



## **6.1 m Update of Habitat Assessment of Ella Bay for the Southern Cassowary**



# Ella Bay Integrated Resort Proposal

## SEIS Submission Response Volume Six

### Update of Habitat Assessment of Ella Bay for the Southern Cassowary



# Executive Summary

## Cassowary studies - Additional Information post SEIS

This update to cassowary assessment from the EIS - Volume II *Impact Assessment and Mitigation Strategies* takes into account a further five cassowary surveys; an additional flora study; subsequent reports on permanent water availability; bridge/underpass usage by cassowaries; feasibility studies and trials for the Cassowary Fencing Strategy's cassowary gate and cassowary fence; and cassowary specific revegetation trials.

Substantial consideration was also given to the significant impact guidelines (EPBC Act) to ensure that suitable mitigation measures will be in place. Impacts such as the potential Isolation of Critical Species Habitat were able to be avoided through the EBIR design review evaluation process.

A *Southern Cassowary Management Sub-Plan* has been specifically written for Ella Bay Development and Ella Bay Road to address and mitigate the potential impacts from the proposed project over the life of the development. An important element of the Sub-plan will be the scientifically designed and conducted cassowary population monitoring program.

## Existing Status of species and habitat

The five surveys were undertaken to monitor during what would be key periods in the cassowary seasonal cycle. They showed an increase in reported (photographically identified) numbers in the past four years - from 6 (2006) to 15 (2010) adult and sub-adult birds. This indicates that the population is healthy and the age class structure and recruitment appears to be sustainable. Furthermore, in this small sample area two females were reported, inferring the population dynamics of breeding females is also sustainable.

Category	Nov 2006 (Moore EIS)		Feb. 2009 (Moore Vol 6.1b)		Nov. 2009 (Buosi Vol 6.1c)		April 2010 (Buosi Vol 6.1d)		Nov. 2010 (Buosi Vol 6.1e)	
	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road
Adult male	2	2	1	1	5 (p 4)	1	4	0	4 (p 5)	2 (p 3)
Adult female	1	1	0	0	1(p* 2)	1	0 (p 1)	0	1	1
Adult sex uncertain	0	0	0	1	0 (p 1)	0	0	1 (p 2)	0	1
Subadults	0	0	1	0	2	1	1	0	4	1 (p 2)
Family groups	0	1	1	1	5 (p 4)	0	3	0	2	2
Chicks	0	1	2	2	11(p 9)	0	5	0	2	2
<b>Total adults</b>	<b>6</b>		<b>3</b>		<b>8 to 10</b>		<b>5 to 7</b>		<b>9 to 11</b>	
<b>Total subadults</b>	<b>0</b>		<b>1</b>		<b>3</b>		<b>1</b>		<b>5 or 6</b>	
<b>Total chicks</b>	<b>1</b>		<b>4</b>		<b>9 to 11</b>		<b>2</b>		<b>4</b>	

Comparison of population estimates between all Ella Bay Cassowary surveys. From Buosi November 2010 survey (Vol 6.1e) P - Possibly P\* - Probably

The surveys identified that the cassowaries within the Ella Bay Development almost exclusively use the riparian or adjacent to the riparian corridors. The areas that are frequented vary throughout the season possibly based on food and water availability although this is not consistently seen. The highest population count did not mean that that more areas were frequented.

## Update of Cassowary Habitat Assessment

The updating of cassowary habitat by reference to the latest flora survey and to water availability produced only one change within Ella Bay site in which the mapping from Moore in

Volume I of the SEIS Cassowary Assessment of the dunal swale area was modified in status from Other to General. This had no impact on the assessment.

The updating of the road assessment also took into account risk factors to the cassowary from road mortality and dogs. There was one change in the habitat assessment with an increase in the value of the Flying Fish Point reserve from moderate to essential to match the categories of the Southern Cassowary Recovery Plan. This change was not reflected in the overall assessment when risk was applied to the areas. The risk factors were left as per Moore's SEIS assessment as subsequent cassowary deaths since the assessment confirmed the status.

In the table below the history of known cassowary mortality in this area has been added to Moore's assessment. Two of these deaths postdate Moore's analysis, confirming his original experience based assessment.

The known cassowary deaths are:

- Ella Bay Road 28/10/2002 Chick - 100mtrs South of Ella Bay NP sign – hit by car (QPWS unpublished)
- Flying Fish Point Road 23/03/2006 Adult – likely hit by car (QPWS unpublished)
- Little Cove Development - 24/12/2011 Male Adult – dogs (pers. obs)
- Flying Fish Point 2007 - Female Adult – dogs (Moore Feb 2009 survey)

Area code	Location	Moore Risk Factor	Known Cassowary death	Vegetation category/habitat value
1	Ella Bay National Park	1.0		A
2	Heath Point	0.5		C
3	Beach front	0.1		D
4	Flying Fish Point Reserve	0.1	Car	D (B)*
5	Southern EB Road verge	0.1		D
6	South Seymour Range	0.1	Dog	D
7	Flying Fish Point west swamp	0.5	Car	C
8	Northern EB Road verge	0.1	Dog	D

Habitat values as a function habitat quality and risk from Moore Working paper 3 (collated in 6.1L) \*Note High risk habitat in area code 4 will be mitigated to Category B

### Summary of Ella Bay Development Cassowary Mitigation Measures

The primary objective of cassowary mitigation strategies of Ella Bay Development is to facilitate the continuation of normal cassowary behaviour while minimising the possibility of adverse contact between cassowaries and humans.

Regional Ecosystem mapping from the latest independent flora study enabled the Essential and Potential Cassowary Habitat to be identified, both on Ella Bay and within the Ella Bay Road corridor. This resulted in the Ella Bay Development's conservation strategy designating significant habitat into Conservation Zoning, ensuring both protection and habitat connectivity; with the majority to be placed into a Conservation Covenant. The strategy also included the creation of a covenanted vegetated fauna corridor, with a minimum width of 100m, which bisects north/south and east/west.

The proposed conservation zones, fauna corridors and fauna underpasses will maintain unimpeded cassowary movement access around the Ella Bay development. The area of access will consist of the fauna corridors and the extensive open space formed by the golf course fairways. The golf fairways will be landscaped with endemic trees and provide the equivalent of

general habitat for the cassowaries with some food source increasing the accessible area to a total of 336ha of the 470ha available.

The conservation zones and open space cover all of the cassowary evidence from the five surveys with the exception of 2ha comprising:

- Clearing of 0.70ha Essential habitat,
- Clearing of 0.25ha General habitat; and
- Isolation of 1.07ha General habitat (central resort).

Revegetation of an additional area totalling 50ha will provide a substantial increase in habitat; of this revegetation 45ha will be high quality cassowary fruiting habitat which will significantly increase Essential habitat and 5ha will be non-fruiting habitat which will become General habitat. Non-fruiting revegetation will be used to the east of the main north/south creek so that cassowaries will not be enticed to the resort areas.

Ella Bay management of significant habitat will involve feral pest and weed control, retention of remnant habitat, with restoration of habitat along critical corridors through rehabilitation. Substantial revegetation will include cassowary fruiting species, edge closure, and widening of corridors which will increase the overall value and cyclone resilience of the habitat. Through revegetation and rehabilitation the area of quality habitat will increase from 176ha to 238ha.

Furthermore, improved habitat quality will be achieved through constructed wetlands extensively increasing the area, volume and availability of permanent water. The majority of the constructed wetlands will be proximal or within the fauna corridor and discharge into the creeks.

The Risk assessment identified road corridor areas with a currently high probability of death or injury to cassowaries accessing these areas from dog attack and car strike due to the unfenced road. The proponent has committed to a 'no dog or cat policy' and instigated control of feral pigs and dogs.

The cassowary mitigation measures at Ella Bay have been prepared from an integrated approach and have looked at the whole road, known cassowary crossing points and behaviour. The measures to reduce this level of risk to cassowaries comprise of three cassowary underpasses and one overpass with the roadside to be fenced. The road will use a fence and funnel mitigation; to funnel the cassowaries to the underpass/overpass to allow access to the habitat on the east of the road; and to exclude cassowaries from accessing the road for the majority of its length. The proposed bypass and fauna overpass through the narrow southern extension of the Seymour Range will ensure connectivity to the lower end of range. The cassowary gate and cassowary fence trials were undertaken to evaluate the feasibility of the fence and funnel strategy. Both fence and one-way escape gate were trialled and proven effective.

On Ella Bay all the roads within the precincts will be fenced and the precincts will be linked by bridges or low speed gated crossings to mitigate against human/cassowary interaction. The precincts will be perimeter fenced to prevent contact between cassowaries and humans, and avoid unrestricted human access into conservation areas.

The proponent will be assisting and/or supporting a number of the Specific Objectives from the Southern Cassowary Recovery Plan which have been included into the mitigation, management and research initiatives for Ella Bay. The proponent has provided ongoing research project support for cassowary tagging and tracking project with the purchase of 5 GPS trackers and recovery of data for future implementation at Ella Bay.

One of the highest priorities will be of continual education on the significance of the cassowary within the Wet Tropics environment, and measures to prevent or discourage inappropriate interactions. The Welcome Centre will be the first point of contact of all arrivals

Integral components of the Ella Bay Development are the mitigation strategies with their goal to improve cassowary numbers, carrying capacity and resistance to cyclonic disturbance, both on a local and regional scale.

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## 1. Introduction

This report updates Volume II *Impact Assessment and Mitigation Strategies* from the EIS (Moore 2006) and Working Paper 3 *Cassowary Habitat Assessment And Preferred Alignment Impact Assessment* (Moore 2007) and addresses further review of Moore's work by Buosi (refer to Volume Six 6.1a). The assessment has been updated to include information from a further four cassowary surveys that post date the original report.

This update also takes into account subsequent reports on water, bridge/underpass usage, fence and escape gate trials and cassowary specific revegetation trials.

### 1.1 Cassowary studies - Additional Information post SEIS

A cassowary survey, assessment and Population Viability Analysis (PVA) was undertaken in 2006 and 2007 and included in the EIS and SEIS. These reports have also been collated in Volume 6 (6.1L EIS and SEIS Cassowary reports Vol I, II, & III & WP 3).

Further surveys were undertaken in 2009 and 2010 and are included in Volume 6 of this report (number reference is to Volume 6):

- 6.1 a Review of EIS and SEIS Cassowary Reports
- 6.1 b Cassowary Survey Feb. 2009
- 6.1 c Cassowary Survey Nov. 2009
- 6.1 d Cassowary Survey Apr. 2010
- 6.1 e Cassowary Survey Nov. 2010
- 6.1 f Cassowary Identification Drawings
- 6.1 g Cassowary Water Survey
- 6.1 h Cassowary Underpass Survey
- 6.1 i Cassowary Gate Trial
- 6.1 j Cassowary Fence Trial
- 6.1 k Cassowary Fencing Strategy
- 6.1L EIS and SEIS Cassowary reports Vol I, II, & III & WP 3

Additional reports that are mentioned within this report

- 6.2 a Ella Bay Vegetation Report by 3D;
- 6.2 f Cassowary Specific Revegetation - A Cyclone Tolerant Orchard At Ella Bay; and
- 6.2 f Conservation Zones at Ella Bay

A review of the EIS and SEIS survey, assessment and PVA including the February 2009 wet season survey (6.1b) was undertaken by P. Buosi to evaluate the survey and assessment technique. (6.1a).

The wet season cassowary survey was requested by SEWPAC and the proponent commissioned further surveys to monitor the cassowaries over what would be key periods in their seasonal cycle. The cassowary surveys (6.1b to 6.1e) show a large variation in cassowary numbers and an increase in cassowary usage of the area.

The cassowary water survey (6.1g) was undertaken to establish the habitat quality with regards to permanent water supply. Assessment of habitat quality was reported in the EIS (6.1L) and commented further by Buosi (6.1a) however the question of permanent water availability was left unanswered. This report shows that water availability was scarce during the 2009 dry season with the only permanent water reported in the creeks and to the northern wetlands. The dunal swale at Ella Bay site and the Unallocated State Land (USL) along Ella Bay Road were both dry. A revised habitat assessment has been prepared.

The cassowary underpass survey (6.1g) was undertaken post the Cairns Stakeholders Workshop on Ella Bay Road (2008). This workshop concluded that cassowaries do use bridges as fauna underpasses however no evidence or research into design had been undertaken. The consensus was that any underpass on Ella Bay Road must be based on bridges that had demonstrated evidence of cassowary use.

The cassowary gate and cassowary fence trials (6.1i and 6.1j) were undertaken to prove the feasibility of the fence and funnel strategy. Both fence and one-way escape gate were trialled and proven effective. These reports are discussed further in Volume 4 (Ella Bay Road Design and Environmental Management Report).

The Cassowary Fencing Strategy (6.1k) details the methodology of construction and operations fencing for Ella Bay Road and for Ella Bay Development.

To gain greater understanding of the habitat value in that area, and identify Essential Cassowary Habitat a supplementary Vegetation Mapping report (6.2a) was produced by 3D Environmental in February 2009, which included a comprehensive analysis of the Ella Bay Road alignment and the surrounding areas' Regional Ecosystems (REs).

A cassowary specific revegetation plan (6.2f) was trialled to establish a specialised protected fruit orchard that would allow early post cyclone access for cassowaries to fruit with the goal of enabling cassowary survival.

The Conservation Zones (6.5f) proposed within Ella Bay Development have been detailed in this report.

## **1.2 Southern Cassowary Management Sub-Plan**

A *Southern Cassowary Management Sub-Plan* has been completed to cover potential impacts on the Southern Cassowary from the planning, construction and operation phases of the Ella Bay Development and Ella Bay Road. The Sub-plan has been specifically written for Ella Bay Development and Ella Bay Road

Recommendations from specialists and the objectives of: the "Recovery Plan for the Southern Cassowary *Casuarius casuarius johnsonii*". (2007): DEWHA 2009, and Significant Impact Guidelines for the endangered southern cassowary (*Casuarius casuarius johnsonii*) Wet Tropics Population - EPBC Act policy statement 3.15 (2007) have been included in the sub-plan.

The Ella Bay Development will be a staged development over a period of 15 years and planning, construction and operations will overlap for that period. The sub-plan has been written to cover all three stages where appropriate, to ensure that a consistent environmental management is followed.

## 2. Cassowary Status at Ella Bay

### 2.1 Existing Status of species and habitat:

The Southern Cassowary, *Casuarius casuarius johnsonii*, is the largest native vertebrate in Australian rainforests. The species has a fragmented distribution between Cooktown in the north of Queensland, south to Townsville and west to the extent of rainforest. The southern population is classified as endangered under the Queensland *Nature Conservation Act 1992* and the northern population is classified as vulnerable. The species as a whole is classified as endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. It is estimated that only between 1200 and 1500 Cassowaries exist in the wild in the Wet Tropics. No regional mapping of the location or distribution of Cassowaries has been undertaken since the mid 1990's studies by Les Moore.

The primary habitat of the Southern Cassowary is rainforest and associated vegetation mosaics, although they also use mangroves, melaleuca and various eucalypt woodlands, swamps and swamp forests. Their habitat is required to have a high diversity of fruiting trees and a ready supply of water. The Southern Cassowary is territorial and solitary. Females will maintain independent while males operate in overlapping home ranges which fluctuate in size depending on season and availability of food. Contact between adult individuals is generally only tolerated during mating, although cassowaries may also tolerate each other in areas of super-abundant fallen fruit and are known to congregate on a regular basis at artificial feeding stations.

#### The Graham-Seymour Range Population

The coastal cassowary habitat south of Cairns predominantly occurs as a narrow strip on the coastal ranges, which parallel the coast. This discontinuous band of vegetation varies from one to four kilometres in width over most of its 200km length. These forested coastal ranges are separated from the main rainforest of the Wet Tropics region by extensive agricultural and urban clearing, and the Bruce Highway, forming a substantial obstacle to east-west cassowary movement. Clearing and road corridors have also led to impediments to north-south movement by cassowaries, creating a series of small sub-populations, faced with declining numbers due to declining habitat and growing threats.

Cassowaries have been identified along the Ella Bay access road and around the Ella Bay property as part of one of these sub-populations known as the Graham-Seymour Range population, which extends from Russell River in the north to the Johnstone River in the south (approximately 32 km). The cassowary population within the Graham-Seymour Range has not been surveyed and is tentatively estimated by Moore to be 51-73 independent birds (Refer to Volume 6.1L SEIS PVA). Population viability analysis indicates that the Graham-Seymour Range cassowary population, along with other coastal cassowary subpopulations south of Cairns, is undergoing a population decline. Moore (Refer to Volume 6.1L SEIS PVA) suggests that this decline is caused by inadequate patch size, isolation from the main habitat blocks to the west, cyclone-induced mortality, and high levels of historical and contemporary anthropogenic impact including urban and agricultural encroachment into their habitat and the edge effects associated with these.

Ella Bay property and Ella Bay Road form the south-eastern boundary of the Graham-Seymour Range cassowary population and the home ranges of the birds sighted during the field survey predominantly lie to the west and north of the survey areas.

#### 2.1.1 Cassowary Abundance, Age, Class Structure and Sex Ratio

Moore (SEIS PVA collated Volume 6.1L) estimated the cassowary density of the Ella Bay Property and Little Cove was one adult per 3.2 km<sup>2</sup> (1 adult/320ha). Based on the vegetated area (229ha) of Ella Bay property less than one cassowary could be supported. Since Moore's original survey, further surveys have been undertaken in both Wet and Dry seasons and additionally surveillance camera monitoring has been in place since January 2009.

Wet season surveys created issues with print and scat competency (Refer to Volume 6.1b Moore 2009). While the wet season is a regular event in North Queensland the timing of intense rain varies over the period and from year to year. The proponent commissioned further surveys to monitor the cassowaries over what would be key periods in their seasonal cycle.

**January – March: Seasonal Movement.** To determine if there is seasonal movement away from the flooded lowlands and support the hypothesis that the local cassowary population makes seasonal use of the coastal lowlands east of Ella Bay National Park.

**April – June: Courting and nesting period.** Adult birds are moving around seeking mates and are more easily located. The relationships between birds (breeding partners) can also be obtained at this time of the year.

**September – December: Hatching of new chicks and weaning of older chicks.** The first chicks appear in September and family parties are easier to locate than single birds. The ability of an area to support breeding birds can be determined in this period and potential recruitment can be assessed.

The five surveys show an increase in reported (photographically identified) numbers in the past four years with an increase from 6 (2006) to 15 (2010) adult and subadult cassowaries indicating that the population is healthy.

Category	Nov 2006 (Moore EIS)		Feb. 2009 (Moore Vol 6.1b)		Nov. 2009 (Buosi Vol 6.1c)		April 2010 (Buosi Vol 6.1d)		Nov. 2010 (Buosi Vol 6.1e)	
	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road	EBIRD Site	EB Road
Adult male	2	2	1	1	5 (p 4)	1	4	0	4 (p 5)	2 (p 3)
Adult female	1	1	0	0	1(p* 2)	1	0 (p 1)	0	1	1
Adult sex uncertain	0	0	0	1	0 (p 1)	0	0	1 (p 2)	0	1
Subadults	0	0	1	0	2	1	1	0	4	1 (p 2)
Family groups	0	1	1	1	5 (p 4)	0	3	0	2	2
Chicks	0	1	2	2	11(p 9)	0	5	0	2	2
<b>Total adults</b>	<b>6</b>		<b>3</b>		<b>8 to 10</b>		<b>5 to 7</b>		<b>9 to 11</b>	
<b>Total subadults</b>	<b>0</b>		<b>1</b>		<b>3</b>		<b>1</b>		<b>5 or 6</b>	
<b>Total chicks</b>	<b>1</b>		<b>4</b>		<b>9 to 11</b>		<b>2</b>		<b>4</b>	

**Table 2.1 Comparison of population estimates between all Ella Bay Cassowary surveys. From Buosi November 2010 survey (Vol 6.1e)**  
**P - Possibly**  
**P\* - Probably**

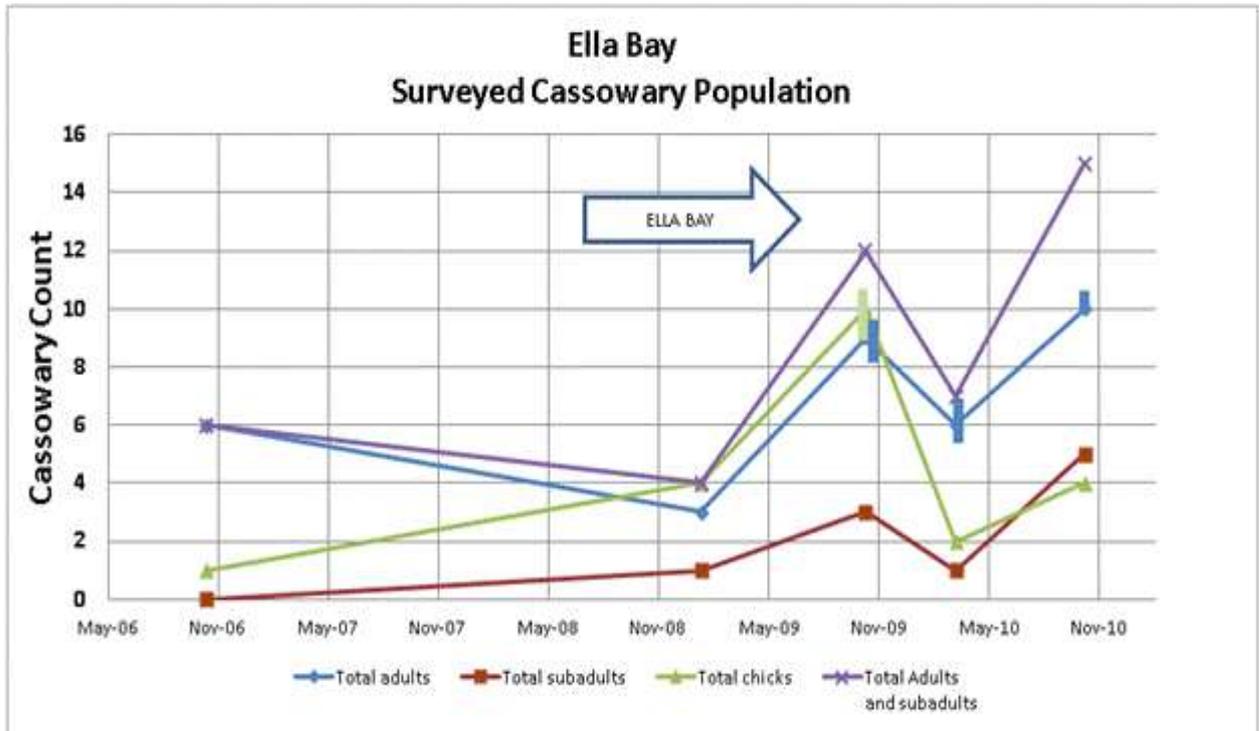
The surveyed cassowary population has varied significantly for each of the surveys. This variation may have been caused by a number of factors:

- Different methodology between the surveys:
  - Moore tracked the cassowaries and defined a “home range”; where as
  - Buosi surveyed the perimeter and riparian corridors of Ella Bay and the proposed Ella Bay Road and made the identification based on camera images.
- Adverse weather conditions:
  - Moore 2006 - 6 months after cyclone Larry;
  - Moore Feb 2009 – surveyed during the wet season with heavy rain; and
  - Buosi April 2010 – surveyed 3 days after heavy rain.
- Wet season migration (hypothesis)
  - Moore Feb 2009 – surveyed during the wet season with heavy rain; and
  - Buosi April 2010 – surveyed 3 days after heavy rain.

