Other threatening processes include:

- Impoundments causing degradation of water quality, increased predation of juveniles, decline in quality and availability of foraging resources, lack of access to refuge habitats during flooding and loss of nesting habitat and access to traditional areas;
- Removal of riparian vegetation preventing recruitment of important instream structure and microhabitat into the aquatic environment;
- Degradation of water quality as a result of extensive land clearing, heavy grazing and sand mining;
- Decreasing habitat suitability as a result of increased siltation and filling of deep pool habitats; and
- Degradation in nesting habitat suitability as a result of sand mining and proliferation of weed species (DotE 2016).

White-throated snapping turtle (Elseya albagula)

The white-throated snapping turtle is listed as critically endangered under the *EPBC Act* and endangered under the *NC Act*. The species is endemic to the Fitzroy, Burnett and Mary River catchments. Within the Mary River catchment, the white-throated snapping turtle occurs from the Mary River Barrage near Tiaro up to Kenilworth in the upper catchment. Individuals have been recorded in main tributaries with permanent water including Tinana Creek, Wide Bay Creek, Obi Obi Creek and Yabba Creek (Limpus 2008).

The white-throated snapping turtle primarily inhabits permanent flowing reaches of streams with a sand/gravel substrate and an abundance of refugia (i.e. rock crevices, submerged logs, macrophytes beds) (Hamann et al. 2007). The white-throated snapping turtle is not thought to occur within farm dams, ephemeral swamplands or brackish waters but does occur in impounded pools at lower densities (Limpus et al. 2011; Hamann et al. 2007)). During the day, the white-throated snapping turtle is generally found in deep pools (>6 m) either up- or downstream from a riffle zone, whereas at night the turtle moves into the shallow riffle zones (Gordos et al. 2007; Hamann et al. 2007).

Juvenile white-throated snapping turtles are carnivorous, while adult turtles are primarily herbivorous, feeding on fruit and leaves of riparian vegetation and aquatic macrophytes (Rogers 2000; Armstrong and Booth 2005). The white-throated snapping turtle can respire aquatically, with turtles obtaining approximately 40-60 per cent of their oxygen requirements from the water (Mathie and Franklin 2006; Clark et al. 2008).

The home range of the white-throated snapping turtle is generally less than 500 m and is usually restricted to the one pool. The turtle is, however, known to move large distances (10 – 55 km) in association with dispersal, courtship and nesting and repositioning following flood displacement. Movement over land is generally only known to occur between adjacent pools (Limpus et al. 2011; Hamann et al. 2007).

The white-throated snapping turtle is thought to aggregate nesting at traditional nesting sites. Nesting aggregations have been recorded near Tiaro, the junction with Munna Creek, Gunalda, upstream from Traveston and along Obi Obi Creek (Limpus 2008). Nesting usually occurs on alluvial sand/loam banks that are deposited by floodwaters. Nesting can; however, occur in a variety of substrates ranging from sand to dark clay and grassed loam slopes. Nests are generally laid on the front face and top of steep slopes, are an average of 16.6 m from the water's edge (Limpus et al. 2011). The white-throated snapping nests from autumn through to early spring (peak activity between May and July) with hatching generally occurring in early summer (December- January) after an embryonic diapause over the winter months (Hamann et

al. 2007). Once they reach sexual maturity (15-20 years) female turtles are thought to breed annually (Hamann et al. 2007).

The key threatening process to the white-throated snapping turtle is the lack of recruitment into the population (TSSC 2014). Predation of nests by foxes, goannas, feral cats, and water rats is extremely high, with close to 100 per cent of clutches predated each season (Limpus et al. 2011; Hamann et al. 2007)). The high mortality of eggs has led to little to no recruitment of hatchlings into the population over the last decade. The population of white-throated snapping turtle in the Mary River is now primarily comprised of adult individuals with only 0.9 per cent of adults recruited into the breeding population each year (Hamann et al. 2007). The protection of turtle nests and the artificial incubation of eggs have been key recovery actions for the species (TSSC 2014).

Other threatening processes include:

- Impoundments causing habitat fragmentation, obstruction of movement, injury and mortality, flow modification, inundation of nesting habitat and loss of riparian vegetation;
- Stocking of top end predator fish into impoundments and recreational fishing;
- Dense aquatic weeds restricting access to nesting areas; and
- Extended drought resulting in poor water quality (TSSC 2014).

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Appendix B – Species profiles

Pineapple zamia (*Macrozamia pauli-guilielmi*)

Scientific name	*Macrozamia pauli-guilielmi*
Common name	Pineapple zamia
Status	EPBC Act: endangered NC Act: endangered
Likelihood of occurrence within project construction footprint	**Known to occur** A total of 57 *M. pauli-guilielmi* individuals occur within 100 m of the project construction footprint, occupying an area of approximately 0.15 ha.
Description	This species is a small cycad with an underground ovoid trunk and spirally twisted leaves (DotE 2016). The crown is sparse, typically comprised of 2 to 8 mature leaves up to 120 centimetres (cm) long. It is distinguished from related cycads by its very narrow, pale green leaflets, which are 15 to 35 cm long and 2 to 4 millimetres (mm) wide. Leaflet bases are white and conspicuously thickened. Male and female cones develop on separate individuals (Queensland Department of Natural (DNR) Resources 2000). Male cones are 8 to 14 cm long, 3.5 to 5 cm wide, and straight. Female cones are oval shaped, 9 to 14 cm long and 4 to 6.5 cm wide. Seeds are 17 25 mm long and 13 to 20 mm wide and red when ripe.
Distribution and habitat	Endemic to south-east Queensland where it is found in the Wide Bay district, from near the Isis River in the north, to near Wolvi in the south; also found on Fraser Island (Queensland Herbarium 2007). *M. pauli-guilielmi* typically occurs in lowland (5 to 230 m altitude) open forest or woodland (wallum) dominated by banksias or eucalypts, or in shrubland or heath, generally on stabilised sand dunes (DotE 2016).
Life history	Pollination between male and female plants is via insect vectors (weevils). Fruit production (coning) only occurs every 4 to 6 years, with seed viability not persisting beyond 6 to 12 months (DotE 2016).
Key threatening processes	Key threatening processes to *M. pauli-guilielmi* include: • Loss of habitat to agriculture or pine plantations • Illegal removal of plants; • Inappropriate fire regimes; • Loss of genetic variation due to limited distribution and small population size; and • Associations with other species under threats (i.e. pollinators).

