David Tucker
Data layers sourced from the Queensland Government
Horizontal datum: WGS84
Version 1, 30/07/2017

Photo 3.5 Fleay's Barred Frog (*Mixophyes fleayi*) on an open bank of Blackfellow Creek.

Photo 3.6 Black-soled Frog (*Lechriodus fletcheri*) on the Winder Track above Blackfellow Creek.

3.4.2 Dalrymple Creek Section

No frogs were heard calling or responded to call-playback during the nocturnal spotlighting survey. However, survey conditions were ideal for detecting frogs actively foraging. Two frogs were detected on the side tributary upstream of the proposed new creek crossing point, a single Eastern Stony Creek Frog (*Litoria wilcoxii*) on a rock in the creek approximately 150 m upstream of the proposed crossing point, and a single Fleay's Barred Frog (**Photo 3.7**) active on the rock platform at the proposed crossing point itself (see **Figure 3.2** and **Appendix B** for location details). A further one Fleay's Barred Frog was found on the bank of Dalrymple Creek upstream of the confluence with the tributary and a further 42 Fleay's Barred Frogs were located along the length of the Cascades walking trail between the proposed crossing point and the Manna Gum campground downstream of the proposed new crossing point, together with several more Eastern Stony Creek Frogs (**Photo 3.8**) and a single Grey Bellied Pobblebonk (*Limnodynastes dumerilii*). The Fleay's Barred Frogs appeared to have focussed their foraging activity along the Cascades public walking trail to exploit the more open nature of the ground layer along the trail, and were found up to 50 m from the banks of Dalrymple Creek.

The abundance of Fleay's Barred Frog (frogs per hour survey effort) was measured as 3 frogs/hr along the creek survey sections (40 min survey effort) and 31.5 frogs/hr along the Cascades Trail (80 min survey effort).

Photo 3.7 Fleay's Barred Frog (*Mixophyes fleayi*) on damp rock platform on Dalrymple Creek tributary.

Photo 3.8 Eastern Stony Creek Frog (*Litoria wilcoxii*) on a rock in Dalrymple Creek.

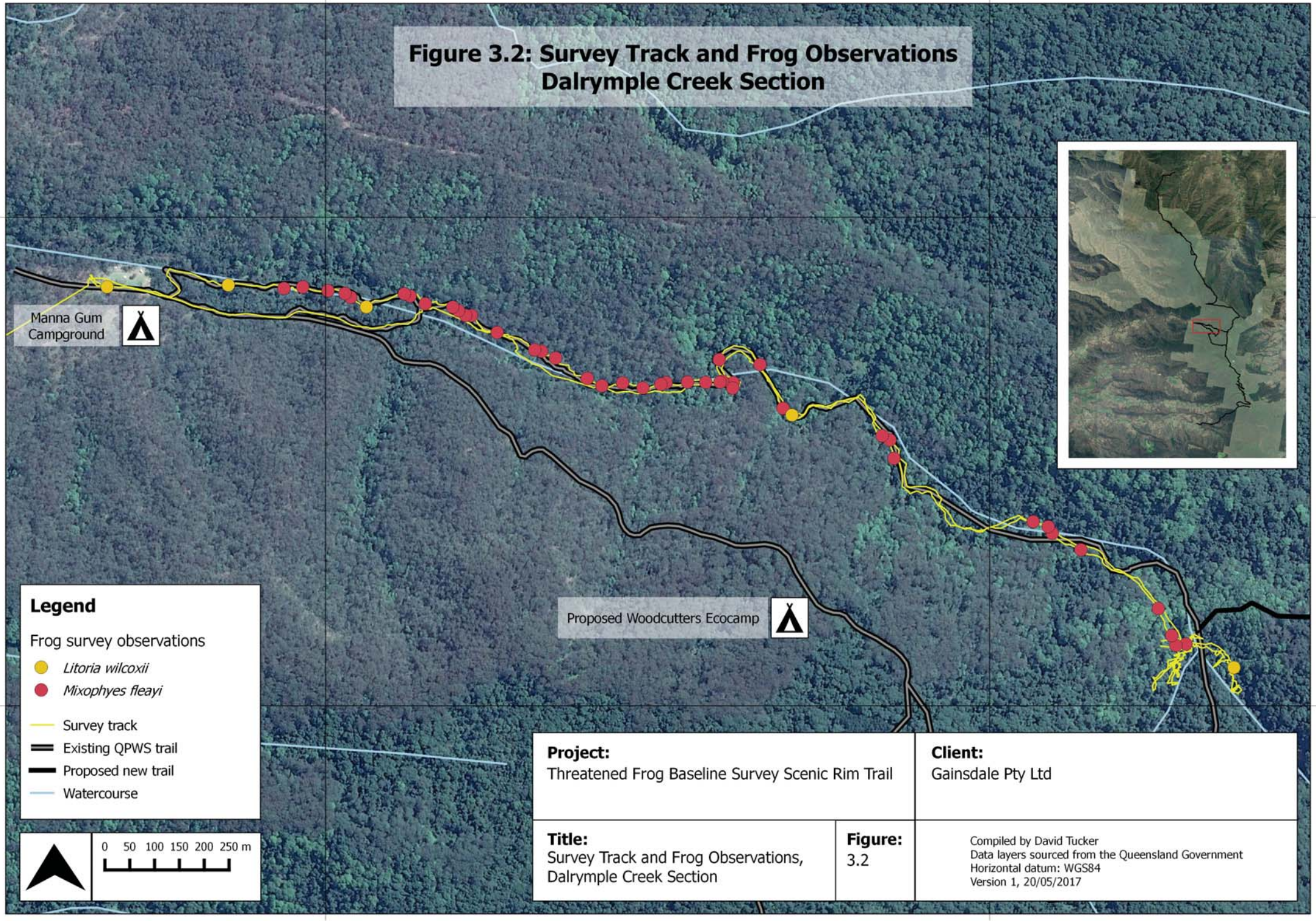
Figure 3.2: Survey Track and Frog Observations
Dalrymple Creek Section
152.35
152.36
-27.98
-27.99
Manna Gum
Campground
Proposed Woodcutters Ecocamp
Legend
Frog survey observations
Litoria wilcoxii
Mixophyes fleayi
Survey track
Existing QPWS trail
Proposed new trail
Watercourse
0 50 100 150 200 250 m
Project:
Threatened Frog Baseline Survey Scenic Rim Trail
Client:
Gainsdale Pty Ltd
Title:
Survey Track and Frog Observations,
Dalrymple Creek Section
Figure:
3.2
Compiled by David Tucker
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Horizontal datum: WGS84
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The relatively turbid waters and strong stream flow did not provide suitable conditions to survey the relative abundance of *Mixophyes* tadpoles. However, dip-netting confirmed that *Mixophyes* tadpoles occurred relatively abundantly in all the pools along the length of the creek surveyed, both above and below the proposed creek crossing point; the section of Dalrymple Creek sampled includes multiple in-stream crossings of the creek by the existing Cascades Trail public walking trail, demonstrating that the existing public walking trail has not prevented Fleay's Barred Frog breeding in this location.

