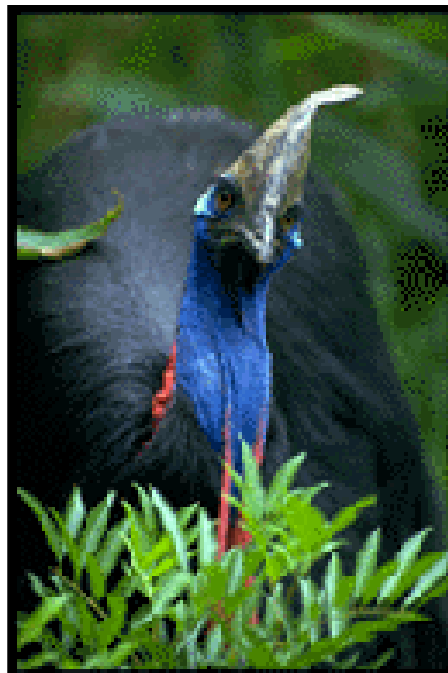


# ELLA BAY RESORT – INTERNAL AND EXTERNAL FENCING STRATEGY

TO ENSURE THE SAFE CO-EXISTENCE OF THE ELLA BAY  
COMMUNITY WITH LOCAL FAUNA AND, IN PARTICULAR,  
THE CASSOWARY



Prepared by:



March 2008

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## Quality Control Data:

Date	Document Status	Version	Reviewed By
4.03.08	Initial draft – Kim Forde	draft	Kate Roper
6.03.08	Response to P.Sparshott comments	v.2	
19.03.08	Response to P Sparshott comments	v.3	
27.03.08	Response to P Sparshott and L Byrne comments	v.4	Kate Roper
01.04.08	Final	v.5	Kate Roper

## ELLA BAY RESORT Fencing Strategy Report

### 1.0 Introduction:

This document builds upon the Fencing Strategy produced within the Ella Bay Supplementary EIS: Key Issues: Refined and Improved – November 2007 by providing comparisons of actual options for fencing – resulting in recommended options for different elements of the site to meet different conservation and management criteria.

The following is an extract from Section 2.2.9.3 of the Fencing Strategy (p. 63) which puts this report into context of the original EIS and the request for additional information and clarification:

### 1.1 Purpose

The Ella Bay Fencing Strategy aims to:

- establish an effective solution to ensure the safe co-existence of the Ella Bay community with the local fauna and, in particular the Cassowary;
- provide reasonable levels of personal security and privacy for all Ella Bay residences;
- use fencing effectively to separate people from fauna (the term gateway is used to describe a controlled access point); and
- direct fauna away from residential areas, centres of human activity and roads using fencing and funnelling strategies

### 1.2 Identified Risk Issues

As part of the Supplementary EIS process, a number of risk issues were identified, as well as management solutions. A strategic objective of the Ella Bay Development is to open up as much habitat as possible to fauna, including the Cassowary. This strategy creates potential risk issues that need to be effectively assessed, managed and monitored. These include:

- the consequences of people's activities on the local fauna; and
- areas of interaction between people and traffic.

The proposed Fencing Strategy accepts that the consequences of people's activities also need to be managed to balance the interests of fauna as well as people sharing the environment at Ella Bay. Such risk activities include:

- motor vehicle movements;
- pedestrian, electric buggy and bicycle traffic;
- noise; and
- fauna movement.

The following (Figure 1) is a diagram that shows the proposed fencing plan for the Ella Bay Development.

Figure 1: Proposed Fencing Plan for Ella Bay Development



### 1.3 Management Solutions

#### A. Clear Separation

A strategy of clear separation of people and fauna will be arranged in areas assessed as containing higher risk activity.

#### B. Fencing of Areas of Frequent Interactions

A network of wildlife corridors will be created at the outset of the Development to begin the process of improving the environment for fauna. Directional fencing will be installed to guide fauna away from roads and people and towards the wildlife corridor network.