Koala (*Phascolarctos cinereus*)

Scientific name	*Phascolarctos cinereus*
Common name	Koala
Status	EPBC Act: vulnerable NC Act: vulnerable
Likelihood of occurrence within project construction footprint	**Likely to occur** No evidence of the koala (i.e. scratches, pellets) was observed within the project construction footprint during field surveys. However, the species has been previously recorded on two (2) occasions within 5 km of the project study area. The project construction footprint contains suitable habitat for the koala including three (3) species of food tree: *Eucalyptus racemosa, Lophostemon confertus* and *Melaleuca quinquenervia*. In accordance with the *EPBC Act* significant impact assessment guidelines for the koala (DotE 2014), the project construction footprint represents habitat critical to the survival of the koala.
Description	The koala is a arboreal, medium-sized marsupial with a stocky body, large rounded ears, sharp claws and predominantly grey-coloured fur (DotE 2016).
Distribution and habitat	This species is endemic to Australia, and its distribution extends from north-eastern Queensland to the south-east corner of South Australia (DotE 2016). The koala is currently widespread in coastal and inland areas, although the occurrence of individuals is not continuous and often defined by environmental variables. Distribution of the koala is influenced by altitude (<800 m above sea level), temperature, and leaf moisture (DotE 2016). Koalas inhabit a range of temperate, sub-tropical and tropical rainforest, woodland and semi-arid communities dominated by Eucalyptus species (DotE 2016). Suitable habitat includes any forest or woodland containing known koala food trees.
Life history	The koala is a leaf-eating species that feeds primarily on the foliage of Eucalyptus species. The species is not territorial and home ranges of individuals commonly overlap. Female koalas are able to produce one (1) offspring per year, with births occurring between October and May. Juvenile koalas become independent at about 12 months of age (DotE 2016).
Key threatening processes	Key threatening processes to the koala include: • Habitat loss and fragmentation; • Vehicle strike; • Predation from domestic or feral dogs; • Disease; and • Climate change and drought (DotE 2016).

Glossy black-cockatoo *(Calyptorhynchus lathami)*

Scientific name	*Calyptorhynchus lathami*
Common name	Glossy black-cockatoo
Status	EPBC Act: not listed NC Act: vulnerable
Likelihood of occurrence within the project construction footprint	**Known to occur** The glossy black-cockatoo was recorded approximately 2 km north of the project study area during field surveys. The Allocasuarina woodland habitat within the project construction footprint contains suitable foraging trees (i.e. Allocasuarina) for this species. Direct evidence of the species in the form of chewed Allocasuarina cones was observed within the project construction footprint during field surveys. There are no large hollow bearing eucalypts within the project construction footprint and, as such, nesting of the species is considered unlikely to occur
Description	The glossy black-cockatoo is small black-brown cockatoo with an inconspicuous crest and broad bulbous bill. Adult males have solid bright red panels in the tail feathers, while females have light orange to red panels with black barring in the tail feathers. Females also have irregular patches of yellow feathers in the head and neck (Pizzey and Knight 2003).
Distribution and habitat	Historically, the species has a widespread distribution ranging to the south-east border of Queensland and inland to Augathella and Tambo. Distribution also extends south into New South Wales, spreading inland to the Central Western Plains of New South Wales, and also in the eastern Gippsland region of Victoria. An isolated population of glossy black-cockatoo is also known to occur on Kangaroo Island in South Australia (Hourigan 2012; Office of Environment and Heritage (OEH) 2014). The species generally inhabits coastal woodlands and drier forest areas, open inland woodlands or timbered watercourse where casuarinas are common (Hourigan 2012; OEH 2014).
Life history	Breeding commonly occurs in large eucalypts, where hollows are used as nests in vertical branches, stems or in trunk cavities. Suitable habitat requires a combination of land resources including feeding trees, nesting sites, roosting areas, and water availability (Hourigan 2012; OEH 2014).
Key threatening processes	Key threatening processes to the glossy black-cockatoo include: • Vegetation clearing and the associated loss of nesting and feeding habitat; • Changes in patterns of bushfires leading to the loss of habitat; • Predation from feral cats and possums; and

	• Competition for nests with galahs and introduced honeybees. Hourigan 2012; OEH 2014).

Wallum froglet (*Crinia tinnula*)

Scientific name	*Crinia tinnula*
Common name	Wallum froglet
Status	EPBC Act: not listed NC Act: vulnerable
Likelihood of occurrence within the project construction footprint	**Likely to occur** The wallum froglet was not recorded during field survey; however, six (6) previous records of the species occur within 5 km of the project study area. Remnant vegetation (12.3.5/12.3.1) within the project construction footprint is mapped as essential habitat for the wallum froglet; however, the riparian habitat and Allocasuarina woodland within the project construction footprint contains limited suitable habitat for this species and no suitable breeding habitat occurs. The Melaleuca swamp habitat located adjacent to the project construction footprint does provide suitable habitat for the species.
Description	Small frog (20 mm in length) with pointed snout. Dorsal surface may be smooth or with rounded projections. Doral colour light grey, beige, red-brown to dark-brown with irregular dark markings. Ventral surface granular, off-white or grey with speckling. Distinct stipe runs from throat to belly (DEHP 2013).
Distribution and habitat	The species' range historically extended from north of Bundaberg in Queensland to Sydney in New South Wales; however, distribution has been significantly reduced and fragmented. The species now only occurs in lowland coastal habitats in south-east Queensland and north-east New South Wales, and on the sand islands off the Queensland coast (DEHP 2013; Meyer 2006). The species is restricted to freshwater swamps in lowland coastal areas, and is found in association with nutrient-poor sandy soils supporting vegetation communities such as heath, sedgeland and woodland (DEHP 2013; Meyer 2006).
Life history	The wallum froglet is a nocturnal, and often can be found utilising crayfish burrows and leaf litter as shelter during the day. Adults feed on small arthropods, whilst tadpoles feed on sediment, detritus and algae. The species relies on acidic swamps and lakes in lowland coastal habitats as essential breeding habitat. Breeding usually occurs in autumn or early winter, but has been recorded in all seasons following rain (DEHP 2013; Meyer 2006).
Key threatening processes	Significant population and range declines of the wallum froglet have been associated with habitat loss, fragmentation and modification from agricultural and urban development, the establishment of exotic

	pine plantations and sandmining (DEHP 2013; Meyer 2006). Other threatening processes include: • Predation of eggs and larvae by exotic fish species; • Habitat degradation as a result of exotic flora and fauna; • Inappropriate fire regimes; • Drainage of habitat; • Decline in water quality; • Use of biocides during weed and mosquito control; and • Human introduced disease (DEHP 2013; Meyer 2006).

