

Department of State Development, Tourism and Innovation

Wangetti Trails Project

Wangetti South Cassowary Management Plan



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Wangetti Trails Project, Wangetti South Cassowary Management Plan

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Appendix A

Cassowary Foodplants in the Wangetti Trails Project Area

1. Introduction

1.1 Introduction

A Cassowary Management Plan (CMP) was prepared in December 2020 (Environment Pacific 2020/DSDTI) to assist in the planning/design, construction and operation/maintenance aspects of the Wangetti Trail (north and south) in consideration of the southern cassowary ('cassowary' *Casuarius casuarius johnsonii*).

The primary purpose of the CMP was to provide guidance in managing potential impacts and negative interactions between cassowaries and human activities. The 2020 CMP was based on the level of available information for the Wangetti Trails project at the time. A key feature of the CMP is that it is to be 'live document' and is to be updated when further detailed information on design, construction and operation for the trails become available.

Subsequent to the release of the 2020 CMP, the design of the trails has progressed, and further information is now available for the Wangetti Trails Project. In particular, the Wangetti South section of the project is now at an advanced stage of planning, and amendments to the 2020 CMP are warranted that reflect current planning.

Habitat modelling and identification of management measures in the 2020 CMP was based on an assessment of the overall values of the entire Wangetti Trails Project Area, including the Wangetti North, Wangetti South, and the Southedge/Black Mountain mountain bike-only sections. For this Wangetti South applicable only CMP update, the modelling was revised to include only those attributes specific to this section of the Wangetti Trails project.

1.2 This Plan

This report is restricted to the Wangetti South trail section of the project and identifies management measures specific to the construction and operation of this trail on the basis of further design and construction information. The provisions of the CMP related to the Wangetti North trail (as presented in the 2020 CMP) continue to apply.

This revised Wangetti South trail CMP does not replace and is subordinate to legislative, regulatory and planning provisions relevant to the management of the values of the Wet Tropics World Heritage Area (WTWHA).

This CMP does not abrogate responsibility of the Management Authorities for the Wangetti South trail from the fulfillment of conditions as may be issued for permits, authorities, and approval for the construction, operation and maintenance of the project. Legislative obligations will prevail where there is a conflict between this Plan and regulatory requirements.

Where there are existing policy, planning and regulatory commitments that include gazetted public roads, recreation reserves, timber/forestry reserves, private property and their access roads, these must be addressed within the context of this Plan.

1.3 Area this Plan Covers

This CMP is limited to those works associated with the construction, operation and maintenance of the Wangetti South trail. This includes:

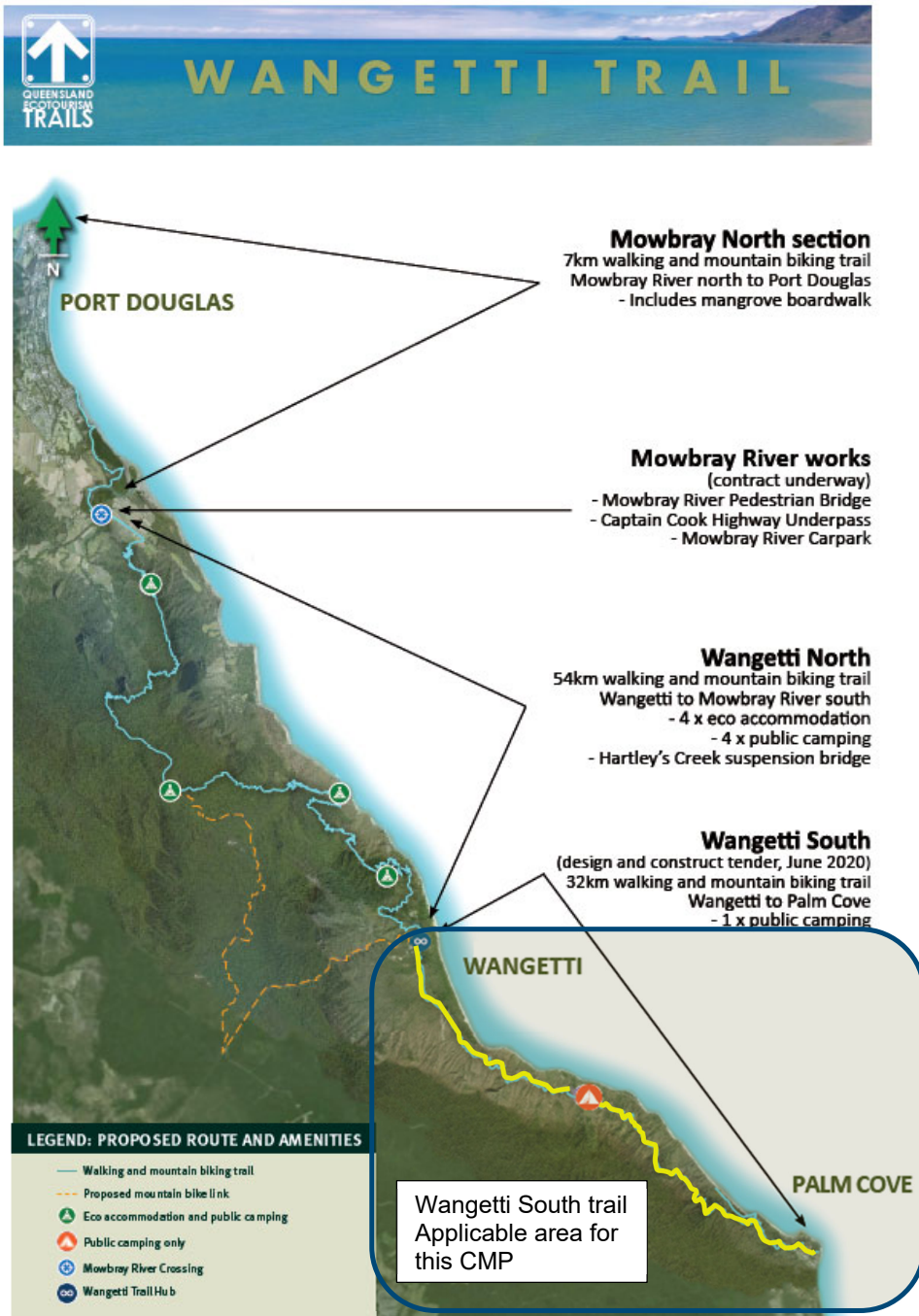
- The 40m wide proposed corridor construction area

- All aspects of construction including construction access trails, laydown and stockpile areas, temporary camps (if required) and any other infrastructure related area.

The alignment of the Wangetti South, trail as shown in the GHD report (2020) and reproduced as

- Figure 1 (following).
- All camping grounds along the trail.
- All service access tracks and roads to trail facilities.
- Carparks, registration areas/trailheads and other locations.

Figure 1 Wangetti Trails Project Extent – Wangetti South



.Source: Wangetti Trails Project: (GHD report 2020)

1.4 Description of Works

A full description of the proposed works is to be found in documentation on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act') project referrals portal at:

<http://epbcnotices.environment.gov.au/referralslist/> Referrals no: [2020/8722](#) and [2020/8723](#).

The following is a summary of the information presented in the *Wangetti Trail South Section (Wangetti to Palm Cove) Matters of National Environmental Significance Baseline Ecology and Impact Assessment Report* (GHD July 2020).

The proposed infrastructure includes:

- A 29.7km¹ shared use trail to accommodate both mountain bike users and hikers. Trail will comprise both natural ground and built surface sections, to a maximum width of 1.5m when formed, with allowance for an additional 0.5m of disturbance either side during construction. A 40m wide construction corridor has been identified (GHD 2020) to allow flexibility of minor realignments and infrastructure aspects during construction.
- Built structures proposed as part of the trail include reinforcement of gully crossings, bridges, staircases, platforms, rock armouring and signage.
- A number of waterway crossings along the shared use trail will require armouring, boulder crossings and low-level bridges for minor waterway crossings.
- Public camping node and amenities block, with a footprint of 0.25 ha and comprising
 - 10 x 4 m diameter elevated camping decks
 - 1 x 2.5 m x 2.5 m toilet block
 - One communal gathering area including bike rack, table and seating, cooking and bench area and shelter
 - Interconnecting pathways, boardwalks and access tracks.
- The upgrading of existing access tracks into service tracks to provide restricted access to the shared use trail and the camping node for construction purposes, operational purposes, maintenance purpose and for emergency purposes. Upgrading will include vegetation trimming and ongoing maintenance, stabilisation of track surfaces, installing drainage controls where required.

¹ Note: this figure is based on original preliminary design. Actual distance may vary depending on constructability along alignment. An explanation of distances/discrepancies is provided in **Notes on Mapping** Section 3.3 of this document.

2. Application of this Plan

2.1 Understanding Cassowaries

2.1.1 Description and Ecology

The southern cassowary (*Casuarius casuarius*) is found in Indonesia, Papua New Guinea and Australia, with the Australian population being considered a subspecies, *Casuarius casuarius johnsonii*. The Australian population has disjunct populations represented on Cape York Peninsular and in the north Queensland wet tropics. Population estimates in Australia vary, with the Cape York populations poorly understood, and previous estimates for the wet tropics population widely varying. The most current estimate is approximately 4,400 (Westcott *et al* 2014).

The origin of the name 'cassowary' has several sources but is considered most likely to derive from Papuan languages referring to the 'horned (kasu) head'(weri) (Boles 1987). In the language of the Eastern Kuku-Yalanji traditional owners the cassowary is "kurrangi" (Hershberger, 1986) and "punta:raa" to the Yirrganydji traditional owners (Biggs, 2013). The cassowary is a totemic animal to traditional owners, and is an iconic emblem of the Wet Tropics World Heritage Area.

The southern cassowary ('cassowary' in this Plan) is a member of the ratites, a grouping of large flightless birds that includes other cassowary species in Melanesia, but also African ostriches, Australian emus, New Zealand kiwis and South American rheas. Cassowaries are large and heavy birds, females being the larger, and may reach heights of 1.8m and weigh 65kg (Biggs 2013). They are a polyandrous species, generally solitary in nature with variable size home ranges, although these ranges are fluid and may overlap the territory of adjacent birds (Crome and Moore 1990, Kutt *et al* 2007, Westcott *et al* 2014). Breeding occurs between June to October/November, with the male alone responsible for incubation and rearing of chicks for between 9 to 18 months after hatching. During the approximately 50 days of incubation males rarely leave the nest.

Cassowaries are primarily frugivorous, their core habitat being rainforest communities that are characterised by a wide diversity of fleshy fruited species. Cassowaries have been documented as being the primary dispersal agent of at least 238 plant species (Mack *et al* 2006).

Cassowaries will however feed on a variety of invertebrates (including crustaceans), carrion, and small vertebrates (Buosi and Burnett 2006, Bentrupperbäumer 1998).

Of importance to this plan is that cassowaries are not restricted to rainforest areas, but require a mosaic of habitats that offer resources, e.g. fruiting plants, that are seasonally only available outside of rainforests (Crome and Moore 1990). Their foraging is also strictly diurnal, meaning that cassowaries will not be active in the evenings (Crome 1976) and being bipedal, their habitat preference is for areas of milder terrain and flatter land. Subsequently the most significant wet tropics populations are to be found in the coastal lowlands (Westcott *et al* 2014) where preferential habitat is most at risk from development.

2.1.2 Conservation Status

The southern cassowary (*Casuarius casuarius johnsonii*) is listed nationally as 'endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The southern population (wet tropics) is listed as 'endangered' under Schedule 1 of the Queensland *Nature Conservation (Animals) Regulation 2020* and Cape York Peninsular

populations are listed as 'vulnerable' under Schedule 2 of the *Nature Conservation (Animals) Regulation 2020*. Internationally the species (*Casuarius casuarius*) is listed under the IUCN Red List as 'vulnerable- declining population trend'.

Habitat loss and fragmentation of remaining habitat is recognised as the primary threat to cassowary populations, and has been most extensive in the coastal lowlands where cassowary densities are the highest (Moore 2003, Latch 2007, Westcott *et al* 2014). Other factors identified in the decline of cassowary populations include road death by vehicle strikes, dog attacks and avian diseases e.g. avian tuberculosis and *Aspergillosis* (Moore 2003). Degradation of habitat through logging, feral pig activity, weed invasion and altered fire regimes is also considered a key factor in reducing resource availability for cassowaries (Kutt *et al* 2009).

2.1.3 Behavioural Aspects

The behaviour of cassowaries is not well understood. They are a cryptic species, and captive individuals rarely exhibit the full range of behavioural aspects that have been observed of cassowaries in the wild (Biggs 2013). The behaviour of individuals to the same stimulus may vary from individual to individual bird, and conversely, the same bird may respond differently to the same stimulus at different times.

There is consensus in published literature (e.g. Crome 1976, Crome and Moore 1990, Bentrupperbäumer 1998, Buosi and Burnett 2006) that changes in behavioural aspects are a significant factor in cassowary mortality and injury. In particular hand feeding of cassowaries, or other ready availability of anthropogenic food sources, e.g. organic rubbish, is directly responsible for attracting cassowaries to road sides, where vehicle strike is the single most direct cause of cassowary mortality and injury (Moore 2003) or into urban, rural/residential areas and into conflict with dogs and urban traffic (Bentrupperbäumer 1998).

Kofron (1999, 2003) assessed the pattern of negative cassowary interactions with people (i.e. attacks) and of the 150 documented cases reported to 1999, 73% of these were in situations where cassowaries were soliciting or expecting food from humans. Other attacks occurred where birds were reacting in response to threat perceptions including defending food sources (5%), defending themselves (15%) or their eggs and chicks (7%). Eight of the attacks resulted in serious injury, and there is one historical mortality in a situation where a cassowary was defending itself from dogs and their handler.

Access to anthropogenic food sources and/or hand feeding appears to increase the changes of negative interactions with cassowaries (Kofron 2003). Behavioural changes relevant to the Wangetti Trails project may include:

- Persistent access to camp areas as a result of availability of anthropogenic food sources e.g. rubbish bins, food left in untended open areas, or hand feeding.
- Persistent occupation of trail areas in home ranges resulting from hikers/riders leaving food scraps or hand feeding birds, and subsequent potential confrontation with users on the trail.
- An increase in aggressive behaviour towards hikers/riders in defending chicks and nest areas in proximity to the trail/camp areas.
- An increase in aggressive behaviour towards hikers/riders in defending food sources, e.g. particular fruiting trees, adjacent to the trail/camp areas.