The Fencing Strategy also accepts the need to fence areas where frequent interactions between fauna (including the Cassowary) and people would otherwise occur. The higher risk areas have been identified: The Ella Bay Village Residential Precinct, the Ella Bay Welcome Centre area, Resort areas, road crossings, and roads or paths in general.

Improving the currently degraded land and using fence and funnel strategies to direct fauna away from the majority of people will ultimately enhance the extent to which this objective will be achieved.

### **C. Fencing to Facilitate Movement**

Seven crossing points for fauna have been added as part of the improved Ella Bay Fencing Strategy. At these crossing points, traffic calming measures will apply with traffic speed limits set at 20 kilometres per hour in these areas.

### **D. Fencing to Restrict Movement**

In certain areas, the Cassowary must not be allowed through a fenced area but other fauna should be able to move freely through, under or over it. Here, specially designed fence features will be created that enable fauna, other than Cassowaries, into and through these designated areas. These areas are principally around the Village precinct area and along the beachfront and have been identified on the Fencing Plan.

Below is an example of design that will help separate fauna from people without unduly restricting movements is shown below.

Figure 2: Conceptual 'fauna friendly' bridge crossing.



### **E. Fencing for Residential Precincts and Access**

All the residential precincts will be fenced, as well as the resort areas, Ella Bay Village Precinct and Ella Bay Welcome Centre areas. This will provide security, as well as a degree of privacy in those areas. Automatic gateways to fenced areas containing residential dwellings will have access controls fitted. The design of access controls for residents and their visitors will be assessed from a practicality and reliability perspective. Electronic toll way type passes may be a solution. Intercom communication linking the gateways and the Welcome Centre may be installed in certain locations, where appropriate.

### **F. Fencing Outside of Ella Bay**

On the road from Flying Fish Point to Ella Bay entrance, similar designed and constructed fence and funnel strategies will be erected. As per appendix A.2.6 Access Road Strategy (Environment North), at the designated crossing points for Cassowaries along this road, flashing illuminated alert signs will show a driver how fast he or she is going. These arrangements will have an impact on slowing traffic to the point that the Cassowary will be able to cross the road at minimum risk levels.

## **G. Education and Information**

All visitors will receive a Cassowary Awareness and Protection presentation, highlighting their value and iconic status and the proponent's commitment to protect them. The Induction will particularly focus on what to do if approached by a cassowary and the edict to not feed any cassowary seen on or approaching the site.

### **1.4 Key Risks associated with Cassowary Interactions**

To summarise, the key risks associated with Cassowary and people interactions at Ella Bay and the access road include road design, traffic movements, hand feeding, the impact of feral animals and pets (particularly dogs and feral pigs), disease, the impact of storm disturbances and the movement and presence of people.

Appropriate design and style of fencing has the potential to address many of the key identified risks.

The fencing types for the project then need to be broken into two specific selection mechanisms based on their purpose:

- within the Ella Bay site: the Village Residential and Resort Precinct, or
- External to Ella Bay: the Access Road.

### **1.5 The Process of Fence Option selection**

This section describes the fencing evaluation and selection process. It commenced with a broad-scale review of types of fencing and scales from the perspective of defining 'all possible fence options technically or potentially available to create fencing at the site' to recommendations for each key use.

Initial Evaluation was based against sustainability criteria – environment, social and economic parameters - with an emphasis upon environmental parameters due to the significance of being the habitat of the endangered Southern Cassowary and the requirement to protect individual birds and their habitat. The 'first pass' therefore considered whether any fence constructed from these materials would safely deter cassowary access to the road or the Village Residential and Resort site whilst having an acceptable 'whole of life cost'. These were then considered with regard to being suitable for use within or approaching a 'sustainable eco-resort' environment.

This initial review (1.6) was classified using a three part "traffic light" code option:

- Red – No, because of a significant and unacceptable negative attribute;
- Orange – Possible but with some negatives; and
- Green – Possible: to be investigated further

Initial fencing options considered all manner of construction materials including:

- timber,
- concrete,
- metal,
- wire,
- fabric,
- glass, and
- electronic options.