Mary River cod *(Maccullochella mariensis)*

Scientific name	*Maccullochella mariensis*
Common name	Mary River cod
Status	EPBC Act: vulnerable NC Act: not listed
Likelihood of occurrence within the project construction footprint	**Known to occur** The Mary River cod was confirmed present within the project study area during DNRM field surveys (DNRM 2016) and three (3) previous records of the species occur within 5 km of the existing bridge. Together with Tinana Creek, Coondoo Creek is known to support one (1) of only three (3) subpopulations of the Mary River cod within the Mary River catchment (Simpson and Jackson 1996). Only 25-30% of Tinana/Coondoo Creek contains deep permanent pool habitat suitable for this species. The project construction footprint forms part of the suitable cod habitat within the Tinana/Coondoo Creek reach and the species is considered likely to occur. In accordance with the *EPBC Act significant impact guidelines* (DotE 2013), Tinana/Coondoo Creek is considered habitat critical to the survival of the Mary River cod as the creek is necessary for critical activities such as foraging and breeding, maintaining genetic diversity and for the long-term maintenance of the species.
Description	The Mary River cod is a large (up to ~23 kg but commonly 5 km) yellowish to pale green fish. Dark heavily reticulated mottling is present on the back and sides, sometimes extending onto the belly. The belly is grey-green to whitish. The fins are clear to dark with grey-green mottling on bases, with whitish margins (DotE 2016).
Distribution and habitat	Historically, Mary River cod were distributed throughout the Mary, Brisbane-Stanley, Albert-Logan and Coomera River systems (Wagner and Jackson 1993). Now, this species is found only in the Mary River catchment and there are reportedly less than 600 individuals remaining in the population (Simpson and Jackson 1996). The distribution of the Mary River cod has also declined within the

	Mary River catchment and it is estimated the species now occurs in less than 30% of its original range (Simpson and Jackson 1996). There are three (3) areas within the Mary River system where cod are relatively abundant. These are Tinana-Coondoo Creek upstream from Tinana Barrage, Six Mile Creek downstream from Lake Macdonald, and upper Obi Obi Creek. These natural subpopulations are isolated from one-another by impoundments and the main river channel (Simpson and Jackson 1996). Tinana-Coondoo Creek provides one of the best refuges for cod in the Mary River catchment (Simpson and Jackson 1996). The range of Mary River cod in Tinana-Coondoo Creek extends at least 30 km into Coondoo Creek and down to at least Tallegalla Weir in Tinana Creek. This makes a total stream length of at least 70 km, only 25-30% of which (i.e. 17-21 km) comprises large pool habitats that are likely to provide permanent habitat for cod (Simpson 1994). Based on this data and electrofishing surveys, the cod population in this creek system is estimated at around 250 individuals (personal communication, J. Koehn). Mary River cod occur in a variety of habitat types within the Mary River catchment, from high gradient, rocky, upland streams, to large, slow-flowing pools in lowland areas. Deep slow moving pools with abundant instream timber and heavy shading by overhanging vegetation are the preferred habitat. Areas of open water were usually avoided (Simpson and Jackson 1996)
Life history	The Mary River cod is largely territorial and occupies a particular home range between 70 m and 1 km in length for up to several years (Simpson and Mapleston 2002). Large scale movement in excess of 30 km either upstream or downstream can occur during high flow events (Simpson and Jackson 1996). The Mary River cod are ambush predators and adults mainly consume fish (DotE 2016). Submerged logs and branches (snags) are used as cover from which to ambush prey, as resting sites, and as nesting sites (DotE 2016). The cod are often found within metres of woody debris structures (Simpson and Mapleston 2002). Spawning occurs during spring when water temperatures reach above 20 ºC (Harris and Rowland 1996). Hollow logs are thought to be used as spawning sites (Simpson and Mapleston 2002).
Key threatening processes	The key threatening processes to the Mary River cod include: • Excessive siltation and in filling of pools as a result of land clearing and grazing; • Reduction in abundance of instream woody debris as a result of riparian vegetation clearing; • Restriction of movement; • Competition with non-indigenous fish species; • Overfishing during the late 1800s and early 1900s;

	• Water quality degradation and pollution; and • Impoundments causing restriction of movement, degradation of water quality, loss of instream woody debris. Other potential threats due to the small isolated populations including disease, loss of genetic variability and inbreeding (DotE 2016; Simpson and Jackson 1996).

White-throated snapping turtle (*Elseya albagula*)

Scientific name	*Elseya albagula*
Common name	White-throated snapping turtle
Status	EPBC Act: critically endangered NC Act: endangered
Likelihood of occurrence within the project construction footprint	**Known to occur** The white-throated snapping turtle was confirmed present within the project study area with three (3) juvenile turtles captured during field surveys (GHD 2016a). The deep permanent pool habitat within the project study area provides suitable habitat conditions for this species. The capture of three (3) juvenile turtles within the project study area may suggest that Coondoo Creek is an important habitat area for facilitating juvenile recruitment into the breeding population and for the long-term maintenance of the species. In accordance with *EPBC Act significant impact guidelines* (DotE 2013), Coondoo Creek within the project study area is therefore considered habitat critical for the survival of the species. The suitability of nesting habitat within the project study area is limited by the density of riparian bank vegetation and *Lomandra longifolia* at the water's edge. No suitable nesting habitat occurs within 2 km downstream or 1.7 km upstream of the project construction footprint (GHD 2017; Appendix C). As a result, nesting of the white-throated snapping turtle within the project construction footprint and broader project study area is considered unlikely to occur.
Description	Large species (carapace reaching 45 cm in length). Carapace is dark brown to black and broadly oval. Head is robust with two barbels on the chin. Irregular white or cream markings are present on the throat and lower sides of the face, particular in females. Plastron is dark in males and yellow in females. Juvenile's shell is heavily serrated (Cann 2008).
Distribution and habitat	The species is endemic to the Fitzroy, Burnett and Mary River catchments. Within the Mary River catchment, the white-throated snapping turtle occurs from the Mary River Barrage near Tiaro up to Kenilworth in the upper catchment. Individuals have been recorded in main tributaries with permanent water including Tinana Creek, Wide Bay Creek, Obi Obi Creek and Yabba Creek (Limpus 2008). The white-throated snapping turtle primarily inhabits permanent flowing reaches of streams with a sand/gravel substrate and an