Other, more general behavioural responses noted with cassowaries that may arise as a direct result of construction and operation along the Wangetti South trail include the following:

- Response to noise (and light at night). Cassowaries are a reclusive species, relying on vocal communication for finding mates, husbanding chicks, and as a warning response. Noise has the potential to adversely impact behaviour which may include abandoning or limiting access to part of their range including water sources (permanent and seasonal), and important staple food sources (e.g. access to fruiting trees). At the most extreme, noise may preclude cassowaries from finding breeding partners in situations over large home ranges. Construction noise may result in only temporary displacement of the cassowary to other parts of their range, however over the extent of the Wangetti South trail, there are no key/essential habitat resource areas in locations where such impacts are expected.
- Cassowaries will readily adopt clearings into their movement patterns, and will use available paths, trails and minor roads to traverse their ranges. While though evidence of cassowaries has been obtained for other sections of the Wangetti Trails project (Wangetti North and the Mountain bike only trail) there have been no documented records of cassowaries using any part of the Wangetti South trail. The volume of hikers and mountain bike riders is not known, however it remains a low to very low possibility that users of the Wangetti South trail will come into contact with cassowaries. In such an event, the behavioural responses are unknown and will largely depend on the site-specific circumstances (e.g. adults with chicks, fruiting trees present, blind corners on fast moving mountain bikes, etc.)

2.2 Abundance and Distribution in the Project Area

2.2.1 Database records, Published Literature and Anecdotal Information

While there have been intensive surveys for specific localities in the Wet Tropics, for example Mission Beach (e.g. Moore 2007), specific information on the abundance and distribution of cassowaries in the Wangetti Trails project area overall is very limited. For the Wangetti South trail, there are no formal records, with the only information being anecdotal observations made in the 1800s with the most recent being 1907 at Tin Creek, near Wangetti. An extensive survey of the Wet Tropics using information obtained through direct observation and DNA analysis was undertaken by Westcott *et al* (2014). Subsequent complexing modelling utilising a number of tools, and including habitat condition and type (identified as essential habitat through Kutt *et al*. 2014) were used to obtain an estimate of cassowary density and population based on sub-regional areas including the Black Mountain corridor between Kuranda and Julatten (west of the Macalister Range), with the Wangetti South trail on the eastern foothills and ridges

With respect to the Wangetti South alignment area, all actual observations are clustered in the southern section of the Black Mountain corridor (outside the Wangetti South project area) with a lesser number of records collected in the northern end, closest to Julatten along Black Mountain road. No cassowaries were recorded east of the Macalister Range and the associated modelling did not include much of the eastern fall of the Macalister Range owing to the lack of suitable habitat including landform features, vegetation associations, permanent water availability and verified records/observations. Subsequently less than 1/10th (7.5%) of the Wangetti Trail south was modelled as having some resource capability for cassowaries. The modelling of occupancy of these areas, either transitory or permanent, identified densities from '0' to 0.12/ha (Kutt *et al* 2014). The boundaries largely follow those of the DERM (2009) essential habit layer shown in **Figure 2**.

2.2.2 Field Survey Data

Ecology surveys of the entirety of the Wangetti South shared use trail of were undertaken in 2019 (GHD). Surveys undertaken in 2020 were restricted to the Wangetti North trail and Southedge Road/Black Mountain Road mountain-bike only trail.

There was no evidence of cassowary utilisation of any part of the Wangetti South trail, with the majority of this trail being outside mapped essential cassowary habitat (DERM 2009 **Figure 2**). The lack of field survey observations (either direct or indirect) support the modelled density and likely occupancy of mapped essential habitat along the Wangetti South trail as estimated by Westcott *et al* (2014), which varied from 0 birds to 0.12 / ha.

Based on the modelled density incorporating Wangetti North, Wangetti South and the Southedge/Black Mountain mountain-bike only section, the current estimate is for 8 to 9 cassowaries within the entirety of the Wangetti Trails project area,. Combined with actual observations, all these birds are believed to occupy ranges west of the Macalister Range, along the Wangetti North trail and Southedge Road/Black Mountain Road mountain-bike only trail..

2.2.3 Field Habitat Observations

A number of environmental aspects considered important in the abundance and distribution of cassowaries in the project area were noted during the 2019 surveys.

- Permanent water is less available along or immediately adjacent the trail sections than would be available in wetter coastal areas of known higher cassowary abundance and distribution, e.g. Mission Beach, Daintree. Nearly all watercourses are ephemeral, and permanent water is restricted to a few major creek systems.
- The very small areas of rainforest types are primarily limited to notophyll vine forest types, i.e. these are drier-type rainforests that are generally characterised by floristic assemblages with a lesser representation of core foodplant species, and a higher representation of families that include genera with non-fruity seeds, e.g. *Flindersia*, *Agathis*, *Agyrodendron*.
- The Wangetti South trail is on the eastern fall of the Macalister Range, and landform and topography is challenging, with steep, rocky slopes, deep sided gullies, and include a number of localities that would pose challenges to bipedal cassowary movement.
- The availability of complex habitat mosaics, e.g. wetlands/swamps, littoral environments, is very limited. These habitat mosaics provide seasonal resources that may not be available in core rainforest habitats, and subsequently cassowary home ranges may be larger than recorded in the lowlands to accommodate this disparity. While some habitats may be important only briefly in the annual cycle of food production, they may be crucial to the survival of cassowaries whose home range encompasses them (Bentrupperbäumer 1998). Crome and Moore (1990) suggest food resources in non-rainforest habitats may be more important at times of food stress in the rainforest, such as after cyclones.

The above field observations of habitat quality are consistent with the modelling of West *et al* (2014) with respect to low to very low/no cassowaries within the Wangetti South alignment.

3. Habitat Management Areas

3.1 Derivation of Management Areas

The derivation of the habitat management areas in the 2020 CMP was based on the application of various habitat factors (see **Table 1**) which were weighted over the entirety of the Wangetti Trails Project Area, including the Wangetti North, Wangetti South, and the Southedge/Black Mountain mountain bike-only sections. As the Wangetti Trails project encompasses very many landform types, ecological communities and microclimates, the overall Wangetti Trails project area approach unduly weighted some attributes which resulted in skewing some outputs. Owing to the complexity of the overall project area, It was beyond the scope of the original modelling to equitably weight all habitat factors for each of the trail sections within the context of the original purpose of the 2020 CMP.

For this Wangetti South applicable only CMP update, the derivation of the Management Areas was revised to include only those attributes specific to the Wangetti South trail, however the overall approach as presented in the 2020 CMP remains the same (as below).

Habitat management areas and their relative priority for action have identified based on the presence of core habitat factors located either directly along the trail and camp areas and/or within an estimate home range of 500m to 1000m radius (Bentrupperbäumer 1998; Campbell *et al.* 2012).

The areas of likely highest occupation and resource utilisation by cassowaries were used to prioritise habitat management areas. These areas were determined through a qualitative weighted criteria analysis undertaken using a spatial query in a GIS platform and supported through evidence of birds observed during field work and of anecdotal records. This analysis also includes the areas of the proposed camps, as users of these facilities, and the operation/maintenance of camps, have a high potential to affect cassowary behaviour. The outcome of this analysis identifies the location of the most probable area of interaction with cassowaries, and forms the basis for habitat management priority areas and actions.

Changes from the original analysis (EnPac 2020) include:

- SQL queries were bounded by the coordinates of the Wangetti South trail, i.e., did not include overall model parameters as done on the first run for the overall Wangetti Trails project area.
- There are no CSIRO, WildNet, or other database records for cassowaries (either of birds or of scats) in proximity to the Wangetti South trail (except for historical anecdotal records at Wangetti.). Removed these records (applicable only to Wangetti North and the mountain bike trail) from the queries.
- Application of vegetation data as specific to the Wangetti South trail i.e. review of habitat complexity and connectivity, and floristics.
- Habitat patch size i.e., size of mapped essential habitat in most instances was smaller than the estimated home ranges of cassowaries ((Bentrupperbäumer 1998; Campbell *et al.* 2012).
- Proximity to permanent water. Review of some streams identified in database mapping as permanent. Only one of the streams actually mapped is considered to be permanent, others are seasonally dry gullies.

- More detailed topography was used. The DERM 2009 mapped essential habitat in some areas is almost precipitous.

The revised criteria, their relative importance, and notes used for identifying priority management areas are presented in Table 1.

The management areas were subsequently qualitatively allocated a ranking from Highest Priority to Lowest Priority based on:

- Quality of environmental factors sustaining cassowary habitat.
- Verifiable evidence (scats, observation, reliable witness accounts) of cassowary utilisation.
- Proposed infrastructure type, nature, and location.
- Existing habitat modelling and available data sources.

These were collectively mapped based on the 40m wide construction corridor identified in the GHD 2020 report, taking into account the potential abundance and density of cassowaries as modelled through Westcott *et al* (2014) within the Black Mountain corridor, any actual records/observations and the suitability of isolated patches of mapped essential habitat to support cassowary home ranges.

3.2 Habitat Management Areas Summary

The 2020 CMP (Section 3.2) recommended that the boundaries of derived habitat management areas and priority rankings should be reviewed following a period of establishment and operation of the trails, indicatively two years, when further data will have been collected on cassowary interactions with trail users and trail/camp operators. The mapping of these habitat management areas is shown in **Figure 2**, and described in the following.

3.2.1 Highest Priority Habitat Management Areas

These are localities within and/or immediately adjacent to essential habitat factors (core foodplant resources, permanent water availability) and supported by direct evidence of resource utilisation (actual birds or scats). Highest priority areas provide critical resources to the survival of cassowaries where seasonal or permanent occupation is supported by habitat components needed for the survival and recovery of the species, or a localised portion of the population.

There is a high to very high probability that interactions between cassowaries and users of the infrastructure in these localities will occur within the construction, operation and maintenance phase of the project.

3.2.2 High Priority Habitat Management Areas

These areas are allocated to infrastructure locations where the majority of the essential habitat factors are represented within an estimated home range area of 500 to 1000m radius of the infrastructure and supported by direct evidence of resource utilisation (actual birds or scats). Some habitat factors e.g. forest structure integrity, may be diminished but still provide critical resources to the survival of cassowaries where seasonal or permanent occupation is supported by habitat components needed for the survival and recovery of the species, or a localised portion of the population.

The probability is moderate to high that interactions between cassowaries and users of the infrastructure in these localities will occur within the project construction operation and maintenance phases.

3.2.3 Moderate Priority Habitat Management Areas

Moderate priority areas are localities in which there are habitat factors that may provide important seasonal resources but potential core habitat features are either diminished or lacking. There are no records of cassowaries, or observations of scats in these areas. These areas may provide important seasonal resources, or resources in the event of a cyclonic damage to core habitat.

Birds may use these areas on a seasonal, transitory and opportunistic basis, however the probability of interactions with users of the facilities is moderate to low and would only occur over a longer timespan during the operational and maintenance phase of the trails.

3.2.4 Low Priority Habitat Management Areas

These areas have greatly reduced habitat factors, and any factors present are small in extent, usually isolated from key habitat resources by topography, and/or large distances of intervening unsuitable habitat types (e.g. rocky sclerophyll woodlands). There are no recent verifiable records of cassowaries in these areas.

Published literature/research also identifies these areas as non-preferential cassowary habitat and the likelihood of interactions between cassowaries and trail users is very low to nil.

3.2.5 Lowest Priority Habitat Management Areas

Locations within developed areas, extensively cleared or with existing infrastructure with no supporting habitat for cassowaries. Habitat factors elsewhere are either absent, or exist in isolation with no other resource capacity to support cassowaries. Areas of mapped essential habitat either have a known history of local extirpation (i.e., coastal Wangetti area), or are too small to support cassowary home ranges. No likelihood of interactions between cassowaries and trail users.

3.3 Notes on Mapping

The mapping has been derived from a number of sources as cited in this plan. The alignments for the trail/road infrastructure were surveyed in the field for previous reports (e.g., GHD 2020) using a hand-held GPS. This has resulted in a number of anomalies arising from the practical need to traverse rough and steep terrain, areas of impassable vegetation, avoidance of large rock outcrops, safe crossings of waterways and similar field obstructions. Subsequently there are discrepancies in distances between original preliminary alignment GPS survey distances (as quoted in the GHD reports), and the distances as identified in this plan. Specifically, the distances used in this plan for the various management sections reflect the approximate centre line median of the 40m wide construction corridor along the GPS field survey alignment. That is, the quoted distances in this plan are shorter than those of the surveyed alignment as the approximate median centreline of the construction corridor does not include the various deviations made during the field surveys.

Table 1 Management Area Derivation

Criteria	Relative Importance	Data Source	Notes and relevance to Wangetti Trail (north and south) and Wangetti Mountain Bike Trail
Direct observation (cassowaries or their scats)	Very high	Field survey data 2019, 2020 RRRC surveys 2012-2014 Anecdotal information, QPWS, WTMA and Qld Forestry	Scats indicate direct utilisation of an area that is within the home range of at least one bird. While though scats provide evidence of presence, they do not reflect the probable density of distribution without further work, e.g. DNA analysis, to identify individual birds. There are no verifiable records of cassowaries in the steep coastal section between Palm Cove and the descent to Wangetti along the Wangetti South trail alignment. Most of this trail section is outside of the essential habitat mapping (DERM 2009) for the wet tropics. Anecdotal information has identified that Wangetti coastal areas may have once hosted a cassowary population, however this population is no longer extant (last record being 1907, Tin Creek).
Existing habitat modelling	Moderate	DERM Essential habitat overlay 2009	Essential habitat has been mapped for cassowaries based upon direct, and verifiable evidence of cassowary utilisation of various regional ecosystem (RE) vegetation types across the Wet Tropics (Kutt <i>et al</i> 2004, DERM 2009). This does not mean that every mapped location of the relevant RE has a verifiable record. Of the 28.8km of the Wangetti South shared use trail, approximately 2.9km is within mapped essential habitat. The majority of this essential habitat has historically no cassowary records, and represent patches which are isolated from core habitat areas. The only significant area is near Wangetti hub (Tin Creek), where no cassowaries have been sighted since tin mining began in 1907. Additionally some of the areas of the small patches of mapped essential habitat along the Wangetti South trail are too small to support the home range of a cassowary, and are not connected with any other habitat.
Complexity and type of habitat	High	RE mapping v.11 Field survey data 2019, 2020 WTWHA mapping, Stanton 2009	Whilst cassowaries are dependent on rainforests, they require a mosaic of habitat types which can provide a year-round supply of flesh fruits. The distribution of cassowaries is constrained by the availability of habitat which can provide a year-round supply of fleshy fruits and access to permanent freshwater for daily drinking and bathing (Buosi & Burnett 2006). Cassowaries are subsequently not exclusively found in rainforest but will venture into vine forest, sclerophyll forest and wetland communities for resources that are seasonally not available in rainforest. Subsequently a home range typically will include ready access to other vegetation types. Within the context of the Wangetti South trail, the availability of suitable vegetation complexes that provide seasonal resources and mapped as essential habitat (other than rainforest types), is extremely limited. The poor representation of such seasonal resources, lack of connectivity with other habitats, lack of permanent water, is identified as a limiting factor to the abundance of cassowaries and their distribution along the Wangetti South trail.
Proximity to permanent water	High	Field survey data 2019, 2020	Cassowaries must have daily access to permanent water for drinking and bathing (Buosi & Burnett 2006). Typically, this implies a radius of less than a kilometre from permanent water within the average home range of a cassowary. Permanent water sources on the Wangetti South trail are present only on the coastal plain near the Captain Cook Highway including near Wangetti and an unnamed stream that passes through the Ellis Beach campground. With