However a number of anthropogenic changes have also occurred in the time frame. The property ceased being a cattle property mid-2008. While cassowaries and cattle are not

competitive for food sources the impact of the farm workings: cattle dogs, chemicals and human activity may have contributed. Additionally the proponent:

- Has restricted access to pig dogs and hunters;
- Engaged in a pig culling program and has culled over 100 pigs since 2008; and
- Removed barbed wire fences.



**Figure 2.1 Comparison of Cassowary population estimates.**

The following trends can be observed from the surveys:

- The number of adults has increased over the survey period;
- The number of subadults has increased;
- The number of chicks has fluctuated greatly and is not in relation to the number of subadults; and
- the number of adults monitored during the wet season surveys is lower than from the previous dry season survey.

**Moore November 2006:** dry season after Cyclone Larry. Moore suggests that the observed abundance of adult Cassowaries approximated the pre-cyclone situation. However the data was characterised by lack of subadults and chicks which would have indicated that there was insufficient food availability for the males to hatch chicks after the cyclone. Two female cassowaries were identified.

**Moore February 2009:** wet season during heavy rain. Moore has hypothesised that there may be a seasonal migration to the foothills during the wet season. Moore recorded no females and noted that a female recorded in the Nov 2006 was killed by dogs at Flying Fish Point.

**Buosi November 2009:** dry season. A significant increase in numbers was recorded in adults, subadults and chicks. Buosi reports

“• *Subadult Cassowaries.* The location of three subadults has been identified. The territories of these subadult birds overlap with adult birds. Subadults are the most likely age class to move into areas of suboptimal habitat which may include some of those areas where Cassowary activity was not recorded during the current study.

• *Adult Cassowaries.* The number and distribution of adult Cassowaries observed during the current study differs markedly from that observed by Moore (2006) and possibly

reflects the situation during more 'ambient' conditions. Further surveys at other times of the year (February to March) are required to confirm use patterns around the coastal fringe.

- *Female Cassowaries.* Moore (2009) concluded that the study area (EBIRD site + proposed access road) contained a single adult female Cassowary. The current study estimates that the same area now contains two (probably three) adult female Cassowaries. A camera on the western slopes of Seymour Range approximately 2.2 km west of the EBIRD site also captured images of a separate adult female Cassowary.”

**Buosi April 2010:** wet season after heavy rain. Fewer cassowaries were reported during this survey indicating that there may be seasonal movement driven by wet weather or most probably food resources. Of note cassowaries used more sections of the study area including beach and foredune habitats. Buosi reports;

*“There appeared to be less food resources in the lowland rainforests in April 2010 and this may have encouraged birds to move into other areas.”*

The large numbers of chicks reported in the previous survey appear not to have resulted in more subadults or chicks fathered into a second season.

**Buosi November 2010:** dry season. This survey reported a further increase in the population of adults, subadults but chick numbers are low. The survey conditions were ideal and there was an apparent abundance of food resources. Of note is that fewer chicks were reported – possibly indicating that the shortage of food resources reported in April 2010, may have resulted in less nesting.

### 2.1.2 Home Range and Sex Ratio

Each survey point has been located on Figure 2.2 note that these are individual photos, scats, prints, feathers or sightings. The figure shows a movement pattern *not* abundance. For example in some surveys many prints were made in soft mud over an extended period prior to the survey.

The surveys identified that the cassowaries within the Ella Bay Development almost exclusively use the riparian or adjacent to the riparian corridors. The areas that are frequented vary throughout the season possibly based on food and water availability although this is not consistently seen. The highest population count did not mean that more areas were frequented.

Buosi in his review of Moore’s work (EIS & SEIS) (Volume Six 6.1a) was concerned regarding the sex ratio and sub-adult population as to the vulnerability of the population given that Moore had surveyed two females in the November 2006 survey and none in the Feb 2007 survey and reported that one female had been killed in Flying Fish Point by dogs. This inference was that the local population was unsustainable and was the major reason that the further studies were undertaken at different times of the year. During the surveys two females were reported in November 2006 (Moore), November 2009 (Buosi) and November 2010 (Buosi) and none in February 2009 (Moore), and April 2010 (Buosi).

The fact that two females were reported in this small sample area would infer that the population dynamics of breeding females is sustainable. The sex ratio from averaging of all the surveys was 3.6 to 1 male to female. This is much higher than that reported by Moore (Moore, 2007) who reported a sex ratio of 1.47 to 1 male to female in the Mission Beach survey of 47 adult cassowaries.

One possible cause of this bias is mistaken identification of females. Taking the November 2009 survey, there were 6 males and 2 females reported. Buosi reported that there was uncertainty in the sexing of males and females and there could be “possibly” five males and “probably” three females but the difficulty in photographic identification made the sightings uncertain. If one of the females was mistakenly reported as a male the male to female sex ratio would reduce to 1.66 to 1.

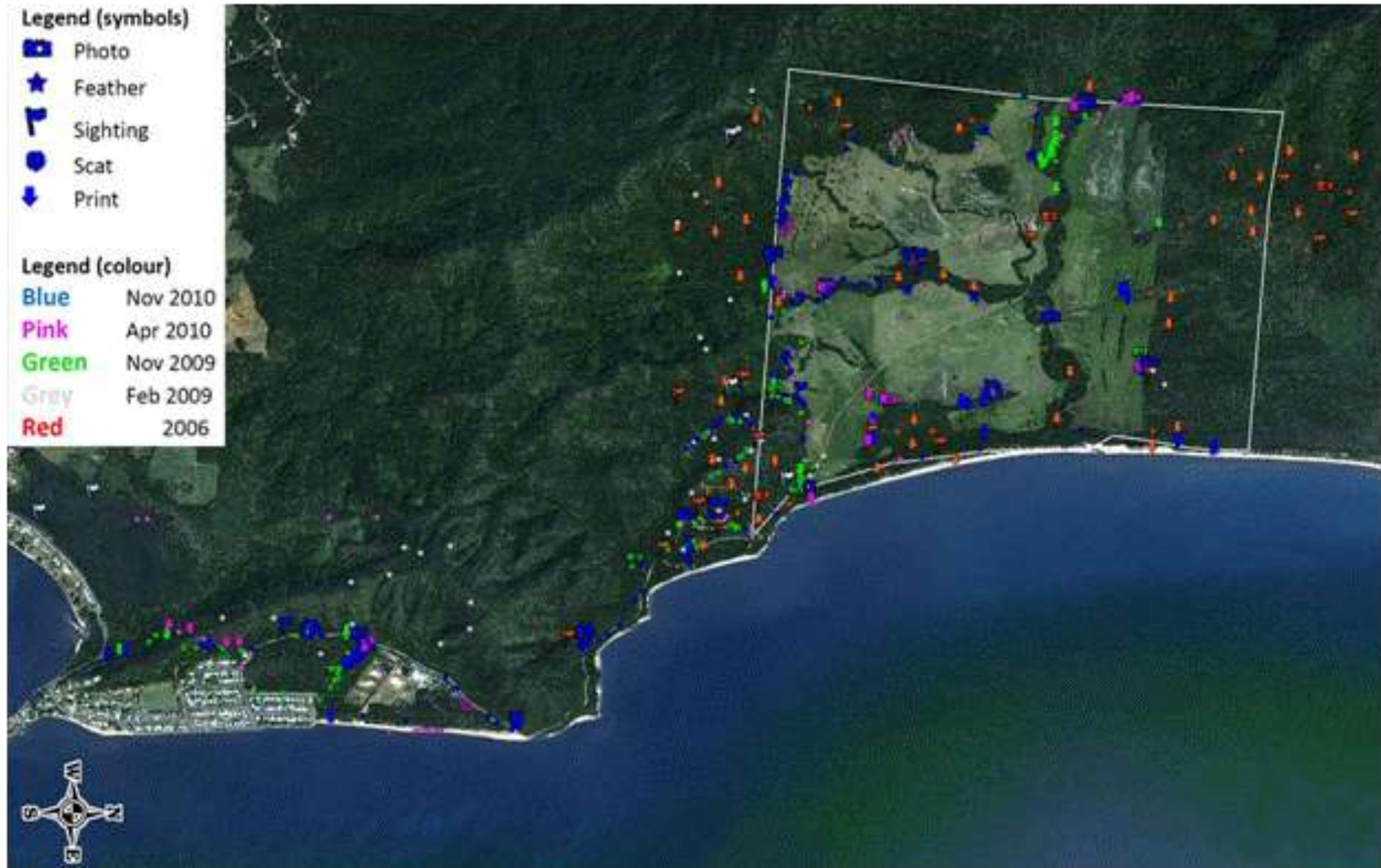


Figure 2.2 Analysis Cassowary findings all surveys (Moore 2006, 2009, Buosi 2009b, 2010a,b) Note that in this figure each scat and footprint are recorded.

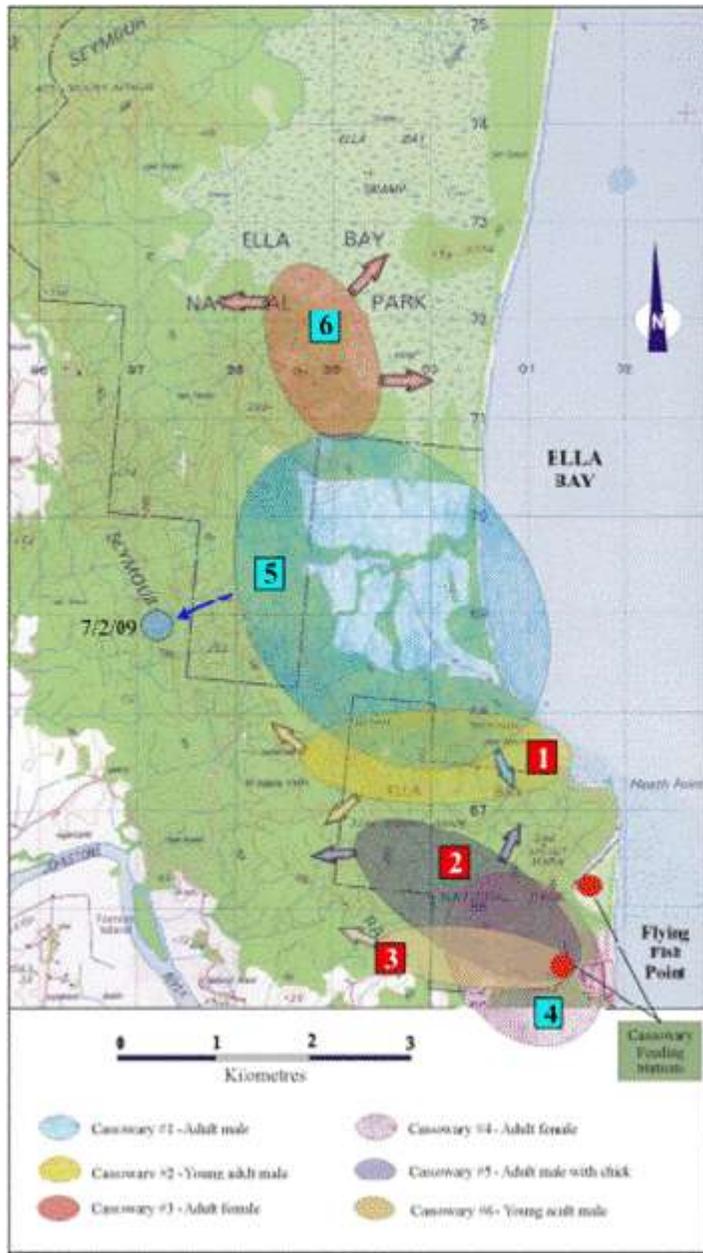


Figure 2.3 Comparison of November 2006 (left) and February 2009 (right) surveys inferred home ranges From Moore (6.1a)



Figure 2.4 November 2009 survey showing inferred home ranges around Ella Bay From Buosi (6.1c)

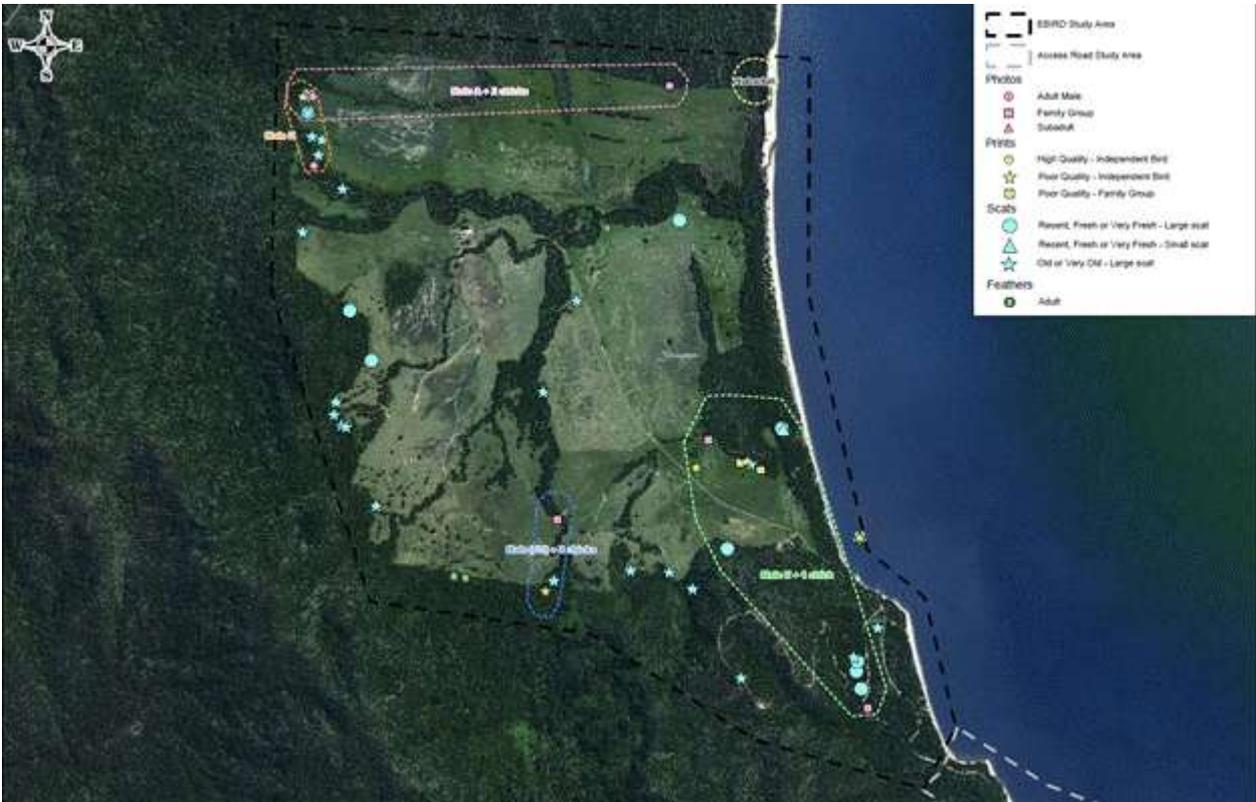


Figure 2.5 April 2010 survey showing inferred home ranges around Ella Bay From Buosi (6.1d)

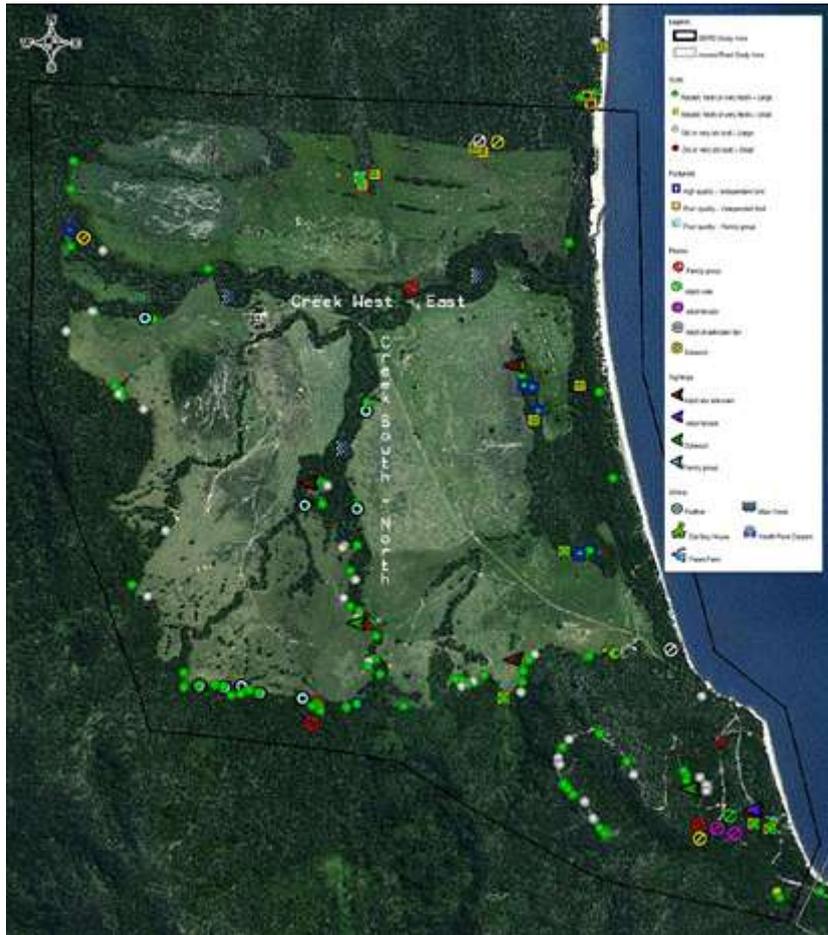


Figure 2.6 November 2010 survey showing cassowary signs



Figure 2.7 Possible 2 km<sup>2</sup> cassowary home ranges within the southern Graham-Seymour peninsula (in yellow) and the Ella Bay survey in red).

The other more probable influence of a bias was highlighted by Moore (2007) in his study of Mission Beach cassowaries in that his conclusion was that small surveys overestimated the population density of cassowaries. Moore concluded that

*“It is shown that a sample plot between 5 and 15 km<sup>2</sup> is necessary to approximate true cassowary density”*

While each the surveys of these reports cover in excess of 4 km<sup>2</sup> this area is too small to infer family dynamics and sex ratios.

Additionally new studies with GPS tagging of cassowaries has provided further information on home ranges which differs from some of Moore’s observations (Moore 2007). The University of Queensland (Campbell H, 2012) has undertaken two yet to be published surveys of multiple cassowary releases using GPS tracking data loggers with assistance from Ella Bay Developments. This data became available subsequent to the cassowary surveys.

The GPS tracking of a number of female and male cassowaries at Etty Bay recorded a different home range pattern for male cassowaries to that reported by (Moore, 2007). The GPS tracked home ranges of three females (Campbell H, 2012) was in agreement with Moore and indicated that females have a core area that they regularly frequent, and then other areas at the extent of the home ranges that they infrequently visited, sometimes only once or twice per month and then return to the core area. Additionally the furthest extent of the female home ranges did not intersect and only touched at the edges of other female ranges. The overall area of the home ranges approximated 2km<sup>2</sup> similar to that reported by Moore of 2.13 km<sup>2</sup>. This observation of females is supported by Moore and other researchers, but Moore reported that both male and female adult cassowaries maintain permanent and defended home ranges that vary in size and shape both seasonally and from year to year, depending on environmental conditions and patterns of food abundance.

As an aside, two of the female birds overlapped at one corner of their home range at a house which was distant from the core area and indicated that the birds would travel considerable distance from their core range including crossing main roads when (apparently) handfed.

The home ranges of three males in the GPS tracking however were much smaller and intersected over other males and over the female ranges. The male ranges were half of what Moore reported 1km<sup>2</sup> vs 2km<sup>2</sup> and Moore reported that the male home ranges did not overlap in his Mission Beach study (Moore 2007).

The significance of this for the five Ella Bay surveys is that to observe multiple females would require the birds to travel to the extent of their home range at similar times for the survey area to intersect the multiple female ranges. Note that the Ella Bay surveys are around Ella Bay property and along the coast and are at the extent of possible travel, whether females have a home range to that extent is unknown and the core of the home range would be expected to be inland from the boundary of Ella Bay and the road. (Refer to Figure 2.7)

Assuming that there were same size non-intersecting 2 km<sup>2</sup> home ranges covering the whole southern vegetated peninsula of the lower section of the Graham-Seymour range only 10 home ranges would fit into the area along the eastern and western slopes and around Ella Bay. In Figure 2.7 the home ranges have been diagrammatically shown as circular for illustration purposes only.

Based on Moore’s observations the total size of the cassowary pool using same size non-intersecting 2km<sup>2</sup> home ranges for males and females along the whole peninsula from Ella Bay would be 10 adults. And using a male to female sex ratio of 1.5 to 1 (male to female) there would expect to be a maximum number of adult cassowaries of 6 males and 4 females.

The Ella Bay surveys recorded 8 to 10 and 9 to 11 cassowaries in November 2009 and November 2010 surveys respectively, (and an additional one male and one female on the western slope in both surveys) which totals an average of 12 recorded adult cassowaries. The Ella Bay surveys show that the number of adult birds within the southern vegetated peninsula would be greater than that estimated by Moore. Campbell’s GPS tracking home range study

also implies that there may be overlapping of male home ranges and that the density could be higher.

Paradoxically the GPS tracking of three male subadults (Campbell H, 2012) produced different observations to that of adult males and to that of sub-adults reported by Moore. The GPS surveys showed that the tracked movement for male sub-adults is possibly far greater than previously observed with an indicative home range of 2km<sup>2</sup> and in one case a movement range of up to 5 km in one day and 10km from the core home range area before return.

The one female sub-adult home range recorded with GPS tracking was smaller at 1km<sup>2</sup> as reported by Moore. In this case the same observation for sub-adults males could be made in that given the home range size the possibility of surveying the population density of sub-adults is limited by the survey size.

Buosi in his review (6.1a) commented on the lack of clarity in Moore's surveys of the cassowary pathways and home ranges and that it should be feasible to infer home ranges. After 5 surveys and continuous camera monitoring for 2 years it has been possible to define regularly used areas within Ella Bay site and these are effectively defined as the edge of vegetation and riparian areas that are in the proposed conservation zones. On occasion cassowaries are observed within the pasture areas immediately adjacent to the riparian areas and contained within the proposed conservation areas.

While each of the surveys has defined an assumed home range for the birds surveyed there is no correlation between the Moore and Buosi surveys. It appears that some of the Moore identified birds have moved out of the area, and there has been an increase in the number of cassowaries and overlapping of many home ranges.

None of the cassowaries identified in the Moore surveys could be matched with cassowaries in the November 2009 survey. This was surprising given some of the distinctive features identified by Moore e.g. High Tower – Male #1. Moore in November 2006 survey (SEIS collated in 6.1L) had proposed that only one male used the Ella Bay site as its home range – Male #1, however it appears that now there are up to 5 males that have Ella Bay on the edge of their home range and that does not include Male #1. Moore reported High Tower 2.5km west of Ella Bay in February 2009 and it does not appear that the bird has returned.