	abundance of refugia (i.e. rock crevices, submerged logs, macrophytes beds) (Hamann et al. 2007). The white-throated snapping turtle is not thought to occur within farm dams, ephemeral swamplands or brackish waters but does occur in impounded pools at lower densities (Limpus et al. 2011; Hamann et al. 2007)). During the day, the white-throated snapping turtle is generally found in deep pools (>6 m) either up- or downstream from a riffle zone, whereas at night the turtle moves into the shallow riffle zones (Gordos et al. 2007; Hamann et al. 2007). Nesting aggregations have been recorded near Tiaro, the junction with Munna Creek, Gunalda, upstream from Traveston and along Obi Obi Creek (Limpus 2008). Nesting usually occurs on alluvial sand/loam banks that are deposited by floodwaters. Nesting can; however, occur in a variety of substrates ranging from sand to dark clay and grassed loam slopes. Nests are generally laid on the front face and top of steep slopes, are an average of 16.6 m from the water's edge (Limpus et al. 2011).
Life history	Juvenile white-throated snapping turtles are carnivorous, while adult turtles are primarily herbivorous, feeding on fruit and leaves of riparian vegetation and aquatic macrophytes (Rogers 2000; Armstrong and Booth 2005). The white-throated snapping turtle can respire aquatically, with turtles obtaining approximately 40-60 per cent of their oxygen requirements from the water (Mathie and Franklin 2006; Clark et al. 2008). The home range of the white-throated snapping turtle is generally less than 500 m and is usually restricted to the one pool. The turtle is, however, known to move large distances (10 – 55 km) in association with dispersal, courtship and nesting and repositioning following flood displacement. Movement over land is generally only known to occur between adjacent pools (Limpus et al. 2011; Hamann et al. 2007). The white-throated snapping turtle is thought to aggregate nesting at traditional nesting sites. The species nests from autumn through to early spring (peak activity between May and July) with hatching generally occurring in early summer (December- January) after an embryonic diapause over the winter months (Hamann et al. 2007). Once they reach sexual maturity (15-20 years) female turtles are thought to breed annually (Hamann et al. 2007).
Key threatening processes	The key threatening process to the white-throated snapping turtle is the lack of recruitment into the population (TSSC 2014). Predation of nests by foxes, goannas, feral cats, and water rats is extremely high, with close to 100 per cent of clutches predated each season (Limpus et al. 2011; Hamann et al. 2007)). The high mortality of eggs has led to little to no recruitment of hatchlings into the population over the last decade. The population of white-throated snapping turtle in the Mary River is now primarily comprised of adult individuals with only 0.9 per cent of adults recruited into the breeding population each year (Hamann et al. 2007).

	Other threatening processes include: • Impoundments causing habitat fragmentation, obstruction of movement, injury and mortality, flow modification, inundation of nesting habitat and loss of riparian vegetation; • Stocking of top end predator fish into impoundments and recreational fishing; • Dense aquatic weeds restricting access to nesting areas; and • Extended drought resulting in poor water quality (TSSC 2014).

Australian lungfish *(Neoceratodus forsteri)*

Scientific name	*Neoceratodus forsteri*
Common name	Australian lungfish
Status	EPBC Act: vulnerable NC Act: not listed
Likelihood of occurrence within the project construction footprint	**Known to occur** The Australian lungfish was confirmed present within the project study area during field surveys with two (2) individuals observed approximately 350 m downstream of the project construction footprint. The deep permanent pool habitat within the project study area provides suitable foraging habitat for this species. No suitable spawning habitat (i.e. macrophyte beds) was observed within the project study area during field surveys.
Description	The Australian Lungfish is a long, heavy-bodied freshwater fish. Adults are commonly 1.3 m but can reach up 2 m (48 kg). The species is olive-green or grey-brown above, and yellow-orange below, with some whitish colour on the belly and underside of the head. Juveniles are dark olive, brown or yellow with a mottled pattern above and a dull pink belly (DotE 2016).
Distribution and habitat	The species is restricted to south-eastern Queensland, with its natural distribution being the Mary, Burnett and possibly Brisbane and North Pine Rivers. Australian lungfish have also been introduced to other rivers and dams including the Condamine and Coomera Rivers and the Enoggera Reservoir (DotE 2016). Within the Mary River catchment, the lungfish occurs from the Mary River Barrage near Tiaro, up to Conondale in the upper catchment. Individuals have been recorded in large tributaries including Tinana Creek, Coondoo Creek, Wide Bay Creek, Obi Obi Creek, Munna Creek and Yabba Creek (Kind 2002). The Australian lungfish inhabits permanent vegetated pools that are still or slow-following. Dense macrophyte beds, submerged riparian vegetation, woody debris and submerged rocks are particularly important habitat features (Kind 2002). They shelter in complex, shaded habitat. The species avoids open water, and very seldom

	uses rocky habitat and eroded banks, which are uncommon in the Mary River (DotE 2016). Adult lungfish generally occupy depths between 2-3 metres (Brooks and Kind 2002).
Life history	Australian lungfish spawns at night between August and December, with peak activity in late October. Spawning occurs amongst aquatic macrophytes with *Vallisneria gigantea* the most commonly used species. The Australian lungfish is a benthic omnivore which primarily forages at night (DotE 2016). The species is largely sedentary but can make annual movements to and from spawning ground (Kind 2002). The Australian lungfish is able to breathe aquatically using its gills, and aerially using its single lung. It usually uses its gills, but surfaces to breathe when it is active and requires more oxygen (DotE 2016).
Key threatening processes	Key threatening process to the Australian lungfish include: • Impoundments causing restriction of movement, degradation of water quality, inundation of breeding habitat and injury and mortality; • Long-lived species with low juvenile survival; • Recreational fishing; • Introduced fish species; and • Loss of riparian habitat (DotE 2016).