The "Green" classified outcomes of the 'first pass' assessment were reviewed in the Broad-scale Scanning of Short-list options against the identified Performance Criteria for each separate use – Village Residential / Resort (2.2) and Road Fencing Options– external to the resort (3.2). Justification of the use of different fence types was undertaken.



Performance Criteria considered detailed:

- environmental parameters – principally preventing cassowary access and harm
- social and amenity criteria – likely village and resort residents concerns: visual impact, views, breezes, light; security, safety and privacy
- economic criteria – both capital and operating costs
- maintenance and durability criteria – particularly cyclone durability and ensuring low maintenance and minimal ongoing environmental impact
- Monitoring potential – damage and fauna crossing

An additional consideration was whether any negative aspect of each design option could be mitigated through a minor design modification or screening by vegetation etc.

Each option was given a rating 0 – 2:

- 0 - meaning it failed to meet the selection criteria
- 1 - meaning that it basically met the selection criteria
- 2 - meaning that it met, and potentially exceeded the requirements of the selection criteria.

The three highest ranked criteria were reviewed with a detailed evaluation of both the advantages and disadvantages presented by that design in meeting the performance criteria for each Fencing use – Village Residential and Resort and Access Road. Based on this detailed evaluation, the rationale for the decision as to the proponents preferred option in each use, was justified in greater detail. Detailed results of each assessment are included at Section 2.3 for within the Village and Resort and Section 3.3 for the Access Road.

## 1.6 Possible Fencing Options

The initial review of fencing options considered all manner of construction materials including:

- timber,
- concrete,
- metal,
- wire,
- fabric,
- glass, and
- electronic options.

Within these general construction materials, where a range of options were available, the significantly different options were considered to determine what would be the ‘best option’ for purpose for each material. It was possible for more than one fence type of a particular material to move forward through the review process.

All construction materials were considered against the principal criteria of being:

- “cassowary friendly” and deterring access to either the Village Residential and Resort area or the Access Road.
- Low maintenance and ‘whole-of-life’ cost ie: to make, construct, maintain, demolish and dispose of
- Appropriateness in the Resort and Village Residential precinct
- Appropriateness for use along the Access Road.

Classification was undertaken using a three part “traffic light” code option, where:

- Red – means No, because of a significant and unacceptable negative attribute;
- Orange – means Possible but with some negatives; and
- Green – Possible by meeting the criteria with no apparent negative attribute. To be assessed in greater detail.



Table 1 below, reviews Timber fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

**Table 1: Timber Fencing Options**

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVERALL - green will be investigated further
<b>TIMBER</b>	within resort	road fence	within resort	road fence			
Palings	possible	possible but costly	non-renewable resource	non-renewable resource	visually inappropriate	visually inappropriate	
Post n Rail - horizontal - local timber	will not prevent cassowary access	will not prevent cassowary access	non-renewable resource	non-renewable resource	possible	possible	
Post n Rail - crossed - local timber	will not prevent cassowary access	will not prevent cassowary access	non-renewable resource	non-renewable resource	possible	possible	
Koppers logs	potential carcinogen	potential carcinogen	potential carcinogen	potential carcinogen / possible leaching into env	potential carcinogen	possible	
Ti-Tree (Brush) fencing	likely	possible but costly	high maintenance but recyclable	high maintenance but recyclable	no visibility, limits air movement, visually inappropriate	possible	

#### 1.6.1 Paling Fence:

Paling fencing, is a possible fencing option that will safely deter cassowaries from the site. From a whole of life cost aspect, most paling fencing available in Australia cannot be certified to come from renewable sources and it requires significant ongoing maintenance to keep it painted and looking neat and clean. In a high rainfall area, the paling fences are highly likely to become mould impregnated which would reduce its life and visual amenity. Within the Village Residential and Resort site, Paling fences would be a visual barrier that prevented flow of breezes and view through them, whilst potentially being a security risk as the construction methodology could give a foothold to climb over them. Although with significant negatives, this fence will be considered further, for use in the Village Residential and Resort, as it is the tallest potential option at 1800mm.