Criteria	Relative Importance	Data Source	Notes and relevance to Wangetti Trail (north and south) and Wangetti Mountain Bike Trail
		Watercourse mapping (Water Act) Qld Watercourse data	the exception of the Wangetti area, there are no historical records of cassowary usage of any watercourses along the Captain Cook highway below the Wangetti South trail.
Cassowary foodplants	Moderate	REDD database WildNet/Herbrecs database Field survey data 2019, 2020 WTWHA mapping, Stanton 2009	<p>The relative abundance and diversity of cassowary foodplants is a significant determinant in their distribution. Cassowaries are reliant on fleshy fruit from a number of rainforest habitat types, but must have access to seasonal resources from adjacent vegetation types. Cassowary foodplants are relatively well documented, and readily identifiable in the data sources cited. Areas with higher abundance of cassowary foodplants are more likely to provide resources and hence habitat utilisation and potential occurrence.</p> <p>Those limited areas of rainforest areas along the Wangetti South trail are primarily notophyll vine forests, Cassowary foodplants are less common in notophyll vine forests, and only seasonal resources would be obtained from adjoining ecotones with sclerophyll forest. In most instances the areas of notophyll vine forest are limited to deep gullies and steep slopes, are thus relatively inaccessible to cassowaries, are too small in area to support a cassowary and too distant from other suitable habitat to form part of a home range.</p>
Location of camps	Low	GHD report and data 2020	The location of the camps is important for prioritising management actions along the Wangetti North trail, however whilst a high degree of management of camp/accommodation areas in cassowary habitat is required, the proposed Wangetti South trail campsite is not in a priority cassowary habitat area and subsequently this is of significantly less weight in consideration of the impacts of a camp on cassowaries.
Topography	High	QTopo database	Cassowaries, being bipedal, are primarily a species with preference for flat/ mild to moderate terrain, and do not typically have extensive areas of steep, rocky, or otherwise difficult to traverse terrain in their home ranges. Such areas of the project area are primarily limited to the coastal eastern ridges and foot slopes of the Macalister Range and are suboptimal as habitat for cassowaries. A significant proportion of the Wangetti South shared use trail alignment is within steep, rocky areas along the Macalister Range that are not considered suitable for cassowaries.

Figure 2 Cassowary management areas, Wangetti South shared-use trail

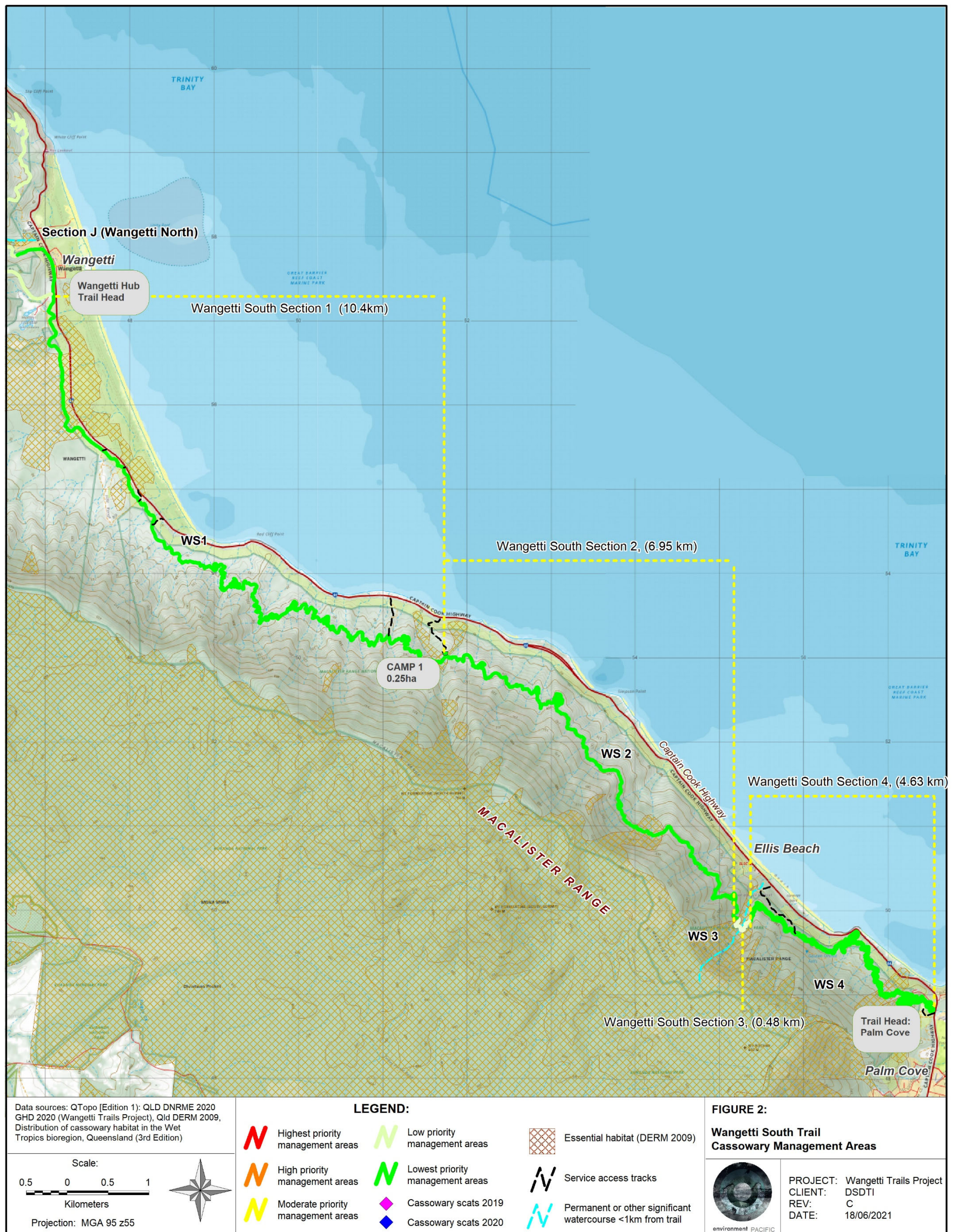


Table 2 Description of Priority Areas, Wangetti South Trail

Location	Distance	Habitat Factors	Summary Description
Highest Priority			
No areas along the Wangetti South trail meet these criteria Refer Figure 2	-	-	-
High Priority			
No areas along the Wangetti South Trail meet these criteria Refer Figure 2	-	-	-
Moderate Priority			
No areas along the Wangetti South Trail meet these criteria Refer Figure 2			
Low Priority			
A small section of notophyll vine forest in a gully behind Ellis Beach between -16.7291° / 145.6419° and -16.7282° / 145.6437° Refer Figure 2 Map Section WS3	480m	<ul style="list-style-type: none"> • Small area of notophyll vine forest with a number of mesophyll vine forest elements present with a variety of staple fleshy fruits present (Lauraceae and Myrtaceae). Dislocated from preferable core habitat areas (>1km) on western side Macalister Range by steep escarpment. • Permanent water present, but is within a steep sided gully and difficult to access. • Topography generally steep and trail inaccessible from habitat areas further west. 	Habitat is marginal, but may offer seasonal resources. The entirety of the vegetation is within a steep to very steep gully on the eastern fall of the Macalister Range that may significant obstructions to ready cassowary movement. Any cassowary utilisation (if at all) would be transitory and opportunistic and at best is considered to be extremely unlikely

Location	Distance	Habitat Factors	Summary Description
Lowest Priority			
<p>Shared use trail between Wangetti township trail head and Camp 1. Between -16.6629° / 145.5657° and -16.7008° / 145.6092°</p> <p>Refer Figure 2, Map Section WS 1</p>	10.4 km	<ul style="list-style-type: none"> No core rainforest habitat present within 2km of the trail Large areas of habitat mosaics are restricted to the eastern side of the highway. The majority of the trail in the Wangetti coastal lowlands is through grassy sclerophyll forest which offer few to no resources for cassowary foraging Proximity to busy highway (mostly less than 150m) and the Wangetti firing range (within 150m at closest point) are strong deterrents to cassowary using resources in this area. Significant watercourses (e.g. Tin Creek) are typically seasonal high flow, short duration events and are not permanent. 	<p>A long section of coastal walk, most of it within 150m of the Captain Cook Highway. Essential habitat features are present in the form of seasonal littoral swamp mosaics, but are separated from the trail by the highway. There is no core mesophyll rainforest habitat within 2km of the trail, and this is restricted to the uplands Mona Mona / Black Mountain corridor. The trail also passes by the Wangetti firing range. There have been no confirmed cassowary sightings in the Wangetti lowlands since European settlement (circa 1907), and the probability of cassowaries using any resources along the trail in this section is negligible.</p>
<p>Camp 1 to Ellis beach, between -16.7008° / 145.6092° and -16.7282° / 145.643725°</p> <p>Refer Figure 2, Map Section WS 2</p>	6.95 km	<ul style="list-style-type: none"> Small sections of notophyll vine forest were noted to be heavily disturbed during field surveys with vegetation characterised by mostly non-palatable species e.g. winged seeds. No permanent water present within 1km of the alignment of this section. There are no suitable habitat mosaics adjacent this section that would provide seasonal resources to cassowaries. Topography is steep (being on the eastern side of the Macalister Range), and is a significant obstacle to cassowary movement. Seasonal resources are only available in littoral coastal vegetation around the Ellis Beach area itself but alienated by Captain Cook Highway Dominant habitat along this section comprises areas of Acacia woodland, open sclerophyll woodlands on rocky slopes and grassy sclerophyll forest. None of these are characterised by cassowary foodplants and have little habitat value as seasonal foraging areas. Most of the trail section is < 500m to the west of the Captain Cook Highway. 	<p>A long section of the trail that is almost exclusively through rocky sclerophyll woodland on ridges above the Captain Cook Highway. Nearest core rainforest is over 1km to the west, and the trail is only accessible via steep to very steep gullies and drainage line from these areas.</p> <p>Small gullies with notophyll vine forest are present across the trail, some mapped as having permanent water however inspections have conformed these are ephemeral drainage lines only.</p> <p>Given the lack of permanent water, the distance from core mesophyll forest habitat and difficult access down steep to very steep slopes, cassowary utilisation (if at all) would be transitory and opportunistic and at best is considered to be extremely unlikely.</p>

Location	Distance	Habitat Factors	Summary Description
<p>Ellis Beach to Palm Cove trail head between -16.7282° / 145.64323° and -16.7391° / 145.6634°</p> <p>Refer Figure 2, Map Section WS 4</p>	4.63 km	<ul style="list-style-type: none"> No core habitat (contiguous mesophyll vine forest) represented within 1km of the trail, and then only on the western side of the range in the upper Flaggy Creek catchment. There is a small area of mesophyll and notophyll vine forest near the Palm Cove trailhead, however this area is fragmented and isolated from other habitat areas and would not be part of any cassowaries' range. There are no permanent water resources along this section of trail Most of the trail section is < 200m to the west of the Captain Cook Highway. Topography is steep and rocky in areas, with deeply dissected gullies across the trail. 	<p>This section of trail between Ellis Beach and Palm Cove trail head is on the lower slopes of the Macalister range, mostly less than 200m from the Captain Cook Highway. Habitat values for cassowaries are negligible, with the primarily Acacia and other sclerophyll forests having very limited to no representation by important cassowary foodplants, and no access to permanent water. A small section of mesophyll / notophyll vine forest on the trail is separated over 1km from core rainforest habitats to the west in the Flaggy Creek catchment (which discharges to the Barron River). Topography in the area is steep to very steep, and presents a significant impediment to cassowary movement.</p> <p>Cassowaries would not be expected to access any part of the trail in this section for core or seasonal resources.</p>
<p>Camp 1 -16.7008° / 145.6092°</p> <p>Refer Figure 2</p>	Footprint of 0.25ha	<ul style="list-style-type: none"> Camp site is located on a sclerophyll ridge adjacent vine forest. No permanent water within 1km of the camp Core mesophyll rainforest > 5km from camp Notophyll vine forest elements in locality do not have a high representation of cassowary food plant species. Topography in locality has steep to very steep slopes 	<p>Camp area is located at the top of a ridge overlooking a notophyll vine forest series of gullies and permanent water is absent. The camp site is more than 1km from core contiguous mesophyll vine forest, and accessible from the west only by a precipitously steep (in places) valley. Cassowaries would not be expected to access this section of trail/camp area for any resources.</p>

4. Wangetti Trail South Management Aspects

4.1 Introduction

The following management aspects are specific to the management of cassowary habitat along the Wangetti South trail, and of potential interactions between cassowaries and humans. This includes all aspects related to the design, construction, operation and maintenance of the Wangetti South trail, and the camp areas that have the potential to direct or indirectly impact on cassowary habitat, individual birds or on their behaviour. These management aspects are not intended to cover all environmental aspects of the project, but are to be considered and included where appropriate, in the detailed Environmental Management Plan (EMP) for the various phases of the Wangetti South including camp and service roads.

These management aspects are also not to be considered in isolation, and any EMP must also cross reference the regulatory/permitting conditions of any approvals issues, mandatory requirements of any existing legislative management plan (e.g. Wet Tropics Management Plan) or policy that is currently extent in part or all of the areas covered in this document. Various government agencies have legislative jurisdiction and management requirements for various tenures and localities within the broader area, and where these directly impact on the project area must also be considered in the EMP, e.g. road maintenance practices.

Of particular note is that the aspects implemented in regard to management of cassowary habitat and of cassowary interactions must align with those of the *Recovery plan for the southern cassowary* *Casuaris casuaris johnsonii* (Latch 2007), which forms the cornerstone of current conservation policy.

4.2 Management Area Summary

A summary of the management sections applicable to the Wangetti South shared use trail are set in the following . The detailed management aspects for each section is shown in **Table 3**.

The Wangetti South shared-use trail includes the following;

- No highest priority habitat management areas.
- No high priority habitat management areas.
- No moderate priority habitat management areas.
- One camp, Camp 1, with a proposed development footprint of 0.25ha, located within a lowest priority section.
- One section of Low Priority shared-use trail of approximately 480m traversing a permanent water course
- Three sections of Lowest Priority shared-use trail totalling 22.31km.