Mary River turtle (*Elusor macrurus*)

Scientific name	*Elusor macrurus*
Common name	Mary River turtle
Status	EPBC Act: endangered NC Act: endangered
Likelihood of occurrence within the project construction footprint	**May occur** The Mary River turtle was not recorded within the project study area during field surveys. The deep permanent pool habitat within the project study area provides suitable habitat conditions for the Mary River turtle; however, the species has not been previously recorded within Coondoo Creek. Targeted surveys for the species has recorded a small number of individuals (N = four (4)) within Tinana Creek, approximately 30 – 50 km downstream of the project study area. The absence of previous records for the species within Coondoo Creek suggest that this region of the Mary River catchment does not support a significant proportion of the Mary River turtle population and does not represent habitat critical to the survival of the species. Individuals of the species may occur in low abundance. Almost all aggregated nesting of the species occurs within the lower Mary River channel near Tiaro (Limpus 2008). The suitability of nesting habitat within the project study area is limited by the density

	of riparian bank vegetation and *Lomandra longifolia* at the water's edge. No suitable nesting habitat occurs within 2 km downstream or 1.7 km upstream of the project construction footprint (GHD 2017; Appendix C). As a result, nesting of the Mary River turtle within the project construction footprint and broader project study area is considered unlikely to occur.
Description	The Mary River turtle is dark brown, rusty red-brown to almost black above, with a greyish underbody, a broadly oval shell with a median notch. The plastron may be cream to yellow, the skin of the inguinal areas pinkish-white, and the dorsal skin grey, suffused with pink on the transverse lamellae scales. The species also has pointed barbels on the neck. Females grow to 34 cm long, and males to 42 cm long. Tails of males are very long and laterally compressed (DotE 2016).
Distribution and habitat	The Mary River turtle is endemic to the Mary River where it primarily occurs in the mainstream of the Mary River and major tributaries, including Tinnana Creek, Yabba Creek and Obi Obi Creek (Limpus 2008). The Mary River turtle generally inhabits well-oxygenated pools associated with riffle zones. Habitat pools vary in depth from 1 - 6 m and generally have a sand or gravel bottom, steep sides and an abundance of submerged shelter in the form of fallen logs, boulders, undercut banks and aquatic vegetation. Very little information is known about the habitat requirements of hatchling turtles; however, rocky outcrops are thought to be of importance (Flakus 2002). Nesting of the Mary River turtle is primarily restricted to alluvial sand/loam banks that occur in depositional areas. These banks generally form at the river's edge and extend back into the immediate riparian zone; however, islands are also known to occur in places. There is insufficient evidence available on species specific nesting requirements to accurately describe optimal nesting bank conditions; however, banks are generally large, steep and sparsely vegetated. The majority of aggregated nesting occurs at traditional nesting banks immediately upstream from Tiaro. Limited turtle nesting has been observed outside this area.
Life history	Nesting occurs from October to December and females are thought to return to the same nesting banks each year. The home range of the Mary River turtle is small with daily movements averaging 200 m. During the breeding season, female turtles may make average daily movements of around 2 km, however, migrations of up to 7 km have been recorded (Flakus 2002). Male turtles are also known to increase movement during the breeding season. During flooding events, the Mary River turtle moves upstream against the current into small creeks, backwaters or eddies. When the water flow subsides, the turtles move back to the same pool from which they originated (Flakus 2002). Movement over land is only known to occur between adjacent pools. Adult Mary River turtles are primarily herbivorous with aquatic plants making up 79% of their diet. Two (2) percent of their diet consists of

	buds, seeds and fruit from terrestrial plants while aquatic insect larvae make up the remainder of their diet. In comparison, the diet of hatchling and juvenile turtles consists of aquatic insect larvae (53%), freshwater sponges (21%) and aquatic plants (25%) (Cann and Leger 1994, Flakus 2002). The Mary River turtle has the ability to respire aquatically with hatchlings obtaining up to 50% of their total oxygen requirements from the water (Clark 2008). Aquatic respiration is achieved via diffusion over the skin or by active ventilation of the cloacal bursae. Hatchling Mary River turtles are able to remain submerged underwater for over 2.5 days without surfacing for air.
Key threatening processes	Illegal poaching during the 1960's and 1970's and high nest predation by feral dogs, foxes and goannas, has result in a 90% reduction in Mary River turtle nesting in the last 50 years (Flakus and Connell 2008). The long term, pervasive and intense egg loss from predation and cattle trampling of nests has been identified as a critical threat to the species (Limpus 2008). Other threatening processes include: • Impoundments causing degradation of water quality, increased predation of juveniles, decline in quality and availability of foraging resources, lack of access to refuge habitats during flooding and loss of nesting habitat and access to traditional areas; • Removal of riparian vegetation preventing recruitment of important instream structure and microhabitat into the aquatic environment; • Degradation of water quality as a result of extensive land clearing, heavy grazing and sand mining; • Decreasing habitat suitability as a result of increased siltation and filling of deep pool habitats; and • Degradation in nesting habitat suitability as a result of sand mining and proliferation of weed species (DotE 2016).

Oxleyan pygmy perch *(Nannoperca oxleyana)*

Scientific name	*Nannoperca oxleyana*
Common name	Oxleyan pygmy perch
Status	EPBC Act: endangered NC Act: vulnerable
Likelihood of occurrence within the project construction footprint	**Likely to occur** The oxleyan pygmy perch was not recorded within the project study area during field surveys; however, Coondoo Creek is known habitat for the species and there is one (1) previous record within 5 km of the project study area. The reach of Coondoo Creek within the project construction footprint does not represent typical habitat conditions for this species. This species is most likely to occur within the Melaleuca swamp habitat located adjacent to the project construction footprint. The project construction footprint is not considered to provide suitable breeding habitat for this species due to absence of dense aquatic macrophyte beds.
Description	Oxleyan pygmy perch are usually light brown to olive in colour and mottled, with three to four patchy, dark brown bars extending from head to tail, and a whitish belly. The gill cover (opercular) has a blue iridescence and there is a conspicuous dark round spot with an orange margin at the base of the tail. The scales have dusky margins and the fins are mainly clear. There is a blue ring around the eye. During breeding the dorsal, pelvic and anal fins darken and the lateral stripes and tail turn scarlet. They can grow to about 60 mm in length, but are more commonly around 35 mm (DotE 2016).
Distribution and habitat	The oxleyan pygmy perch has a restricted and patchy distribution between Fraser Island and northern New South Wales. The species is known from approximately 20 localities in Queensland (Arthington et al. 1996; Thompson et al. 2000) and approximately 25-30 localities in northern New South Wales (Knight 2000). Within Queensland, the species has been recorded from Searys, Carland and Coondoo/Tinana Creeks in the Tin Can Bay area; the Noosa River and its tributaries; Marcus, Mellum and Blue Gum creeks near the Glasshouse Mountains; and Burpengary Creek, Deception Bay (NSW DPI 2005). The oxleyan pygmy perch inhabits coastal heath or 'wallum' habitats defined as acidic freshwater systems which drain through sandy coastal *Banksia spp*-dominated heath or wallum vegetation assemblages (NSW DPI 2005). Oxleyan pygmy perch have also been found in creeks that run into adjacent areas out of wallum heath. Key habitat features include dense emergent and submerged marginal vegetation (60—80 % cover), leaf litter beds, and occasionally woody debris if present (Arthington et al. 1996;