### **2.1.3 Summary of Cassowary Surveys**

The number of adult cassowaries recorded in 2006 to 2010 in the immediate vicinity of Ella Bay Development and the access road has increased from 6 adults to 10 adults. The population appears to have a higher density than that reported by Moore in his Mission Beach Survey.

Moore suggests that the western side of the Seymour range may have a greater carrying capacity than that of the Eastern side. And this may have been due to cyclonic disturbance. The increase in adult cassowary numbers since his 2006 survey indicates that the eastern side of the range has a greater carrying capacity and population density.

The population increase is not consistent with Moore's Mission Beach interpretation of home ranges and would indicate that the male home ranges at Ella Bay overlap. The localised increased male presence may be due to local food availability and/or reduced threat status.

There appears to be a sex bias with the number of males recorded being higher than the 1.5:1 sex bias ratio reported by Moore at Mission Beach. The number of females reported total of 2 (possibly 3) is lower than expected from the sex bias ratio however, there is ambiguity in sex determination through monitoring photographs and the surveys did not include the whole of the southern vegetated peninsula which would be required to establish population density and sex ratio.

The number of sub-adults recorded has increased since 2006 from zero to between 3 and 5 probably representing movement of the sub-adults around Ella Bay. The zero in 2006 may represent the impact of cyclone Larry or that the sub-adults are mobile as reported by Campbell

(2012) and had moved from the area. The age class structure and recruitment appears to be sustainable.

The decrease in numbers reported during the wet season is consistent with cassowaries moving within their home ranges away from the lowland and inundated areas.

In all the total number of cassowaries, of females and of subadults for recruitment has shown an increase in reported numbers and indicates a local healthy population, however the defining of home ranges and cassowary interaction has raised more questions which only extended GPS monitoring will be able to resolve.

### 3. Cassowary Habitat Use Within Ella Bay

Three categories of habitat utilised by cassowaries have been identified and mapped in the Wet Tropics by the EPA in 2004. The habitat categories include:

- **Essential habitat** - regional ecosystem with verified cassowary use for breeding, feeding and general activity.
- **General habitat** - regional ecosystem with verified cassowary use, but not preferred habitat.
- **Rehabilitating habitat** - non-remnant regional ecosystem of rehabilitating vegetation that provides shelter and supplementary feeding and breeding resources. If allowed to recover, likely to be categorised as either essential or general cassowary habitat.

These cassowary habitat types are recognised in the National Recovery Plan for the Southern Cassowary. Although not include in the recovery plan a further subdivision of non-cassowary habitat has been made under the EPA (2004) mapping:

- **Unknown** - Mapped vegetation polygons where the regional ecosystem type is unknown at present.
- **Cleared** - Regional ecosystems cleared of native vegetation, and therefore not considered cassowary habitat.
- **Cultivated** - Regional ecosystems representing agricultural and forestry plantations.
- **Other vegetation** - Remnant regional ecosystems that are either too small or too distant to satisfy the patch analysis rules, or are considered geographically and climatically unsuitable, despite being essential or general cassowary habitat types.

#### Regional Ecosystem mapping – Recovery Plan for the Southern Cassowary

This Recovery plan designates the following Regional Ecosystems (RE) as Essential Cassowary Habitat in the Wet Tropics, which are present within the project area:

Regional Ecosystem	Description
7.2.1	Mesophyll vine forest on beach ridges and sand plains of beach origin
7.2.25	Melaleuca leucadendra +/- vine forest species, open-forest to closed-forest, on alluvium fringing streams
7.2.4	Eucalyptus spp. (often E. pellita or Corymbia intermedia) open-forest and/or Lophostemon suaveolens (swamp mahogany) open-forest on swampy sandplains and Pleistocene beach ridges
7.3.3	Mesophyll vine forest with Archontophoenix alexandrae, on poorly drained alluvial plains
7.3.10	Simple-complex mesophyll to notophyll vine forest, on moderately to poorly-drained alluvial plains, of moderate fertility
7.11.1	Simple-complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands

**Table 3.1 Regional Ecosystems (RE) of Essential Cassowary Habitat**

Potential cassowary habitat has been identified by DEWHA 2009 and is included in Figure 3.1, with an inset of Ella Bay site.

Regional Ecosystem mapping from the Flora Study (6.2a) is included in Figure 3.2 with REs representing Essential Cassowary Habitat identified in red outline.

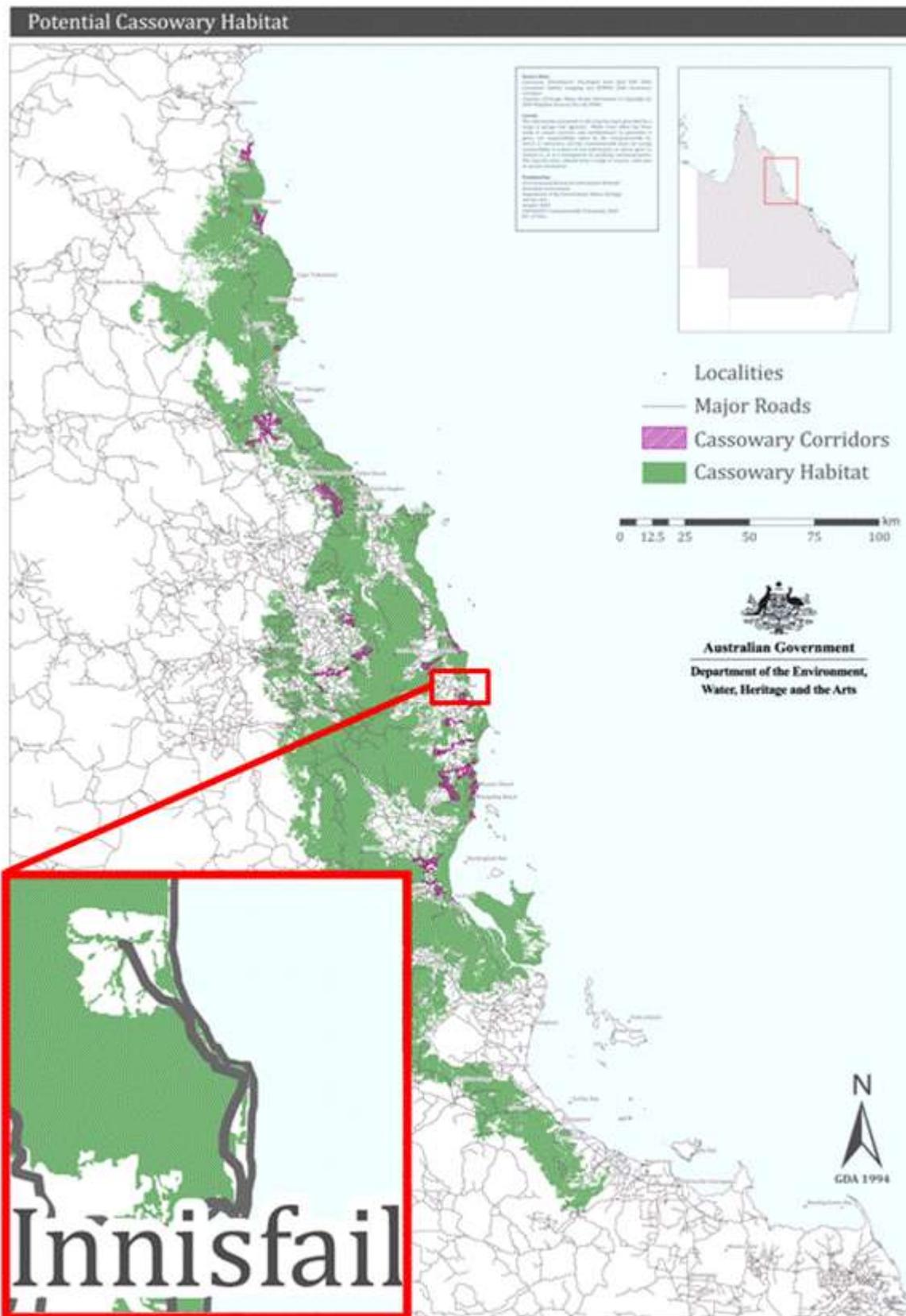


Figure 3.1 Potential Cassowary Habitat DEWHA 2009. Areas of key ecological function, broad movement corridors and appropriate rehabilitating habitat

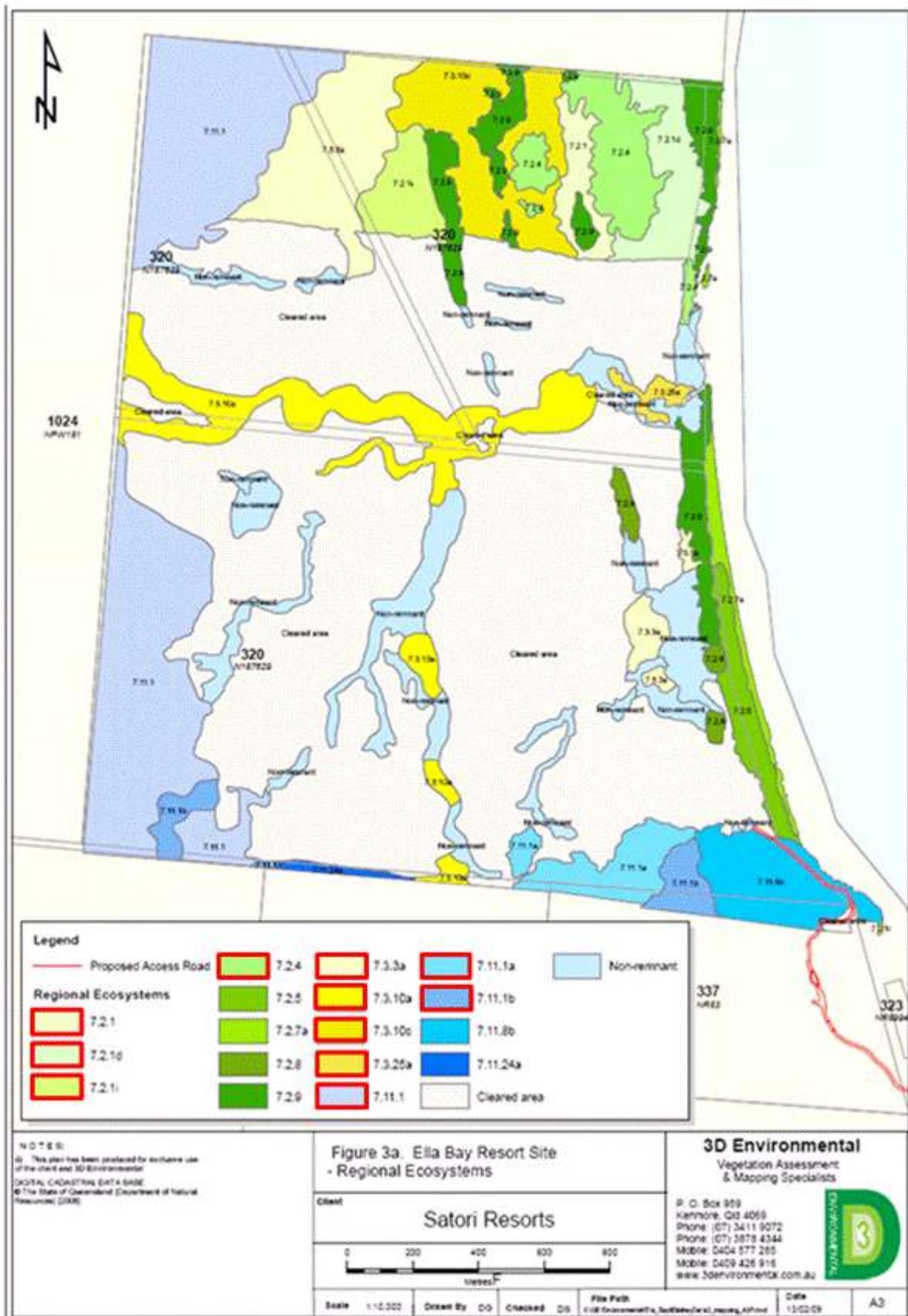


Figure 3.2 Regional Ecosystem mapping. Essential cassowary habitat has been identified by red square

### 3.1 Cassowary Habitat Assessment

The majority of the Ella Bay property has been cleared since at least 1902. Narrow strips of riparian vegetation have regrown along the creek banks since the Army mapping of 1943 (Army, 1943). These areas provide some feeding resources for cassowaries and movement corridors traversing east-west and north-south. However, the viability of the property for the cassowary is reduced due to the impact of:

- High levels of historical and contemporary anthropogenic impact;
- Grazing by herbivores (cattle, and wallabies) continuing to degrade remnant vegetation within the property;
- Infestation with Weeds of National Significance (WONS), including Pond Apple, an inappropriate food source for the cassowary which creates a mono-culture;
- The property and surrounding areas supporting feral pigs in large numbers destroying vegetation, destabilising creek banks and disturbing habitat; and
- Barbed wire fencing (being progressively removed).

A further requirement for cassowaries is access to permanent water sources. Moore in his assessment (Vol II EIS collated in 6.1L) did not include the requirement for permanent water in his assessment. Buosi (6.1a) recommended that the Proponent survey and determine the extent of water availability (known or potential) for the cassowary, in particular during the dry season.

*“This approach does not consider the location and importance (known or potential) of permanent water for drinking and bathing. Even if water is not a limiting factor, the location of permanent water sources, especially during very dry years, is an important consideration for the impact assessment process.”* Buosi 2009 (6.1a)

Within Ella Bay property only the North/South and East/West creeks and the northern swamp area provided permanent water during the dry season (refer to Figure 3.3 from Volume 6.1g). The water survey was undertaken in October and November 2009 under NRA’s guidance, two to four weeks prior to the Buosi November 2009 survey which reported a large increase in the number of reported cassowaries.

The rainfall for the month of October was approximately 28% lower than the Innisfail BOM (Bureau of Meteorology) long term mean, however during the period of the survey the rainfall was above average. The BOM rainfall data, substantiated by the onsite weather station recorded for the three days prior to the start of the survey an accumulation of 12 mm rain, and during survey period a total of 80.8 mm of accumulated rain was recorded.

Moore in *Ella Bay Cassowary Assessment: Volume I* (EIS collated in Volume 6.1L section 4.1 *Status Of Cassowary Habitat At Ella Bay Property*) analysed the habitat based on his mapping of habitat types. Buosi in a review of the EIS and SEIS has further commented on Moore’s work (6.1 a).

Buosi also commented that

*“Revised habitat assessment using a consistent and transparent methodology for all areas. Ideally habitats should be reassessed based on more recent vegetation mapping (3D Environmental 2009), the location of permanent water, existing (Moore 2006, 2009) and further field data collection.”*

Assessment of the Cassowary habitat is presented in Table 3.2 and in Figure 3.4. The table presents Moore’s locations to a physical Location on Ella Bay Site and to the proposed Conservation Zoning status (6.5 f *Conservation Covenant Zones*); the water availability in the dry season (Volume 6.1g) of the location; the Regional Ecosystem from (3D, 2009); VMA classification; Moore’s habitat classification; the cassowary habitat classification based on RE from Southern Cassowary Recovery Plan and the current assessment taking into account subsequent cassowary surveys and monitoring camera results.

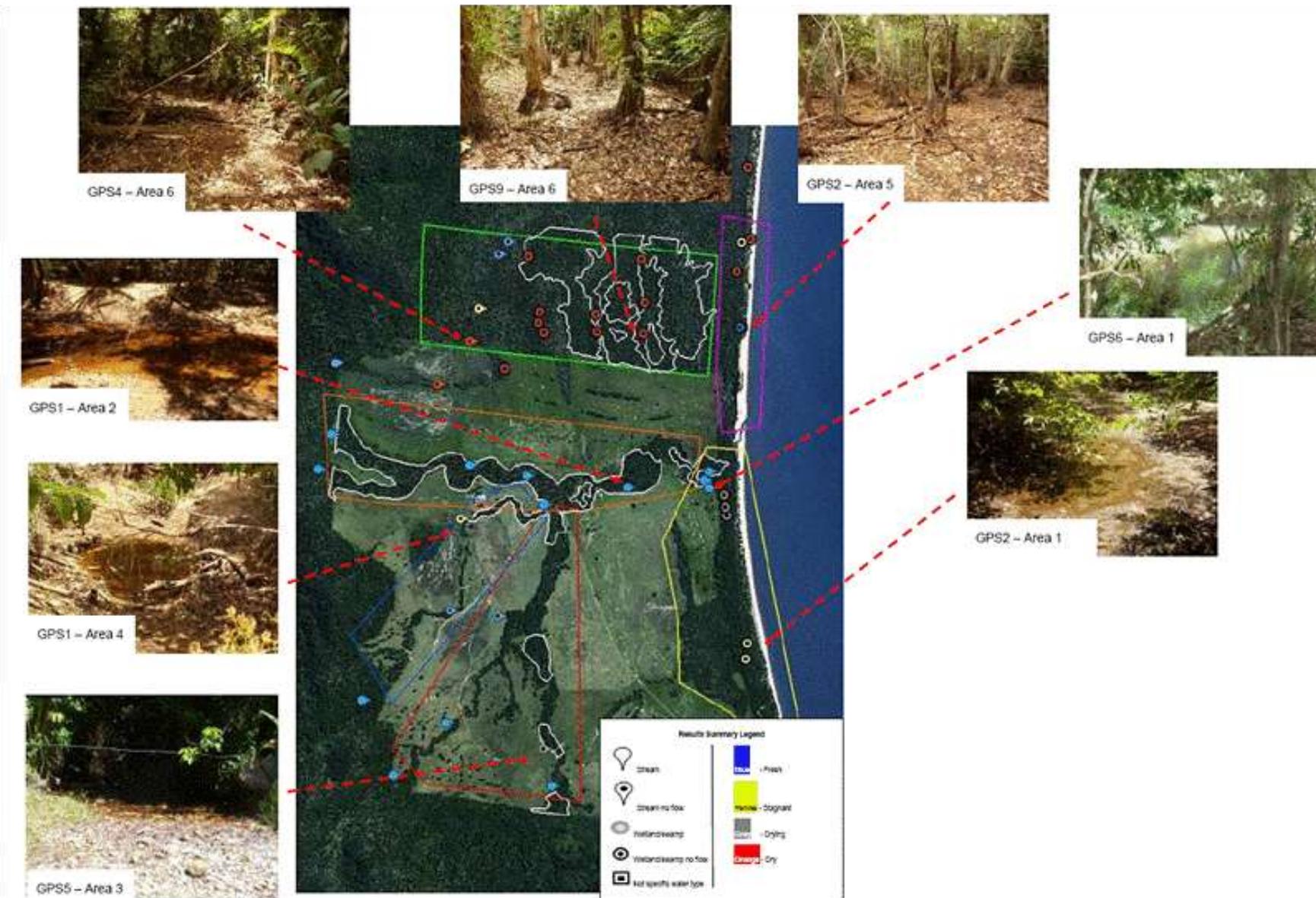
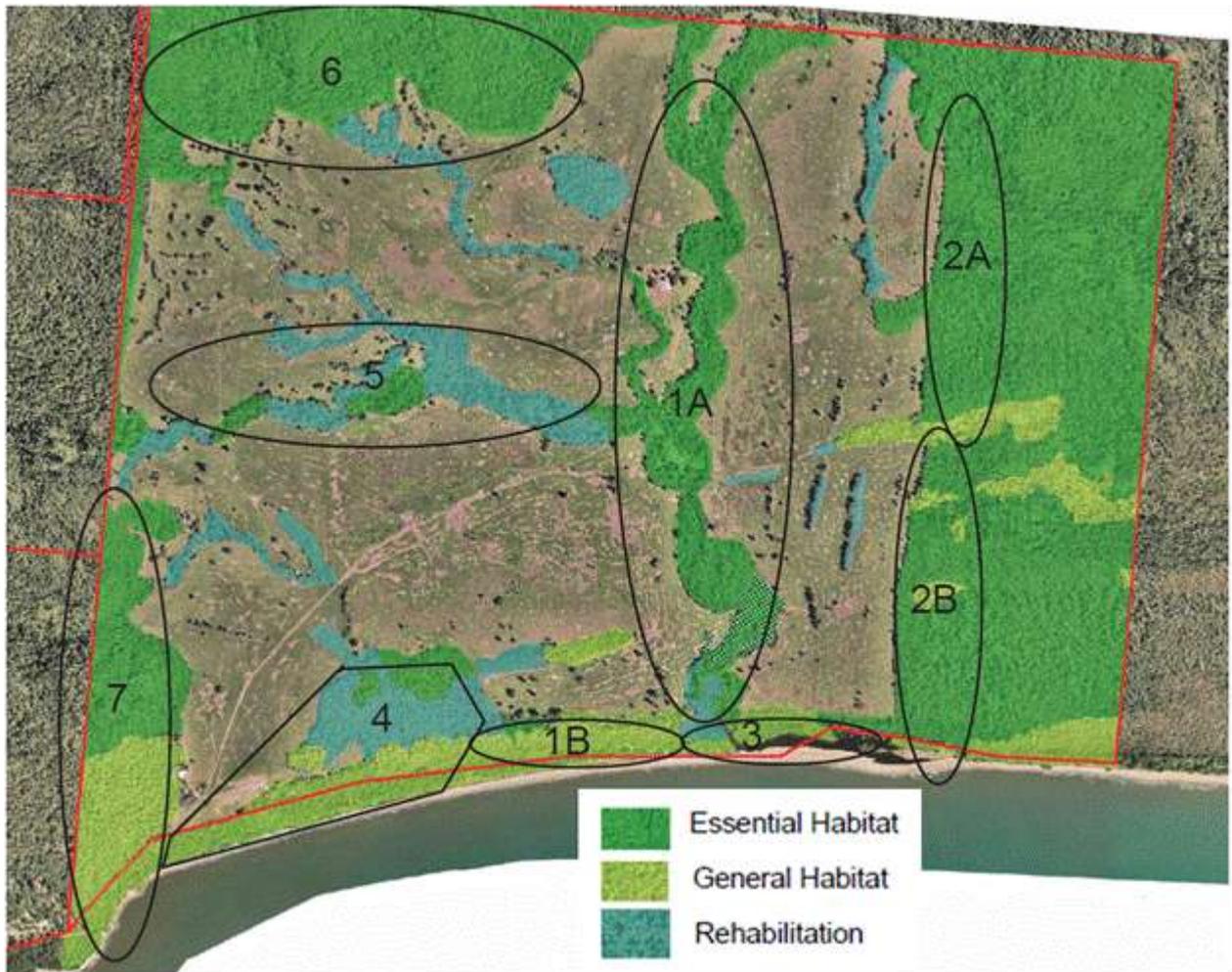


Figure 3.3 Extent of Dry season water availability for cassowaries October/November 2009.