Table 3 Management Aspects Wangetti South Trail

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Habitat management 1. Infrastructure layout and design – camp areas	Camp areas must be located and designed such that their development footprint and impact on habitat values present is minimised. This is particularly important for this project as cassowary habitat quality is already diminished in most areas owing to logging and cyclones. Retention of existing habitat, and where practical, avoidance of cassowary resource areas altogether, must be a key component of the design aspects. Concurrently, the design must be such that cassowaries will not seek resources that may be present (e.g. water and food sources) at the camps.								
	Site clearance survey of camp areas by experienced ecologist to be undertaken prior to any construction with the following requirements: <ul style="list-style-type: none"> - Location of potentially important cassowary foodplant trees within and immediately adjacent development footprint - Location and orientation of permanent water in relation to development footprint. Assessment of likely cassowary access routes to any of the above resources identified (tracks, pads etc)	-	-	-	-	X	X	X	
	<ul style="list-style-type: none"> • Survey outcomes to be used in design of the layout of camp infrastructure, including construction access routes, location of buildings, water and sewage requirements, waste management requirements 	-	-	-	-	X	X		
	<ul style="list-style-type: none"> • Provisions to be made to ensure that no open water is provided at the camps (e.g. basins, taps, laundry facilities, tanks, etc) that can be accessed by cassowaries, thus providing an attractant to the camp areas. 	-	-	-	-	X	X	X	X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	<ul style="list-style-type: none"> Any grey water discharge is to go to a sump, and not to irrigation or any surface drain accessible by cassowaries. 	-	-	-	-	X	X	X	
	<ul style="list-style-type: none"> Signage for camp and eco accommodation users at strategic locations advising of the requirements to ensure that cassowaries cannot access food, 	-	-	-	-	X	X		X
	<ul style="list-style-type: none"> Signage for camp and eco accommodation users at all water sources/disposal areas regarding water management and security from cassowary access 	-	-	-	-	X	X		X
	<ul style="list-style-type: none"> Lighting (where required) to be confined to directional and subdued lighting and address Australian Standard AS/NZS 4282:2019. Control of the obtrusive effects of outdoor lighting, which provides information in Appendix C about the impact of artificial light on biota 	-	-	-	-	X	X	X	X
	<ul style="list-style-type: none"> An audit of listed/declared weed species must be undertaken at the proposed camp sites prior to construction. This audit will provide the baseline for future monitoring of weed incursions and/or introduction of new weeds. Species, abundance and distribution need to be recorded. 	-	-	-	-	X	X	X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority WS 3	Lowest Priority WS 1, 2, 4 Camp 1	Design	Construction	Operation
Habitat management 2. Infrastructure layout and design – trails	The Wangetti South trail requires a potential higher level of construction than other trails, however does not traverse any identified highest, high or moderate habitat management areas. Notwithstanding, where practical, the basic precepts as set out below should be followed.								
	<ul style="list-style-type: none"> Trails in highest, high priority and moderate priority sections are to have clear line of sight for a minimum of 20m from any significant (permanent or ephemeral) watercourse crossing to enable hikers to have a clear view of key cassowary utilisation areas. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Signage at all such locations warning of cassowary crossing and their potential use of riparian areas. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Steep descents with sharp changes in angle of direction where the opposite side cannot be seen on the approach should not occur in high priority or moderate priority trail sections. Realignment to obtain clear line of sight to avoid blind corners is the preferred option. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Where possible, all constructed watercourse crossings will be at level that will not obstruct potential cassowary movement. Preference is given to a bed level crossing that will not obstruct waterflow, and to be comprised primarily of natural material, e.g. laid stone pavements. Where there are practical limitations to the construction of bed level crossings, crossings should be designed such that their height will not obstruct cassowary movement, i.e., are capable of being stepped up onto, and over (or 	-	-	-	X	X	X	X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	under). Heights are to comply with the Building Code of Australia AS 2156.2 (Walking Tracks Part 2: Infrastructure) and AS 5100 (Bridge Design) with respect to requirements for hand rails. Hand rails/balustrades on bridges/crossings will pose an impediment to cassowary movement and hence crossings should be of a 'low fall' design, less than the 1300 – 1400mm specified in AS 5100 for bicycles.								
	<ul style="list-style-type: none"> No clearing to be undertaken in highest, high or moderate priority shared use trail areas until site survey identifies potentially significant cassowary foodplants or high-quality habitat areas. 	-	-	-	-	-			
	<ul style="list-style-type: none"> An audit of listed weed species along the proposed alignments and must be undertaken prior to construction. This audit will provide the baseline for future monitoring of weed incursions and/or introduction of new weeds. Species, abundance and distribution need to be recorded. 	-	-	-	X	X	X	X	X
	<ul style="list-style-type: none"> Warning signs and speed limiting signs on approaches to bridges over permanent water where cassowaries may be likely to be encountered. 	-	-	-	X	-	X	X	X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Habitat management 3. Vegetation clearing and rehabilitation	Vegetation clearing to 1.2m width will be required for the majority of the trail, centred on a construction corridor approximately 40m wide. The vegetation along the Wangetti South shared use trail is dominated by sclerophyll woodlands on moderate to steep slopes, often in rocky areas, and dissected by steep gullies and drainage lines. These do not represent optimum cassowary habitat conditions and clearing therefore is not expected to have any quantifiable impact on cassowary habitat integrity in this vegetation community type. There are small areas of notophyll vine forest, mostly in steep gullies and watercourse areas, where vegetation clearing will also be required. These areas are mapped as essential habitat (DERM 2009), but represent (mostly) isolates from contiguous cassowary habitat, are on steep slopes and are too small in area and isolated to form part of a cassowary home range. Additionally, the availability of food plant species in these drier rainforest types is significant less than found in mesophyll vineforest. Littoral rainforest in the Wangetti coastal plain represent potentially important cassowary habitat, however cassowaries are locally extinct in this area and the Captain Cook Highway alienates the majority of the suitable habitat from the Wangetti South trail.								
	<ul style="list-style-type: none"> Vegetation clearing is to be restricted to that as only required for the safe construction, operation and maintenance of camp sites. 	-	-	-	-	X	X	X	X
	<ul style="list-style-type: none"> As above, vegetation clearing will be restricted to the minimum required for the safe construction, operation and maintenance of trails. Note that other agencies may have responsibilities for road/track maintenance according to the tenure and gazettal status. 	-	-	-	X	X	X	X	X
	<ul style="list-style-type: none"> Vegetation to be cleared at camps is to be clearly demarcated on all drawings and plans, and in practice by highly visible means such as biodegradable survey tape. Obstructive visible barriers such as orange Tensar construction fencing is not to be used. 	-	-	-	X	X	X	X	
	<ul style="list-style-type: none"> Important food plant trees identified as part of the preclearance survey are to be included as components of retained vegetation e.g. within movement 	-	-		X	-	X	X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	corridors and preferably not left as isolates within clearings.								
	<ul style="list-style-type: none"> Greenfield vegetation clearing generally is to be undertaken only in accordance with protocols agreed with Traditional Owners representatives of the relevant locations and with a fauna/flora spotter present. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Vegetation removed along trails will be the minimum required to ensure clear line of sight for cyclists (and hikers) approaching permanent or significant ephemeral watercourses (approximately 20m prior) 	-	-	-	X	X	X	X	X
	<ul style="list-style-type: none"> Vegetation waste is not to be mulched. Waste will be cut to practical sizes to transport to edge of clearings and allowed to naturally decompose. 	-	-	-	X	X		X	X
	<ul style="list-style-type: none"> All clearing is to comply with requirements of relevant permits and approval conditions, with specific reference to erosion and sediment control plans that clearly identify mechanisms to avoid the discharge of sediment during construction off site into local habitat. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Any works involving the replanting of vegetation is not to use important cassowary food plants as found locally (refer Appendix A) within or immediately adjacent camp/eco-accommodation precincts, which may otherwise attract cassowaries into proximity with humans. 	-	-	-	X	X		X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Construction management 1. Noise and vibration	Cassowaries use vocalisation to communicate and locate other cassowaries across sometimes large areas. This is particularly important during the breeding season June to November. They also vocalise as a stress/threat mechanism. Loud, persistent and disruptive noise will stress cassowaries, and may cause them to abandon sections of their range. Noise during construction is unavoidable, however cassowaries are extremely unlikely to occur in any area along the Wangetti South trail. Notwithstanding, the construction impacts generally should be minimised with regard to the following.								
	<ul style="list-style-type: none"> On-site standard construction hours will apply as per EP (Noise) Policy 2019, local government statutes and permit conditions. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> All machinery used in construction and operation should be silenced to manufacturers specifications and maintained to that condition. 	-	-	-	X	X		X	X
	<ul style="list-style-type: none"> Blasting of hard rock areas for construction will not be permitted in any areas. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Use of any recreational radios, playing of music, or general broadcasting will be strictly confined to in-vehicle operation whilst transiting to and from site only and not played within any highest, high or moderate priority areas during construction. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Helicopters can only be used for the transport of materials to construction sites in all but Highest priority and High priorities areas where: <ul style="list-style-type: none"> They are able to operate outside of the ground effect zone when hovering. Drop zones are in low or lowest priority areas where likely cassowary occurrence is nil or extremely unlikely. Preclearance of any drop zones for materials near watercourses or 	-	-	-	X	X		X	X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	rainforest (essential habitat areas) identifies no evidence of cassowary presence. <ul style="list-style-type: none"> Helicopter overfly of WTWHA is in accordance with regulatory provisions of the Wet Tropics Plan 								
	<ul style="list-style-type: none"> Helicopters can be used in any area where emergency evacuation is required. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Helicopters will not be used for the transport of construction personnel 	-	-	-	X	X		X	X
Construction management 2. Vehicle movements	<ul style="list-style-type: none"> Construction vehicle movements along formed roads through moderate and high/highest priority habitat areas is not to occur 5 to 7am, and between 5 to 7pm, when cassowaries are most active. This is applicable only to the Black Mountain Road, Southedge Road and Twin Bridges Road. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Transit to construction sites will be via approved and designated access routes only, and no in-field unauthorised tracks/roads will be used. 	-	-	-	X	X	X	X	
	<ul style="list-style-type: none"> Construction vehicles will be of the smallest practical size to access the required areas, this includes the use of quad bikes with trailers, small rubber tracked excavators, etc. 	-	-	-	X	X		X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Construction management 3. General	Management of construction activities will be via an Environmental Management Plan (EMP) approved by relevant regulatory authorities (QPWS, WTMA, DERM, Douglas and Mareeba Shire Councils). The EMP will typically address environmental, physical and social requirements of the construction. The following should be included in all project EMPs								
	<ul style="list-style-type: none"> Domestic animals at all times are not permitted on site, this includes animals that are restrained inside vehicles. Poultry may be a vector for the introduction of avian diseases 	-	-	-	X	X	X	X	X
	<ul style="list-style-type: none"> Temporary fencing for construction purposes at camps (e.g. around open pits, newly laid concrete areas) will not be made of wire, nor obstruct fauna movement across the general site area. No fencing of any type to be used in vegetation retained for corridor/habitat purposes. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> No organic/food waste at any time is to be disposed of on site. All waste is to be collected and removed at the end of each day. Temporary storage of non-organic waste, e.g. cutoffs from construction materials, can be stored under a cover until they can be transported from site. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Any development adjacent permanent or significant ephemeral watercourses (e.g. crossing works) will have full erosion and sediment control measures implemented and maintained for the duration of the works as per the ESCP to be developed for the project. The ESCP is not to be a generalised document, but will address specific infrastructure requirements for any works in moderate, high and highest priority areas. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> The induction program for all construction personnel will include a 	-	-	-	X	X	X	X	

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	component on cassowary management measures, and will include methodologies for de-escalating confrontational interactions.								
	<ul style="list-style-type: none"> On any construction work site, should a cassowary approach the works area, then works in that particular location will cease until the cassowary has left of its own accord. All construction work should have a plan for alternate work sites and tasks in this contingency. 	-	-	-	X	X		X	
	<ul style="list-style-type: none"> Construction in watercourses must include consideration of the potential for interference with cassowary movements e.g. within the creek bed, or access to riparian resources. Watercourse crossings should either be at bed level, or at a level that enables cassowaries to traverse the watercourse bed without obstruction, e.g., low enough that they can step onto and over the crossing. Handrails and balustrades on waterway crossings represent a significant obstacle to movement. Bridge/crossing structures should therefore be less than the 1300 to 1400mm height for 'low fall' defined structures in Building Code of Australia and relevant standards to avoid the need for handrails. 	-	-	-	X	X	X	X	
	<ul style="list-style-type: none"> Biosecurity management, regular inspection of construction areas for electric ants, yellow crazy ants, potential Phytophthora infestation, and other highly invasive species that may be identified as a risk. 	-	-	-	X	X		X	X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Operational Management 1. Camp areas: waste management	Cassowaries are attracted by organic waste and are known to access compost piles, rubbish bins and unattended food in open areas (e.g. backpacks). This aspect increases the probability of human interactions with cassowaries. Waste management plan to be developed and implemented for the operation/maintenance of camps and eco accommodation. This plan should (at a minimum) adopt the following.								
	<ul style="list-style-type: none"> Waste containers should be in a secured receptacle, e.g. wooden palisade barricaded area, that cannot be accessed by cassowaries. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Waste water management at camp area and eco-accommodation must take into account potential cassowary access and potential to impact on local water source quality. Waste water discharge is not to occur into a situation where the discharge can be accessed by cassowaries and should go to a sump. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Signage in camp and eco-accommodation must clearly identify locations of waste receptacles, and protocols in separating and disposing of waste. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Organic waste cannot be composted on-site and must be disposed of (preferably off site) daily in a manner / location that is not detectable or accessible by cassowaries. This includes all kitchen waste from the eco-accommodation area. 	-	-	-	X	-			X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
Operational Management 2. Camp areas: water management	The camp sites have the potential to have open source water areas that may include dripping taps, wash basins, water tanks, etc, that may serve as attractants to cassowaries, particularly during dry periods of the year when opportunistic ephemeral water is not available. Cassowaries are known to access urban garden ponds, sprinkler systems and other similar water sources.								
	<ul style="list-style-type: none"> Ensure that there is no cassowary accessible permanent water source within the camp and eco accommodation areas. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Signage for camp and eco accommodation users at all water sources/disposal areas regarding water management and security from cassowary access. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Rain water collection points off roofing (e.g. water tanks) to be sealed, with excess runoff to be directed to a sump. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Storm water discharge from eco accommodation and drains about the camp areas must not drain into any perennial water course. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Waste water discharge at the camp area and eco-accommodation similarly must take into account potential cassowary access and potential to impact on local water source quality. As for storm waste water should be directed to a sump. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Camp management to monitor condition of all potential water sources and ensure they are not available to cassowaries. 	-	-	-	X	-			X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	<ul style="list-style-type: none"> Any watering of rehabilitation areas for establishment purposes is to be undertaken using handheld hoses and portable tanks and not through irrigation systems. 	-	-	-	X	-			X
	<ul style="list-style-type: none"> The use of ground water is to be considered only after an assessment of the recharge capacity and the potential for impact on surface environmental flows of nearby watercourses. 	-	-	-	X	-	X		
Operational Management	Cassowaries are a reclusive species and exclusively diurnal in their foraging activities. Cassowaries may be stressed by loud noise, lights and human movement and can exhibit varying behaviour from complete avoidance and retreat, to confrontational responses. Feeding of cassowaries is the primary cause of aggressive interactions with cassowaries and will be a core management precept for the entire project, however this is unlikely to be an issue for Wangetti South trail camp area owing to the unsuitability of the habitat conditions locally, and subsequently lack of cassowaries.								
3. Camp areas: Human activities	<ul style="list-style-type: none"> Domestic animals of all types are banned in all parts of the project area, even if restrained inside vehicles. This includes contractor service vehicles. Poultry has the potential to be a vector for the introduction of avian diseases (e.g. avian tuberculosis, aspergillus) 	-	-	-	X	X	X	X	X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	<ul style="list-style-type: none"> Feeding of cassowaries is banned in all parts of the project area and is to be a prominent message at trailhead hub locations, at camp areas, and in eco-accommodation areas. Signage will be placed in all these locations and be part of any information package given to hikers, campers, mountain bike riders. Penalties should be considered if users of the trails and facilities are identified deliberately feeding cassowaries. 	-	-	-	X	X			X
	<ul style="list-style-type: none"> Deliberate loud noises including portable music devices, external speakers, radios etc cannot be used in any camp or along the high and moderate priority trail sections. Users may continue to use headphones with portable devices. 	-	-	-	X	-			X
	<ul style="list-style-type: none"> Security lighting may be required for some facilities, e.g. toilets, at camp areas. Lighting (where required) to be confined to directional and subdued lighting and address Australian Standard AS/NZS 4282:2019. Control of the obtrusive effects of outdoor lighting, which provides information in Appendix C about the impact of artificial light on biota. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Generators should not be used for power generation except as an emergency resource. Power generation should be reliant on alternative technologies e.g. solar 12V systems, lithium battery storage and backup, and similar low intensity energy systems. 	-	-	-	X	-	X		X
	<ul style="list-style-type: none"> Vehicles will be required to service the operation/maintenance of the facilities. All drivers are to be compliant with speed directions with no travel undertaken between 5pm and 7am (overnight) on any vehicle road 	-	-	-	-	-			