3.5 CHYTRID FUNGUS SURVEY RESULTS

Of the five samples collected from tadpoles in Blackfellow Creek, two tested positive for chytrid fungus (all three replicates tested positive), two were equivocal (1 to 2 replicates tested positive) and one tested negative (all three replicates tested negative). Of the five samples collected from tadpoles in Dalrymple Creek and its tributary, one tested positive and four tested negative for chytrid fungus (see **Appendix C** for the laboratory results in their original form). These results confirm the presence of chytrid fungus in both the Blackfellow and Dalrymple catchment systems.

3.6 MAPPING SUITABLE HABITAT FOR FLEAY'S BARRED FROG

The quality of potential breeding habitat for Fleay's Barred Frog was assessed as high quality in terms of both stream habitat condition and water quality at both sites (see **Section 3.2**). This conclusion is supported by the presence of adult Fleay's Barred Frogs and relative abundance of Fleay's Barred Frog tadpoles in all the pools of the streams (see **Section 3.3**). The perennial streams of upper Blackfellow Creek and Dalrymple Creek, including a 40 m wide corridor centred on the middle of the stream beds, therefore meet the definition of habitat critical for breeding of Fleay's Barred Frog in accordance with the *Recovery plan for stream frogs of south-east Queensland 2001-2005* (Hines and the South-east Queensland Threatened Frogs Recovery Team 2002).

Radio-tracking studies have demonstrated that male Fleay's Barred Frogs rarely move more than 20 m from perennial rainforest streams that serve as breeding habitat, but females range more widely across the rainforest landscape and can be found foraging in suitable rainforest habitat along ridge-tops hundreds of metres from the nearest stream, where they favour foraging along cleared roads and walking tracks (Doak 2005).

Suitable breeding habitat for Fleay's Barred Frog in proximity to the proposed new trail sections is restricted to within 20 m of the banks of perennial streams with alternating pool and riffle zones, as mapped in **Figures 3.3** and **3.4** for the Blackfellow Creek and Dalrymple Creek sections respectively, noting that watercourse locations mapped in **Figures 3.3** and **3.4** are identified on the basis of Queensland Government watercourse mapping, which may not accurately reflect the on-ground locations due to spatial inaccuracies in the watercourse mapping.

Suitable foraging habitat for Fleay's Barred Frog in proximity to the proposed new trail sections includes all rainforest habitat.