Figure 3: Paling Fence

### 1.6.2 Post and Rail Fence

Post and Rail Fencing is not a suitable fencing option due to its inability to prevent cassowary, pig or dog access to the site. It could be climbed by humans, so is also a security risk. It may not be able to source from renewable sources. Traditional post and rail fences are generated from 'the bush' and are liable to white-ant predation unless treated with significant chemical applications which are not suitable in this environment.



Figure 4: Post-n-Rail Fence

### 1.6.3 Koppers log fences

Koppers log fences are durable and could be constructed to deter cassowary access, however significant research has indicated that the copper arsenic treatment of this product has the potential to be carcinogenic, and therefore is no longer recommended in any situation where children and small animals (who may chew on the log) are likely to come into contact with the product. From a 'whole of life' consideration, especially the great difficulty in safely disposing of this product, it is deemed unsuitable for either road option.



Figure 5: Koppers Log Fence

### 1.6.4 Ti-tree (Brush) fencing

Ti-tree (Brush) fencing can be both sourced from a renewable forestry source in Australia and can be recycled at the end of its life. It can be designed to safely deter cassowaries from entering the site as it would not be easily climbed by either cassowaries or humans and will screen cassowaries from potential food and water sources. Although it may limit breezes and visibility from a human perspective within the Village Residential and Resort Precinct, it will be considered further against specific criteria for this aspect.



Figure 6:Ti-Tree Brush Fence

Table 2 below, reviews Concrete fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

**Table 2: Concrete Fencing Options:**

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVERALL - green will be investigated further
CONCRETE	within resort	road fence	within resort	road fence			
Besser block	possible	too difficult to construct too expensive	high environmental cost to construct and transport	high environmental cost to construct and transport	visually inappropriate	visually inappropriate	
Re-formed vertical slab (concrete sleeper fence_	possible	too difficult to construct too expensive	high environmental cost to construct and transport	high environmental cost to construct and transport	visually inappropriate	visually inappropriate	
Bricks - with or without air pattern	possible	too difficult to construct too expensive	high environmental cost to construct and transport	high environmental cost to construct and transport	possible	visually inappropriate	

#### 1.6.5 Besser Block fence

Besser Block fencing is possible to construct but has a very high environmental cost associated with its manufacture, transport, demolition and disposal. It is visually inappropriate for the Village Residential and Resort Precinct environment, not allowing for air movement or views to the surrounding natural environment. It is heavy to manually handle during construction and may not be stable in cyclonic conditions.

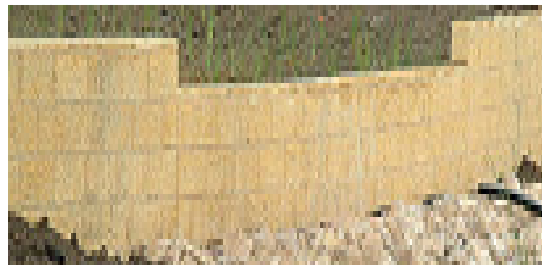


Figure 7: Besser Block Fence

#### 1.6.6 Pre-formed concrete (concrete sleeper) fence

Pre-formed concrete (concrete sleeper) fence - similar constraints and negative aspects as Besser Block Fencing



Figure 8: Concrete Sleeper Fence

### 1.6.7 Block or brick fencing with openings in design

Block or brick fencing with openings in design has similar environmental whole of life cost constraints as identified for all concrete fence types. This design option may not limit access for animals and would be inappropriate from a security perspective within the Village Residential and Resort Precinct site.