	Thompson et al. 2000). They are often found amongst fine rootlets of riparian vegetation growing into the stream (DotE 2016).
Life history	Spawning in the species generally occurs between October and December but may continue as late as May. Water temperatures above 20 ºC are required to trigger breeding with eggs deposited on aquatic vegetation or substrate (NSW DPI 2005; DotE 2016). The oxleyan pygmy perch feeds primarily on aquatic insects and their larvae (Allen 1989) as well as diatoms, filamentous algae and a few terrestrial insects (NSW DPI 2005). The species is not known to undertake large scale upstream or downstream migrations.
Key threatening processes	Key threatening processes to the oxleyan pygmy perch include: • Loss of coastal health vegetation as a result of urban development, agriculture, forestry and mining; • Habitat degradation as a result of increased siltation, riparian vegetation clearing, pollution and channelisation of creeks; • Restriction of movement, particularly during high flow events and overland flows; • Introduced fish species; • Aquarium collecting; and • Loss of genetic diversity (DotE 2016; NSW DPI 2005).

Platypus (*Ornithorhynchus anatinus*)

Scientific name	*Ornithorhynchus anatinus*
Common name	Platypus
Status	EPBC Act: not listed NC Act: special least concern
Likelihood of occurrence within the project construction footprint	**Known to occur** The platypus is known to occur within the Mary River catchment and the species was confirmed present within the project study area during field surveys (GHD 2017). Aquatic habitat within the project study area is considered suitable foraging habitat for the species. No burrows were observed within the project construction footprint or broader project study area during field surveys and the fine sandy riverbed is not considered to provide optimal burrowing conditions.
Description	The platypus has a streamlined body with short limbs, webbed feet, duck-like bill and a broad flat tail. Mid brown coloured fur above and pinkish brown below. Males have a sharp poisonous spur on each hind ankle. Males are generally 50 cm long and 1.5 kg while females are 40 cm long and 1 kg in weight.
Distribution and habitat	Platypus are found in eastern Australia from far north Queensland to Tasmania. In Queensland, the species inhabits rivers east of the Great Dividing Range, and some western-flowing streams (DEHP

	2011). Platypus habitat includes freshwater creeks, slow-moving rivers, lakes joined by rivers, and built water storages such as farm dams. Preferred habitat for the species is defined as areas that have steep, well vegetated banks (Grant and Temple-Smith 1998). Platypus occupy a wide range of aquatic habitats, are tolerant of degraded systems, and show notable adaptability (Grant and Temple-Smith 1998). Burrows are built in river banks, just above water level and often among a tangle of tree roots (DEHP 2011).
Life history	Platypus mostly live alone, but can share a water body with several other platypus. Platypus show fidelity to home ranges with daily foraging movements of several kilometres. Platypus eat small aquatic invertebrates such as insect larvae, freshwater shrimps, and crayfish. The species detects electrical currents in the water with its bill and this is used to find prey. Dawn and dusk are periods of increased activity (DEHP 2011). Platypus can remain submerged underwater for up to 10 minutes (DEHP 2011). In Queensland, platypus mate in August. After mating, the female increases consumption of food and builds a nesting burrow. Nursing burrows can be up to 30 m long. Incubation for the 17 mm eggs takes about 1-2 weeks. Tiny young are born naked, blind and with undeveloped limbs. At four (4) months, the young venture out of the burrow and are fully grown by the time they're one (1) year old (DEHP 2011).
Key threatening processes	Platypus were hunted for their fur early last century. This practice has since ceased and the species is now legally protected under the NC Act. The key threatening processes to platypus include: • Pollution to waterways; • Increased algal growths; • Siltation and destruction of riparian vegetation which put platypus burrows under increasing pressure; and • Predators including snakes, water rats, goannas, foxes, and crocodiles.

Appendix C – Turtle nesting and basking monitoring

Department of Transport and Main Roads

Coondoo Bridge Replacement Project

Turtle Nesting and Basking Monitoring

February 2017

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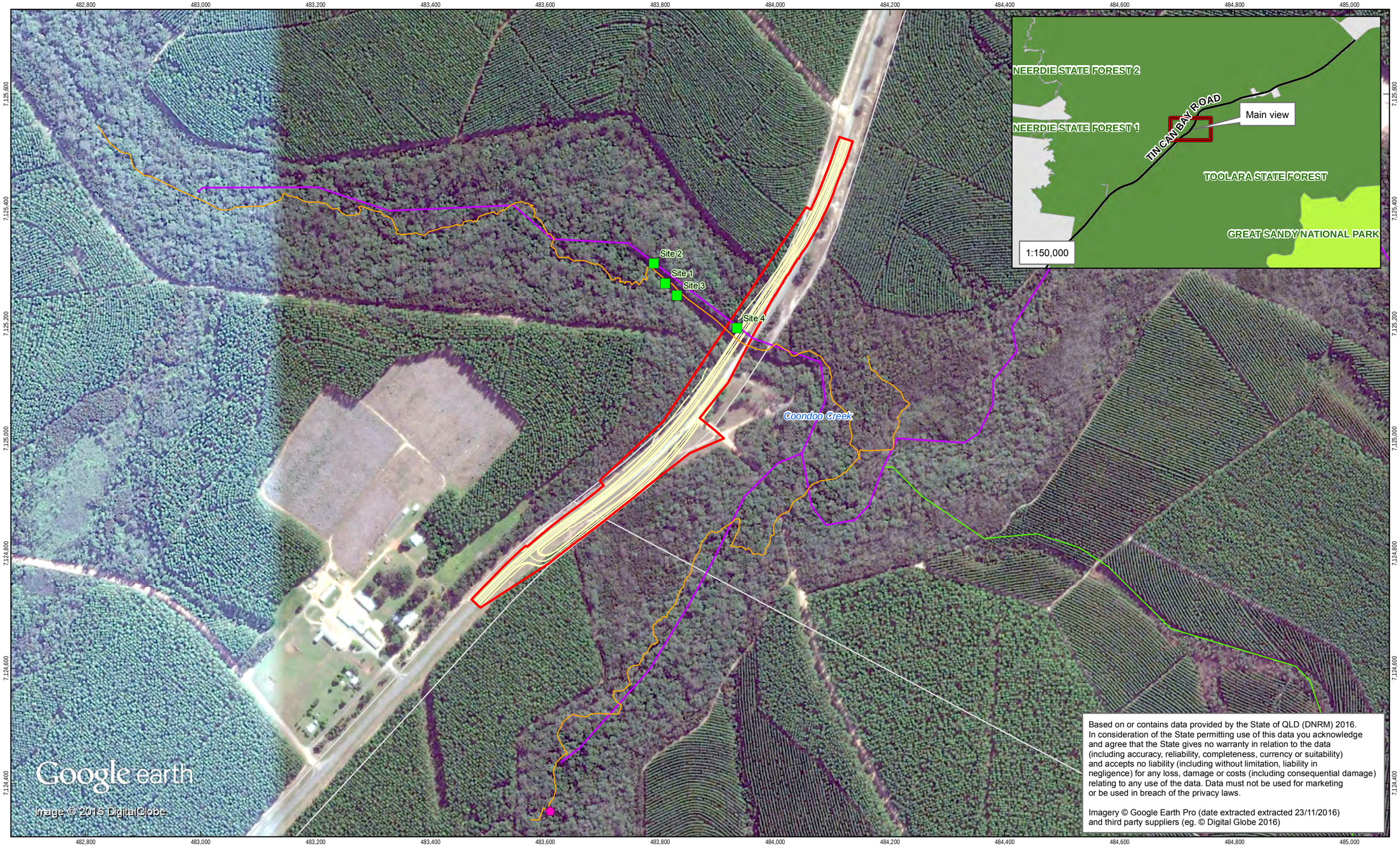
1. Introduction