Moore reference	Location on Ella Bay site	Conservation Zone	Water dry season	RE	RE vegetation description	VMA	Moore Assessment	RE <sup>1</sup> cassowary habitat	Assessment
1a	East/west creek	C	Perm	7.3.10a	Simple to complex Mesophyll to novotphyl	Of Concern	Essential	Essential	Essential
			Perm	Non Rem		Non Rem		Rehab	
			Perm	7.3.25a	<i>Melaleuca leucadendra</i> open forest	Of Concern		Essential	
1b	Dunal Swale	C	No	7.2.9	<i>Melaleuca quinquenervia</i> (swamp paperbark) shrub.	Of Concern	General	General	General
			No	7.2.7a	Coastal foredune complex with <i>Casuarina equisetifolia</i>	Of Concern		General	
2a	Northern wetland	A & B	No	7.2.1d	Mesophyll vine forest with <i>Archontophoenix alex.</i>	Endang ered	Essential	Essential	Essential
			No	7.2.1	Mesophyll vine forest	Endang ered		Essential	
			No	7.3.10c	Simple to complex mesophyll to notophyll vine forest	Of concern		Essential	
			No	7.2.4	<i>Lophostemon suaveolens</i> (swamp mahogany) open forest.	Of concern		Essential	
			No	7.2.9	<i>Melaleuca quinquenervia</i> (swamp paperbark) shrubland to closed forest	Of concern		General	
2b	Northern Hill	A & B	Perm	7.3.3a	Mesophyll vine forest with <i>Archontophoenix alex.</i>	Of Concern	Essential	Essential	Essential
			Perm	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not of Concern		Essential	
3	Fore-shore of Northern Resort	C	Perm	Non Rem		Non Rem	Other	General	Other
			Perm	7.2.4	<i>Lophostemon suaveolens</i> (swamp mahogany) open forest	Of Concern		Essential	
4	Swamp North of Village	C	No	Non Rem		Non Rem	Other	General	Rehab
			No	7.2.3.3a	Mesophyll Vine Forest with <i>Archontophoenix alexandrae</i>	Of Concern		Essential	
5	North South Creek	C	Perm	Non Rem		Non Rem	Rehab	Rehab	General
			Perm	7.3.10a	Simple to complex Mesophyll to novotphyl	Of Concern		Essential	
6	South West	A & B	Perm	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not of Concern	Essential	Essential	Essential
7	South East	C	No	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not of Concern	N/A	Essential	General
			No	7.11.8	<i>Acacia mangium</i> and <i>A. celsa</i> open to closed forest	Of Concern		General	

**Table 3.2 Updated Cassowary habitat assessment of Ella Bay property.**

<sup>1</sup> The habitat type has been matched to the RE from 2008 Flora survey (6.2a)



**Figure 3.4** Cassowary habitat locations referenced to Moore Volume I section 4.1 Status Of Cassowary Habitat At Ella Bay Property (EIS collated in 6.1L)

**Location 1a:**

East West Creek; Conservation Zone C - 100m wide fauna corridor; Permanent water;

- 7.3.10a Simple to complex mesophyll to notophyll vine forest; Of Concern; Essential cassowary habitat;
- Non-Remnant; and
- 7.3.25a *Melaleuca leucadendra* open forest and woodland; Of Concern; Essential cassowary habitat.

This strip of riparian vegetation is narrow, degraded and cyclone damaged, making the importance of the area to the species significantly reduced. The creek is sinuous and is steep banked in the upper reaches with rainforest restricted to the steep banks and in some cases to the terraces of meander beds. In places the clearing is to the steep bank of the creek.

The creek banks are filled with cyclone debris from Larry and Yasi. This area was particularly damaged by Cyclone Yasi with canopy crowns broken a number of trees felled and the vegetation denuded. However, it does currently serve as a movement corridor and a permanent water supply.

Cassowary movement is predominately noted on the cleared edge of the creek. In the western reaches of the creek; cassowaries are regularly photographed by monitoring cameras including adults, chicks and subadults. Cassowaries were observed using this area in all surveys except for April 2009 wet season survey. A number of individual isolated fruiting trees are found to the north of the creek in this area (mango and fig) which are regularly visited in season.

In the lower reaches near the main creek crossing cassowary movement is noted infrequently, usually solitary, and seasonal, matching fruiting of the pond apple. It appears from the monitoring cameras that cassowary movement into the foreshore and disturbed swampland pond apple infestations is not through 1A and 1B but predominately through the finger of vegetation between the western point of Location 7 leading into Location 4. Cassowaries were surveyed using this area in Nov 2006 and Nov 2010.

The area contains Pond Apple more extensively in the lower reaches; however, the weed control program will eliminate this exotic species. In the central reaches of the creek, the corridor contains numerous potential cassowary food trees, including significant numbers of the favoured cassowary food tree, blue quandong, *Elaeocarpus angustifolius*. These are likely to provide a food resource for cassowaries in the future. The area also allows an alternative access route for cassowaries to forage in the feather palm dominated mesophyll forest in the north of the property.

This riparian corridor is regrowth from previous agricultural clearing.

**Assessment 1a** – damaged Essential Habitat providing a food source and permanent water supply and movement corridor.

#### **Location 1b.**

Dunal Swale; Conservation Zone C - 100m wide fauna corridor; No permanent water.

- 7.2.9; *Melaleuca quinquenervia* (swamp paperbark) shrubland to closed forest; Of Concern; General cassowary habitat;
- 7.2.7a; Coastal foredune complex with *Casuarina equisetifolia*. (this RE is only present within the Esplanade and foreshore.) Of Concern, essential cassowary habitat.

In Moore's assessment the dunal area is divided into three assessment areas:

- 1B East/west creek mouth south including extensive Pond Apple,
- 3 East/west creek mouth north including mangroves and
- 4 Littoral rainforest

This foreshore vegetation of the Ella Bay property comprises a highly disturbed non-rainforest mix of open forest woodland with broad-leaved paperbark *Melaleuca quinquenervia*. There are limited native cassowary food trees in this vegetation association apart from exotic weeds. Although the area has been mapped as 'essential cassowary habitat', in EPA mapping it is considered to be more accurately categorised as 'general habitat' because, while cassowaries have been recorded here, it is not preferred habitat. (also recognised as general habitat based on RE).

The dunal swale does not provide permanent water during the dry season reducing to isolated brackish pools before drying up. Pond Apple is a deciduous and fruits late January to March during the wet season. Cassowaries have only been recorded in this area (1B) in surveys Nov 2006 and Nov 2010. This area is not used as a corridor.

Moore's recommendation was due to human interaction that this area be closed to cassowary movement. Buosi commented that this area may be more important to cassowary foraging due to understatement of remnant fruiting vegetation, however the subsequent surveys have shown that not to be the case.

**Assessment 1b** – damaged General Habitat which is weed infested. No permanent water. Not a cassowary corridor.

#### **Location 2a:**

Northern wetland, (north of the Northern Resort Precinct); Conservation Zone A & B; No permanent water;

- 7.2.1d; Mesophyll vine forest with *Archontophoenix alexandrae*; Endangered; Essential Cassowary Habitat;
- 7.2.1; Mesophyll vine forest; Endangered; Essential Cassowary Habitat;

- 7.3.10c; Simple to complex mesophyll to notophyll vine forest; Of Concern; Essential Cassowary Habitat;
- 7.2.4; *Lophostemon suaveolens* (swamp mahogany) open forest; Of Concern; Essential Cassowary Habitat;

This area comprises disturbed simple-complex mesophyll to notophyll vine forest. Although severely impacted by Cyclone Larry, this habitat currently provides important food and wet season water resources for cassowaries. In the dry season Water Survey all areas of the wetlands were reported as dry to greater than 300m north of the Northern Resort Precinct.

Cassowaries were often monitored moving along within the vegetation edge, in particular on the old logging trails. All Surveys reported cassowary presence in this area.

Assessment 2a – damaged Essential Habitat providing a food source and water supply in most seasons and movement corridor.

**Location 2b;** Northern hills (North of Northern Residential Precinct); Conservation Zone A & B; Permanent water

- 7.3.3a; Mesophyll Vine Forest with *Archontophoenix alexandrae*; Of Concern; Essential Cassowary Habitat;
- 7.11.1; Simple-complex mesophyll to notophyll vine forest; Not of Concern; Essential Cassowary Habitat.

This area comprises a mosaic of open forest with vine forest sub-canopy, and feather palm dominated mesophyll vine forest. For cassowary habitat it is similar to location 2a, in providing important food however this area had flowing permanent water in the dry season water survey. It has been mapped as essential habitat.

**Assessment 2b** – damaged Essential Habitat providing a food source and water supply and movement corridor.

### Location 3

Foreshore of Northern Resort Precinct; Conservation Zone C & D: Permanent Water

- Non-remnant within Ella Bay boundary; and
- 7.2.4, *Lophostemon suaveolens* (swamp mahogany) open forest; (on the Esplanade) Of Concern; Essential Cassowary Habitat.

This area is a highly disturbed association of non-rainforest habitats comprising open Mahogany and secondary shrubland/closed shrubland. The vegetation zone is very thin varying from 3m to 20m with some 10m of fringing low height mangroves. The vegetation has been extensively cyclone damaged. There is limited pond apple along the foreshore, due to salinity.

Only one surveyed scat has been reported in this area from all surveys. The area is not used as a corridor. Moore's recommendation was due to human interaction that this area be closed to cassowary movement. Buosi commented that this area may be more important to cassowary foraging due to understatement of the importance of mangroves. This has not been observed in the subsequent surveys.

This location is mapped as 'general habitat' by RE but Moore suggested that the thin strands should be reclassified as 'other vegetation'.

**Assessment 3** – General habitat; rarely used corridor only. Little value to cassowaries.

### Location 4:

Swamp north of Village Precinct; Conservation Zone C; Limited Water

- Non Remnant; Unknown habitat value; heavily infested with Pond Apple
- 7.3.3a; Mesophyll Vine Forest with *Archontophoenix alexandrae*; Of Concern; Essential Cassowary Habitat;
- 7.2.5; Mesophyll to notophyll vine forest of *Syzygium forte* subsp. Of Concern, (Critically Endangered EPBC); Essential Cassowary Habitat

The majority of habitat in this area is currently classified as 'unknown'. The vegetation is non-remnant with a canopy dominated by Pond Apple mixed with a scattering of native species including *Melaleuca leucadendra* and *Archontophoenix alexandrae*. Whilst these communities are recognised as regrowth in the Wet Tropics Vegetation Community Mapping (Stanton and Stanton, in prep.), the EPA regional ecosystems mapping describes these areas as remnants of the *Endangered* RE 7.2.1. This area was reported as a few stagnant puddles during the dry season water survey. Extensive rehabilitation will be required using mostly non cassowary fruiting species. The Littoral rainforest RE 7.2.5 extends to the south with large *Syzygium forte*.

This area was visited in all cassowary surveys by one cassowary with the exception of April 2009. Pond Apple provides enormous food source availability but given the quantity of Pond Apple this area is surprisingly sparingly accessed by cassowaries.

**Assessment 4** – This area has been re-classified as general because of current use of Pond Apple; seasonal food source. No Permanent water. After rehabilitation little value to cassowaries will become general and a corridor only.

#### **Location 5;**

North South Creek; Conservation Zone C & D; permanent water;

- Non Remnant; rehabilitating habitat value;
- 7.3.10a; Simple to complex mesophyll to notophyll vine forest; Of Concern; Essential Cassowary Habitat

This area is classified as 'rehabilitating habitat' by the EPA mapping. The vegetation comprises discontinuous strips of vine forest, with scattered emergent trees above a severely wind disturbed sub-canopy which dropped to near ground level in some places. Heavily wind disturbed fringing meandering creek line. High species diversity within the community. Weed impacts particularly on margins. The later vegetation mapping recognises some small enclaves of RE 7.3.10a.

The vegetation does not provide much in the way of food resources or breeding alternatives for cassowaries as it is narrow and much of its length comprises secondary regrowth forest with little sub-canopy

It provides an alternative movement corridor for cassowaries in the south of the property, allowing them to access the main east-west corridor, and thus to the National Park located to the west. Most of the surveys reported cassowary evidence along this creek line, whether as a movement corridor to the East West Creek or as a source of water. The dry season survey and Moore report the creek as a series of pools in the dry season.

**Assessment 5** – Rehabilitating, corridor and water source, frequent movement; will be improved to Essential.

#### **Location 6:**

South West Corner; Conservation A & B: permanent water

- 7.11.1 Simple-complex mesophyll to notophyll vine forest; Not of concern; Essential cassowary habitat.
- 7.11.1b Mesophyll vine forest recovering from disturbance, with *Acacia* canopy or emergents. Very wet; Of concern; Essential cassowary habitat.

This habitat currently provides important food and water resources for cassowaries and has been designated Essential habitat. The vegetation has been extensively wind damaged. The cassowary surveys did not record extensive cassowary evidence in this area probably attributable to the difficult nature of the terrain caused by *calamus* post wind disturbance.

**Assessment 6:** damaged Essential, permanent water.

#### **Location 7:**

South East Corner; Conservation C & D: No water

- 7.11.1a Mesophyll vine forest. Very wet; Not of concern; Essential cassowary habitat;
- 7.11.1b Mesophyll vine forest recovering from disturbance, with *Acacia* canopy or emergents. Very wet; Of concern; Essential cassowary habitat;
- 7.11.8b *Acacia mangium* and *A. celsa* open to closed forest; General cassowary habitat.

This habitat provides some food but no water resources for cassowaries. The vegetation has been extensively wind damaged. The cassowary surveys did not record extensive evidence in this area except on the western margin. The eastern corner behind the house has been previously cleared and the frequency of markers at this point is also related to a number of large mango trees near the house. The acacia provides no food value to the cassowary.

**Assessment 7:** General habitat with no water; removal of the mango trees will remove a large proportion of the seasonal food supply.

### 3.1.1 Habitat Assessment Summary

The updating of cassowary habitat by reference to the latest flora survey and to water availability produced only one change within the mapping from Moore in Volume I of the SEIS Cassowary Assessment. Moore categorised two areas as “other vegetation”,

- Area 3 is the dunal swale area containing the extensive infestations of Pond Apple. This area is almost a monoculture of Pond Apple surrounding the wet area of the dunal swale. The Pond Apple is the only food source and weed control will remove the motivation for the birds to forage. The RE has been determined by the upper canopy of *Melaleuca* extending over the Pond Apple. This area should retain the Moore classification of other vegetation.
- Area 4 was originally classified as Unknown in the EPA mapping (2004) and contains Pond Apple but to a lesser degree than area 3. The area includes a mixture of wetland and back dune vegetation, including a small number of *Syzygium forte* and other cassowary food sources. This classification has been changed to General.

### 3.1.2 Impact of Ella Bay Development

The Ella Bay conservation strategy is to place the majority of existing vegetation under conservation covenant, plus create a covenanted vegetated fauna corridor bisecting north/south and east/west. The fauna corridor will be a minimum of 100m in width. The majority of the existing riparian vegetation is less than 100m in width and has recovered from previous agricultural clearing to either remnant status or with revegetation and closing of edge effects will become remnant.

Moore in his assessment suggested that the dunal swale areas (Areas 3 & 4) should be isolated from cassowary access due to possible human/cassowary interaction (Refer to Volume II *Impact Assessment and Mitigation Strategies* collated in 6.1L). While the area is recognised as low value apart from the Pond Apple there appears to be no justification for isolating this area:

- The surveys have shown that even with the Pond Apple the areas are infrequently used by cassowaries;
- The revegetation of the earlier stages, provision of increased access to permanent water through the constructed wetlands and there will be little motivation for the cassowaries to frequent the area
- The development will be staged and there will be a number of years between removal of the Pond Apple, replacement with non-cassowary food source vegetation and construction; and
- The precincts will be fenced.

The impact on each of the areas from the development will be:

1A	<p>The creek and riparian zone will be included within Conservation Zone C. The vegetation width will be increased to greater than 100m wide. The revegetation will widen and increase the cyclone resilience of the riparian zone. The revegetation species will primarily be cassowary fruiting species similar to the revegetation trial (refer 6.2f)</p> <p>The initial stage of revegetation which has been planted within the western cleared fork and western edge of the Northern Residential Precinct has already started fruiting and will facilitate improved foraging as a replacement for the Pond Apple removed from the swamplands.</p> <p>Limited clearing will be required along the creek line to accommodate discharge structures for Stormwater treatment wetlands and Bioretention filters. These structures will be less than 6m wide and comprise rocks, and/or gabions and will appear like creek intersections.</p> <p>Clearing will be required at the edges of the current main crossing to accommodate a bridge across the creek. The clearing is a minor increase in the existing clearing approximately 200m<sup>2</sup> (0.02ha) with subsequent revegetation of 500 m<sup>2</sup> after completion of construction. This bridge will be of sufficient height and width for a cassowary underpass providing a continuous movement corridor. The handrail of the bridge and the precinct fencing will be linked to form a movement funnel. During construction of the bridge (one dry season) cassowary access will be temporarily restricted to prevent injury to the cassowaries.</p> <p>Stormwater runoff from the development will be recovered in Constructed wetlands (providing permanent water) and Bioretention filters. The current bare earth erosion will be reduced.</p> <p>The revegetation plan is provided in Figure 5.3. The revegetation will be temporarily fenced during the initial growth stages to minimise damage from wallabies. This will not prevent cassowary access along the riparian corridor as demonstrated within the trial revegetation plots.</p>
1B	<p>The dunal swale will be included within Conservation Zone C. The vegetation width will be increased by 15m within Zone D to provide edge closure. The Pond Apple will be removed and the area will be rehabilitated and revegetated with non-cassowary fruit species. The pond apple control and rehabilitation will take a number of seasons due to the seed bank and extensive pond apple infestation.</p> <p>Two beach access pathways and one nature walk will be provided in this area. The paths will be a combination of natural ground and boardwalk.</p> <p>It is not proposed to isolate this area and the infrequent cassowary movement is not seen as a being problematic for human-cassowary interaction.</p> <p>This area will change from a seasonal cassowary food source with pond apple to a minimal food source.</p> <p>Two resorts will be located adjacent to this area within a fenced precinct.</p>
2A	<p>There is no proposed impact on this area with the exception of proposed walking trails within this area. Water quality and availability will be improved over present.</p> <p>This area will be included within Conservation Zones A (National Park) and B with a buffer of Conservation D. This area has minor stands of Pond Apple which will require control. The inclusion of constructed wetlands within the North South Fauna Corridor will provide permanent water for the cassowaries.</p> <p>Adjacent to this area will be three landscaped “organic” golf course holes with constructed wetlands treating the runoff.</p>

2B	<p>There is no proposed impact on this area with the exception of minimal impact walking trails within this area. Water quality and availability will be improved over present.</p> <p>This area will be included within Conservation Zones A (National Park) and B with a buffer of Conservation D. This area has stands of Pond Apple which will require control.</p> <p>Adjacent to this area will be the northern resort and residential area. A vegetated buffer of 50m width will improve the edge closure of the vegetation and minimise the existing agricultural edge impact. This corridor will be improved by the new vegetated north/south corridor joining 1A.</p> <p>There will be one landscaped golf course hole with constructed wetlands treating the runoff. There will be increased permanent water availability and increased cassowary food source.</p>
3	<p>There is no proposed impact on this area with the exception of proposed beach access trails within this area. The vegetation width will be substantially increased to 100m</p> <p>This area will be contained within Conservation Zone D and will be revegetated with salt tolerant species and predominately non cassowary fruiting species. This area will remain accessible to cassowaries but the food sources and use motivation will be reduced through removal of the pond apple.</p> <p>Adjacent to this area will be the northern resort.</p>
4	<p>There is no proposed impact to this area with the exception of minimal impact walking trails within this area. Water quality and availability will be improved over present.</p> <p>The vegetation species mix will be improved significantly with the removal of the pond apple. The area will be rehabilitated and revegetated with non-cassowary fruit species. The pond apple control and rehabilitation will take a number of seasons due to the seed bank and extensive pond apple infestation.</p> <p>Moore recommended that this area be excluded from cassowary movement due to possible human interaction. Although this area will be adjacent to the highest human population density the Proponent has proposed that this area remain accessible to cassowary movement through a fauna corridor. Removal of the Pond Apple and revegetation with non-cassowary fruiting trees will reduce the motivation.</p>
5	<p>The creek and riparian zone will be included within Conservation Zone C. The vegetation width will be increased to greater than 100m wide. The revegetation will widen and increase the cyclone resilience of the riparian zone (predominately non remanent. The revegetation species will primarily be cassowary fruiting species similar to the revegetation trial (refer 6.2f)</p> <p>Limited clearing will be required along the creek line to accommodate discharge structures for Stormwater treatment wetlands and Bioretention filters. These structures will be less than 6m wide and comprise rocks, and/or gabions and will appear like creek intersections.</p> <p>Clearing will be required at the edges of the current crossing to accommodate a bridge across the creek. The clearing is a minor increase in the existing clearing approximately 200m<sup>2</sup> (0.02ha) with subsequent revegetation of 500 m<sup>2</sup> after completion of construction. This bridge will be of sufficient height and width for a cassowary underpass providing a continuous movement corridor. The handrail of the bridge and the precinct fencing will be linked to form a movement funnel. During construction of the bridge (one dry season) cassowary access will be temporarily restricted to prevent injury to the cassowaries.</p> <p>Stormwater runoff from the development will be recovered in Constructed wetlands (providing permanent water) and Bioretention filters. The current bare earth erosion will be reduced.</p>

	<p>The revegetation plan is provided in Figure 5.3. The revegetation will be temporarily fenced during the initial growth stages to minimise damage from wallabies. This will not prevent cassowary access along the riparian corridor as demonstrated within the trial revegetation plots.</p> <p>Cassowary food supply and water availability will be improved.</p>
6	<p>There is no proposed impact on this area with the exception of proposed walking trails within this area.</p> <p>This area will be included within Conservation Zones A (National Park) and B with a buffer of Conservation D.</p> <p>Revegetation of the 100m buffer to the National Parks will be with Cassowary fruiting species. The cassowary food supply will be significantly improved.</p>
7	<p>The northern fringe of this area to the west of the existing house will be cleared (0.8 ha) for development and the mango trees removed (poor health). The existing non remnant vegetated finger between the western end of area7 and area 4 will be revegetated with non-cassowary fruiting species.</p> <p>The cassowary food supply will be minimally reduced with removal of the mango trees.</p>

## 4. Cassowary Habitat Use along the Ella Bay Road

The proposed access road follows the existing gazetted unsealed Ella Bay Road as it passes through or adjacent to Ella Bay National Park between Flying Fish Point and Ella Bay.

The vegetation along the proposed access road has been surveyed for flora and for its importance to the cassowary, from the Ella Bay Property gate in the north, to the Flying Fish Point-Innisfail Road in the south, and including the eastern slopes and adjacent ridges of the Seymour Range.

Moore (SEIS collated in 6.1L) developed a risk assessment approach to enable finer detail evaluation of the suitability of the habitat. Moore used field survey data from his previous survey (Nov 2006), together with BAAM vegetation mapping (EIS Vol 8 A6.1) and professional opinion to map areas as high, moderate or low quality Cassowary habitat. These habitat categories are a combination of category descriptions used in EPA (2004). Moore also assessed the perceived risk to the cassowary in accessing that vegetation (low risk, moderate risk and high risk) of each area mapped and this, together with habitat quality, used this to identify a habitat value category (negative value, moderate value and high value).

According to this method of evaluating cassowary habitat, as the level of anthropogenic threats increases, the usefulness of otherwise suitable cassowary habitat decreases. The level of existing risk is thereby factored in to the assessment of cassowary habitat. In doing so, this method attempts to establish the habitat value, or the true contribution made by habitat to conserving the cassowary populations in an area.