3.7 EXTENT, NATURE, AND SEVERITY OF CURRENT THREATS

Current threats to Fleay's Barred Frog within the areas subject to this assessment include chytrid fungus and feral pigs. The testing for chytrid fungus confirmed that this pathogen is already present within the Blackfellow Creek and Dalrymple Creek catchments, as originally anticipated. Given the relatively high abundance of adult frogs and tadpoles detected during the surveys, it is likely that Fleay's Barred Frog populations in the Blackfellow Creek and Dalryple Creek catchments have recovered following the initial impacts of chytrid fungus, as has been documented elsewhere in the range of Fleay's Barred Frogs (Newell *et al.* 2013, Quick *et al.* 2015).

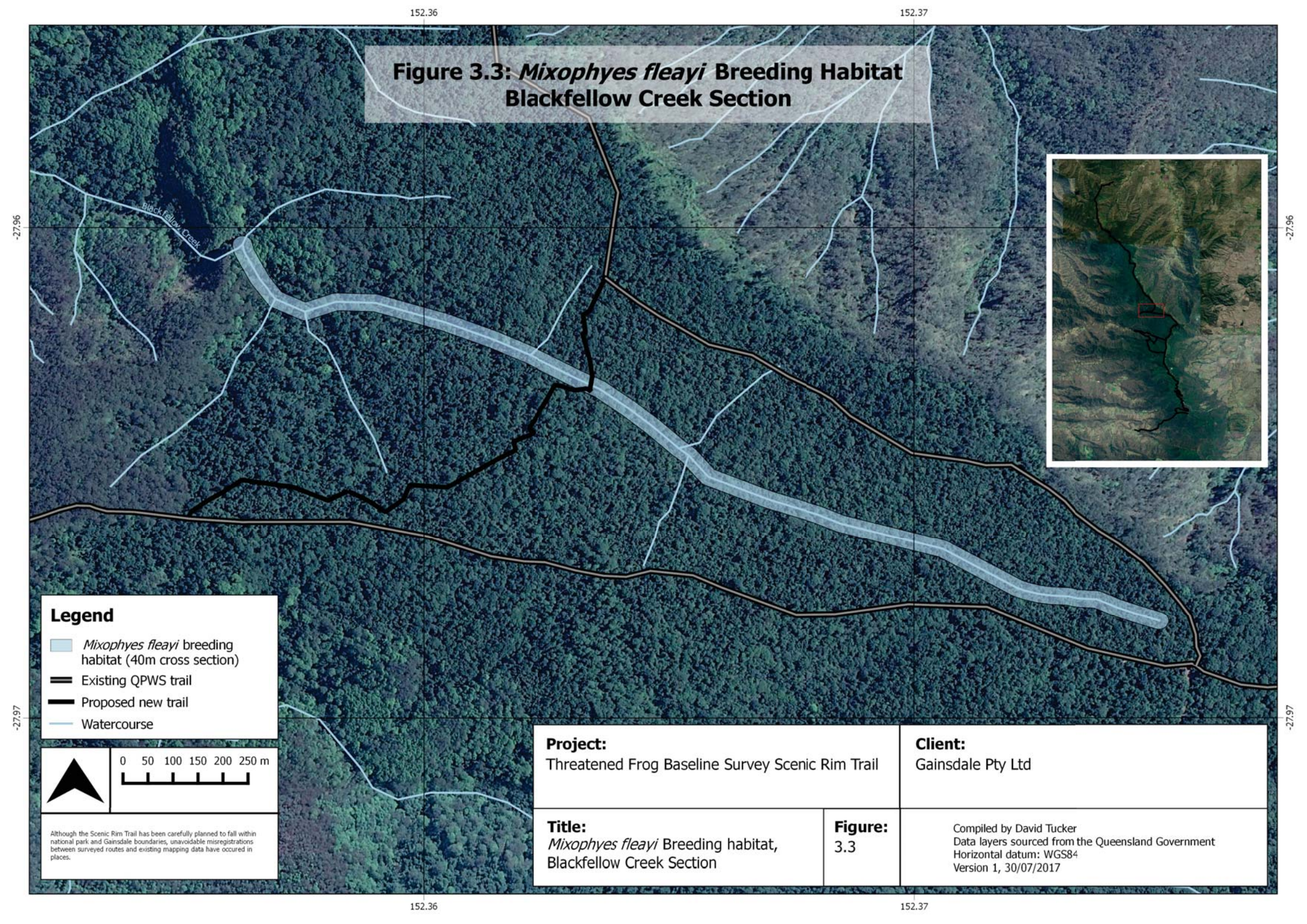
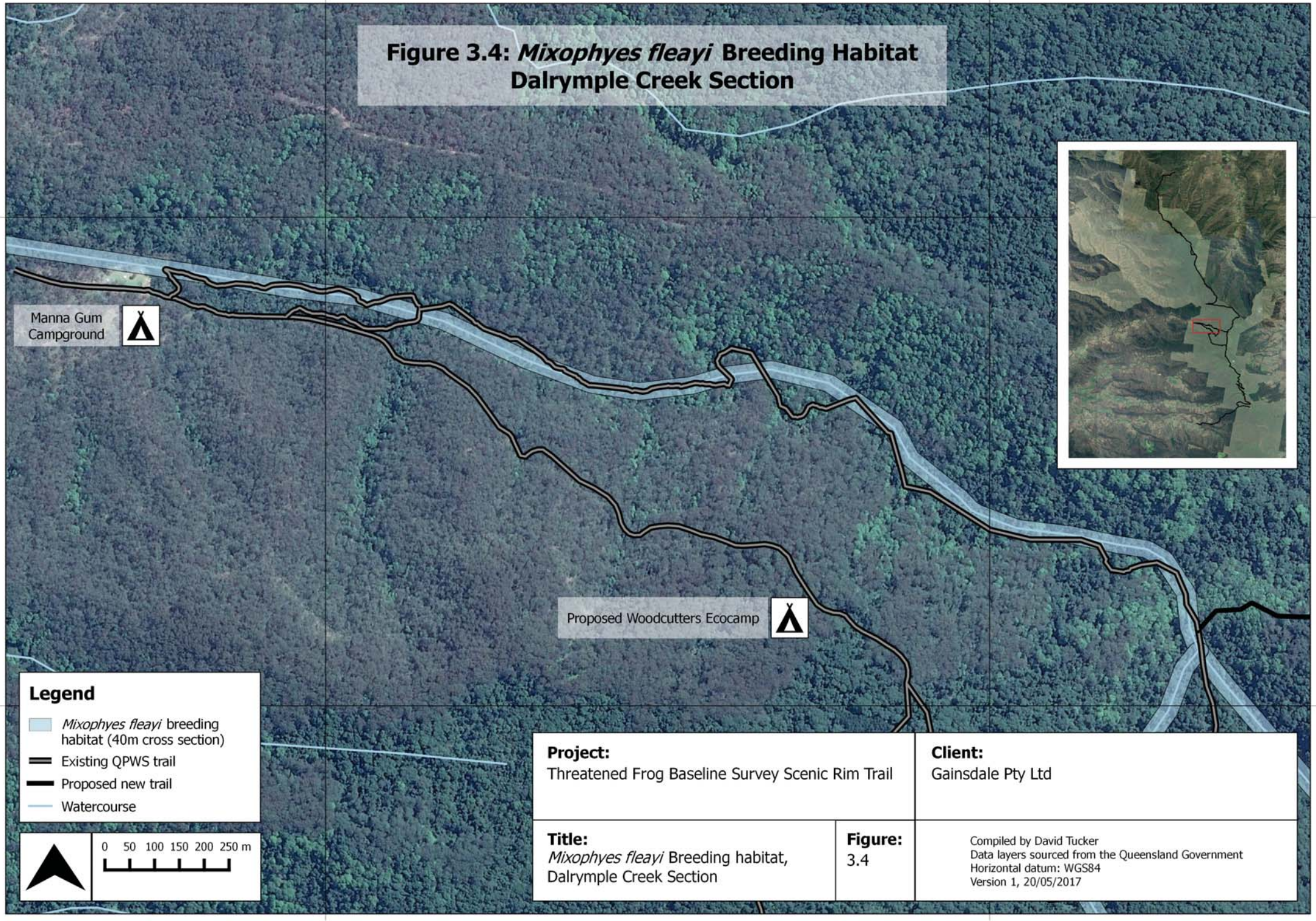