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	through moderate/high priority management sections. This is applicable only to the Southedge, Black Mountain and Twin Bridges Roads.								
	<ul style="list-style-type: none"> Helicopters can be used in any area where emergency evacuation is required. 	-	-	-	X	X			X
	<ul style="list-style-type: none"> Helicopters will not be used for the transport of personnel. 	-	-	-	X	X			X
Operational Management 4. Trail sections	Operation of the trail sections must consider the maintenance requirements of the use of the various trails. Sections of the various trails are within tenures where there may be pre-existing conditions related to maintenance of trails/roads, e.g. Southedge Road subject to conditions on a WTMA permit. Any conditions on those permits must be incorporated into the relevant activities and EMPs associated with the project.								
	<ul style="list-style-type: none"> Warning and speed limiting signs on vehicular road approaches to crossings over permanent water where cassowaries may be likely to be encountered. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Cyclists and hikers must not use any trail before first light and after last light each day, times dependent on the season. Times to be set by camp/trail operators with consideration of seasonal visibility early morning/late afternoon. Cassowaries may settle for the evening on road/track verges. 	-	-	-	X	X			X
	<ul style="list-style-type: none"> Maintenance vegetation clearing, e.g. for <i>Calamus</i> regrowth and fallen vegetation, will be required over the trails. Vegetation not to be mulched but sawn to manageable lengths and put in locations off the trails and allowed to decompose. 	-	-	-	X	X			X

Aspect	Management Measures	Wangetti South Shared Use Trail APPLICABLE TRAIL SECTIONS & CAMPS					Project Phase Applicable		
		Highest Priority	High Priority	Moderate Priority	Low Priority	Lowest Priority	Design	Construction	Operation
					WS 3	WS 1, 2, 4 Camp 1			
	<ul style="list-style-type: none"> Helicopters can be used in any area where emergency evacuation is required. 	-	-	-	X	X			X
	<ul style="list-style-type: none"> Usage of helicopters for maintenance is subject to same requirements as per for construction. 				X	X			X
	<ul style="list-style-type: none"> Condition of watercourse crossings in highest, high and moderate priority sections of the trails are to be inspected after major rainfall events and repaired when required. 	-	-	-	-	-			
	<ul style="list-style-type: none"> Road/track conditions used as service road access to be inspected regularly for condition and areas of erosion off site to be repaired. 	-	-		X	X		X	X
	<ul style="list-style-type: none"> Monitoring of potential weed incursions must be a key requirement for the maintenance of the trails/tracks. Some agencies may have responsibility for management of listed weed species but the trail operators will be responsible for monitoring, reporting, and contribute to actions removing if required. 	-	-	-	X	X		X	X
	<ul style="list-style-type: none"> Monitoring of feral pig disturbance areas, location, size, general observations of damage 	-	-	--	X	X			X
	<ul style="list-style-type: none"> Biosecurity management, regular inspection of facilities for fire ants, yellow crazy ants, potential Phytophthora infestation, and other highly invasive species that may be identified as a risk. 	-	-		X	X		X	X

4.3 Other Management Aspects

4.3.1 Roles and Responsibilities

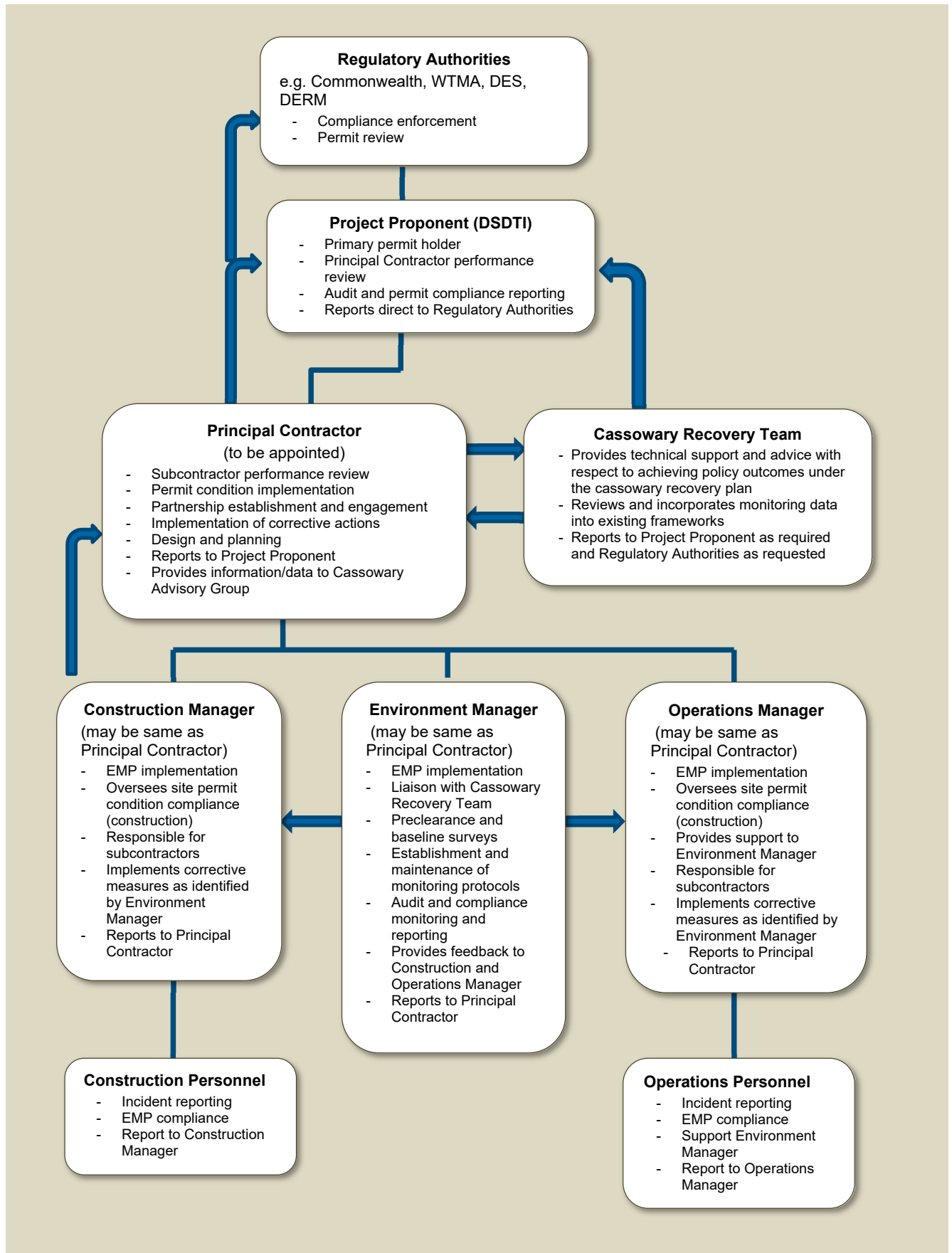
Management of the Wangetti South shared use trail (as part of the overall Wangetti Trails Project) will require a clearly demarcated hierarchy of management to ensure that management of cassowaries and their habitat is effective, and meets the overarching requirements of the Commonwealth and State adopted *Recovery Plan for the Southern Cassowary* (Latch 2007). The Recovery Plan's overall objective is "to secure the long-term protection of cassowary populations through improved planning mechanisms supported by robust monitoring, threat abatement and community engagement programmes". Recovery Plan specific objectives and actions include to "institute a more coordinated and stronger planning response to development issues in cassowary habitat" and "help develop better planning scheme mechanisms to protect cassowary habitat". The Recovery Plan does not cover all the particular circumstances for this project, i.e. a private, commercial venture will be responsible for the construction, operation and maintenance (within the context of the permitted activities) of the Wangetti Trails Project.

The Wangetti Trails Project traverses tenures where government agencies have various legislative and policy obligations in relation to fulfilling environmental management responsibilities. Additionally, a significant section of the Wangetti Mountain Bike Trail utilises a private road (Southedge Road) that is subject to permit conditions under the *Wet Tropics Plan 1998* for the maintenance (but not use of) this particular road.

Multiple regulatory requirements and permit conditions will be required to be met by the project. In the first instance, the Queensland Department of State Development, Tourism and Innovation has applied for and will hold overarching authorities under the Commonwealth EPBC Act and the Wet Tropics Plan (permit through the WTMA) that will consolidate approvals and conditions for the Wangetti Trails with consensus from other stakeholder groups, e.g. other government agencies (such as QPWS) and Traditional Landholders. Additional approvals will be required, including those over tenure where other regulatory/policy requirements must be met. For example, use of Forestry managed roads for commercial activities, use of Southedge Road by agreement with the landholder and in accordance with the administering authority of the maintenance permit on use of the road for commercial activities.

Management of cassowary habitat, and cassowary interactions, will be integral to the Wangetti Trails. The following figure identifies a suggested framework roles and responsibilities in ensuring that no long-term, cumulative or adverse impacts on cassowary habitat and cassowary populations arises from the project.

Figure 3 Suggested Cassowary and Habitat Management Framework



4.3.2 Project Monitoring

A monitoring program will be implemented to ensure that any direct, indirect, and cumulative impacts on cassowaries and their habitats are able to be detected and management actions undertaken at the earliest opportunity. The monitoring program would not be necessarily unique to cassowaries, as those factors potentially affecting cassowary habitat also would be more widely affecting habitats/ecosystems for fauna/flora generally. Notwithstanding there are a number of aspects to monitoring that would be particular to cassowaries owing to their ecology and behavioural characteristics.

Three monitoring components are recommended.

1. Habitat condition and integrity
2. Recording of cassowary interactions (including direct observations of birds, scats, etc)
3. Facilities management

The primary aim of the monitoring program would be to collect verifiable data that can be used to review, modify or implement any additional management requirements that support the Recovery Plan for the southern cassowary.

Habitat condition and integrity

The condition of the natural environment may be classically defined by the abundance and distribution of naturally occurring functional ecological communities and diversity of natural ecological processes (DEE 2017). In the context of this monitoring program, ecological communities include vegetation types, their floristic composition, and their extent areas.

While condition refers to the quality of that vegetation defined by the abundance and distribution of natural vegetation types, 'integrity' is an indicator of likely long-term viability or sustainability of ecological processes (DEE, 2017). This considers the extent to which these processes have been affected by past or present condition, the ability of the community subject to these processes to rebound (or be rehabilitated) and a time frame for any restorative process.

Simplistically, a complete monitoring program encompassing all of the above is neither practical, nor effective in applying to a project and site-specific scale. Both the condition and integrity of cassowary habitat in the project area have been impacted to varying degrees. These include anthropogenic factors (e.g. logging) and natural factors (including cyclonic events). The surveys by GHD in 2019, and further surveys specific to cassowary habitat in 2020 have confirmed that habitat values for cassowaries have been significantly diminished by these factors. Logging has been intense in many areas and altered fire regimes in sclerophyll/rainforest ecotones and cyclonic damage has resulted in a patchy habitat landscape that is difficult to monitor on-ground. Climate change may also have longer term impacts on habitat but are beyond the scope of this project to monitor.

There are many models in deriving a monitoring program for habitat condition and integrity. The suitability and applicability of a particular model should be derived in consultation and partnership with the Cassowary Recovery Team. Regardless of the model and methodologies to be used, there are a number of basic precepts for a monitoring program that should be observed. These include:

Establishing the purpose of the monitoring: what is the data to be used for, how is to be collected, who will undertake the analysis, how will this be used to manage cassowary habitat.

Defining the sampling unit: what attributes exactly are to be monitored? What is the practicality in collection and analysis of these units.

Scope and extent of the program: determine a realistic scale for monitoring, extent, time factors, statistical accuracy.

Identification of threshold levels: deciding on a minimum detectable change that is biologically meaningful.

Type of data analysis: the appropriate level of data analysis will depend on the first point, purpose of the monitoring.