An area's habitat quality level is combined with a risk level to arrive at 'Habitat Values' for the vegetation. Four categories are recognised as follows:

- Category A – high value (high quality and low risk).
- Category B – moderate (moderate quality and moderate risk).
- Category C – alternative habitat (low quality, steep terrain).
- Category D – negative value (varying quality and high risk).

Buosi (Vol 6.1a) in his review of Moore's work commented on a lack of explanation around some of the decisions by Moore. Of particular importance is the decision surrounding areas to the north of Flying Fish Point

*"The 'Low Quality Habitat' designation could be justified if it is demonstrated that water is not a limiting resource in the local area (including periods of drought/extended dry) and Cassowaries don't regularly forage in the area. ....Given the available information we suggest that this area be regarded as important or 'High Quality Habitat' unless proven otherwise.*

*It is unclear why Flying Fish Point Reserve was designated as 'Moderate Quality Habitat' (as opposed to 'High Quality Habitat') in Moore 2007 as the report states that part of the area 'may hold the only water source available to Cassowaries in this area during dry periods' and 'probably provides both food and water resources for Cassowaries'."*

### 4.1 Updated Cassowary Habitat Assessment

Refer to Table 3.1 for Southern Cassowary Recovery plan designation of Regional Ecosystems (RE) as Essential Cassowary Habitat present within the project area:

#### Location 1

Ella Bay National Park – Seymour Range. Permanent Water

- 7.11.1 Simple-complex mesophyll to notophyll vine forest, Not Of Concern, Essential cassowary habitat
- 7.11.34 Complex of shrubland, low heathy or shrubby woodlands, Of Concern, General cassowary habitat
- 7.2.1 Mesophyll vine forest, Endangered, Essential cassowary habitat

This area contains the home ranges of a number of cassowaries and contains permanent water supplies. There may be a small impact from noise. There is no change in mapping.

**Assessment 1** - Essential cassowary habitat. Moore maps this as High value.

#### Location 2

Heath Point headland; Permanent Water

- 7.11.34 Complex of shrubland, low heathy or shrubby woodlands Of Concern General

This area is steep and provides transport through the gullies to the upper Seymour Ranges.

This area will be fenced from the road where the embankment is less than 2m high vertically or 45°. There will be some impact from noise.

**Assessment 2** - this habitat is classified as Other, due to steepness and dry heathland with little food supply but permanent source of water in one of the gullies. Moore classifies this as Alternative.

#### Location 3

Beach Front – No Permanent water

- Non Remnant, General
- 7.2.5, *Lophostemon suaveolens* (swamp mahogany) open forest, Of Concern, General
- 7.2.7a Coastal foredune complex with *Casuarina equisetifolia*, Of Concern, General
- 7.2.8 *Melaleuca leucadendra* (weeping tea tree) open forest, Of Concern, General

The Beach front was surveyed in detail in the 2008 vegetation survey. Stanton (6.2a) comments that the beach vegetation is being severely degraded:

*“The construction of the boulder retaining wall on the Flying Fish Point beachfront has severely compromised the integrity of foredune vegetation to the immediate north of this structure. Accelerated erosion and destruction of foredune vegetation has occurred as sedimentary process has re-equilibrated in an attempt to reinstate normal crescent shaped beach morphology. This accelerated erosion appears to have been responsible for salinisation and dieback of back dune *Melaleuca leucadendra* swamplands as a rapidly regressing foredune has become susceptible to saltwater breach during storm surge and spring tides.”*

The foredunes have also been damaged by access tracks and partial clearing as well as extensive invasion of weeds. The most dominant of these is Singapore Daisy, with stands of Prickly Pear, lantana, Mother-in-Laws tongue, Guava and intense seedlings of Pond Apple,

Cassowary signs (scats) were reported in this area in only one survey; April 2010 despite all surveys recording activity in the adjoining Flying Fish Point Reserve. The poor vegetation quality and lack of fresh water means that this area is only used on rare occasions.

**Assessment 3** – this habitat is classified as Other, due to the lack of suitable vegetation, no permanent water, clearings, and receding dying dunal vegetation.

#### Location 4

Flying Fish Point Reserve

- 7.3.10a, Simple to complex Mesophyll to novotphyl, Of Concern, Essential
- 7.3.25a, *Melaleuca leucadendra* open forest, and woodland, Of Concern, Essential
- 7.3.3a, Mesophyll vine forest with, *Archontophoenix alexandrae*, Of Concern, Essential

This area forms a broken dunal swale extending to Heath Point, the areas has been impacted by anthropogenic impact over a century of proximity to the village and the neighbouring aquaculture. The vegetation within the reserve is severely wind affected, after cyclone Larry and Yasi. The centre of the vegetation is characterised by seasonal water logging (7.3.25a and 7.3.3a) and an extensive drainage channel has been created along Ruby and Bindon Streets with an invert to 2m AHD top manage local drainage.

Cassowaries were surveyed here in all the surveys. The surveys reported regular road crossings on one of two locations and one off crossings at a number of other locations. Post cyclone Larry there were two feeding stations in this area and it is suspected that cassowaries are still being handfed (photographs of cassowaries in house yards - Ella bay Staff 2010). The more recent surveys show a line of signs to the north of the reserve adjacent to the non-remnant vegetation. The vegetation within the reserve is thick with dense stands of Calamus and Pandanus and difficult to walk through. It may be possible that this area is more cleared.

The water survey (6.1g) reports that there was no permanent water in the reserve during the dry season. The drainage feeding the reserve are short length ephemeral streams from the eastern side of the range while the drainage channel around the south and east of the reserve has probably contributed to accelerated drying.

This area has been extensively damaged from cyclones and anthropogenic impact, but provides a food source for the 2 cassowaries and one subadult that frequent this area. The frequency of appearance and defined movement paths indicate that these cassowaries have probably become habituated and are handfed.

**Assessment Location 4** – This area is damaged essential habitat although is not rehabilitating. The habitat is classified as essential habitat. Moore classified this area as moderate quality which is an equivalent classification.

#### **Location 5**

Southern Ella Bay Road verge no water

- 7.11.1 Simple-complex mesophyll to notophyll vine forest, Not Of Concern, Essential
- 7.3.10a Simple to complex Mesophyll to novotphyl, Of Concern, Essential

RE 7.11.1 is the dominant vegetation along the road edge to the lower slopes of the range. The ecosystem comprised tall mesophyll vine forest with dominant *Castanospermum australe*, *Litsea leafeana*, *Ficus destruens*, *Intsia bijuga* and *Melicope vitiflora* (all cassowary fruits). Additionally at the northern extent of this location are extensive areas of native olive (*Olea paniculara*) (pers. Obs.) on the steep slopes to the range above Heath Point.

The drainage in this area are short length ephemeral streams from the eastern side of the range. This area was not surveyed for water but the drainage feeds the Flying Fish Point Reserve.

**Assessment location 5** – Essential cassowary habitat, no permanent water. Moore mapped this vegetation as High.

#### **Location 6**

South Seymour Range no permanent water\*

- 7.11.1, Simple-complex mesophyll to notophyll vine forest, Not of Concern, Essential

This area is on the steeper slopes where the stage 2 road will be constructed for the Flying Fish Point Bypass. All surveys reported cassowary signs along the alignment. The alignment is located on a previous clearing which near the upper sections is believed to be an old logging trail and at the lower section is the location of a large drain that has been excavated to prevent runoff from inundating the houses below. This ease of use track is favoured by the cassowaries when moving from the top of the range down to the town and Flying Fish Point Reserve (USL).

The vegetation is extremely wind affected. The area may provide food sources for the cassowary apart from the steepness appears to be used mainly for movement corridor. The water was not surveyed in the Cassowary Water Survey but is the location of one of the water monitoring sites and is known to be ephemeral.

**Assessment location 6** – Wind Degraded General cassowary habitat, no permanent water. Moore mapped this vegetation as Low.

#### **Location 7**

Flying Fish Point west swamp Permanent water

- 7.1.1 Mangrove low closed forest to open, Shrubland, Not of Concern, General

This location was not surveyed by Stanton and has reported little cassowary signs. There will be no disruption to this area.

**Assessment location 7** –General cassowary habitat, permanent water. Moore mapped this vegetation as Low.

#### **Location 8**

Northern EB Road verge permanent water

- 7.11.1, Mesophyll vine forest, Not of Concern, Essential
- 7.2.1, Mesophyll vine forest, Endangered, Essential cassowary habitat

RE 7.11.1 is the dominant vegetation along the west of the road edge, with 7.2.1 on the coast. This area provides high quality food sources for the cassowaries. All surveys reported cassowary signs in this area.

This area is the location of the Little Cove development and will have two bridges as fauna underpasses to maintain connectivity and fencing of the resort area, plus low speed 40km/h winding road to slow traffic. There are two permanent creeks running through the area.

**Assessment location 8** - This area is essential cassowary habitat. Moore mapped this area as High.

#### **4.1.1 Habitat Assessment Summary**

The updating of cassowary habitat by reference to the latest flora survey, cassowary surveys and to water availability produced only one difference to the mapping from Moore in Volume I of the SEIS Cassowary Assessment. That was with location 4 which is the Flying Fish Point Reserve. Moore introduced a further grading into his assessment over that of the Southern Cassowary Recovery Plan in adding a moderate quality. The Recovery plan only lists vegetation as Essential, Rehabilitating and General. In this area due to the extensive wind damage it could be argued that the area should be classified as Rehabilitating however the degree of cassowary usage would infer that the area is essential habitat. This raises the question of whether the usage is natural or human induced through post cyclone feeding stations and hand feeding.

#### **4.2 Habitat Risk**

Moore applied a risk factor to the “risk of accessing the habitat”. Moore’s assessment was based on professional experience of the impact of dogs and traffic. In this Areas 3, 4, 5, 6 and 8 were mapped as negative value habitat for the Southern Cassowary. According to this risk assessment, there is currently a high probability of death or injury to cassowaries accessing these areas from dog attack and car strike due to the unfenced road.

In Table 4.1 the history of known cassowary mortality in this area has been added to Moore’s assessment. Two of these deaths postdate Moore’s analysis, confirming his original experience based assessment.

The known cassowary deaths are:

- Ella Bay Road 28/10/2002 Chick - 100mtrs South of Ella Bay NP sign – hit by car (QPWS unpublished)
- Flying Fish Point Road 23/03/2006 Adult – likely hit by car (QPWS unpublished)
- Little Cove Development - 24/12/2011 Male Adult – dogs (pers. obs)
- Flying Fish Point 2007 - Female Adult – dogs (Moore Feb 2009 survey)

Area code	Location	Moore Risk Factor	Known Cassowary death	Vegetation category/habitat value
1	Ella Bay National Park	1.0		A
2	Heath Point	0.5		C
3	Beach front	0.1		D
4	Flying Fish Point Reserve	0.1	Car	D (B)*
5	Southern EB Road verge	0.1		D
6	South Seymour Range	0.1	Dog	D
7	Flying Fish Point west swamp	0.5	Car	C
8	Northern EB Road verge	0.1	Dog	D

**Figure 4.1 Habitat values as a function habitat quality and risk from Moore Working paper 3 (collated in 6.1L)**

**\*Note High risk habitat in area code 4 will be mitigated to Category B**

Moore's risk assessment has been taken as appropriate and confirmed in this update. When applied to the update habitat quality parameter only changed the habitat value of Flying Fish Point Reserve from 0.2 to 0.3 which correlates with category D – negative habitat.

Although categorised as negative value habitat, the Flying Fish Point Reserve remains important to the continued presence of cassowaries in this south-east section of Seymour Range. Although the streams between Flying Fish point and Heath Point flowing to the Reserve are ephemeral, the Reserve provides both food and water resources for cassowaries for most of the year.

As such, measures to reduce the level of risk to cassowaries using the reserve, such as the fence and funnel strategy, will effectively increase the habitat value of Flying Fish Point Reserve and the adjoining sections of the Ella Bay Road from the current negative value habitat to moderate value habitat.

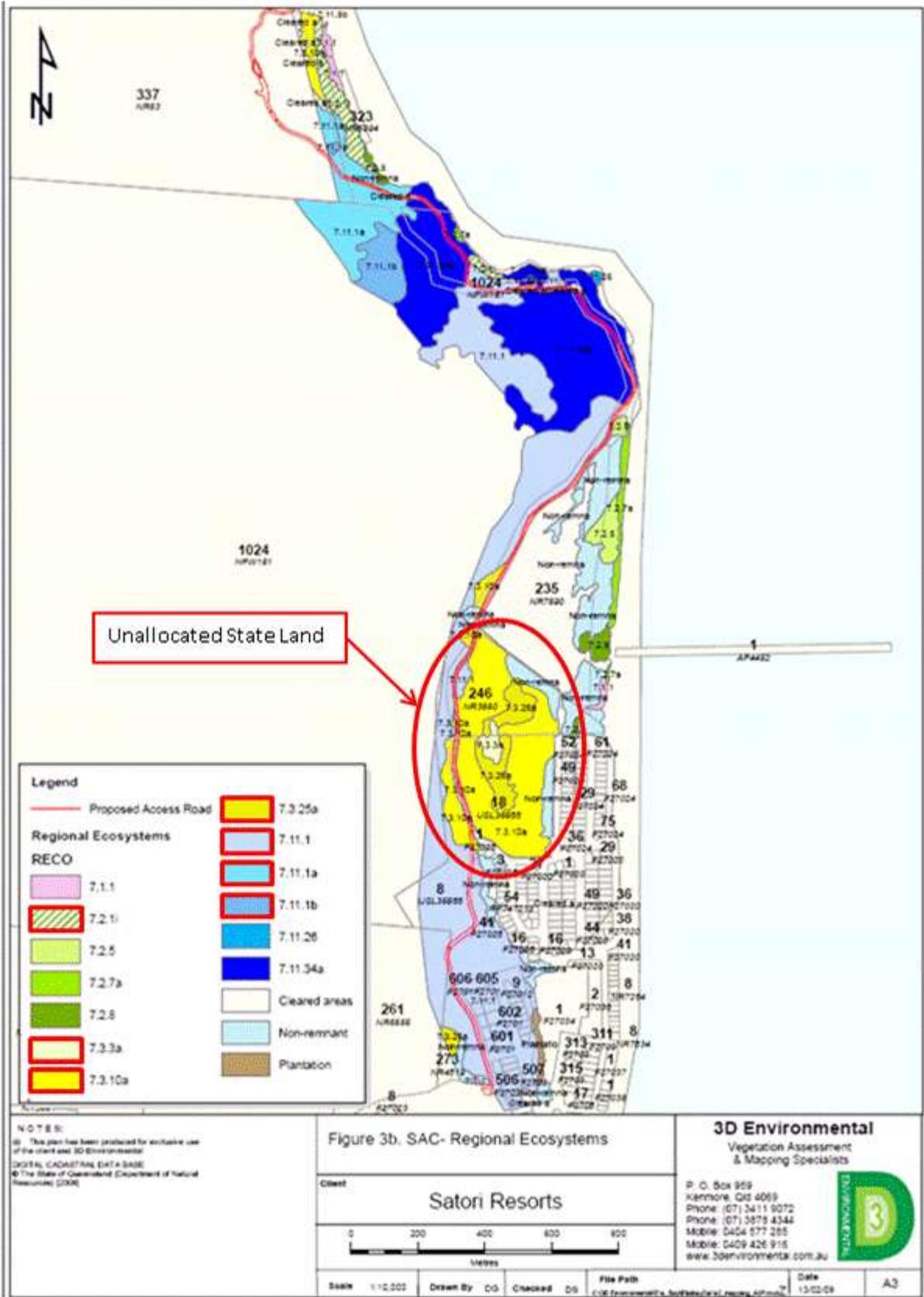
*“Along the access road a fauna crossing opposite the reserve is to be constructed as a raised bridge that cassowaries can cross beneath. The road can then be fenced both sides and birds can be funnelled into it - we would only need the one road crossing point. This mitigation strategy would remove ALL the current risk for road crossing birds at the reserve, and raise the reserve's habitat value significantly.”*

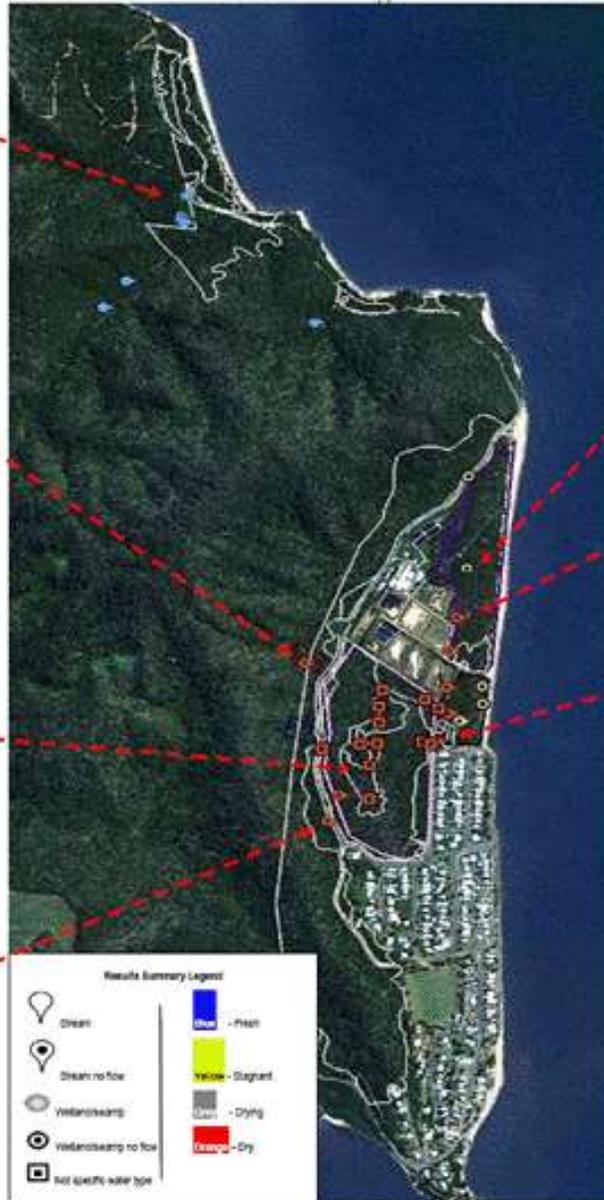
*L.Moore pers.comms email 9.10.2007*

Moore reference	Location on Ella Bay Road	Water dry season	RE	RE vegetation description	VMA	RE <sup>1</sup> cassowary habitat	Moore Assessment			Assessment
							habitat Quality	Habitat Value	Value	
1	Ella Bay NP	Perm	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not Of Concern	Essential	High	3.0	High	Essential
		No	7.11.34	Complex of shrubland, low heathy or shrubby woodlands	Of Concern	General				
		Perm	7.2.1	Mesophyll vine forest	Endang ered	Essential				
2	Heath Point	Perm	7.11.34	Complex of shrubland, low heathy or shrubby woodlands	Of Concern	General	Low	0.5	Low	Other
3	Beach Front	No	Non Rem		Non Rem	Other	Low	0.1	Neg.	Other
		No	7.2.5	<i>Lophostemon suaveolens</i> (swamp mahogany) open forest	Of Concern	General				
		No	7.2.7a	Coastal foredune complex with <i>Casuarina equisetifolia</i>	Of Concern	General				
		No	7.2.8	<i>Melaleuca leucadendra</i> (weeping tea tree) open forest	Of Concern	General				
4	Flying Fish Point Reserve	No	7.3.3a	Mesophyll vine forest with <i>Archontophoenix alexandrae</i>	Of Concern	Essential	Mod.	0.2	Neg.	Essential
		No	7.3.10a	Simple to complex Mesophyll to novotphyl	Of Concern	Essential				
		No	7.3.25a	<i>Melaleuca leucadendra</i> open forest and woodland.	Of Concern	Essential				
5	South'n EB Road verge	No	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not Of Concern	Essential	High	0.3	Neg.	Essential
		No	7.3.10a	Simple to complex Mesophyll to novotphyl	Of Concern	Essential				
6	South Seymour Range	No*	7.11.1	Simple-complex mesophyll to notophyll vine forest	Not of Concern	Essential	Low	0.1	Neg.	General
7	Flying Fish Point west swamp	Perm*	7.1.1	Mangrove low closed forest to open shrubland	Not of Concern	General	Low	0.5	Low	General
8	Northern EB Road verge	Perm	7.11.1a	Mesophyll vine forest	Not of Concern	Essential	High	0.3	Neg.	Essential
			7.2.1	Mesophyll vine forest	Endang ered	Essential				

**Table 4.1 Updated Cassowary habitat assessment of Ella Bay Road.**

<sup>1</sup> The habitat type has been matched to the RE from 2008 Flora survey (6.2a)





Flying Fish Point and Surrounding Areas			
Survey Area	Area Colour	Description	Summary
7	Blue	Beach fore dune adjacent fish farm.	Dry creek beds to south of area and some stagnant salt water ponds to north closer to road.
6	Black	Beach fore dune adjacent fish farm.	Dry or drying creek beds. Closer to beach stagnant water wetlands/swamp.
9	Grey	Flying Fish Point Reserve	All locations were dry including drains, creek beds and possible streams. No water found.
10	Yellow	Creek into reserve	Dry creek bed. No water.
11	Blue	Creek into reserve	Dry drain into reserve. No Water.
12	Green	Creek (Cassowary Ck)	Freshwater flowing stream.
13	xx	Additional Areas	Frog Creek, freshwater flowing stream.