1.1 Project background

The Department of Transport and Main Roads (TMR) is intending to replace the bridge on Tin Can Bay Road that crosses Coondoo Creek between Gympie and Tin Can Bay, Queensland (Latitude: -25.9923; Longitude: 152.8396) (refer Figure 1-1). The existing bridge is subject to frequent inundation during flooding events and TMR has identified that the bridge is in need of replacement to provide a safe and reliable crossing point for local traffic and emergency vehicles. TMR is proposing to construct a new concrete bridge, located approximately 13 metres (m) to the west (downstream) of the existing structure (i.e. distance from edge barrier to edge barrier). The project will also involve a realignment of the approaches for a distance approximately 600 m south of the bridge and 420 m to the north. The high voltage powerline present within the road reserve west of Tin Can Bay Road will be relocated and offset a minimum distance 2 m west of the new road formation batters and table drains.

An assessment of the existing ecological values of the site (GHD 2016) identified Coondoo Creek as habitat critical for the survival of the white-throated snapping turtle (*Elseya albagula*) and potential habitat for the Mary River turtle (*Elusor macrurus*). The deep permanent pool habitat within Coondoo Creek provides suitable habitat conditions for these threatened species with key habitat features such as instream woody debris, undercut banks and overhanging riparian vegetation present in a relatively high abundance. However, the suitability of turtle nesting habitat within the project study area was limited, principally due to the dense layer of Lomandra species on the banks of the creek (GHD 2016). Based on this assessment, nesting of the white-throated snapping turtle and Mary River turtle within the project construction footprint and broader project study area was considered unlikely to occur.

To further support the assessment of turtle nesting habitat suitability within the vicinity of the project, TMR engaged GHD to conduct additional turtle nesting habitat surveys upstream and downstream of the project construction footprint. Potential turtle basking habitat was also monitored within the project study area to target the Mary River turtle and further inform the species likelihood of occurrence assessment.



Based on or contains data provided by the State of QLD (DNRM) 2016. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

Imagery © Google Earth Pro (date extracted extracted 23/11/2016) and third party suppliers (eg. © Digital Globe 2016)

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0 25 50 100 150 200

Metres

Map Projection: UniversalTransverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Potential turtle nesting habitat
- Basking camera locations
- Turtle nesting survey area
- Proposed Alignment
- State-controlled Road
- Waterways
- Waterway barrier works - Risk of impact
  - 1 - Low
  - 4 - Major
- Construction Footprint
- Cadastral Boundary
- National Park
- State Forest

Department of Transport and Main Roads
Coondoo Creek Bridge Replacement

Job Number	41-29641
Revision	0
Date	31 Jan 2017

Turtle nesting survey area and basking camera locations

Figure 1-1

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145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: DAF: WWBW(2013); DNRM: Waterways (2010), Cadastral Boundary (2013), Protcted Areas (2016). TMR: State-controlled Roads (2013), GHD: Turtle nesting survey area (2016), Basking camera locations (2016), Potential turtle nesting habitat (2016). Proposed Alignment (2016), Construction Footprint (2016). Google Earth: Aerial Imagery (date extracted: 23/11/2016). Created by: AJ

1.2 Species information

1.2.1 White-throated snapping turtle (*Elseya albagula*)

The white-throated snapping turtle is listed as critically endangered under the Commonwealth *Environment, Protection and Biodiversity Conservation Act 1999* (EPBC Act) and endangered under the Queensland *Nature Conservation Act 1992* (NC Act). The deep permanent pool habitat within the project study area is considered to provide suitable habitat conditions for this species and three (3) juvenile turtles were captured during field surveys (GHD 2016). As the population of white-throated snapping turtle within the Mary River catchment is comprised mainly of aging adults (Limpus 2008), the capture of three (3) juvenile turtles within the project study area may suggest that Coondoo Creek is an important habitat area for facilitating juvenile recruitment into the breeding population and for the long-term maintenance of the species. In accordance with the *EPBC Act significant impact guidelines* (DotE 2013), Coondoo Creek within the project study area is therefore considered habitat critical for the survival of the species.

The white-throated snapping turtle is thought to aggregate nesting at traditional nesting sites. All known nesting aggregations have been recorded from the main Mary River channel (i.e. near Tiaro, junction with Munna Creek, Gunalda, and Traveston) and along Obi Obi Creek (Limpus 2008). Almost all nesting occurs on alluvial sand/loam banks that are deposited by floodwaters. Isolated nesting has however, been recorded in a variety of substrates ranging from sand to dark clay and grassed loam slopes. Nests are generally laid on the front face and top of steep slopes, are an average of five metres from the water's edge and are three metres above the water level (McDougall et al. 2015; Hollier 2010; Hamann et al. 2007). The white-throated snapping turtle nests from autumn through to early spring (peak activity between May and July) with hatching generally occurring in early summer (December- January) after an embryonic diapause over the winter months (Hamann et al. 2007). Once they reach sexual maturity (15-20 years) female turtles are thought to breed annually (Hamann et al. 2007).