Budget and resources: who is paying for it, time and resource commitments in reporting and implementing recommended actions

Some potential indicators could be:

- Using available Landscape scale monitoring undertaken through the State-wide Landcover and Trees Study (SLATS), a scientific monitoring program undertaken through the Department of Environment and Science in partnership with a number of other institutions. On a broad scale over the project area this may be a useful indicator of changes in vegetation type and extent.
- Simple site level indicators, e.g. disturbance by feral pigs, location of activity, relative intensity and general observations.
- Weed presence: - baseline surveys pre-construction of existing weeds along the alignment and within the camp areas, assessment of their extent, abundance and potential invasiveness. Weeds would be continued to be monitored as part of the operational program of the Wangetti Trails Project and would be expected to be part of the ongoing operational EMP.
- Phenology of cassowary foodplants. A list of cassowary foodplants known to occur within the project facility areas is included in Appendix A. A preconstruction survey of the location of significantly important individual trees may identify particular resources utilised by cassowaries. An understanding of the phenology (flowering and fruiting patterns) of these resources may assist in developing management responses for resources that may be impacted by project activities.
- Plot based studies on recruitment and recovery of cassowary habitat. For areas that are identified as within a cassowary home range, and subject to impacts from project activities, it may be useful to establish plot-based studies to determine forest recruitment and successional processes. The outcomes of these may be used in rehabilitation or other offset programs over the longer term that would benefit improving forest recovery.
- Water quality monitoring. Cassowaries are critically dependent on the availability and access to permanent water. A water quality monitoring program for permanent water courses in proximity to facility infrastructure in habitat areas (e.g. Camp 4, trails along Twin Bridges Road parallel and adjacent to permanent water) may provide threshold indicators suitable for habitat analysis.

Cassowary Interactions

Cassowary interactions includes any aspect of direct dealings, observation of cassowaries or evidence of cassowaries. The exact population and distribution of cassowaries in the project area is unknown. While it is predicted that they are in low abundance over a relatively wide area, verifiable quantitative information is limited to observations from two surveys. Only one direct observation of a cassowary has been made to date: a female in the vicinity of the proposed Camp 4 locality on the Wangetti North Trail. Scats observed along a linear transect (i.e. the trail alignment) is not a reliable mechanism for determining population. Scats indicate

utilisation of an area, and a formal field survey specific to cassowaries is time consuming, logistically extremely difficult, and ultimately of limited use as cassowaries are a naturally cryptic species and field surveys may well underestimate a population.

Westcott *et al* (2014) implemented the use of DNA analysis of faecal material for their surveys between 2012 and 2014 to identify individual birds. The technology and cost of faecal DNA monitoring is prohibitive and requires expert analysis. The project area is in a “black hole” with regards to quantitative data. It would be to the advantage of the project if collaborative partnerships could be made with research agencies through the Cassowary Recovery Team, whereby field work could be undertaken by Wangetti Trails project staff, with direction and sampling methodologies provided through a research partner. This may involve:

- A database of direct cassowary observations, including date, location, general description of the bird, identifying features (e.g. bent casque) etc. This database could be established at Hub areas or at the eco-accommodation centres, with provision for hikers and trail bike riders to enter observations.
- Establishment of motion triggered remote trail cameras in key locations.
- Sand traps to record footprints, e.g. along watercourses, under bridges, and similar locations to record frequency of utilisation of these areas
- Collection of scats, feathers, other organic material from cassowaries, under direction from the research partner with methodologies about sampling, collection, storage requirements.
- Results from the habitat condition and integrity monitoring.
- Any other records, observations (e.g. what cassowaries may have been observed foraging).

Facilities Management

Management of facilities *per se* is not a specific monitoring program. Rather, the purpose of including facilities (trails, camp, eco-accommodation areas) is to ensure a rigorous approach to complying with requirements of the EMP for the project. Primarily the monitoring would be a series of checklists against the specific elements of the EMP which may have an impact on cassowary habitat, or on cassowary behaviours. This may include:

- Ensuring water sources at the camps comply with EMP conditions, i.e. are not available to cassowaries, do not discharge to the environment, and make no demands on local environmental flows or impact on water.
- Noise and light levels at the camps, considering that up to 40 people per night may be feasible in some locations (e.g. Camp 4 on the Wangetti North trail), this represents a substantial potential impact.
- Regular maintenance inspection of facilities e.g. trails and condition, noting erosion areas, watercourse crossing degradation and other aspects that have an impact on habitat condition and integrity arising from use of the facilities.
- Any other aspects identified during the project development (including site clearance surveys to guide design).

4.3.3 Education and Communication

Education and communication will be a core component in ensuring that negative interactions with cassowaries are minimised or do not occur in the first instance. Negative interactions include adverse impacts on cassowary habitat, and changes in cassowary behavioural aspects as a result of anthropogenic influences (e.g. access to food, hand feeding, access to artificial water sources, noise/light, general human presence) that may cause stress to the birds.

The Cassowary Recovery Team (CRT) is a partnership of organisations working together to implement the Recovery Plan for Southern Cassowaries. The CRT is sponsored and coordinated through the Wet Tropics Management Authority and is the peak body engaged in the dissemination of information and providing support to organisations and individuals engaged in the protection of cassowaries and their habitats through planning, monitoring and community engagement. The Wangetti Trails Project should, as a matter of high importance, engage with and be involved with the CRT.

Cassowary Recovery Team.

c/o Wet Tropics Management Authority | PO Box 2050 | Cairns QLD 4870 | Australia

Within Australia – Telephone: 07-4241-0500 | Fax 07-4241-0550

International – Telephone: +61-7-4241-0500 | Fax: +61-7-4241-0550

Email: [cassowary recovery team](mailto:cassowaryrecoveryteam@wta.gov.au)

Website: <http://cassowaryrecoveryteam.org>

Many non-government community groups such as Kuranda EnviroCare, Trees 4Life etc, are active in cassowary conservation and management and may be contacted through the CRT or through their own websites. Research organisations are also active within the CRT and can provide specific advice related to technical monitoring and reporting. The development of partnerships with these organisations would be a favourable outcome for the Wangetti Trails Project. Traditional Owner inputs would similarly benefit the Wangetti Trails Project in aspects related to cassowary habitat management (as well as a host of other management aspects).

This Cassowary Management Plan has highlighted that informing the design team of site-specific factors related to cassowary habitat and utilisation is a key early step in the education process. Early information requirements include baseline surveys, assessment of cassowary utilisation areas, identification of water sources, key movement/corridor areas, key foraging locations etc, will assist in ensuring that design of facilities is sympathetic to the management of cassowary habitat and interactions.

At the construction phase, all contractors must enter into a vigorous induction program as part of the EMP which would include specific elements such as:

- Vehicle movements, traffic speed and limitations
- Working hours
- Noise and lights
- Biosecurity (yellow crazy ants, electric ants, weeds, avian disease potential)
- Protocols for dealing with cassowaries at work sites, including de-escalating confrontations
- Enforce the no feeding, no external water, no rubbish work ethic.

The appointment of an Environmental Manager (or similar) for the Wangetti Trails Project could also include duties related to information, communication and education. Various mechanisms for different means of communication and their efficacy in getting the message across re: cassowaries, could be implemented with consideration of the target audience. Education / communication would range across various media, from booking offices, to signage, to social media/digital platforms. The program of education can also include commercial and non-commercial promotional material including on-line resources such as social media, at booking offices, the Wangetti Hub, government partner agency offices, local government offices, brochures at tourism information centres/etc.

Education material could also include signage at the Wangetti Hub, all camps/eco

accommodation areas, on approaches to watercourse crossings in highest, high and moderate priority areas, and any other areas identified during the projects operation.

Prospective educational material can canvass:

- Cassowary behaviour and management, e.g., highlight no feeding, no deliberate approaches etc
- Ways to de-escalate unexpected interactions between cyclists, hikers and campers with cassowaries.
- Curfew times in relation to travel on the trails.
- Lights and noise minimising requirements.
- General camp/eco-accommodation cassowary habitat management protocols
- Biosecurity issues.
- Provision for hikers/cyclists to enter cassowary observation data (either scats or interactions) through web-based media, physical hardcopy at camp/eco-accommodation areas and telephone hotline (e.g. <http://www.daintrecassowary.org.au/index.php/submission>)

Much of the information for education and communication is already available through various government agencies, community groups and online resources. The Wangetti Trails Project, can adapt material to be specific to the requirements of the project, and the Cassowary Recovery Team, in the first instance, would be the most applicable contact in this regard.

5. Summary

5.1 Abundance and Distribution

Based on the modelling of Westcott *et al* (2014), survey results in 2019 and 2020, and field habitat assessments in 2020, cassowaries are believed to be in low abundance (possible as few as 8 to 9 individuals) over an area of approximately 4,000 ha, centred on the upper Spring Creek, Allen Creek catchments in the Wangetti North Trail sections, and in the Big Rooty and Hartleys Creek catchments in the Wangetti Trail mountain bike sections. There are no records of cassowaries within the majority of Wangetti South trail area, nor does suitable habitat exist over most of this trail. The only exception is the Wangetti coastal plain, however cassowaries have not been recorded in this area since 1907 and are locally extinct.

Cassowaries are a cryptic species, and simple counts of observed scats indicates utilisation of an area but does not indicate specific individuals. DNA faecal analysis and/or long-term intense area surveys are required to determine more accurately the numbers of cassowaries and their home range extent within the Wangetti Trails project area.

5.2 Key Threatening Processes and Impacts

The following summary is an abbreviated version of the full report section found in the EnPac 2020 CMP. The following is relevant only to the Wangetti South shared use trail.

The primary threatening process to cassowaries within the Wangetti Trails project area is believed to be anthropogenic interactions that result in behavioural impacts. However, these interactions are anticipated to either be nil to exceptionally rare events along the Wangetti South trail owing to the paucity of suitable habitat along the trail as identified in this specific CMP. Notwithstanding, basic precepts related to the day-to-day management e.g. rubbish, litter or other potential food sources and/or being hand fed along trails and in camp should continue to be observed

Available permanent surface water is a key cassowary resource, and the only permanent watercourse along the Wangetti South trail alignment confirmed is a spring fed system traversing the trail near Ellis Beach. This watercourse is within a rainforest community, however is isolated from core habitat areas, has no record of cassowaries, is on steep to very steep slopes, and is extremely unlikely to be utilised by these birds. Tin Creek, at the northern end of the Wangetti South trail, is subject to high volume, short duration flows during the wet season, but otherwise is dry for most of the year. Groundwater flow through the substrate does however contribute to the maintenance of littoral rainforest types in the Wangetti coastal area, which was known to host cassowaries until their localised extinction *circa*. 1907 with the advent of tin mining. Construction of infrastructure through/over waterways along the Wangetti South trail will not impact on potential cassowary movement.

Cassowaries use vocalisation over large distance to locate and communicate with other cassowaries, and noisy camp/eco-accommodation areas in cassowary habitat may stress and cause animals to abandon parts of their ranges, potentially putting them into conflict with the home ranges of neighbouring cassowaries. However the proposed camp along the Wangetti South trail is not in a location where noise/light or similar human related disturbances will have any impacts on cassowaries.

Habitat degradation as a result of the project will be minimal, with trails in the highest, high and moderate mapped priority habitat management areas primarily using existing tracks, roads and infrastructure (e.g., Southedge Road, Black Mountain Road, Twin Bridges Road). Most habitat removal will be along the Wangetti South Trail, the majority of which is not within mapped essential cassowary habitat. While habitat condition and integrity as a result of logging, cyclones and altered fire regimes do not represent optimal habitat conditions for cassowaries, ecosystems are in a state of advancing restoration, and there is minor potential for degradation to water quality and soil/water processes as a result of the construction/operational phases. These are expected to be addressed through the EMP for the project.

Table 4 following, sets out a detailed summary of the likely impacts of various project elements on cassowary behavioural aspects, the nature of the interactions and summary of proposed management measures. This summary is for the entirety of the Wangetti Trails Project Area, with revisions as necessary identifying specific references to the Wangetti South trail.

Table 4 Summary, Key behavioural aspects, threatening process and general mitigation