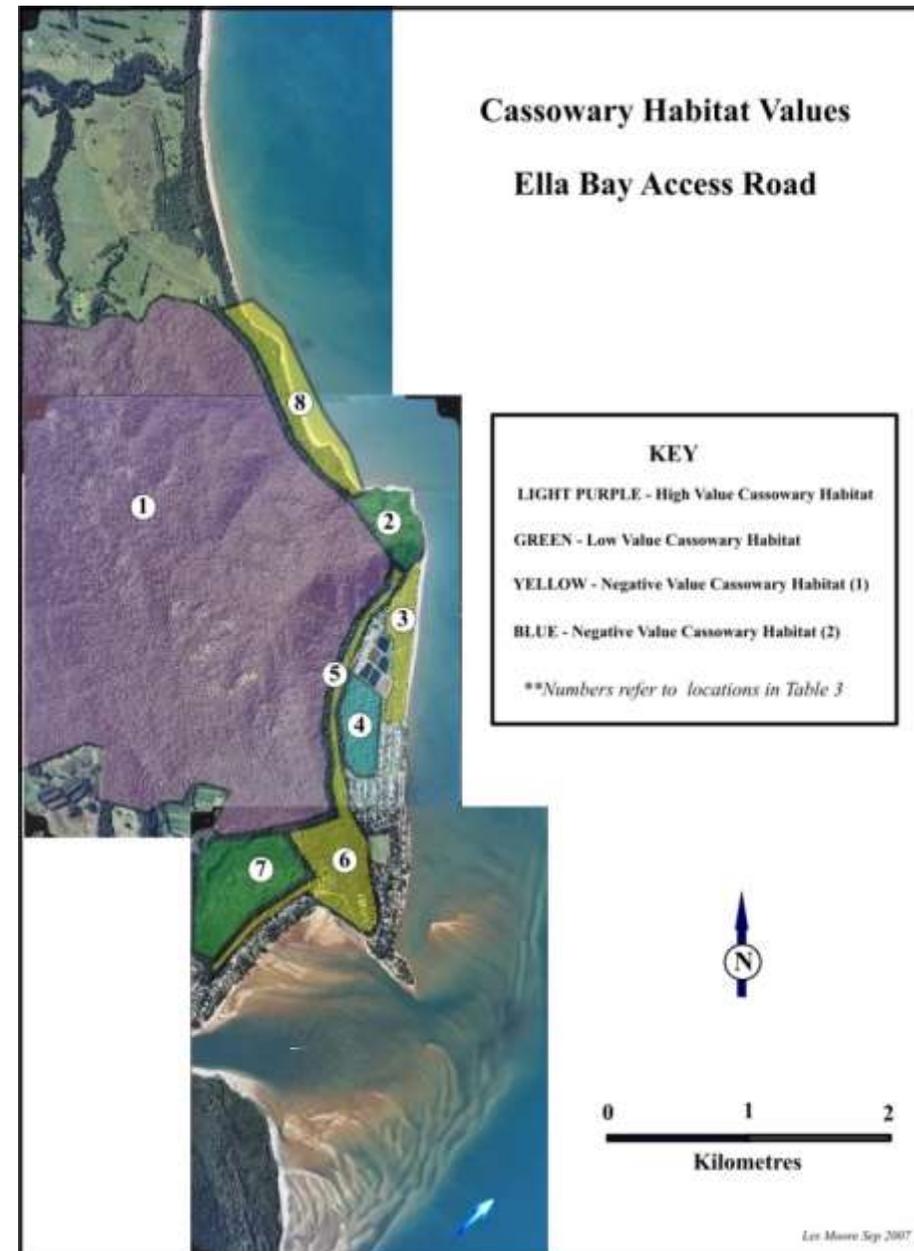
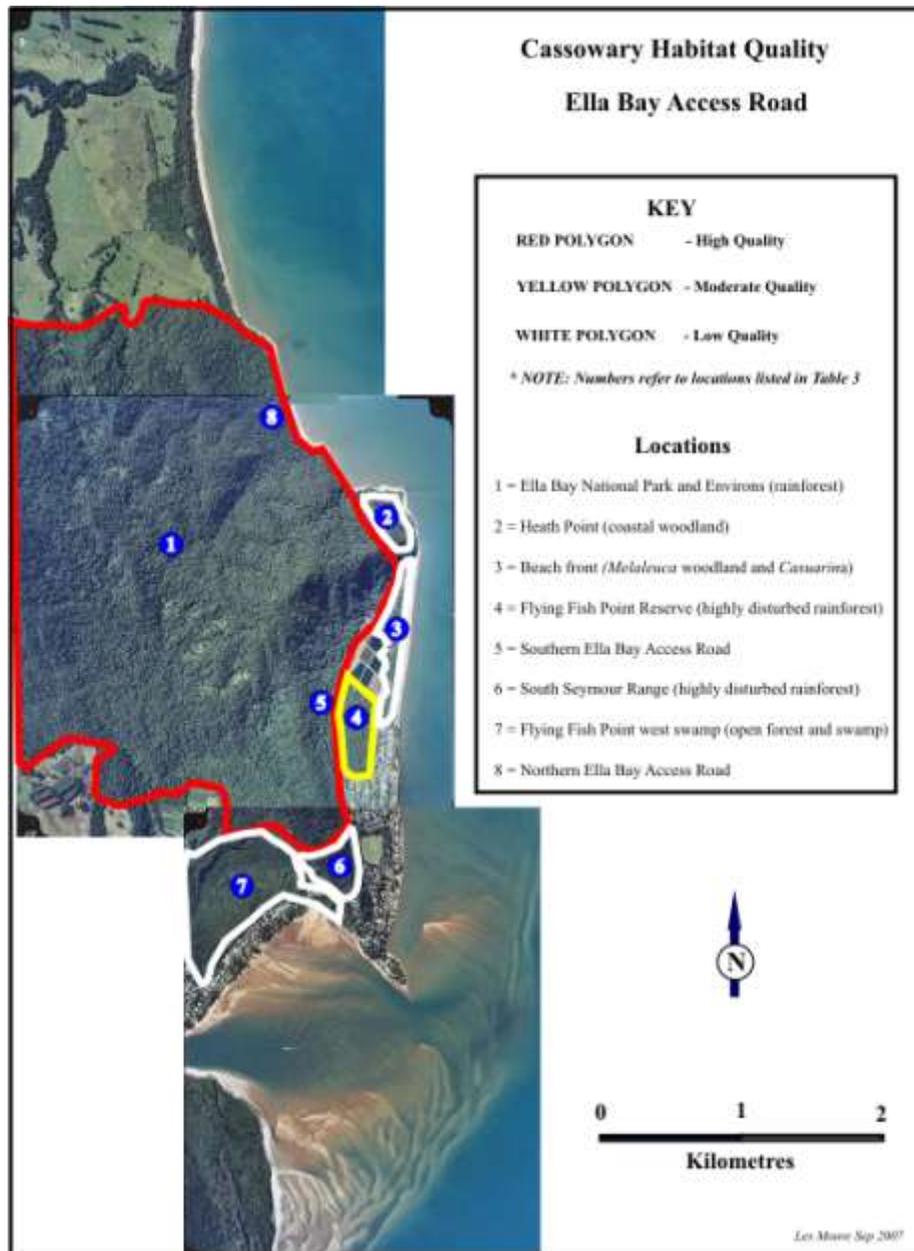


Figure 4.2 Cassowary Habitat Quality and Values from Moore SEIS Working paper 3 (Collated in Volume Six 6.1L)

## 5. Summary of Ella Bay Development Cassowary Mitigation Measures

The primary objective of cassowary mitigation strategies of Ella Bay Development is to facilitate the continuation of normal cassowary behaviour while minimising the possibility of adverse contact between cassowaries and humans.

The mitigation strategies are an integral component of the Ella Bay Development and have been developed to protect both the cassowaries known to use the area, as well as to achieve a net benefit for the population as a whole. The goal is for cassowary numbers, carrying capacity and resistance to cyclonic disturbance to improve, locally and regionally.

The Masterplan has incorporated ecological sensitive design and focussed on retaining the existing vegetation and fauna access and corridors. Mitigation of potential direct and indirect impacts of pre-construction, construction and operational phases of the development have also been considered.

Potential impacts on the cassowary from the proposed resort development will be managed through the implementation of the Southern Cassowary Management Sub-Plan. This plan details a comprehensive program of management actions to be implemented over the life of the development.

An important element of the Sub-plan is a scientifically designed and conducted cassowary population monitoring program. This monitoring program will allow the identification of negative (or positive) cassowary population trends, the likely causal factors and the implementation of contingency plans in the event performance criteria are not met.

### 5.1 Masterplan Design

The proposed mitigation has been further improved through revisions to the Masterplan over that of the SEIS. The major improvements have been:

- An increase in covenanted area and setbacks and widening of fauna corridor;
- A reduction in area of the precincts;
- The inclusion of a cassowary research area;
- An increase in the number of bridge overpasses for unimpeded cassowary movement to improve connectivity;
- No dogs (except for guide or assistance dogs) and cats policy; and
- Revegetation staging brought forward

#### 5.1.1 Fauna Corridors and Cassowary Access

The proposed conservation zones, fauna corridors and fauna underpasses will maintain unimpeded cassowary movement access around the Ella Bay development. The area of access will consist of the fauna corridors and the extensive open space formed by the golf course fairways. The golf fairways will be landscaped with endemic trees and provide the equivalent of general habitat for the cassowaries with some food source. The conservation zones and open space cover all of the cassowary evidence from the five surveys with the exception of 2ha comprising:

- Clearing of 0.70ha Essential habitat,
- Clearing of 0.25ha General habitat; and
- Isolation of 1.07ha General habitat (central resort).

Cassowary movement corridors around the site will be unimpeded pre-development to post-development. The total area of the conservation covenant and open space is 336 ha of the 470ha.



Figure 5.1 Ella Bay Conservation Zones totalling 276.8ha of which 62.8ha will comprise part of the Offset package.



Figure 5.2 Cassowary accessible areas (green shading) totalling 336ha out of a 470ha with movement corridors. The white outline is the edge of the conservation zoned areas.

The vegetation within the property has been mapped as either essential habitat, general habitat or rehabilitating habitat for the Southern Cassowary. The distribution of each of the habitat types within the Ella Bay Development site is mapped in Figure 3.4.

▪ Essential	176ha
▪ General/Other	20ha
▪ Rehabilitating (non-remnant)	33ha

This cassowary habitat will be maintained, protected and increased.

Revegetation of an additional area totalling 50ha will provide a substantial increase in habitat; of this revegetation 45ha will be high quality cassowary fruiting habitat which will significantly increase Essential habitat and 5ha will be non-fruiting habitat which will become General habitat. Non-fruiting revegetation will be used to the east of the main north/south creek so that cassowaries will not be enticed to the resort areas.

Rehabilitation totalling 64ha will change weed infested non-remnant habitat of which approximately half is mapped currently as rehabilitating habitat into essential or general habitat.

The future habitat designation after completion of the development and maturity of the vegetation will be:

▪ Essential	238ha
▪ General	39ha
▪ Cleared/isolated	2ha

All of the Essential and General habitat above will be protected under conservation zoning (refer to Figure 5.1) which accounts for nearly all of the surveyed cassowary signs. The area accessible to cassowaries will also include the landscaped golf course open areas will increase the accessible area by a further 61ha to a total of 336ha of the 470ha available.

The existing riparian zone ranges in width from 30 to 50m wide for the majority with some areas up to 100m wide. The planned north/south and east/west cassowary corridors will increase all the riparian vegetation in the main corridors to at least 100m wide. A number of additional corridors radiate between the main corridors and the perimeter vegetation and will maintain the current movement patterns.

Both the main north/south and east/west corridors have been cleared previously and are regrowth vegetation. The vegetation has been damaged by two category five cyclones in the past 5 years and while there has been some crown destruction, defoliation and subsequent weed infestation the vegetation has survived and is thickening. The high unnatural number of wallabies has however stopped natural recruitment in most riparian zones, with only non-palatable species or species that are growing on steep banks or protected areas able to recruit.

Revegetation along the border of the riparian zone and the exclusion of wallabies will strengthen the zone and also provide edge closure; an important factor in decreasing wind related damage and improving the ecological habitat within the riparian zone.

The Proponent's revegetation trials

- Have focussed on selection of endemic species that are cassowary fruiting, cyclone tolerant, and with selected species to provide edge closure.
- The trials have shown that natural recruitment has extensively increased the number of species even within the short period of 18 months.
- Cassowary feeding from early fruit producing trees within 18 months of planting.

The selection of vegetation species chosen to resist wind damage – “Learning from Larry” will provide the future revegetation to be more cyclone resistant.

The argument that 100m width is satisfactory for a cassowary corridor is;

- That there are many movement pathways which intersect the creeks not just the main corridors and cassowaries currently use these corridors;
- That the regrowth vegetation has survived a number of cyclones in the past 5 years; and

- That the revegetation will focus on cyclone resistant tree species and edge closure to grow a more cyclone tolerant corridor.

A Revegetation and Rehabilitation Management Sub-plan will be prepared based on the species and learnings of the revegetation trial. This plan will include locations, species, numbers, site preparations, and timing of activities. This plan will identify management actions (such as revegetation, appropriate species, weeding and fencing), performance criteria, responsibilities and costs needed to effectively restore and manage cassowary habitat on site.

### 5.1.2 Permanent Cassowary Water Sources

Cassowaries require access to water several times daily for drinking and bathing and permanent water is an important consideration

There will be no hydrological impact on the existing water sources from the development and the storm water flows have been designed close to the predevelopment flows maintaining the existing water sources for the cassowary (refer to 6.4c & 6.4d). There will be extensive increase in the area of permanent water from the constructed wetlands. The constructed wetlands require both ephemeral and permanent wetland areas for the macrophytic plants.

The majority of the constructed wetlands will be proximal or within the fauna corridor and discharge into the creeks.

### 5.1.3 Ella Bay Development Precinct Fencing

The Ella Bay Development will lead to a significant increase in internal traffic flows within the property compared to the near non-existent current traffic flow. The threat is to traffic interaction and mortality of cassowaries, common Mistfrog and other fauna.

The transport strategy at Ella Bay is to:

- Minimise the risk of interaction by separating the cassowaries from the roads and vehicles;
- Reduce the use of internal private motorcar trips by encouraging electric buggies, bicycles, shuttle buses and walking;
- Enforced 40km/h speed limits for all vehicles within the precincts; and
- 20km/h for any unfenced gated crossings.

To mitigate against the interaction all the roads within the precincts will be fenced and the precincts will be linked by bridges or low speed gated crossings linking. The precincts will be perimeter fenced to prevent interaction between cassowaries and humans, and unrestricted human access into conservation areas. The roadways will be included within the precinct fencing to eliminate cassowary road trauma. The creeks will be crossed by elevated bridges (cassowary underpasses) to provide fauna habitat connectivity throughout the site to all Open Space/Recreation and Conservation areas. All the main internal roads servicing the resorts will have elevated bridges/underpasses. Only four secondary internal roads with low volume, controlled low speed 20km/h traffic will have unfenced gated crossings of the open space or fauna corridor. The longest of these gated crossing will be 100m across the northern section of the north/south fauna corridor in the northern residential precinct. The speed will be controlled by traffic calming; signage and raised speed platforms.

The fence will be 1.2m dark-coloured powder-coated aluminium pool fencing, which will provide a physical barrier but not an impassable barrier to a cassowary. Unlike the Ella bay Road fence if the precinct fence is breached there is not a risk of imminent cassowary mortality. The fence will only be screened or vegetated in strategic locations and the outside of the fence will have enough clearance for inspection and maintenance of the fence.

Management of the gate system and resident spillage and illegal access into the external area will be managed by the design of fence boundaries so staff and the community can monitor boundaries (McWilliam, et al., (2010).

Positive aspects of this strategy are as follows:

- Significantly increased habitat after revegetation from current use as cattle property;
- High risk areas of cassowary/people interaction are reduced and or eliminated;
- Fencing will not impede the movement of small fauna (using open cassowary specific fencing);
- The current movement corridor along the beachfront is maintained;
- The east/west movement corridor to the beach along the creek is maintained and improved;
- Cassowaries can use vast majority of the site with no “funnelling effect”
- No dead end potential predator traps; and
- Native cassowary fruit trees can be planted in the open space areas including the golf course.

The fence will not have cassowary escape gates installed. The fence will have an open visual appearance and it will be difficult to discriminate a visual window to identify the gate and it is considered that this will make the success of the escape gate less likely. This situation will be monitored to determine if cassowaries are breaching the fence or entrances. The areas that will be closely monitored will be the higher risk areas where frequent interactions between cassowaries and people would otherwise occur have been identified as the Ella Bay Village Precinct and the Ella Bay Welcome Centre area, and the road crossings. Manual gates will be located close to the entrances and the road crossings such that if a cassowary should breach the entrance, the gates can be opened and funnel the cassowary out.

#### **5.1.4 Internal Traffic, Pathways and Tracks**

There will be extensive areas of open space and conservation covenant to allow free fauna movement (illustrated by the red arrows in Figure 5.2) to all areas of the site external to the fenced precincts.

There will be an extensive network of pedestrian and bicycle pathways throughout the precincts and open space.

- The pedestrian/bicycle pathways will be along the edge of 100m wide main fauna corridors (conservation Zone C).
- Pedestrian walkways through or crossing the main cassowary corridors will be elevated above the forest floor to separate cassowaries and people, and to provide unhindered cassowary use of the creek and associated vegetation;
- The pedestrian walkways will be strategically located to minimise any disturbance to the normal behaviour of the cassowary(s);
- The pedestrian ‘walkovers’ may serve as a focal point for ecological interpretation, particularly that of the endangered cassowary;
- Bicycle and buggy pathways crossing the creeks and the main cassowary corridors will have at least 30m of elevated section for cassowary movement under the structure, the pathways leading to the bridge will not be fenced or prevent cassowary access across them;
- Nature walkways, predominately boardwalks will provide access for ecological interpretation through Zone C,

The precinct fence will be gated for access to the open space pathway system for walking, bicycle and buggies. Walking and bicycle only gates will be manually opened and closed. These gates will have pool childproof locks to prevent underage children from accessing the open space. Some of these may be fitted with pass operated locks for security. Buggy gates will be managed similarly to the road crossing gates with automatic opening/closing for high use areas and manually controlled for low use. At all gates cassowary warning and behaviour signage will be displayed.

## 5.2 Summary of Ella Bay Road Fauna Mitigation Measures

The design, specification, mitigation measures, and environmental management are detailed in Volume Four *Ella Bay Road Design and Environmental Management Report* of this submission. Ella Bay Road will be constructed in two stages with Stage 1 utilising the existing road alignment from Flying Fish Point to Ella Bay and Stage 2 bypassing Flying Fish Point.

To minimise the environmental impact of Ella Bay Road; the goal is to restrict the traffic speed to a level which:

- Minimises the risk of fauna mortality;
- Minimises the clearing envelope; and
- Allows the visitor to appreciate the road and views

The cassowary mitigation measures at Ella Bay have been prepared from an integrated approach and have looked at the whole road, known cassowary crossing points and behaviour. (Refer to Volume Four Chapters 5 & 8) The integrated approach has focussed on:

- Excluding cassowaries from the road;
- Excluding cassowary visibility of the roadside;
- Providing a safe crossing with attractant vegetation;
- Providing an escape mechanism if the cassowary accesses the road; and
- Slowing the traffic in case of a cassowary on the road.

The road will use a fence and funnel mitigation to exclude cassowaries from accessing the road for the majority of its length and underpasses to allow access to the habitat on the east of the road. The proposed bypass and fauna overpass through the narrow southern extension of the Seymour Range will ensure connectivity to the lower end of range.

The fence will be 1.8m high shade cloth directing the cassowaries to fauna underpasses and an overpass located at known crossing points. In other locations the steep natural terrain or embankment heights will provide additional exclusion. The fence will include a one-way escape gate to minimise the risk of cassowaries being trapped in the road reserve.

Ella Bay Road will be a low speed environment (60km/h) and to ensure effective speed control; fixed and psychological calming will be used to increase driver awareness. The 1.5m wide road shoulder is designed for use as a bikeway and will be delineated to provide a bicycle lane on both sides. Extensive traffic calming comprising delineated roadside shoulders, cassowary signage, transverse line markings, chicanes and raised speed platforms will be used to reduce the operational speed. Additionally pull off lanes will be included in the design to enable parking while servicing and monitoring mitigation features. The bike lane and traffic calming will be used to support the “change of focus” as people enter the Ella Bay area.

The following mitigation measures will be included in the road design:

- Fauna Underpasses – 3: Bridge 1 CH 0440; Bridge 2 CH 3000; Bridge 3 CH 3250.
- Fauna Overpass (Stage 2) – 1: Tunnel CH 0500.
- Small Fauna Underpasses with furniture – 4: Culvert 3 CH 0635, Culvert 15 CH 2170, Culvert 16 CH 2400, Culvert 20 CH 3123
- Cassowary Fencing will be installed at the following locations:

Stage 1	Western side of road Length m	Eastern Side of Road Length m
Unfenced Flying Fish Point roads NB. chainage starts at Ruby St.	120m	150m
Cassowary Fence	2290m	955m
Seahaven Prawn Farm Fence		690m
Bridge fencing	205m	205m
Too Steep/Retaining Wall	1385m	1960m
Total	40000m	4000m

Stage 2	Western side of road Length m	Eastern Side of Road Length m
Unfenced Bay Rd roundabout	35m	35m
Cassowary Fence	525m	190m
Noise Attenuation Fence		100m
Tunnel	125m	120m
Too Steep/Retaining Wall	195m	435m
Total	880m	880m

- Cassowary Escape Gates (Stage 1) - 19 gates; (Stage 2) – 6 gates
- Frog Fence - 25m either side of the following; Bridges 1, 2, 3. Culvert 3, 15, 16, and 20
- Pipe culverts replaced by box culverts – 19 places.

Les Moore (Pers. Comm.) in response to the submission response regarding the road mitigation and possible mortality replied

*“The potential loss of cassowaries due to road death on the Ella Bay access road while also not a certainty, is a possible outcome, and as such has been addressed by the development, implementation, and monitoring of effective mitigation. The mitigation strategy for the Ella Bay access road aims to reduce or remove the risk of any collision between cassowaries with cars. Intensive monitoring and inspection programs detailed in the CAS-EMP (Southern Cassowary Management Sub-Plan) allow for corrective actions to be taken in the event that mitigation does not meet performance criteria i.e., no cassowary road death. Currently there are no mitigation strategies for the existing road and cassowary death have occurred at the cassowary road crossing just before the FLYING FISH POINT Township.”*

To protect essential habitat; mature trees have been protected where possible to provide canopy shading with over 20 trees requiring guard rail protection because of their proximity to the road. To achieve this level of tree retention the road alignment has been modified to specifically avoid the trees and road safety mitigation added where the alignment has remained too close to the tree.

Revegetation will take place as each stage or partial stage of works is completed. A detailed plant species selection for revegetation has been undertaken. This was based on selecting endemic non-cassowary food plant species that suit the criteria for the roadside vegetation; blend with the surrounding vegetation and complement the natural surroundings; and seal the edge of the forest to reduce the potential of edge effects. Plant selection will also be required to meet road safety criteria where the species do not inhibit sight distances and are frangible.

The road cross-section has been designed with a 3% one-way fall towards the east so that upstream flows emanating from heavily vegetated rainforest will be able to bypass contamination from road runoff by transport in table drains to culverts on the western side of the road. On the eastern side, the road runoff will be treated for gross and fine particulates removal with sensitive areas incorporating bioretention swales for treating soluble toxins from first flush road runoff.

### 5.2.1 Ella Bay Road Fencing

Ella Bay Development will increase the traffic volumes along Ella Bay Road and increase the potential road mortality threat to the cassowary. The cassowary population along Ella Bay Road to Little Cove property has been surveyed over different seasonal conditions and has remained stable at 2 or 3 adult cassowaries with one sub-adult or chick (Vol 6.1e). As a result extensive mitigation has been incorporated to minimise the impact.

The mitigation will comprise three cassowary underpasses and one overpass. The roadside will be fenced to funnel the cassowaries to the underpass/overpass. (Refer to Volume Four: *Road Design and Environmental Management Report*).

The fence will be a 1.8m high neutral coloured (dark grey/black/green) shade cloth to provide a visual and a softer resilient barrier that will not damage the birds.

The fence alignment will run 3m to 12m within the vegetation parallel to the road alignment, to minimise visibility from the road. The fence will be installed to follow the natural contours to reduce the risk of erosion and visual impact and will be constructed predominately with only hand pruning of native flora. No significant or EVR species will be cleared. The impact of the fence installation and maintenance will be from localised hand clearing and the potential for weed incursion. Weeds will be cleared around the path and surrounding area. The fence alignment will be made to fit and go around mature vegetation with the fence weaving between trees. The disturbance width will be minimised and where possible kept less than 1m wide. (Refer to Volume 6.1j *Report on Cassowary Exclusion Fence Trials*; Volume 6.1i *Report on Cassowary Escape Gate Trials*; Volume 6.1k *Cassowary Fencing Strategy*).