Figure 9: Brick fence with openings

Table 3 below, reviews Metal fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

**Table 3: Metal Fencing Options**

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVERALL - green will be investigated further
	within resort	road fence	within resort	road fence			
<b>METAL</b>							
Pool fence type - powder coated aluminium	likely	possible but expensive	likely	possible but environmentally 'expensive	most suitable	possible	
Colorbond panel	likely	possible but very expensive	possible	possible but environmentally 'expensive	visually intrusive; not in keeping with resort theme	possible	
Lattice (metal)	possible	inappropriate	likely	inappropriate	possible	Inappropriate	

#### 1.6.8 Powder coated Aluminium fence panels

Powder coated Aluminium fence panel is strong, durable, low maintenance and without sharp edges or small sections to trap cassowary heads, feet or feathers. It meets low maintenance and 'whole of life' costs criteria, and would be suitable from a visual amenity, light, air and security aspect for the 'Village Residential and Resort Precinct' environment. Its lack of foothold and proven effective use as a pool and boundary fence makes it worthy of investigation in more detail against performance criteria for both Village Residential and Resort Precinct.



Figure 10:  
Powder-coated Aluminium

#### 1.6.9 Colourbond steel fencing

Colourbond steel fencing is strong and durable, meeting maintenance and durability aspects. It is capable of deterring cassowary and other animal access and deterring humans from climbing over. Steel construction has higher environmental creation costs and purchase costs than most other options. It would be Visually intrusive and not in keeping with the resort 'theme'.



Figure 11: Colourbond Steel Fencing

#### 1.6.10 Powder coated aluminium lattice

Powder coated aluminium lattice would be a physical deterrent to cassowaries but has potential to be 'climbed' due to the ability to get a foothold in the product, by both cassowaries and humans. There is potential for cassowary wings or toes to be trapped between cross-pieces similar to risk from other wire fencing of similar shape. It has potentially higher maintenance requirements as the close spaced frame will facilitate vine climb – increasing maintenance frequency and effort. Not visually appropriate for a Village Residential and Resort

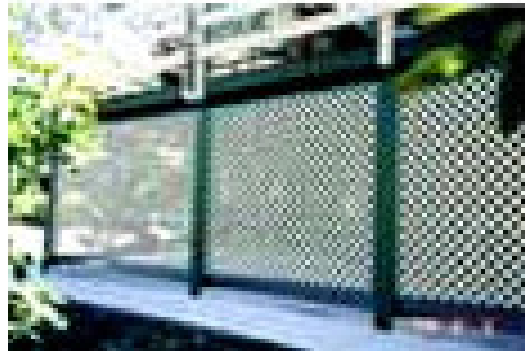


Figure 12: Powder-coated lattice

Table 4 below, reviews Wire fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

Table 4: Wire Fence Options

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVER ALL - green will be investigated further
	within resort	road fence	within resort	road fence			
<b>WIRE</b>							
10cm diamond chainwire	possible	regulator requested option		has been used in other situations	visually / aesthetically inappropriate	has been used in other situations	
10cm square chainwire (dogfence)	possible	possible but expensive	possible	possible but 'environmentally expensive'	visually / aesthetically inappropriate	has been used in other situations	
4 x single strand - plain	possible	likely	possible	likely	visually / aesthetically inappropriate	likely	
4 x single strand - top barbed	inappropriate in all situations - fails 'fauna friendly fencing' criteria	inappropriate in all situations - fails 'fauna friendly fencing' criteria	possible	possible	visually / aesthetically / safety inappropriate	inappropriate in all situations - fails 'fauna friendly fencing' criteria	
4x single strand - with shade cloth cover	possible but needs significant planting and maintenance	likely	possible	possible but higher maintenance than desirable	visually / aesthetically inappropriate	likely	
Electric fence	electric fence not appropriate within resort	possible but untried for cassowaries	possible	possible but higher maintenance than desirable	safety of patrons paramount	significant maintenance issues	may warrant further investigation



#### **1.6.11 1800mm wire fence with or without barbed wire top**

1800mm wire fence with or without barbed wire top – Option requested for consideration by Queensland government regulators. There is recent evidence from Mission Beach of cassowaries being injured by trapping feathers or toes in this fence type. The fence height would be a barrier which would deter any animal or human from crossing. This option is visually and aesthetically inappropriate in a Village Residential and Resort Precinct situation. As evidenced on Ella Bay Road, this fence is high maintenance to remove vines and other scrambling vegetation, the weight of which may act to pull down sections of the fence. If damaged, sections of the fence cannot be repaired or easily replaced. It will be considered further for the Access Road.