Figure 3.3: *Mixophyes fleayi* Breeding Habitat
Blackfellow Creek Section
152.36
152.37
-27.96
-27.97
Black Fellow Creek
Legend
Mixophyes fleayi breeding habitat (40m cross section)
Existing QPWS trail
Proposed new trail
Watercourse
0 50 100 150 200 250 m
Although the Scenic Rim Trail has been carefully planned to fall within national park and Gainsdale boundaries, unavoidable misregistrations between surveyed routes and existing mapping data have occured in places.
Project:
Threatened Frog Baseline Survey Scenic Rim Trail
Client:
Gainsdale Pty Ltd
Title:
Mixophyes fleayi Breeding habitat, Blackfellow Creek Section
Figure:
3.3
Compiled by David Tucker
Data layers sourced from the Queensland Government
Horizontal datum: WGS84
Version 1, 30/07/2017

Figure 3.4: *Mixophyes fleayi* Breeding Habitat Dalrymple Creek Section



Project: Threatened Frog Baseline Survey Scenic Rim Trail	**Client:** Gainsdale Pty Ltd
Title: *Mixophyes fleayi* Breeding habitat, Dalrymple Creek Section	**Figure:** 3.4

Compiled by David Tucker
Data layers sourced from the Queensland Government
Horizontal datum: WGS84
Version 1, 20/05/2017