The fence will not be installed where:

- The road edge and surrounding slopes are steeper than 1:1 or where the embankment is vertically greater than 1.5m e.g. gabions walls.
- Other barriers such as guard rails and noise fences provide an exclusion function where the above conditions are met.

In the event of significant cyclone risk, the fence will be pulled to the ground and tied with cable ties to keep it rolled up and safe from damage. The fence will only be pulled down immediately prior, and during cyclonic weather events.

Additional traffic management procedures will be required to minimise the risk of cassowary vehicle strike while the fence is down; temporary warning signs will be used identifying that the fence has been dropped and the vehicle speed limit reduced to 40km/hr.

The Proponent and there after the body corporate will retain responsibility for maintenance and monitoring of Ella Bay Road fauna and flora mitigation measures as outlined in the Corridor Management Plan (Refer Volume Four Chapter 12).

### 5.3 Mitigation during Preconstruction, Construction and Operations

Potential impacts on the cassowary from the construction and operation of the Ella Bay Development and access road are discussed below and are also outlined in further detail in the Southern Cassowary Environmental Management Sub-Plan (Volume Three). In particular, the Sub-Plan details the necessary management actions, performance criteria, timeframes, reporting requirements and costs associated with effective cassowary management on site.

The objective of the mitigation is:

- To avoid injury to cassowaries or damage to cassowary habitat as a result of EBD activities; and
- To maintain the normal foraging and breeding behaviour of the cassowary during the construction of the Ella Bay Development (EBD) and Ella Bay road.

The proposed mitigation will reduce the impact of increased human population from Ella Bay Development on the World Heritage values, making these threats relatively small and the development will not have a significant impact on the Southern Cassowary.

In all stages of the development, a strong emphasis will be on education of the workforce, contractors, residents and guests through inductions and the Welcome Centre of the significance of the cassowary, and measures to prevent or discourage inappropriate interactions.

### 5.3.1 Pre-construction/design phase

The pre-construction phase of Ella Bay Development includes the planning and staging of construction plus site based activities including inspections, surveying, revegetation, and ongoing of weed and feral animal control. The potential impacts on the Southern Cassowary include habitat degradation and loss of connectivity.

The mitigation strategy will be to ensure that the planning and staging of construction related activities will recognise all the surveyed cassowary movement areas, water sources and ensure that there is minimal impact to cassowary connectivity, habitat, foraging and behaviour through:

- Identify in the planning information, survey, protect and prohibit access for humans and machinery to cassowary movement corridors, habitat and water sources;
- Ensure the staging of road construction will maximise connectivity for cassowaries;
- That any disturbance is located:
  - away from cassowary movement corridors and water sources
  - within cleared areas or areas of previously disturbed vegetation;
  - proximal to construction areas; and
  - to avoid vehicles moving across vegetated corridors.
- Cassowary habitat revegetation staging will utilise the learnings from the revegetation trials (Volume Six 6.2f);
- Weed control will adhere to the Weed Management Sub-Plan (Volume Three);
- That site based revegetation, weed and feral animal control which may impact on habitat connectivity, and behaviour
- No dog policy on site (except for guide and assistance dogs) and removal of any feral dogs; and
- Feral pig control will continue using the Feral Pig Control Report (Volume Six 6.3d) in the interim and the Pest & Wallaby Management Sub-plan will be prepared.

### 5.3.2 Construction phase

The construction phase has the potential to create a range of impacts on the cassowary including additional habitat loss, habitat degradation, loss of connectivity, increased risk of road deaths and an increased risk of negative human interactions. The nature of each of these potential impacts is outlined below.

#### 5.3.2.1 Habitat loss

Construction of the proposed development will lead to a total loss of 3.55 ha of remnant vegetation. This includes 1.11 ha of vegetation loss within the Ella Bay property and 2.44 ha of vegetation loss along the access road.

The vegetation loss within the Ella Bay property comprises:

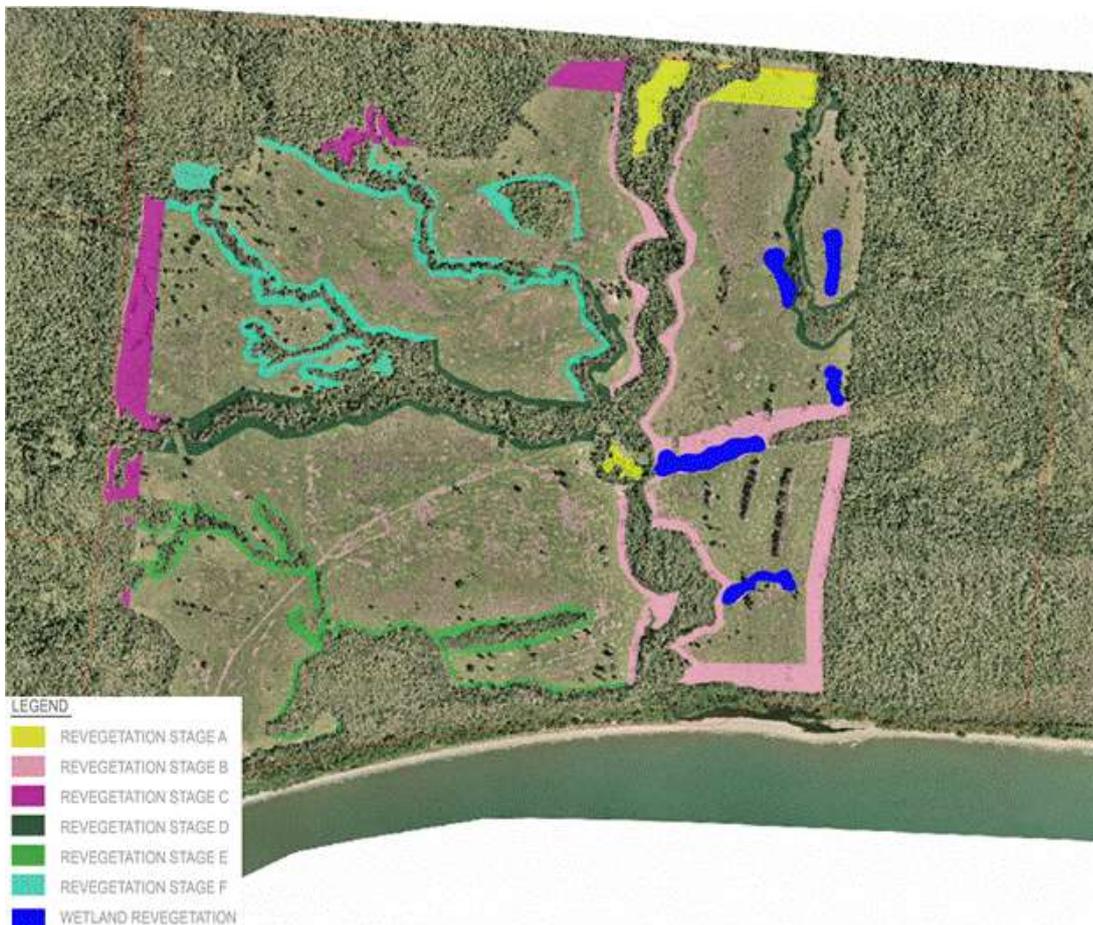
- Clearing of 0.70ha of Essential habitat;
- Clearing of 0.25ha of General habitat; and
- Isolation of 1.07ha of General habitat.

During the construction phase of Ella Bay Development the net essential cassowary habitat will increase prior to clearing or isolation. The revegetation trial (Volume Six 6.2f) has shown that natural recruitment and cassowary use is initiated within the first two years and it is expected that a meaningful contribution to habitat will occur within the first four years with habitat maturing and fruiting of most species within seven years. The construction and revegetation staging have

been sequenced such that there will be approximately 20ha of revegetation of essential habitat greater than four years old prior to clearing greater than 0.5ha. (refer to Figure 5.3)

The strip of coastal vegetation along the eastern boundary (locations 3, 1b and 4 shown in Figure 3.4) will be rehabilitated and the pond apple removed and replaced with non-cassowary fruiting species. The pond apple removal will be undertaken early in the construction staging prior to fruit production of the revegetation. This will lead to a reduction in the available food supply during January to April of the pond apple fruiting period. This area was only utilised by one cassowary during the surveys with similar use during pond apple fruiting period (April 2010) as to the November surveys, indicating that the pond apple was not such a key contributor to diet. The impact to the cassowaries will be minor, less than that of an intense wet season where the cassowary would move to the higher extent of its home range and not feed in the area.

This habitat loss will create a temporary net loss of cassowary habitat and the revegetation staging has been based on minimising the net impact. The Revegetation and Rehabilitation Management Sub-plan will identify the areas, management actions (such as revegetation, appropriate species, weeding and fencing), timeframes, performance criteria, and responsibilities needed to effectively restore and manage cassowary habitat on site.



**Figure 5.3 Revegetation staging plan**

Construction of Ella Bay Road (stage 1) will be on the critical path for construction and will be initiated near the start of the project prior to maturity of any compensating revegetation. The clearing required will comprise vegetation that is listed as essential cassowary habitat and additionally there will be essential habitat that will be isolated by the cassowary fence. The cassowary fence along the road and the underpasses will isolate some essential cassowary habitat. Additionally any revegetation works within the fenced road alignment will exclude cassowary fruiting species to reduce the possibility of enticement on to the roadway.

### Stage 1 Flying Fish Point to Ella Bay

- Clearing Essential Cassowary Habitat 0.99 ha
- Isolation Essential Cassowary Habitat 0.31 ha
- Total Essential Habitat loss Stage 1 1.30 ha

Construction of Flying Fish Point bypass (Stage 2) will occur several years after stage 1 when revegetation at Ella Bay Development will contribute to a net benefit of habitat however the distance of the bypass from the revegetation will negate any benefit to the home range of cassowaries in the area. There will be approximately 0.5ha of revegetation of cassowary fruiting species after construction of the cut and cover tunnel.

### Stage 2 Bay Road to Ella Bay Road

- Clearing Essential Cassowary Habitat 1.48 ha
- Isolation Essential Cassowary Habitat 0.11 ha
- Total Essential Habitat loss Stage 2 1.59 ha

The total essential habitat loss from construction of the road will be 2.88ha.

### 5.3.2.2 Habitat degradation

Cassowary habitat can be degraded without damage to vegetation through disturbance that prevents the cassowary from using its full home range. The size of a home range is far greater than the magnitude of construction disturbance and disturbance to an edge can be accommodated by restriction of movement, however long term disturbance is likely to lead to increased stress and competition to defended home ranges. Disturbance can be accommodated for a short period and noise is reported as being habituated with cassowaries around Mission Beach (Moore pers. comm.). The objective is to minimise habitat degradation that affects cassowary habitat, movements, foraging, behaviour and maximise the cassowary carrying capacity. See also Volume Four *Ella Bay Road and Environmental Design Report* Chapters 10 and 11 which specifically address road construction management.

Construction activities have the potential to degrade cassowary habitat:

- Trespass creating edge effect of construction workers and equipment;
- Noise and dust disturbance may cause the birds to withdraw from adjacent forest;
- Weeds and pathogens may be introduced into adjoining cassowary habitat; and
- Nutrient runoff and water quality contamination may degrade adjoining cassowary habitat.

Mitigation measures that will be implemented to manage these potential impacts include:

- Clear designation of work areas, vehicle tracks and foot-access areas together with the use of barrier mesh and prohibition signage to prevent staff and contractors from trespass, and/or introduction of clothing borne weeds and soil pathogens;
- The use of dust suppression measures and road speed restrictions to minimise dust;
- The minimisation of vibration and noise, in particular that the machinery complies with construction noise limits specified under the Environment Protection Act;
- Minimising construction impact through the use of designated bunded Construction Management Compounds (refer to Volume Four Chapter 11) for vehicle parking, fuel and materials stores, stockpile areas and workers facilities, and the use of offsite shuttle parking for Ella Bay Road construction;
- Adhere to best practice procedures for the importation of materials (refer to Volume Four Chapter 10);
- Weed control will adhere to the Weed Management Sub-Plan (Volume Three) including washdown of all off-road vehicles; and
- An approved Erosion and Sediment Control Sub-plan will be implemented at all construction sites and relevant staff/subcontractors will be trained in erosion and sediment control techniques and infrastructure maintenance.

### 5.3.2.3 Loss of connectivity

Construction activities at the Ella Bay property and along Ella Bay Road have the potential to impact cassowary habitat connectivity or create barriers to traditional movement corridors. To minimise this, construction infrastructure and access tracks will be located to avoid creating barriers to cassowary movement along or between habitat corridors.

During construction of the internal roads of Ella Bay Development, bridges will be built to cross the cassowary corridors. The bridges will be located over existing creek crossings that have been previously cleared and are currently used for farm access. The bridges will have sufficient clearance for use as cassowary underpasses. The construction process while being ecologically sensitive will require the closing of the cassowary corridors for periods for cassowary safety during construction.

During construction of Ella Bay Road upgrade, areas of habitat will be temporarily isolated. A temporary construction fence will be installed along the road prior to construction and in particular during the construction of the three underpasses and the overpass to prevent possible cassowary vehicle/construction workforce interaction. Temporary fencing of the underpass near Flying Fish Point will isolate access of up to three cassowaries from approximately 10% of their habitat during one dry season. The two underpasses at Little Cove will isolate one cassowary from approximately 3% of its habitat during one dry season. It is neither feasible nor desirable to allow the cassowaries to pass and possibly be trapped on the coastal side of the road during the construction.

It was initially considered that cassowary corridors would be able to remain open using slow speed crossing, however the risk of mortality from vehicle/cassowary collision has resulted in recommending that the cassowary corridors

### 5.3.2.4 Increased traffic

There will be increased traffic flows within Ella Bay Development and along the Ella Bay access road during the construction phase of the project. Consequently, there is a greater risk of road trauma to cassowaries occupying adjacent or nearby habitat.

To manage this risk, a road traffic management strategy for the Ella Bay property and access road will be in place during the construction phase. Key requirements will include:

- Temporary cassowary exclusion fencing will be erected prior to start of each construction phase to exclude cassowaries from accessing construction sites (refer to Volume four Chapter 10 & 11, and to Volume Six 6.1k *Cassowary Fencing Strategy*);
- All vehicles to remain within the designated road alignment;
- For any cassowary habitat areas or road crossings that are unfenced;
  - a 20km speed limit will be enforced for all construction and non-construction vehicles including at road crossing points,
  - a traffic control program will be in place with specific road-based mitigation at known cassowary crossing points,
  - daily inspections of the status of cassowary crossing points will be carried out, looking at aspects such as fencing integrity and evidence of crossings, and
- A reporting system will be established for vehicle and workforce incidents with cassowaries.

### 5.3.2.5 Increased human activity

The increased level of human activity at the Ella Bay property and along the access road during the construction phase of the development increases the risk of negative human interactions with the Southern Cassowary. Inadequate litter disposal can attract the cassowaries to the site and there is the risk of habituation due to feeding.

To manage these risks, the following conditions will be in place:

- An induction course will be prepared on appropriate behaviour around cassowaries which all staff and subcontractors will have to attend;
- There will be no access by the workforce to the adjoining forest;
- A waste management strategy will be established to ensure the correct disposal of construction material such as wires, plastics or other 'attractive' items that may be ingested by cassowaries;
- Food consumption will only be permitted in designated areas and covered bins for the disposal of food scraps will be provided in these areas;
- Extended activities in or adjacent to known cassowary road crossing points and highly frequented habitat will be avoided;
- Temporary cassowary exclusion fencing (barrier mesh) will be erected prior to the start of each construction phase to dissuade birds from accessing construction sites,
- Protocol on appropriate methods for removing cassowaries from construction areas will be developed in conjunction with QPWS, and
- A nominated 'vet-on-call' will be contacted immediately to facilitate response.

### 5.3.3 Operational phase

The operational phase of Ella Bay will be the day to day living of established residents, resort guests and day visitors. The ongoing physical threats will be from transport through the development and along Ella Bay Road, grounds and golf course maintenance, tourist activities such as nature trails and recreational activities. The daily operations will provide different potential threats to the cassowaries and fauna with an increased risk of negative human interactions and habituation of the birds.

There will be an additional risk of the success of the cassowary mitigation measures including underpass use, fence integrity and habitat reinstatement.

#### 5.3.3.1 Education

One of the highest priorities will be of continual education on the significance of the cassowary within the Wet Tropics environment, and measures to prevent or discourage inappropriate interactions.

The Welcome Centre will be the first point of contact of all arrivals and every opportunity will be used to educate on the awareness of the significant surrounding ecosystems and the responsibilities of individuals within these sensitive environments. A key objective of the education process will be to provide comprehensive information on how to live safely with the cassowary. This is applicable whether people are just visiting for the day, staying on holiday, or living as a permanent resident within Ella Bay.

The education will comprise the Welcome Centre and associated community education program, signage, resort literature, regular newsletters and information sessions. The following measures will be adopted:

- Inductions will be compulsory for all workers, and residents, while resort guests and day guests will be provided with target specific education literature on appropriate behaviour around cassowaries and will include:
  - strictly enforced 'no feeding' policy and why this is so important;
  - education of the dangers of interaction;
  - appropriate behaviour within the precinct with regards to food, rubbish and 'attractive' items that may be ingested by cassowaries;
  - appropriate behaviour in cassowary habitat, specific responses and behaviour for golfers, walkers and cyclists in open spaces;
- Advisory signage on cassowary behaviour at open space entrance locations;
- Monitoring and location awareness through cassowary sighting reports;
- Adaptive management through reporting of cassowary incidents within the precincts and open space; and

- The development of guidelines on appropriate methods for removing cassowaries from construction, residential or resort areas.

The education will also focus on minimising edge effects causing habitat loss from inappropriate access to revegetation, beach dunal and forested areas.

### 5.3.3.2 Cassowary/human Interaction and Habituation

Management of the negative cassowary/human interactions and ensuring that cassowaries do not become habituated to humans will focus on education to discourage inappropriate human behaviour and minimising the opportunities for contact between humans and cassowaries.

The total revegetation and rehabilitation area will be greater than 110ha and will be an opportunity to subtly change the foraging habits of the cassowaries with the focus of encouraging cassowaries away from the dunal swale and resort areas. The tree species used in the coastal revegetation after the removal of pond apple will be non-fruiting species while the species used in revegetation of the areas to the west of the north south fauna corridor will be predominantly cassowary fruiting species. The western revegetation especially along the riparian strips of cassowary fruiting species will provide a significantly more abundant food source than the current degraded vegetation.

There will also be a significant increase in the availability of permanent water from the constructed wetlands to manage stormwater. The constructed wetlands will contain both ephemeral water and permanent water to sustain the vegetation mix necessary for nutrient removal. By nature of purpose the constructed wetlands will be located adjacent to the creeks and often within the fauna corridor. The provision of additional extensive permanent water will reduce the requirement for cassowaries to access the dunal swale.

The precincts will be fenced to exclude cassowaries from the developed areas. The Ella Bay body corporate will be responsible for regular monitoring of the integrity of the fence together with education and community participation.

In the event that a cassowary becomes habituated and a nuisance; the bird will require removal and relocation from the area. The large home range of a cassowary and the ability to move between neighbouring populated areas to Ella Bay may mean that habituation occurred remote from the development. Some of the Ella Bay cassowaries were reported to have been handled after cyclone Larry (Moore EIS collated in 6.1L) and habituated from cyclone feeding stations. Any handling or relocation will be conducted by QPWS.

### 5.3.3.3 Habitat Degradation and Edge Effect

During the operations phase the cassowary habitat will improve in quality, fruit abundance and area following the maturation of the revegetation, rehabilitation of weed infested areas and removal of the agricultural edge effects. New threats will arise through resort and residential population and intensity.

The major threats to potential habitat degradation are from;

- The introduction of exotic plant species or disease to adjoining habitat;
- Encroachment, dumping and littering by residents and guests; and
- Disturbance from increased human activity, noise levels and night lighting along streets and in residences.

The landscaping of public areas and open space will be planned and will be controlled by planting guides to not prevent the spread of exotic species. The public areas will be kept well maintained and free of invasive plants in particular focus will be on those species listed in Weeds of the Wet Tropics (WTMA).

The control of residential plant species will be through education and community engagement with the site nursery able to provide preferred species. The objective will be to educate the residents on how to address environmentally acceptable gardening in sensitive natural areas. A

list of prohibited and potentially invasive plants will be provided to all residents for yard and gardens as part of the ownership covenant.

The purpose of the perimeter precinct fencing will be two-fold: cassowary exclusion and to reduce the incidence of resident encroachment on the native vegetation. Experience in other developments bordering national estate (McWilliam, et al., 2010) has shown that encroachment, weed and rubbish dumping and the intensity of ecological impacts was significantly reduced with education and fencing. McWilliam concluded that the greatest reduction in encroachment could be achieved by installing fences around development housing, pathways within the vegetation, design boundaries so staff and the community can monitor boundaries, and monitor infrequently.

To minimise the impact of light, noise and human activity within Ella Bay Development:

- Motor vehicle noise within the precincts will be reduced through the use of electric buggies;
- Cassowaries will be discouraged from access near the more intense resort areas of the development on the east of the property by change in vegetation through removal of the pond apple;
- The conservation areas are surrounded by the open space areas and combined the open space and conservation areas will be 2½ times greater than the precinct area, reducing the impact of disturbance; and
- The control of light spread by using downlights will also be necessary for species such as turtle breeding and nocturnal fauna.

The major threats to potential habitat degradation along Ella Bay Road are:

- Disturbance from increased traffic noise and light;
- Pollutants from road runoff; and
- The introduction of weeds along the road from the disturbance caused by the cassowary fence.

The increased traffic volumes along Ella Bay Road will increase the noise, and light into the rainforest over the current road traffic. The only comparison of this impact that has been studied with regards to the Wet Tropics is for Kuranda Range Road and projected noise levels for Ella Bay Road (Refer to Volume Four) will be significantly lower -7db(A) than the current Kuranda Range traffic. The predicted noise level for Ella Bay Road is less than one quarter that of Kuranda Range and distance that the noise penetrates is about one third. Recent studies (Dawe, G. and Goosem, M, 2008) have reported that there is an impact of compensatory pitch adjustments to the dominant frequency of song in avian rainforest fauna and the reduced densities of avifauna in habitat adjacent to roads.

Studies at Mission Beach (Moore pers comm.) however indicate that cassowaries appear to have habituated to the sound of cars and trucks on the roads. This is illustrated by many observations of cassowaries standing by the roadside waiting for an adequate break in the traffic flow to allow them to cross. They take little notice of cars even when birds are foraging close to the road corridor, but loud trucks, noisy trailers, or sudden noise do startle them. In these situations they move away from the road initially but generally come back if the source of the unexpected noise ceases.

The road runoff will be treated for gross and fine particulate removal in sensitive areas by incorporating bioretention swales for treating soluble toxins from first flush road runoff. The volume of water from the road surface is relatively low compared to the bypassed flows from the western range and will flow east where there is little cassowary habitat.