Figure 13: 1800mm wire

#### **1.6.12 Steel Wire 'Dog-Fence'**

Although Steel Wire 'Dog-Fence' would deter access, it but could be climbed if a toe-hold gained, because of strength of framework. It has potential to trap cassowaries similar to option 1.6.11 above. It would be visually and aesthetically inappropriate in a Village Residential and Resort Precinct situation. This option is costly from an environmental perspective to create. Although not requiring painting this option is high maintenance to remove vines and other scrambling species who could utilise this structure in a tropical climate.



Figure 14: Steel Dog Fence



### 1.6.13: Multi-strand Wire Fence (many options)

Multi-strand Wire Fence can take many forms, however, no option with barbed wire would be appropriate as it fails the ‘fauna friendly fencing’ criteria from World Wildlife Fund (WWF). Neither would it be aesthetically appropriate in a Village Residential and Resort Precinct situation. No open wire options would exclude cassowary chicks and other fauna – especially feral pigs and dogs; nor would it deter humans from climbing over or through the fence. The use of wire as a framing structure with shade-cloth cover is an option to be considered further for the Access Road.

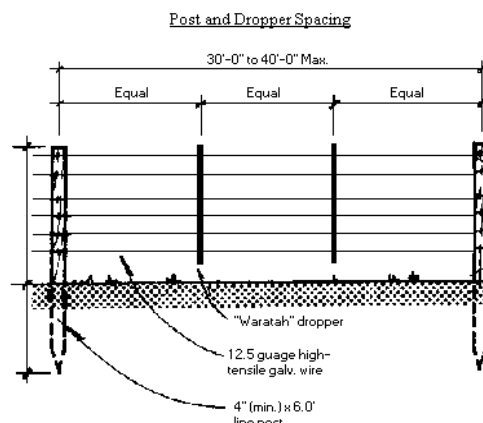


Figure 15: Multi-strand wire

### 1.6.14: Electric Fencing

Electric Fencing, although available for many animals has no option currently deemed suitable for cassowaries and all are considered inappropriate in any potential interaction with humans. The Emu is most similar in physical structure to a Cassowary so success and impacts of an Electric Fence are considered to be similar, with evidence that the electric charge may not pass through the Emu's feathers. Manufacturers recommend that “If keeping predators out (from an Emu enclosure) then design the fence for the predator.” As people are considered the principle threat to cassowaries, this option will not be considered further.

Table 5 below, reviews Fabric fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

**Table 5: Fabric/Polypylene Fence Options**

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVERALL - green will be investigated further
<b>FABRIC</b>	within resort	road fence	within resort	road fence			
Shade-cloth	possible	likely	likely	likely	visually / aesthetically inappropriate	likely	
Polypylene	possible	likely	possible	likely	visually / aesthetically inappropriate	likely	

#### **1.6.15 Wire Fence with Shade-cloth covering**

Wire fence with shade-cloth covering acts as visual deterrent and can be constructed to exclude cassowaries and other fauna. It is not appropriate for the Village Residential and Resort Precinct site but has been successfully utilised for 'fence and funnel' options across the Wet Tropics region; so will be considered further as a road fencing option.



Figure 16: Shade cloth covered wire

#### **1.6.16 Polypropylene fencing on wire or star picket frame**

Polypropylene on wire or star picket frame is a proven existing option utilised on Kuranda Range Road to deter cassowaries from accessing roads and 'funnel' them to cross at appropriate and designated safe cassowary crossing points. It is inappropriate for within the Village Residential and Resort Precinct site, but will be considered for road fencing options.