Damage from feral pigs was first detected in Main Range National Park in 2001, at both Cunningham's Gap and Mount Mistake (Hines and the South-east Queensland Threatened Frogs Recovery Team 2002). During the preliminary survey in November 2016, feral pigs were relatively abundant at Mount Mistake, but the only other evidence of feral pig damage was detected on the escarpment edge well south of Sylvester's Lookout. Notably, no evidence of feral pigs was detected on the Winder Track close to the escarpment edge in November 2016. However; during the current survey, fresh feral pig diggings were abundant along the Winder Track, but there was no evidence of feral pig damage along upper Blackfellow Creek just 200 m downslope from the feral pig damage along the Winder Track. Furthermore, no evidence of feral pigs was detected along Dalrymple Creek. These observations confirm ongoing invasion of feral pigs into Main Range National Park from the escarpment edge. While feral pigs do not appear to have caused damage to Fleay's Barred Frog breeding habitat along upper Blackfellow Creek and Dalrymple Creek, damage can be expected to occur in the future unless sustained feral pig control is undertaken.

4.0 REFERENCES

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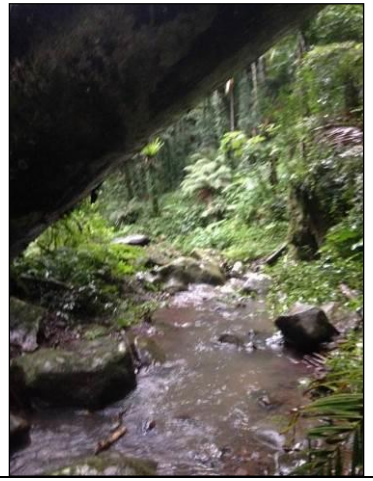
APPENDIX A

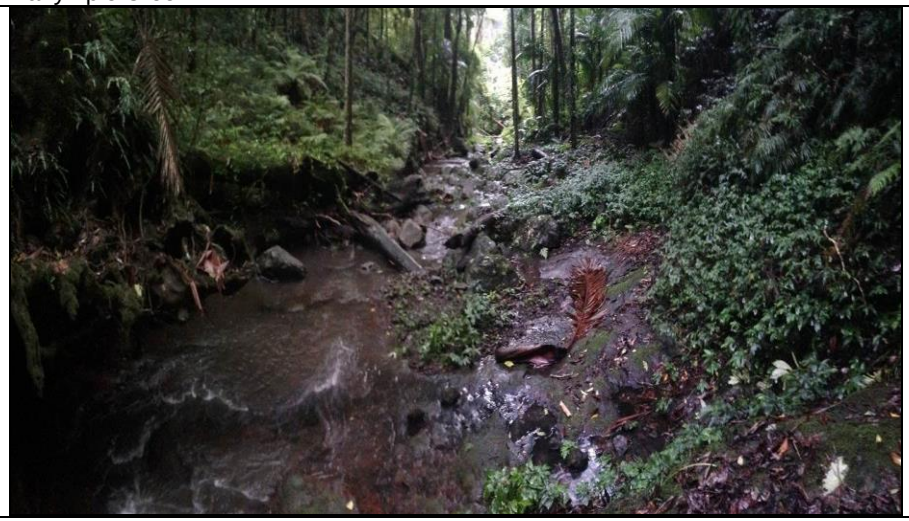
Stream habitat assessment results

Site	Dalrymple Creek, DUS4			**Waterway**	
Date surveyed:	22/03/2017			Tributary on eastern side of Dalrymple Creek	
					
Upstream				Downstream	
Channel Morphology		**Substrate**		**Aquatic Habitat in Reach**	
Stream order	NA	**Composition**	bedrock 80%	**Habitat present**	shallow and deep pools, run and riffle, undercut bank, large woody debris,
Waterway classification	Upper Tributary		boulder 5%		large boulders, small pools on bank after high flow event
Pattern	irregular		cobble 5%	**Disturbance of habitat**	very low
			pebble 5%	**Bank description**	
			gravel 5%		**Left Bank** / **Right Bank**
Hydrology			sand 0%	**Average height**	3 m / 1.5 m
Flow regime	perennial		silt / clay 0%	**Slope**	vertical, steep / moderate, low
Water level	moderate – high		**Total 100%**	**Shape**	wide lower bench / wide lower bench
Water depth	0.3 m			**Stability**	high / high
Wetted width	2 m	**Deposits**	sand		
Flow	moderate – fast	**Bed stability**	bed stable	**Weed species**	none
Discharge	1 m/s				
Channel width	5 m			**Adjacent land use**	National park Walking track (Cascade track) on western side (left bank)

Comments: The site is upstream of the proposed walking track crossing on Dalrymple Creek, on a tributary on the eastern side of Dalrymple Creek. The left bank is steep and relatively high, with exposed roots and an undercut bank. Large trees have fallen across this section of the creek. Small pools and sandy deposits have formed behind large obstructions (boulders) after a recent (<24h) rain event. The vegetation along this creek consists of rainforest trees, ferns and creeping undergrowth. The native herbaceous plants *Pollia crispata* and *Elatostema reticulatum* (rainforest spinach) are common on the creek banks, the latter forming small beds. The bed and bank stability are high despite recent high rains and flows.