The cassowary fence will require regular inspection and maintenance which will be accomplished on foot from the forest edge. Walking along the fence alignment will be avoided as much as possible to minimise weed invasion. Weeds will be treated in accordance with the Weed Management Sub-Plan.

#### 5.3.3.4 Traffic

The operation of Ella Bay Development will significantly increase traffic flows along the access road and within the property once it is operational. This will increase the risk of road death to cassowaries occupying adjacent or nearby habitat. The mitigation measures are summarised in Section 5.2.1 and are fully described in Volume four. The key to success of the mitigation will be a monitoring program to determine cassowary use of the underpasses and bridges. The monitoring program will comprise

- Logging of opportunistic sightings and incidents by the public, staff and cassowary fence surveys;
- Monitoring of the fauna underpasses usage with remote cameras;
- Monitoring of cassowary escape gates with remote cameras, counters or sand print beds;
- Transect surveys of road envelope area combined with strategic placement of monitoring cameras; and if possible
- Monitoring of dynamic movement by GPS telemetry to model cassowary land use patterns within the reserve and east side of the range to fauna underpass usage.

The results of the monitoring will be used to assess the risk of cassowary mortality and the success of the mitigation:

- Adherence to the enforced speed limits and psychological calming;
- Integrity of the exclusion fencing along the road corridor to prevent cassowaries accessing the road;
- Willing usage of the underpasses by cassowaries; and
- Monitoring and logging of all cassowary road incidents.

Failure of any of these key areas will require adaptive management. For example:

- For speed limits - installation of further physical calming such as increased number of speed bumps or chicane;
- Failure of the fence integrity - change in maintenance, fence type or relocation of the cassowary ;
- Failure of the underpasses – enticement through alternative vegetation species selection, construction of screening, artificial feeding or as a last resort fall back to road crossings and a low speed environment with physical calming, warning signs, and warning lights.

With fence and funnel exclusion based mitigation the greatest risk is fence failure and cassowaries trapped within the road corridor. There will be two methods of cassowary removal from the road corridor:

- Escape through cassowary one-way escape gates located at regular intervals to allow cassowaries to exit the road corridor; and
- Manual removal of the bird by QPWS and trained Ella Bay Environment staff through dropping of the fence by manual release of the shade cloth shear clips (as per the cyclone procedure)

#### 5.3.3.5 Interactions with domestic animals

Despite a cat and dog ban the daily operation will experience the presence of domestic animals whether from inadvertent accompaniment, stray or dumped animals and feral predators. To manage potential interaction;

- No cats or dogs apart from assistance dogs will be permitted within the development;
- Any domestic cats and dogs found within EBIR will be removed by Council dog control officers; and
- Wild or feral dogs and cats will be actively controlled with the feral pig control program.

Poultry and aviary birds will be permitted to be kept by residents with body corporate permission under appropriate care guidelines to avoid any possible spread of disease to cassowaries.

### 5.3.3.6 Pest Management

Feral pigs are classed as a pest in the WTWHA and are primarily responsible for habitat degradation. Pigs are also thought to contribute to egg predation on the cassowaries and turtles. The proponent has instigated a feral pig trapping and baiting program and over 100 pigs have been culled to date. (Volume Six 6.3d)

The major threat to cassowaries however is not from the pigs but from the indiscriminate killing by hunting pig dogs. The Wet Tropics are considered a mecca for pig dog hunting and the locals have developed a culture of pigging and organise special events to capture pigs.

The pig dogs are released in pack of 2 or 3 and run wild chasing scent and then “capture” any species often including cassowaries. The cassowaries have no defence for these specially bred killers. The culture ignores World Heritage boundaries and many pig dogs have found their way to Ella Bay site from over the range and through the property gates.

Unfortunately cassowaries have been found after being mauled and two deaths are known in the past 5 years, however most deaths go unreported as these deaths are in remote areas often not sighted and definitely not reported by the pig hunters.

### 5.3.3.7 Cyclone Response

Cyclone events are one of the major impacts on the survival of the endangered Southern Cassowary. Cassowaries have proven to be extremely vulnerable to disruption to the fruit cycle following the destruction of a significant cyclone. In the aftermath of Cyclone Larry the immediate loss of food from fruit drop and the structural damage to Cassowary habitat had a significant impact on cassowary mortality. Many birds starved to death, while others were aided by widespread feeding stations while handfeeding resulted in some birds becoming nuisances to the local residents especially around Mission Beach. Cassowaries entering into built-up areas increased in search of hand-outs increased their risk of mortality from interaction with vehicles and dogs.

Queensland Parks and Wildlife Service (QPWS) confirmed that 23 cassowaries had been killed since Cyclone Larry, most of them hit by cars. A number of the problem birds were anaesthetised and relocated to the western less-cyclone ravaged areas. The relocation was a last resort action as the territorial nature and home range instinct of the cassowary would have meant a difficult if not impossible existence.

The mitigation of cyclone impact on cassowaries will be planned:

- Identify post-cyclone cassowary feeding stations prior to the cyclone season which are based on home range surveys, and where food can be placed without human habituation;
- Enhance the resilience of existing vegetation through additional plantings, edge closure and species selection; and
- Plant ‘cyclone tolerant’ species to protect less tolerant species intermingled with cassowary “fruit sources”. that fruited in the late wet season or early dry season.

A revegetation trial of 12,000 trees has been undertaken in the north-west of Ella Bay, specifically planned develop a post cyclone refuge for cassowaries. The location provides some topographic protection for the trees and will also be away from major population centres within the resort and development area.

Large, tall ‘cyclone tolerant’ and ‘cassowary fruiting’ tree species were intermingled with cassowary fruiting species and planted in rows. Smaller trees and shrubs, also species of high fruiting yield that fruited in the late wet season or early dry season were planted in areas between rows. The intention is that during high wind events the larger trees offer some protection to the smaller trees/shrubs reducing the degree of fruitfall, and the late wet season fruiting trees would not have interruption of fruit cycle allowing for continued fruiting after the event. The cyclone tolerant species were selected from reports of “Learning from Larry”.

### 5.3.3.8 Ella Bay Road Cassowary Fence - Cyclone Operating Procedure

The cassowary fence along Ella Bay Road will be subject to damage from intense cyclonic winds. The fence has been trialled in low intensity cyclones without damage. With Cyclone Yasi (category 5) under trial conditions sections of the fence that were prepared for the cyclone survived without damage where lengths of the fence that were left upright were destroyed (Refer to 6.1j).

In the event of significant cyclone risk, the fence will be pulled to the ground; the top carrier wire will be manually removed from the shear clip and relocated to the lower wire clip where both wires will be held together. The shadecloth fence will be effectively folded down to the ground and the shade cloth material tied every 2-3m in between posts by use of cable ties or similar to keep it rolled up and safe from damage. The fence will only be pulled down immediately prior, and during cyclonic weather events by Ella Bay Environmental Staff.

Additional traffic management procedures will be required to minimise the risk of cassowary vehicle strike while the fence is down; temporary warning signs will be used identifying that the fence has been dropped and the vehicle speed limit reduced to 40km/hr.

The reinstatement of the fence will be a high priority post cyclone events. Initially, the debris will be removed from fence area to facilitate the erection where the fence top carrier wire will be placed in clips and inspected for damage. Any fence damage will be repaired locally by either replacing entire sections of the fence from strainer assemblies or only repairing small sections by cutting the wires, threading a new shadecloth section and rejoining the wire using a mechanical wire joiner and sowing the replaced shadecloth. Damage to the tensioning assemblies will be a low risk unless by direct tree strike.

### 5.3.3.9 Cassowary Monitoring

Ella Bay Developments has monitored cassowary populations surrounding the area from Flying Fish Point to Ella Bay, both on a formal and informal level since 2007, including five (5) field transect surveys (Moore 2007, 2009 and Buosi 2009a, 2010a & b) and continuous camera monitoring for 2 years. The camera monitoring involved between 6 to 12 cameras with some permanently monitoring riparian corridors, with other cameras set up at specific fruiting trees.

The objective is to develop a database of the individually identified cassowary population in this habitat.

During the survey period a variation in cassowary population from 6 adults to 15 adults and subadults (all photographically identified) was reported. The conclusion from the observations and surveys were that:

- Numbers varied between 6-22 (adults and chicks) depending on season, weather conditions and fruit availability;
- Identification of individuals and sexes through monitoring cameras was difficult and would require clearer better quality photos;
- Identification of home ranges was difficult from the static photos and transect surveys;
- Initial GPS tracking appeared to provide a far superior method of determining home ranges; and
- DNA analysis of scat samples would enable the positively identify the population and their relationships.

The future monitoring of cassowaries will be focussed on

- Population monitoring to allow the identification of negative and positive cassowary population trends and likely causal factors of variation. The large variability in population will mean that individual transect surveys will not be sufficient to monitor a dynamic population and either GPS tracking or a number of individual surveys will be required.
- Monitoring of the effectiveness and use of cassowary corridors within Ella Bay Development; and

- Monitoring of the effectiveness and use of cassowary mitigation underpasses along Ella Bay Road;

The proponent has also provided ongoing research project support for cassowary tagging and tracking project with the purchase of 5 GPS trackers and recovery of data for future implementation at Ella Bay.

## 6. Southern Cassowary Assessment

### 6.1 Cassowary Population Viability Analysis

A Population Viability Analysis of the Southern Cassowary subpopulation of the Graham-Seymour Range and was presented in the SEIS (collated 6.1L) by Les Moore. Moore reported that the Graham-Seymour Range cassowary population

*“is a linear subpopulation which has lost all connectivity with the larger cassowary populations to the west, the Graham Seymour Range population is currently experiencing high levels of anthropogenic impact, and declining rapidly as a result.”*

The time frame predicted by Moore’s modelling for extinction varied from 60 to 100 years for isolated populations with moderate to low impact. Moore also concluded that

*“Natural catastrophes in the form of severe cyclones and the environmental uncertainties of climate change, are hastening this decline.”*

According to the Population Viability Analysis (PVA) the Graham-Seymour Range cassowary sub-population is currently in a declining vortex whereby extinction of that sub-population appears to be inevitable. Many of the present indirect impacts of the local environment are cumulative and are contributing to this decline. That is; a “do nothing” scenario will lead to extinction of the Graham-Seymour Range cassowary sub-population.

The PVA indicates that along with the other coastal cassowary subpopulations south of Cairns, the Graham-Seymour Range cassowary population is undergoing a population decline. It is postulated that this decline is caused by inadequate patch size, isolation from the main habitat blocks to the west, cyclone-induced mortality, and high levels of historical and contemporary anthropogenic impact exacerbating the naturally low reproductive rate of cassowaries.

Moore (pers. Comm.) added

*“The results of PVA are just one factor in any social and decision-making context and should always be considered only as a precursor to good judgment (Brook et al. 2002). It is important to recognise that the quantitative analyses in predictive population modelling are based on probabilities rather than certainties. Thus the results of the PVA study at Ella Bay can only provide information on the ‘probability’ of extinction or decline given certain assumptions about the biology and status of the cassowary population. Thus, extinction of the Graham-Seymour Range cassowary population is not certain but it does have a high probability of occurring. This is particularly so given the imminent fragmentation of the Graham-Seymour Range cassowary population at three separate locations.”*

### 6.2 Ella Bay Development Threats

Moore identified specific threats and impacts to cassowaries around Ella Bay and applied a risk analysis methodology to determine an overall effect. Moore assessed the risks against Direct, Indirect and Cumulative impacts similar to those identified by the Significant Impact Guidelines for the endangered southern cassowary.

The assessment compared the agricultural grazing use continuation to the proposed development with the result that Ella Bay Development would not increase the impact over the exiting land use. It must also be noted that substantive additional mitigation, and the result of the subsequent cassowary surveys which potentially show the real impact of the previous land use were not included in the assessment. Bousi (6.1a) concluded that

*“Moore (2006) has identified most of the project-related threats for the impact assessment process. However a discussion of potential impacts on important water sources and threats associated with extreme climatic events is needed. We anticipate that the greatest project-related threats include the potential for vehicle strike (especially on the access*

*road to the Ella Bay site), negative human-Cassowary interaction and maintenance of connectivity.”*

Ella Bay Development has applied appropriate mitigation and management strategies that will minimise impact to the Southern Cassowary and contribute to conservation.

Under the EPBC Act guidelines for determining significance, a significant impact is ‘an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts’ (DEH 2006).

The significant impact criterion for a critically endangered or endangered species establishes whether there is a real chance or possibility that an impact will:

- **Lead to a long-term decrease in the size of a population.**

The mitigation included within the Ella Bay Development will improve the available carrying capacity, minimise the risk of dog attack and mitigate against the increase in traffic.

The five surveys have shown an increase in reported (photographically identified) numbers in the past four years - from 6 (2006) to 15 (2010) adult and sub-adult birds following the change in management practices and the end of agricultural use of the site in 2008.

The Population Viability Analysis of the Graham-Seymour Range subpopulation has shown that the present anthropogenic impacts are causing a declining vortex whereby extinction of that sub-population appears to be inevitable. That is; a “do nothing” scenario will lead to extinction of the Graham-Seymour Range cassowary sub-population.

- **Reduce the area of occupancy of the species;**

The Ella Bay conservation strategy has designated cassowary-significant habitat into Conservation Zones, ensuring both protection and habitat connectivity. The total area of conservation zoning will comprise 277ha of which essential cassowary habitat currently comprising 176ha will be increased through revegetation and rehabilitation to 238ha and the total accessible habitat available including landscaped open space will be 336ha out of 470ha. The area of access will consist of the fauna corridors and the extensive open space formed by the golf course fairways. The golf fairways will be landscaped with endemic trees and provide the equivalent of general habitat for the cassowaries with some food source.

Within Ella Bay site 2ha of essential/general habitat will be lost to clearing or isolation including clearing of 0.95ha of essential/general habitat.

Along Ella Bay Road 3.9ha of essential/general habitat will be lost to clearing or isolation including clearing of 2.80ha of essential/general habitat.

- **Fragment an existing population into two or more populations;**

Cassowary movement within the existing habitat of Ella Bay site will be maintained through extensive network of conservation corridors, crisscrossing the development with cassowary underpasses and safe fauna crossing points to maintain movement corridors.

The cassowary mitigation measures for Ella Bay Road have been developed to maintain movement corridors through fence and funnel mitigation comprising three cassowary underpasses and one overpass. The roadside will be fenced to funnel the cassowaries to the underpass/overpass to allow access to the habitat on the east of the road.

The proposed bypass and fauna overpass through the narrow southern extension of the Seymour Range will ensure connectivity to the lower end of range

- **Adversely affect habitat critical to the survival of a species;**

The existing habitat will be protected, and rehabilitated. The existing weeds and feral pests will be controlled. The cyclone tolerance of the existing vegetation and cassowary habitat will be improved through widening of the riparian corridors using a selection of cassowary fruiting cyclone tolerant species and edge closure

The value of the cassowary habitat will be improved with an extensive increase in the area, volume and availability of permanent water through constructed wetlands. The majority of the constructed wetlands will be proximal or within the fauna corridor and discharge into the creeks.

- **Disrupt the breeding cycle of a population;**

The five surveys of the Ella Bay environs has shown a more than doubling in cassowary numbers since 2006, and indicated the population is healthy and the age class structure and recruitment sustainable. At least two females were reported in three out of the five surveys inferring the population dynamics of breeding females is also sustainable.

- **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;**

The existing habitat will be protected, improved through rehabilitation, and extended through revegetation. Quality habitat will be increased 176ha to 238ha and total habitat including landscaped open space will be 336ha.

Access to all habitat will be maintained with the exception of clearing/isolation of 2ha within Ella Bay Development and 3.9ha along Ella Bay road.

- **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;**

The existing vegetation has major infestations of weeds that will impact the WTWHA and cassowary habitat. Ella Bay Development has implemented a weed control program and a Weed Management Sub-plan.

The existing environment has an extensive feral pig population. Ella Bay Development has instigated a feral pig trapping and baiting program with over 100 pigs culled to date and will prepare a Pest & Wallaby Management Sub-plan.

The major threat to cassowaries however is not from the pigs but from the indiscriminate killing by hunting pig dogs. The proponent has committed to a 'no dog or cat policy' and hunting being forbidden on the property with perpetrators reported to the authorities

- **Introduce disease that may cause the species to decline; or**

There is no recognised impact of disease on the Southern Cassowary and the Recovery Plan for the Southern Cassowary (2007) has no guidelines on preventative measures.

As a precautionary measure, any poultry or aviary birds kept by residents will be required to conform to appropriate care guidelines to avoid any possible spread of disease to cassowaries.

- **Interfere with the recovery of the species.**

Ella Bay Development has prepared a site specific *Southern Cassowary Management Sub-Plan* and *Ella Bay Cassowary Recovery Plan Implementation* which supports Specific Objectives of the "Recovery Plan for the Southern Cassowary *Casuarius casuarius johnsonii*". (2007): DEWHA 2009, and recommendations from the Significant Impact Guidelines for the endangered southern cassowary (*Casuarius casuarius johnsonii*) Wet Tropics Population - EPBC Act policy statement 3.15 (2007).

Each of the specific objectives are addressed in Table 6.1 *Cassowary Recovery Plan Matrix*.

Ella Bay Cassowary Recovery Plan Implementation referenced against objectives of the **Recovery plan for the Southern Cassowary *Casuarius casuarius johnsonii*** Peter Latch for the Cassowary Recovery Team

Cassowary Recovery Plan (2007) Latch.	Ella Bay Cassowary Conservation Commitments
<p><b>Specific objective 1:</b> Protect essential cassowary habitat and landscape corridors</p>	<p>Regional Ecosystems classified as Essential Cassowary Habitat in the Recovery Plan for the Southern Cassowary <i>Casuarius casuarius johnsonii</i>, (Latch 2007) have been identified and mapped both on site and along the road. On Ella Bay site the vast majority of this Habitat will be protected by gifting to National Parks or under Conservation Covenant.</p> <p>An offset comprising 62.8ha of essential habitat within Ella Bay property and a 63.6ha offset property have been proposed in the Offset Package. The offset property has been purchased and will be revegetated. The offset property is positioned within a strategically important East-West regional corridor as identified in the Recovery Plan for the Southern Cassowary <i>Casuarius casuarius johnsonii</i>, (Latch 2007) as an area of key ecological function, broad movement corridors and appropriate rehabilitating habitat. Additionally the corridor 'would significantly improve the mobility of cassowaries between Eubenangee Swamp and the Graham Ranges' (Biotropica, 2005). This cane farm property will be revegetated with a Cassowary Habitat Corridor increasing the accessibility for birds from the Eubenangee Swamp National Park to World Heritage Area.</p> <p>The clearing of Essential habitat along Ella Bay Road has been avoided unless road safety or the saving of mature trees dictated.</p>
<p><b>Specific objective 2:</b> Institute a more coordinated and stronger planning response to development issues in cassowary habitat</p>	<p>Ella Bay is committed to conserving the cassowary sub-population. A number of protection measures will be implemented addressing issues arising from the development; such as planning and design for habitat connectivity; fencing the road to reduce vehicle strike; no dogs allowed; gifting 62.8ha of the property to National Parks; providing a 63.6ha offset property positioned within a strategically important East-West regional corridor; and Conservation Covenanting 154ha of revegetated riparian fauna corridors traversing the site.</p>
<p><b>Specific objective 3:</b> Implement strategies to protect cassowary populations by minimising the adverse impacts of roads, dogs, pigs and cyclone events</p>	<p>Implementation of the above</p> <p>Development of a suitable fencing strategy including purpose designed escape gate. To be installed along a Cassowary Coast Regional Council owned road.</p> <p>Cassowary specific underpass and 3 bridges to retain connectivity along Ella Bay Road.</p> <p>Ella Bay Road upgrade will retain the existing level of corridor width in order to reduce edge effect impacts on the terrestrial environment. The only clearing to occur would be in</p>

Cassowary Recovery Plan (2007) Latch.	Ella Bay Cassowary Conservation Commitments
	<p>specifically areas in order to:</p> <ul style="list-style-type: none"> <li>• Provide safety in terms of evasive action and correct sight distances;</li> <li>• Provide the alignment with a proper, adequate, environmentally sensitive drainage design,</li> <li>• Prevent the potential for landslides at Heath Point</li> </ul> <p>Successfully implemented feral pig trapping programme across Ella Bay since 2008 with greater than 100 pigs culled.</p> <p>No dogs and cats permitted</p> <p>Cassowary specific revegetation has been undertaken on 5ha at the base of the range in the north-west corner of Ella Bay. This location provides topographic protection to the trees, while being away from major population centres within the resort and development area.</p> <p>‘Dry’ season fruiting cassowary-diet species were chosen to fruit after the cyclone season where many cassowary food trees may be badly damaged/drop fruit load due to high wind. Additionally, high wind tolerant species were chosen within this species selection then planted as ‘wind breaks’ to protect the smaller, more vulnerable trees.</p>
<p><b>Specific objective 4:</b> Develop an effective cassowary rescue, rehabilitation and release programme</p>	<p>Ella Bay is collaborating with the University of Queensland and QPWS to reintroduce rehabilitated orphaned cassowaries back into the wild.</p> <p>To monitor the results of the subadult’s translocation Ella Bay purchased 5 GPS units to tag the birds, also financing their recovery for analysis.</p>
<p><b>Specific objective 5:</b> Cassowary populations are monitored to assess population size, trends and status</p>	<p>Substantial survey information of the Cassowary population in the surrounds of Ella Bay has been collected, collated and assessed by staff and Cassowary advisors over the past 3 years. From this information Ella Bay has established a Cassowary database.</p> <p>The revegetation strategy for the offset property is aimed at restoring and widening a priority East-West regional movement corridor.</p> <p>Ella Bay proposes to assist and be involved in the population survey methodology based on faecal DNA research.</p>

Cassowary Recovery Plan (2007) Latch.	Ella Bay Cassowary Conservation Commitments
<p><b>Specific objective 6:</b> Improve understanding of cassowary ecology and threats to its survival.</p>	<p>Implementation of the above</p> <p>A cassowary research station is to be located within the 5ha cyclone tolerant fruiting trees revegetation trail, with a number of ongoing projects being monitored, such as the monitoring of cassowary use of the revegetation plot, determining cassowary diet and energetics through remote sensing.</p> <p>The UQ tagging of subadults will provide dispersal pattern and other population information</p>
<p><b>Specific objective 7:</b> Engage the community in cassowary conservation and education</p>	<p>The cassowary is significant within a marketing perspective of the area, and its conservation profile will be raised as a result.</p> <p>The Welcome Centre will both inform and educate residents and visitors alike. A section of the Welcome Centre will be dedicated to the cultural significance of the area, and the fauna and flora within it.</p> <p>Staff and contractors will be inducted before entering site, raising awareness and importance of the cassowary to the area.</p>
<p><b>Specific objective 8:</b> Manage the recovery programme</p>	<p>A site specific (including Ella Bay Road) Cassowary Environmental Management Sub-Plan has been developed, which will involve regular, ongoing monitoring, reporting and evaluation of activities.</p> <p>The Environmental Management Plan will comprise other sub-plans which will ensure the mitigation measures; such as weed control, and feral pig cull and revegetation are successful.</p>

**Figure 6.1 Cassowary Recovery Plan Matrix**

## 7. References

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