Behaviour and Aspect	Nature of Interaction	General Mitigation (full reference Table 3)
<p>Resource access, water.</p> <p>Cassowaries require daily access to permanent water for drinking and bathing within their home range, usually using the same general location that has an easy access. They will also use ephemeral streams on an opportunistic basis.</p> <p>Permanent accessible water appears to be the major determinant of cassowary distribution and potential abundance along the trails. Permanent water is found along Allen Creek and other tributaries of Spring Creek which parallel the Twin Bridges track north of Camp 2. Camp 2 is also located less than 100m from permanent water, and a cassowary was photographed here in October 2020 and scats observed within two km in 2019 field surveys.</p> <p>The camp sites and eco accommodation have the potential to have open source water areas that may include dripping taps, wash basins, water tanks, etc, that may serve as attractants to cassowaries, particularly during dry periods of the year when opportunistic ephemeral water is not available. Cassowaries are known to access urban garden ponds, sprinkler systems and other similar water sources.</p> <p>Permanent water is present in one location on the Wangetti South trail, in a location that is noted as being extremely unlikely to be utilised owing to unsuitability of habitat factors associated with cassowary occupation.</p>	<p>Cassowaries may be cumulatively impacted through noise, human activity, and partial clearing of movement corridors from accessing habitual watering locations. Camp 4 (Wangetti North trail) has a footprint of 3.5ha, directly within a confirmed cassowary occupation area, with a potential for up to 40 campers per night (20 within camp ground, 20 at eco accommodation areas). With any open source water present there is a very high probability of interactions between cassowaries accessing open source water (if present) and camp ground users.</p> <p>Users of the trails will cross two permanent water sources in high priority management areas, and sections of trails are parallel in close proximity to permanent water. There is a high probability that cassowaries will be encountered by some users in these localities.</p> <p>Cassowary response may vary, depending largely on the site-specific situation of the interaction. Cassowaries may simply retreat from trails and areas in frequent human use, or may, depending on territorial and parental instinct, defend territory (including food tree resources) and chicks (if present) vigorously.</p>	<ul style="list-style-type: none"> - Ensure that there is no cassowary accessible permanent water source within the camp and eco accommodation areas. - Signage for camp and eco accommodation users at all water sources/disposal areas regarding water management and security from cassowary access - No development west of Twin Bridge Road and south of existing east-west track at Camp 4 - Warning signs and speed limiting signs on approaches to bridges over permanent water where cassowaries may be likely to be encountered. - New vehicle bridges (where required) over permanent watercourses are to allow head room of 2m to enable cassowary undercrossing via creek bed. - Pedestrian and mountain bike watercourse crossings should be designed to be either be at bed level, or at a height that enables cassowaries to traverse the structures without obstruction. - Rain water collection points off roofing (e.g. water tanks) to be sealed. - Waste water management at the camp area and eco-accommodation similarly must take into account potential cassowary access and potential to impact on local water source quality. Grey water discharge, including irrigation from eco accommodation for example, is not to occur into a situation where the discharge can be accessed by cassowaries. - Abstraction of water from surface watercourses is not to occur at any location. - Storm water discharge from eco accommodation and drain about the camp areas must not drain into any adjacent perennial water course.
<p>Resource access, food resources</p> <p>While cassowaries are omnivorous, they are reliant on core rainforest types that have a high representation by suitable food plants, and also reliant on more marginal habitat areas for seasonal resources that may not be available in core habitat. The home range for cassowaries in the project area is expected to be larger than that for birds in the lowlands owing to wider and less reliable water sources and a high level of habitat disturbance. These home ranges may vary from season to season and overlap with adjoining territories. A large number of cassowaries foodplants have been identified in mesophyll rainforest types in primarily high priority (and highest priority) management areas, with a significantly lower representation in more marginal habitats, e.g. notophyll vine forests, and fewer still in sclerophyll rainforests. Many of the successional species in the disturbed mesophyll areas are important cassowary food plants, e.g. those species in the Elaeocarpaceae family.</p> <p>While cassowaries are known to share communally share important fruiting trees with other cassowaries (e.g. a mast flowering/fruiting event), this is a rare event and they are more prone to defend key food plants than share them. This includes vigorous intimidation of other animals, and humans, that may be in the vicinity and considered a threat to their food source.</p>	<p>Access to important foraging areas may be treated in a similar manner as access to water. Cassowaries have an internal 'map' for locations of important food plants in their home range and have been documented as accessing an important food source despite clearance of vegetation leaving a particular tree behind. That is, if an important food plant/tree is left within the boundary of a camp area/eco accommodation area, then in the absence of any significant hindrance (infrastructure, human activity/noise) cassowaries would reasonably be expected to continue accessing that resource. In this instance they would come into contact with camp users, with varying behaviour responses that may include defending that resource from a perceived threat, simply ignoring human presence, or retreating.</p> <p>Conversely, if the cassowary can no longer access that resource, e.g. clearing, infrastructure obstruction, then that is a direct impact on habitat resources supporting that bird (and potentially offspring), within that home range. If a particular tree is an important annual seasonal resource, then the loss of that tree, either through obstruction, human activity or clearing, may have significant impacts on an individual/offspring.</p> <p>Important fruiting trees beside the trails may attract seasonal visitation and cassowaries may regard users of the trail as threats, and either defend their resource, or abandon it for the duration that people are present.</p> <p>Rehabilitation/revegetation may be required in some localities post-construction and/or during operation. The planting of cassowary foodplants in locations close to high use trail and camp areas is strongly not recommended as it may encourage cassowaries into situations where interaction with humans and trail/camp activities (e.g. servicing/maintenance) may be unavoidable.</p>	<ul style="list-style-type: none"> - Site based planning of camp and eco – accommodation must take into account location and importance of potential cassowary food plant resources. Any significant (e.g. a large fruiting tree) within the camp area should be retained within buffering vegetation or vegetated corridor through the camp and not be an isolate. - Cassowary food plants are not to be used in revegetation/rehabilitation in high use human activity areas, e.g. around the camps. - Rubbish at camp and eco accommodation area must in be situations that cannot be accessed by cassowaries. - Organic waste cannot be composted on-site and must be disposed of (preferably off site) daily in a manner / location that is not detectable or accessible by cassowaries. This includes all kitchen waste from the eco-accommodation area. - Permanent barrier fencing, of any sort, is not be employed in any situation. Any secured areas e.g. around waste disposal locations, should use wooden palisade fencing. Temporary fencing for construction purposes (e.g. around open pits, newly laid concrete areas) will not be made of wire, nor obstruct movement across the general site area. No fencing of any type to be used in vegetation retained for corridor/habitat purposes within the Camp 4 general site. - General educational signage at trail heads, Wangetti Hub, at all eco accommodation areas, camps and potential rest areas, must directly identify that feeding of cassowaries is not to occur under any circumstance, the appropriate rubbish disposal protocols while hiking/cycling, and waste management requirements at camp and eco accommodation areas. - General education on cassowaries as per the following notes should also be pursued.
<p>Territorial and threat perception</p> <p>Cassowaries are known to have home ranges which are largely determined by habitat quality, including variability in habitat for seasonal resources, access to permanent water,</p>	<p>As noted, the responses of individual cassowaries to the same perceived threat/activity is not consistent and will vary from bird to bird. Also, the response of the same bird cannot be taken for granted to be predictable. The</p>	<ul style="list-style-type: none"> - Education on ways to de-escalate unexpected interactions between cyclists, hikers and campers (either camps or eco accommodation areas) is the singularly most important element in managing encounters with cassowaries.

Behaviour and Aspect	Nature of Interaction	General Mitigation (full reference Table 3)
<p>and core habitat with staple food plants present. Cassowaries have various documented responses to incursions to their home ranges and perceived threats, either to resources in their home range, themselves, or their chicks. Individual birds have varying responses to these aspects, with individual birds having responses to the same perception in different manners. Cassowaries have no fixed behavioural response, which may vary from indifference to vigorous (and aggressive) defence.</p> <p>Particular aspects to this project may include food trees adjacent to trail (or in camp areas), which may lead to interactions between feeding cassowaries and hikers/ mountain bike users, cassowaries with chicks on the trail being startled or approached by hikers/ mountain bike users, adult cassowaries themselves being startled e.g. by fast moving mountain bikes on sections on the trail where birds cannot be seen on the trail, e.g. on sharp bends. The presence of dogs (particularly) are seen as a threat, or any other unexpected interaction generally where the cassowary has no forewarning of the approach of people.</p>	<p>same individual may respond differently to the same territorial/perceived threat at different times (e.g. males with chicks present).</p> <p>For all interactions, the constant response must be from users of the trail and the camping/eco accommodation areas. This will be to de-escalate the potential for threatening interactions by withdrawal from the location at the earliest opportunity.</p> <p>Mountain bike users, at speed, present a challenge in addressing this issue where the rider cannot see forward around blind corners on descents, and particularly on approaches to water courses and gully areas, which are key cassowary utilisation areas. There is a probability albeit low, that cassowaries in in these trail “blind spots” may have a very vigorous response and/or be injured when surprised/encountered by a fast-moving bike.</p>	<ul style="list-style-type: none"> - Education can begin with all commercial and non-commercial promotional material including on-line resources such as social media, at booking offices, the Wangetti Hub, government partner agency offices, local government offices, brochures at tourism information centres/etc. - Existing information from QPWS, WTMA, and other agencies and community groups on how to respond to a cassowary interaction are already available. Leverage could be made of these existing sources, coupled - The operator of the facilities and trail should have an information officer or similar position to support education, cassowary interactions and the monitoring program. This may be part of a wider environmental role for this position. - Domestic animals, under no circumstances, are to be taken into any part of the project area, trails, or camp grounds, nor to accompany service/maintenance vehicles during operation (even if they stay in the vehicle). - Cyclists and hikers must not use any trail before first light and after last light each day, times dependent on the season. Times to be set by camp/trail operators with consideration of seasonal visibility early morning/late afternoon. - Alignment of the mountain bike only trail, and shared use trail should include consideration of clear line of sight when approaching watercourses and “blind corners” in high and highest priority areas. The distance of clear line of sight should consider the speed factor (e.g. slope, for cyclists) and the ability to respond to a cassowary. No minimal distance is suggested at there are no known standards, but the distance should be enough for a downhill cyclist to come to a safe stop on sighting a cassowary on a bend.
<p>General disturbance, construction and operation aspects</p> <p>As has been noted, the behavioural response of individual birds will vary, and an individual’s response to the same disturbance may also vary from event to event. Some behavioural aspects however have been observed to be generally consistent. For example, cassowaries will avoid situations of high activity associated with construction at the eco accommodation areas. This may be temporary and reversible, depending on the nature of the vegetation cleared, and restrictions to site resources, e.g. notable food plants cleared, or access to permanent water restricted.</p> <p>Vegetation clearing and chainsaws are a high disturbance issue as are generators for electrical tools and other equipment in use during construction. These are generally deterrents to cassowaries, with birds retreating to other sections of their range. Other noise: humans talking, vehicles, hammering, using tools, etc during construction are less intrusive, but similarly will result in birds retreating to other areas of their home range. This is applicable to both trail construction and camp / eco-accommodation areas.</p> <p>This may be problematic in those situations where key resources, such as permanent water, are not accessible during construction or important food trees may be lost.</p> <p>Cassowaries use vocalisation to communicate and locate other cassowaries across sometimes large areas. This is particularly important during the breeding season.</p> <p>Operationally, noise and traffic (including maintenance and service traffic) along the trail areas are not anticipated to have a measurable effect on cassowary behaviour, excepting for those general notes under Territory and Threat Perception (point previously).</p> <p>Cassowary abundance and distribution in key habitat areas (those mapped as high and highest priority) is considered to be sparse, and the numbers of hikers and trail riders will be capped and subject to quotas. Camp 4 (Wangetti North trail) and immediate surrounds is the only location with a very high probability of cassowaries at some stage interacting with people, with the probability increased if there are obvious resources, such as permanent water or food resources present (both natural sources and anthropogenic sources).</p> <p>Noise at the camp areas during the day is anticipated to be a minimal disturbance and</p>	<p>Primarily, direct interactions between cassowaries and human activity are not anticipated during construction owing to the high level of noise and human presence related to certain activities (e.g. vegetation clearing and building construction). Cassowaries in these situations generally respond through withdrawal to other parts of their home range, and will only resume their utilisation area post disturbance. If key resources (including removed food plants or access to permanent water) in the activity area (construction areas along trails or camps) are permanently removed, then re- occupation of that part of their home range may not occur (other than traversing).</p> <p>Provided cassowaries have visual or audible warning of cyclists or hikers approaching, then similarly the normal expected response would be for cassowaries to withdraw into adjoining habitat (temporarily). On occasions they may hold their ground if the interaction is unexpected/unannounced.</p> <p>As noted, cassowaries are diurnal, most active earlier in the mornings and later in afternoons. They are seldom active in the evenings. The minimal lights and noise at the camps in the evenings are not anticipated to result in any human/cassowary interactions unless cassowaries are attracted by some aspect, e.g. water availability. Night time trail use by cyclists/hikers will not occur. Minor camp noise during the day will not deter cassowaries from accessing camp areas, particularly if there are anthropogenic sources of water and food resources accessible. However continued disruptive loud noise during the day and in the evenings, has a high potential to stress cassowaries in the locality who may abandon part of their range as a result.</p> <p>Eco-accommodation, and general camp areas and trail will require maintenance and servicing by mechanised vehicles. Access roads and trails to all but Camp 4 (Wangetti North trail) and the high priority trail areas are not in localities where cassowaries are known to occur, nor predicted to occur in other than in very rare transitory and opportunistic circumstances. In most cases not at all. Vehicle access to Camp 4 (Wangetti North trail) will require traverse of high priority cassowary management areas. Vehicle type, speed</p>	<p>The Environmental Management Plan (construction and operation/maintenance) will have a clearly defined element that specifically addresses the potential for impacts on cassowaries arising from the project, and will identify the mitigation mechanisms that must be implemented to address these. These will include the following as a minimum</p> <ul style="list-style-type: none"> - Helicopters cannot be used in any highest or high priority management areas. The only exception for helicopter access to these areas will be for emergency situations. - In other locations helicopters can be used for construction material drop-off provided they comply with WTMA regulatory requirements, can operate outside of ground effect zone, and a site clearance of the drop-zone has been surveyed by an ecologist and vetted as clear of cassowary occupation/possible utilisation. - Domestic animals, under no circumstances, are to be taken into any part of the project area, trails, or camp grounds, nor to accompany service/maintenance vehicles during operation (even if they stay in the vehicle). - Any development adjacent permanent or significant ephemeral watercourses (e.g. bridge works) will have full erosion and sediment control measures implemented and maintained for the duration of the works as per the ESCP to be developed for the project. The ESCP is not to be a generalised document, but will address specific infrastructure requirements for any works in moderate, high and highest priority areas. - On any construction work site, should a cassowary approach the works area then works in that particular location will cease until the cassowary has left of its own accord. All construction work should have a plan for alternate work sites and tasks in this contingency. - As per the EMP for the project, all machinery used in construction and operation should be silenced to manufacturers specifications and maintained to that condition. Lighting and electrical supply to the eco-accommodation and emergency lighting should be reliant on alternatives to fuel generators. - Lighting (where required) to be confined to directional and subdued lighting and address Australian Standard AS/NZS 4282:2019. <i>Control of the obtrusive effects</i>

Behaviour and Aspect	Nature of Interaction	General Mitigation (full reference Table 3)
<p>unlikely to be a deterrent to cassowaries accessing those areas if resources are present. However excessive and disruptive noise, e.g. radios, media devices, generator equipment have the potential to stress cassowaries in proximity to these impacts as it effectively renders them incapable of communicating/locating other cassowaries.</p>	<p>and driver education are the primary determinant in the nature of any type of interaction with cassowaries along the service road.</p>	<p><i>of outdoor lighting</i>, which provides information in Appendix C about the impact of artificial light on biota.</p> <ul style="list-style-type: none"> - Vehicles will be required to service the construction and operation/maintenance of the facilities. Motorised vehicles may range from quad bikes (or similar) to 4WD vehicles and light trucks. All drivers are to be aware of speed limits for the varying sections of road/track.
<p>Monitoring and management responses</p> <p>Monitoring of cassowary habitat, individual birds and of encounters with cyclists/hikers and service providers (e.g. maintenance contractors for eco-accommodation areas) will form the cornerstone of determining management responses to habitat maintenance and in dealing with individual birds where intervention is deemed necessary. Monitoring will require a multi-task approach, as cassowaries in the project area are considered to have a low population density with a sparse distribution.</p> <p>Monitoring of cassowary activity, habitat status and interactions will be the responsibility of the trail/camp operator in cooperation with members of the Cassowary Recovery Team.</p> <p>The key element to monitoring will be having multiple mechanisms whereby cyclists, hikers and campers (and staff servicing the trail/infrastructure) are able to communicate encounters and observations. Scientific monitoring methodologies e.g. use of DNA to identify individual birds through scat collection and analysis, will depend on the inputs and requirements from research members of the Cassowary Recovery Team.</p>	<p>The Queensland National Parks and Wildlife Service (QPWS) under the Qld <i>Nature Conservation Act 1992</i> has the final responsibility in determining any management response that involves direct manipulation of cassowaries, or their habitat. In order to determine an appropriate response to any negative interaction (e.g. territorial cassowary within campgrounds), it will be necessary for the management authority to have full access to all data, information and other relevant factors collected during the monitoring program relevant to that situation.</p> <p>Management responses may vary from measures that can be implemented by trail and camp/eco-accommodation operators, e.g. altering speed limits, temporary restrictions on access to certain areas, modifying water source availability within camp areas; to direct intervention by QPWS that may include (at the extreme) relocation of a bird following problematic, repeat negative interactions that cannot be managed at the operator level.</p>	<ul style="list-style-type: none"> - Clearly defined reporting mechanisms and responsible agencies/authorities are to be enacted for the project. A range of reporting situations are to be covered that reflect compliance with permit conditions and recommendations from Cassowary Recovery Team - Provision for hikers/cyclists to enter cassowary observation data (either scats or interactions) through web-based media, physical hardcopy at camp/eco-accommodation areas and telephone hotline. - Cassowary data to be shared with the Cassowary Recovery Team, who will have access to all observation data. This may be through direct access to online data, including the data recording portal being set up within one of the existing CCT cassowary information portals, reporting mechanisms on a regular basis by the trail/camp operator or on as needs basis (e.g. on negative interactions being recorded). - Education on ways to de-escalate unexpected interactions between cyclists, hikers and campers (either camps or eco accommodation areas) is the singularly most important element in managing encounters with cassowaries. - Education will include signage at the Wangetti Hub, all camps/eco accommodation areas, on approaches to watercourse crossings in highest, high and moderate priority areas, and any other areas identified during the ongoing operational monitoring program. - The program of education will also be implemented through online and digital media resources acting as a promotional vehicle, with booking agencies, social media or any other media that acts as a commercial mechanism for the operator.