Site	Dalrymple Creek, Proposed Crossing			**Waterway**	
Date surveyed:	21/03/2017			Confluence of tributary on eastern side and Dalrymple Creek	
					
Upstream				Downstream	
Channel Morphology		**Substrate**		**Aquatic Habitat in Reach**	
Stream order	NA	**Composition**	bedrock 70%	**Habitat present**	shallow pool, run and riffle, large woody debris, macrophytes
Waterway classification	Upper Tributary		boulder 10%		large boulders, cascades and waterfall
Pattern	irregular		cobble 10%	**Disturbance of habitat**	very low
			pebble 10%	**Bank description**	
			gravel 0%		**Left Bank** / **Right Bank**
Hydrology			sand 0%	**Average height**	3 m / 3 m
Flow regime	perennial		silt / clay 0%	**Slope**	vertical, steep / vertical, steep
Water level	moderate – high		**Total 100%**	**Shape**	wide lower bench / wide lower bench
Water depth	0.5 m			**Stability**	high / high
Wetted width	3.6 m	**Deposits**	none		
Flow	moderate	**Bed stability**	bed stable	**Weed species**	none
Discharge	0.5 m/s				
Channel width	4 m			**Adjacent land use**	National park Walking track (Cascade track) on western side (left bank)

Comments: The site is the proposed crossing of an additional walking track in Main Range National Park, at the confluence of a tributary of Dalrymple Creek, with the tributary entering the main creek from the southeast. The site is characterised by steep banks, cascades and waterfalls upstream and downstream, and shallow pool habitat. The banks are steep with a wide flat bench and exposed bedrock. Large woody debris and some macrophytes are present. The dominant vegetation on this site is thick native rainforest, with a fallen tree on the main creek downstream of the confluence creating a break.

Site	Dalrymple Creek, DDS4			**Waterway**	
Date surveyed:	22/03/2017			Dalrymple Creek	
					
Upstream				Downstream	
Channel Morphology		**Substrate**		**Aquatic Habitat in Reach**	
Stream order	NA	**Composition**	bedrock 60%	**Habitat present**	shallow and deep pools, run and riffle, small woody debris, large boulders, macrophytes (*E. reticulatum*, *P. crispata*)
Waterway classification	Upper Tributary		boulder 20%		
Pattern	irregular		cobble 10%	**Disturbance of habitat**	very low
			pebble 5%	**Bank description**	
			gravel 5%		**Left Bank** / **Right Bank**
Hydrology			sand 0%	**Average height**	5 m / 3 m
Flow regime	perennial		silt / clay 0%	**Slope**	vertical, steep, moderate / steep, moderate, low
Water level	moderate		**Total 100%**	**Shape**	stepped / wide lower bench
Water depth	0.5 m			**Stability**	high / high
Wetted width	4.5 m	**Deposits**	none		
Flow	moderate	**Bed stability**	bed stable	**Weed species**	none
Discharge	1 m/s				
Channel width	15 m			**Adjacent land use**	National park Walking track on eastern side (right bank)

Comments: The site is on the main arm of Dalrymple Creek, downstream of the proposed crossing, and upstream of an existing crossing of the Cascades track. The left bank is shallower than at site DUS4, but steeper than the right bank, which is stepped. There is exposed bedrock near the edge, and large fallen trees upstream of the site. The in-stream habitat is characterised by a mix of cascades and riffle, interspersed with small pools, with some deeper than 1m. There is no obvious deposition of sand or silt. *Elatostema reticulatum* (rainforest spinach) is common on the right bank and forms beds, some of which are located within the streambed due to moderately high water levels. The stability of both bed and bank is high.

Site	Blackfellow Creek, BCUS4	**Waterway**
Date surveyed:	21/03/2017	Blackfellow Creek

Upstream

Downstream

Channel Morphology

Stream order	NA
Waterway classification	Upper Tributary
Pattern	mildly sinuous
	irregular

Hydrology

Flow regime	perennial
Water level	high
Water depth	0.3 m
Wetted width	1 m
Flow	fast
Discharge	> 1 m/s
Channel width	3 m

Substrate

Composition	bedrock	50%
	boulder	10%
	cobble	20%
	pebble	10%
	gravel	10%
	sand	0%
	silt / clay	0%
	Total	**100%**
Deposits	none	
Bed stability	bed stable	