1.2.2 Mary River turtle (*Elusor macrurus*)

The Mary River turtle (*Elusor macrurus*) is listed as endangered under the EPBC Act and NC Act. The deep permanent pool habitat within the project study area provides suitable habitat conditions for the Mary River turtle; however, the species has not been previously recorded within Coondoo Creek and no individuals were recorded within the project study area during field surveys (GHD 2016a; DNRM 2016). Targeted surveys for the species have recorded a small number of individuals (N = four (4)) within Tinana Creek, approximately 30 kilometres (km) downstream of the project study area (DNRM 2016). The absence of previous records for the species within Coondoo Creek suggest that this region of the Mary River catchment does not support a significant proportion of the Mary River turtle population and does not represent habitat critical to the survival of the species.

Nesting of the Mary River turtle is primarily restricted to alluvial sand/loam banks that occur in depositional areas. These banks generally form at the river's edge and extend back into the immediate riparian zone; however, islands are also known to occur in places. There is insufficient evidence available on species specific nesting requirements to accurately describe optimal nesting bank conditions; however, banks are generally large, steep and sparsely vegetated. The majority of aggregated nesting occurs at traditional nesting banks immediately upstream from Tiaro. Limited turtle nesting has been observed outside this area (Limpus 2008).

1.3 Purpose of this report

This report details the findings of the turtle nesting habitat surveys and basking habitat monitoring undertaken for the project. The report includes:

- Introduction – detailing project background and species information
- Methodology – details of the turtle nesting habitat survey and basking habitat monitoring methodology
- Results – results of the field survey and photo analysis
- Conclusion – discussion of results and legislative requirements.

The purpose of the report is to further inform the impact management plan for the project and the requirement for a Species Management Program under the NC Act.

1.4 Scope and limitations

This report: has been prepared by GHD for TMR and may only be used and relied on by TMR for the purpose agreed between GHD and the TMR as set out in this report. GHD otherwise disclaims responsibility to any person other than TMR arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by TMR and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report. Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Methodology

2.1 Turtle nesting habitat survey

An assessment of turtle nesting habitat was undertaken within Coondoo Creek to identify areas potentially suitable for turtle nesting and to detect nesting activity levels. The surveys were conducted on the 14th and 15th November 2016 following preceeding rainfall and reports of Mary River turtle nesting activity in Gympie (Marilyn Connell pers.com). This period coincided with the nesting season of the Mary River turtle and the early hatching season of the white-throated snapping turtle (winter nesting species).

The surveys involved traversing the creek in a kayak and/or on foot and mapping the locations of potentially suitable nesting habitat (as defined by existing literature). The turtle nesting habitat surveys were undertaken for approximately 2 km upstream and downstream from the existing bridge (hereafter referred to as the turtle nesting habitat survey area; Figure 1-1). This area was selected to extend beyond the expected area of direct and indirect impacts from project activities (e.g. noise disturbance) and to encompass the likely range of turtle movement during nesting season (i.e. average daily movement of the Mary River turtle during the nesting season is 2 km (Flakus 2002)).

Where suitable habitat was detected, a survey for nesting activity was undertaken in accordance with standard Department of Environment and Heritage Protection (DEHP) methodology. This method involves systematically searching accessible bank margins for evidence of nesting (i.e. turtle tracks, nest depressions, predated egg shell) along strip transects parallel to the water's edge. Any evidence of turtle nesting activity is photographed and GPS coordinates recorded. Any intact turtle nests identified has nest protection mesh installed over the site to protect the turtle eggs from predation.

2.2 Basking habitat monitoring

Potential turtle basking habitats (i.e. emergent logs) were identified within 200 m of the existing bridge and four sites were selected for monitoring with remote surveillance cameras (Reconyx Hyprefire Tail Camera HC600).

The cameras were initially set at two potential basking habitats (Sites 1 and 2) from 17th September to 12th October 2016 (Figure 1-1). The cameras were set to be motion triggered and to take a photograph every 15 minutes (min) during daylight hours.

An initial comparison of the images obtained through motion trigger verses those taken at set times (every 15 min) indicated that the temperature difference between the reptile species photographed and the environment was not great enough to trigger the motion sensor. The set time photographs also reveal that some basking individuals were being missed by the 15 min photograph frequency. This was evident from photographs showing the basking logs becoming wet between sequential photographs but no individuals captured basking. As a result of these findings, the cameras were moved to two new potential basking habitats between 12th October – 2nd November 2016 (Sites 3 and 4; Figure 1-1) and the camera photograph frequency rate increased to every 5 minutes.

The photographic images taken were analysed and fauna species identified.

The characteristics of each basking habitat, monitoring timeframe and image capture specifications are provided in Table 2-1.

Table 2-1 Basking habitat monitoring sites

Camera location	Habitat	Monitoring timeframe	Image capture specifications
Site 1		17 - September - 12 October 2016 26 days	Motion trigger Set time frequency – 15 minutes
Site 2		17 - September - 12 October 2016 26 days	Motion trigger Set time frequency – 15 minutes
Site 3		12 October – 2 November 2016 22 days	Motion trigger Set time frequency – 5 minutes
Site 4		12 October – 2 November 2016 22 days	Set time frequency – 5 minutes

3. Results

3.1 Turtle nesting habitat suitability

Coondoo Creek within the turtle nesting habitat survey area consisted of a large permanent pool habitat at the site of the existing bridge with narrow shallow pools upstream and downstream. The creek channel diverged into multiple anabranches at various points along the length of the creek. At the time of survey, water levels were low with the average depth of the narrow pools <0.5 m and some sections completely dry.

The bank characteristics of Coondoo Creek were relatively consistent along the length of the turtle nesting habitat survey area. The bank substrate was predominately a sandy loam with extensive leaf litter coverage. Bank height was generally 1 – 2 m on the lower banks, increasing to a maximum of 10 m high on the right bank of the larger permanent pool.

The banks of the creek were dominated by mature eucalypt forest with riparian and gallery rainforest elements present in the sub-strata. Banks were densely vegetated by *Lomandra* species (*Lomandra hystrix* and *Lomandra longifolia*) which extended 2 -10 m from the waters' edge.

Plate 3-1 Large permanent pool habitat with fringing vegetation

Plate 3-2 Narrow shallow pool with mature riparian vegetation and extensive *Lomandra* coverage

Plate 3-3 Anabranches of Coondoo Creek with mature riparian vegetation and extensive *Lomandra* coverage