6. References

- Bentrupperbäumer, J. M. (1998). Reciprocal ecosystem impact and behavioural interactions between cassowaries, *Casuarius casuarius* and humans, *Homo sapiens* exploring the natural-human environment interface and its implications for endangered species recovery in north Queensland, Australia. Unpubl. PhD thesis. James Cook University of North Queensland. Townsville.
- Biggs, J. R. (Ed) (2013) Captive Management Guidelines for the Southern Cassowary *Casuarius casuarius johnsonii*, Cairns Tropical Zoo, Cairns
- Boles, W. (1987) Alias Emu. *Australian Natural History*, 22: 215-216.
- Campbell, H. A., Dwyer, R. G., Fitzgibbons, S., Klein, C.J., Lauridsen, G., McKeown, A., Ollson, A., Sullivan, S., Watts, M. E., and Westcott, D. A. (2012). Prioritising the protection of habitat utilised by southern cassowaries *Casuarius casuarius johnsonii*. *Endangered Species Research* 17:53-61
- Crome, F. H. J. (1976). Some Observations on the Biology of the Cassowary in North Queensland. *Emu*, 76: 8-14.
- Crome, F.H.J. and Bentrupperbäumer, J. 1991. *Management of Cassowaries in the fragmented rainforests of north Queensland*. Unpublished report to the Endangered Species Programme of the Australian National Parks and Wildlife Service.
- Crome, F., & L. Moore. (1988b). *The Southern Cassowary in North Queensland – A pilot study*. CSIRO, Atherton Queensland.
- Crome, F. H. J., & Moore, L. A. (1990). *Cassowaries in North-Eastern Queensland - Report of a Survey and a Review and Assessment of Their Status and Conservation and Management Needs*. *Australian Wildlife Research*, 17: 369–385.
- Crome, F.H.J. and Moore, L.A. 1993. *Cassowary populations and their conservation between the Daintree River and Cape Tribulation. II*. Background, Survey Results and Analysis. Unpublished report to the Douglas Shire Council.
- Department of the Environment and Heritage. (2004). The southern cassowary. Threatened species and communities.
- Department of Environment and Resource Management (2009), Distribution of cassowary habitat in the Wet Tropics bioregion, Queensland (3rd Edition), DERM, Queensland.
- Department of the Environment, Water, Heritage and the Arts (2010) Significant impact guidelines for the endangered southern cassowary (*Casuarius casuarius johnsonii*) <http://www.environment.gov.au/epbc/publications/pubs/casuarius-casuarius-johnsonii.pdf>
- Department of the Environment and Energy (2017). Ecosystems Toolkit. Module 5: Integrated Ecosystem Condition Assessment. Australian Government Department of the Environment and Energy, Canberra.
- Environment Pacific (2020), *Wangetti Trails Project, Cassowary Management Plan*, Report to Department of State Development, Tourism and Infrastructure. Qld Govt.
- Goosem, M., Moore, L. A., Byrnes, P. and Gibson, M. (2011) *Mission Beach Road Research: Impacts on Cassowaries and other Fauna and Strategies for Mitigation*. School of Earth and Environmental Science, James Cook University, Cairns.
- Hershberger D., and R., (ed) (1998) Kuku-Yalanji Dictionary, Work Papers of SIL-AAB, Series B Volume 7 Sept 1986, Summer Institute of Linguistics, Australian Aborigines and Islanders Branch, Darwin 1998

- Kofron, C.P. (1999). Attacks to humans and domestic animals by the Southern cassowary (*Casuarius casuarius johnsonii*) in Queensland, Australia. *Journal of Zoology*, 249: 375–81.
- Kofron, C. P. & Chapman, A. (2006). Causes of Mortality to the Endangered Southern Cassowary *Casuarius casuarius johnsonii* in Queensland, Australia [online]. *Pacific Conservation Biology*, 12(3): 175-179.
- Latch, P. (2007). National recovery plan for the southern cassowary *Casuarius casuarius johnsonii*. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Environmental Protection Agency.
- Mack, A. L., & Druliner, G. (2003). *A Non-Intrusive Method for Measuring Movements and Seed Dispersal in Cassowaries*. *Journal of Field Ornithology*, 74: 193-196.
- Moore, L.A. (2007). Population ecology of the southern cassowary *Casuarius casuarius johnsonii*, Mission Beach north Queensland. *Journal of Ornithology*, 148(3): 357-366.
- Stocker, G. C., & Irvine, A. K. (1983). *Seed Dispersal by Cassowaries (Casuarius casuarius) in North Queensland's Rainforests*. *Biotropica*, 15(3): 170-176.
- Westcott, D. A. 1999. *Counting cassowaries what does Cassowary sign reveal about their abundance?* *Wildlife Research* 26:61–8.
- Westcott, D.A., Metcalfe, S., Jones, D., Bradford, M., McKeown, A., Ford, A. (2014) *Estimation of the population size and distribution of the southern cassowary, Casuarius casuarius, in the Wet Tropics Region of Australia*. Report to the National Environmental Research Program. Reef and Rainforest Research Centre Limited, Cairns (21pp.).
- Wet Tropics Management Authority (2013): Vegetation mapping of the Wet Tropics Bioregion 2008 (WTMA). eAtlas.dataset.
<https://eatlas.org.au/data/uuid/82f4c977-caf3-497c-92c8-d2db7a18be89>

APPENDIX A:

Cassowary Foodplants Recorded within the Project Area

Cassowary foodplants recorded within the project area, including field observations, regional ecosystem detailed descriptions, HERBREC, WildLife OnLine. This does not necessarily represent all foodplants present. Detailed audits of the construction footprints would be required to establish those of significance in the habitat areas. Revegetation within areas of high human utilisation locations, e.g. camp areas, should avoid using the following in rehabilitation efforts.

Family	Species	Common Name
Anacardiaceae	<i>Pleiogynium timorense</i>	Burdekin Plum
Annonaceae	<i>Cananga odorata</i>	Ylang Ylang
Apocynaceae	<i>Cerbera floribunda</i>	Cassowary Plum
Araliaceae	<i>Leea indica</i>	Bandicoot berry
Araliaceae	<i>Polyscias australianum</i>	Ivory Basswood.
Arecaceae	<i>Archontophoenix alexandrae</i>	Alexandra Palm.
Arecaceae	<i>Licuala ramsayi</i>	Fan palm
Arecaceae	<i>Ptychosperma elegans</i>	Solitaire Palm.
Asparagaceae	<i>Cordyline cannifolia</i>	Cordyline
Asparagaceae	<i>Cordyline petiolaris</i>	Palm Lily.
Burseraceae	<i>Canarium australianum</i>	Mango bark
Burseraceae	<i>Canarium muelleri</i>	Scrub Turpentine
Combretaceae	<i>Terminalia sericocarpa</i>	Damson Plum
Cunoniaceae	<i>Davidsonia pruriens</i>	Davidsons plum
Elaeocarpaceae	<i>Aceratium megalospermum</i>	Bolly carabeen
Elaeocarpaceae	<i>Elaeocarpus bancroftii</i>	Kuranda quandong
Elaeocarpaceae	<i>Elaeocarpus eumundii</i>	Eumundii Quandong
Elaeocarpaceae	<i>Elaeocarpus grandis</i>	Blue Quandong
Lamiaceae	<i>Gmelina dalrympleana</i>	White beech
Lamiaceae	<i>Gmelina fasciculiflora</i>	White beech
Lauraceae	<i>Beilschmedia obtusifolia</i>	Blush walnut
Lauraceae	<i>Beilschmiedia bancroftii</i>	Yellow walnut
Lauraceae	<i>Beilschmiedia recurva</i>	Ivory walnut

Family	Species	Common Name
Lauraceae	<i>Beilschmiedia tooram</i>	Brown walnut
Lauraceae	<i>Cryptocarya clarksoniana</i>	Clarkson's laurel
Lauraceae	<i>Cryptocarya grandis</i>	Cinnamon laurel
Lauraceae	<i>Cryptocarya hypospodia</i>	Purple laurel
Lauraceae	<i>Cryptocarya laevigata</i>	Glossy laurel
Lauraceae	<i>Cryptocarya mackinnoniana</i>	Rusty laurel
Lauraceae	<i>Cryptocarya murrayi</i>	Murrays laurel
Lauraceae	<i>Cryptocarya triplinervis var. riparia</i>	Three vein laurel
Lauraceae	<i>Endiandra compressa</i>	Greenheart
Lauraceae	<i>Endiandra hypotephra</i>	Rose Walnut
Lauraceae	<i>Endiandra sankeyana</i>	Sankeys walnut
Lauraceae	<i>Endiandra wolfei</i>	Black Mountain laurel
Lauraceae	<i>Litsea leefeana</i>	Brown Bollywood
Lauraceae	<i>Neolitsea dealbata</i>	Grey Bollywood
Lecythidaceae	<i>Barringtonia calyptрата</i>	Cassowary Pine
Moraceae	<i>Ficus benjamina</i>	Weeping fig
Moraceae	<i>Ficus congesta</i>	Red Leaf Fig
Moraceae	<i>Ficus copiosa</i>	Plentiful fig
Moraceae	<i>Ficus drupacea</i>	Red fig
Moraceae	<i>Ficus hispida</i>	Hairy fig
Moraceae	<i>Ficus racemosa</i>	Cluster Fig
Moraceae	<i>Ficus septica</i>	White stemmed fig
Moraceae	<i>Ficus variegata</i>	Variegated fig
Myrtaceae	<i>Archirhodomyrtus beckleri</i>	Small leaf myrtle
Myrtaceae	<i>Decaspermum humile</i>	Brown myrtle
Myrtaceae	<i>Gossia bidwillii</i>	Python tree
Myrtaceae	<i>Gossia dallachiana</i>	Lignum
Myrtaceae	<i>Rhodamnia sessiliflora</i>	Iron mallet
Myrtaceae	<i>Syzygium alliligneum</i>	Onionwood
Myrtaceae	<i>Syzygium angophoroides</i>	Yarrabah satinahs
Myrtaceae	<i>Syzygium australe</i>	Creek lily pilly
Myrtaceae	<i>Syzygium cormiflorum</i>	Bumpy satinash
Myrtaceae	<i>Syzygium cryptophlebium</i>	Powderpuff lily pilly
Myrtaceae	<i>Syzygium divaricata</i>	Cassowary Satinash

Family	Species	Common Name
Myrtaceae	<i>Syzygium fibrosum</i>	Sour satinash
Myrtaceae	<i>Syzygium forte ssp forte</i>	White apple
Myrtaceae	<i>Syzygium graveolens</i>	Cassowary Satinash
Myrtaceae	<i>Syzygium gustavioides</i>	Watergum
Myrtaceae	<i>Syzygium hemilampra</i>	Broad leaf lilly pilly
Myrtaceae	<i>Syzygium kuranda</i>	Kuranda satinash
Myrtaceae	<i>Syzygium leuhmanii</i>	Small leaf lilly pilly
Myrtaceae	<i>Syzygium suborbiculare</i>	Lady apple
Myrtaceae	<i>Syzygium tierneyanum</i>	River Cherry
Myrtaceae	<i>Syzygium wilsonii</i>	Powderpuff lily pilly
Oleaceae	<i>Chionanthus ramiflorus</i>	Northern Olive
Phyllanthaceae	<i>Breynia sp. Black Mountain</i> (B.Hyland 25658RFK)	Breynia
Phyllanthaceae	<i>Breynia stipitata</i>	Breynia
Podocarpaceae	<i>Podocarpus grayae</i>	Brown pine
Rhamnaceae	<i>Alphitonia whitei</i>	Red Ash
Rhizophoraceae	<i>Carallia brachiata</i>	Corky bark
Rosaceae	<i>Prunus turneriana</i>	Almond bark
Rubiaceae	<i>Atractocarpus fitzalanii</i>	Native gardenia
Rubiaceae	<i>Atractocarpus sessilis</i>	Brown gardenia
Rubiaceae	<i>Cyclophyllum coprosmoides</i>	Coffee canthium
Rubiaceae	<i>Morinda citrifolia</i>	Cheese fruit
Rubiaceae	<i>Nauclea orientalis</i>	Leichardt Tree
Rutaceae	<i>Acronychia acidula</i>	Lemon Aspen
Rutaceae	<i>Acronychia acronychioides</i>	White aspen
Rutaceae	<i>Acronychia vestita</i>	Hairy aspen
Salicaceae	<i>Scolopia braunii</i>	Flintwood
Sapindaceae	<i>Aglia sapindina</i>	Boodyarra
Sapindaceae	<i>Castanospora alphanthii</i>	Brown Tamarind
Sapindaceae	<i>Diploglottis diphyllostegia</i>	Northern tamarind
Sapindaceae	<i>Diploglottis smithii</i>	Smith's Tamarind
Sapindaceae	<i>Ganophyllum falcatum</i>	Scaley Ash
Sapotaceae	<i>Niemeyera prunifera</i>	Boxwood
Sapotaceae	<i>Palaquium galactoxylon</i>	Pencil cedar

Family	Species	Common Name
Sapotaceae	<i>Planchonella chartacea</i>	Thin leaf coondoo
Sapotaceae	<i>Planchonella myrsinodendron</i>	Yellow boxwood
Sapotaceae	<i>Planchonella pohlmaniana</i>	Boxwood
Thymelaeaceae	<i>Phaleria clerodendron</i>	Scented daphne
Zingerberaceae	<i>Alpinia caerulea</i>	Native ginger