Aquatic Habitat in Reach

Habitat present	shallow pools, run and riffle, large and small woody debris, macrophytes (*E. reticulatum*, in beds, see photos)
Disturbance of habitat	very low

Bank description

	Left Bank	**Right Bank**
Average height	0.5 m	0.5 m
Slope	flat	flat
Shape	convex	convex
Stability	high	moderate

Weed species	none
Adjacent land use	National park Walking track and access track to the northeast side (right bank)

Comments: The site is on one of the southern tributaries of Blackfellow Creek, upstream of the proposed walking track crossing. The creek in this reach is relatively shallow and fast flowing, with recent rains increasing the water level and forming small cascades and shallow to moderately deep pools at obstructions. The banks on both sides are flat but stable and densely covered with native rainforest vegetation. Rainforest spinach (*E. reticulatum*) covers parts of the banks and streambed and is more common than on other sites. Some bar formation in-stream, bars without vegetation. Aquatic habitat consists of pools, riffles and runs, as well as large rocks, boulders and woody debris.

Site	Blackfellow Creek, Proposed Crossing			**Waterway**	
Date surveyed:	21/03/2017			Blackfellow Creek	
					
Upstream				Downstream	
Channel Morphology		**Substrate**		**Aquatic Habitat in Reach**	
Stream order	NA	**Composition**	bedrock 50%	**Habitat present**	shallow run and riffle, trailing bank vegetation, small rapid sections, glide
Waterway classification	Upper Tributary		boulder 20%		macrophytes in beds
Pattern	straight		cobble 20%	**Disturbance of habitat**	very low
	mildly sinuous		pebble 10%	**Bank description**	
Hydrology			gravel 0%		**Left Bank** / **Right Bank**
Flow regime	perennial		sand 0%	**Average height**	0.5 m / 0.5 m
Water level	high		silt / clay 0%	**Slope**	flat / flat
Water depth	1.5 m		**Total 100%**	**Shape**	wide lower bench / wide lower bench
Wetted width	3 m	**Deposits**	none	**Stability**	high / high
Flow	fast – moderate	**Bed stability**	bed stable	**Weed species**	none
Discharge	1 m/s			**Adjacent land use**	National park Walking track and access track to the northeast (right bank)
Channel width	2 m				

Comments: This site is at the proposed crossing of a new walking track, in the upper reaches of Blackfellow Creek. The reach is characterised by run and riffle habitat and is relatively straight. There are large beds of *E. reticulatum* and *P. crispata* on both banks of the creek, and. large woody debris forms additional habitat. Recent high rainfall has increased water depth and flow. Native rainforest vegetation on both banks.

Site	Blackfellow Creek, BCDS4	**Waterway**
Date surveyed:	21/03/2017	Blackfellow Creek

Upstream

Downstream

Channel Morphology

Stream order	NA
Waterway classification	Upper Tributary
Pattern	irregular

Hydrology

Flow regime	perennial
Water level	high
Water depth	1.5 m
Wetted width	3 m
Flow	fast
Discharge	>1 m/s
Channel width	10 m

Substrate

Composition	bedrock	70%
	boulder	10%
	cobble	10%
	pebble	5%
	gravel	5%
	sand	0%
	silt / clay	0%
	Total	**100%**
Deposits	none	
Bed stability	bed stable	

Aquatic Habitat in Reach

Habitat present	shallow and deep pools, run and riffle, undercut bank	
	I	
Disturbance of habitat	very low	
Bank description		
	Left Bank	**Right Bank**
Average height	1.5 m	1 m
Slope	low	flat
Shape	stepped, undercut	concave
Stability	high	high
Weed species	none	
Adjacent land use	National park Walking track and access track to the northeast (right bank)	

Comments: This site is on the upper reaches of Blackfellow Creek and is downstream of the proposed crossing. It is characterised by cascades and shallow pools, with a small waterfall further downstream of the reach. Recent high rainfall has increased water depth and flow. Native rainforest vegetation on both banks. The habitat differs from most of the other sites in Blackfellow Creek as it has a fairly wide channel and a relatively low cover of *E. reticulatum* and *P. crispata* on both banks. There are some unvegetated mid channel bars and exposed bedrock on the right bank.

APPENDIX B

Frog survey data

Appendix A Frog Survey Data

Table A1. Location details for frog species recorded during the field survey, and their status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and Queensland *Nature Conservation Act 1992* (NCA)

Date	Latitude	Longitude	Section	Species	EPBC	NCA	No.
20/03/2017	-27.960838	152.369053	Blackfellow Creek	*Mixophyes fleayi*	E	E	1
20/03/2017	-27.960242	152.367498	Blackfellow Creek	*Mixophyes fleayi*	E	E	3
20/03/2017	-27.960257	152.367509	Blackfellow Creek	*Mixophyes fleayi*	E	E	1
20/03/2017	-27.96007	152.367325	Blackfellow Creek	*Mixophyes fleayi*	E	E	2
21/03/2017	-27.988183	152.3684	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.988278	152.368316	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.988063	152.368531	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98751	152.368258	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.986308	152.366672	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98597	152.366084	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.985834	152.366002	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.985731	152.365694	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.984435	152.362843	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98406	152.36276	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.983972	152.362602	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.983409	152.36057	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982516	152.360101	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982414	152.359265	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982885	152.359552	Dalrymple Creek	*Mixophyes fleayi*	E	E	2
21/03/2017	-27.982995	152.359539	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982857	152.359328	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982875	152.359281	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98288	152.358989	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982875	152.358615	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982885	152.358176	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982918	152.358071	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982994	152.357702	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982892	152.357285	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98295	152.356861	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982799	152.356562	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982381	152.355912	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982244	152.355628	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.982213	152.355486	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981859	152.354716	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981511	152.35419	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981509	152.354071	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981413	152.353924	Dalrymple Creek	*Mixophyes fleayi*	E	E	2
21/03/2017	-27.981337	152.353806	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98127	152.353242	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.98111	152.352934	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981066	152.352814	Dalrymple Creek	*Mixophyes fleayi*	E	E	1

Date	Latitude	Longitude	Section	Species	EPBC	NCA	No.
21/03/2017	-27.981136	152.351716	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981059	152.351601	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.981003	152.351252	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.980928	152.350734	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.980955	152.35035	Dalrymple Creek	*Mixophyes fleayi*	E	E	1
21/03/2017	-27.988718	152.369806	Dalrymple Creek	*Litoria wilcoxii*		LC	1
21/03/2017	-27.983549	152.360754	Dalrymple Creek	*Litoria wilcoxii*		LC	1
21/03/2017	-27.981335	152.352038	Dalrymple Creek	*Litoria wilcoxii*		LC	1
21/03/2017	-27.980887	152.34921	Dalrymple Creek	*Litoria wilcoxii*		LC	1
21/03/2017	-27.980925	152.346728	Dalrymple Creek	*Litoria wilcoxii*		LC	1
20/03/2017	-27.958256	152.368113	Blackfellow Creek	*Lechriodus fletcheri*		LC	1
20/03/2017	-27.960908	152.37327	Blackfellow Creek	*Bufo marinus*		*	1
20/03/2017	-27.961815	152.376493	Blackfellow Creek	*Bufo marinus*		*	1
20/03/2017	-27.962504	152.377279	Blackfellow Creek	*Bufo marinus*		*	2

Abbreviations: E = endangered; LC = least concern; * = introduced species.

APPENDIX C

Chytrid fungus test results

Research Consultant:	Sue Song
Supervisor:	Dr Andrew Weeks
Receipt of samples:	31 March 2017
Date analysed:	15 April 2017
Report:	17 April 2017

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Sample ID	qPCR positives (of 3)	Chytrid presence	No. Zoospores
B1	2	equivocal	0
B2	3	positive	2.27
B3	1	equivocal	0
B4	3	positive	5.22
B5	0	negative	0
B6	0	negative	0
B7	0	negative	0
B8	0	negative	0
B9	3	positive	1.66
B10	0	negative	0

Standard curve for quantitative analysis

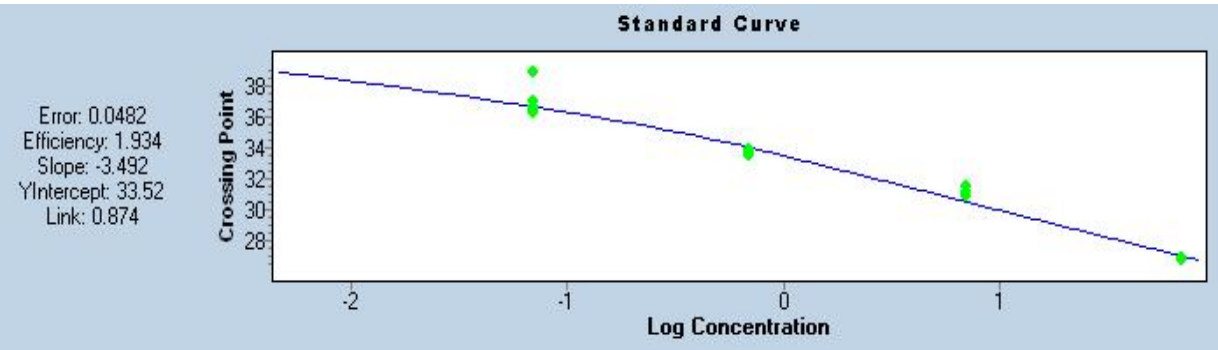

Figure 1. *Batrachochytrium dendrobatidis* standard curve used 'in run' for the determination of the pathogen in experimental samples. Plot of log number of zoospores against Ct value

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