Figure 17: Polypropylene fence

Table 6 below, reviews Glass and Virtual Fences as fencing options against the criteria identified above. Below the table are images of each proposed fence type and a brief discussion of the suitability of this type against the assessment criteria.

**Table 6: Glass and Virtual Fence Options**

Option material	cassowary 'friendly' and deterring access		low maintenance; low whole of life cost		Resort appropriate	Access Road appropriate	OVERALL - green will be investigated further
GLASS / VIRTUAL	within resort	road fence	within resort	road fence			
Glass	no visual deterrent	no visual deterrent	high environmental and actual cost; high maintenance	high environmental and actual cost; high maintenance	initial cost, safety and maintenance costs	significant maintenance issues	
virtual fence - electronic/ laser signal	not appropriate within resort	possible but untried for cassowaries	currently high cost to install and operate	possible but untried in rainforest situations	safety risk to patrons unacceptable	possible but untried in rainforest situations	may warrant further investigation

#### 1.6.17 Glass pool fencing

Glass pool fencing may be appropriate within areas of the Village Residential and Resort Precinct, around the pool but not in any other area due to breakage risk; high initial and environmental cost and high maintenance requirements. Clear glass does not act as a visual deterrent to cassowaries trying to access the site, increasing the risk that the cassowary may hurt itself if it tries to get through a barrier it cannot see.



Figure 18: Glass Pool fence

#### 1.6.18 Electronic 'Virtual' Fences

Electronic 'Virtual' Fences puts a static electrical impulse on fine wires that form the electronic barrier. The barrier blends into the surroundings & is almost invisible. When a bird or animal encounters the wires it discovers that this is highly unpleasant and avoids repeating the experience. Manufacturers state that "This is not the same as a farm electric fence. It will not harm any birds, animals or people. The electrical impulse is simply like strong static electricity."

In this instance the fineness of the wire would not be considered to deter cassowaries or humans from crossing. Its unknown impacts of cassowaries at this point render it inappropriate at this time.

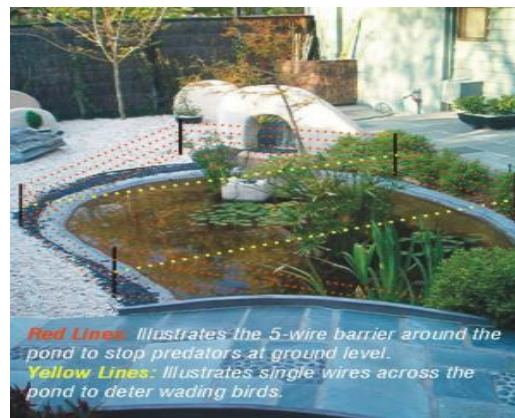


Figure 19: Virtual Fences

### 1.7 Summary of First Pass Assessment - Short-listed Options

The “Green” classified outcomes of the ‘first pass’ assessment became the short-list, and were:

- Ti-tree fencing
- Powder coated Aluminium “Pool” fencing
- 10cm Diamond pattern chain-wire fencing
- Multi-strand plain wire fencing
- Shade-cloth or polypropylene fencing.

All others were discounted at this point due to the reasons outlined within the discussion.

These were readily segregated into two groups depending on their perceived suitability within the Village Residential and Resort Precinct or on the Access Road, except for the Pool Fence which will be assessed for both options.

Short-list Options to be considered against the specific use performance criteria for the Village Residential and Resort Precinct were:

- Ti-tree fencing: The default height for Ti-tree fencing is 1400 or 1500mm.
- Powder coated Aluminium “Pool” fencing: the default height for Powder-coated Aluminium “Pool” Fencing is 1200mm.

Although it has not met all other criteria, at the request of the proponent, to ensure a range of heights are considered further, the 1800 mm Paling Fence option will be considered in greater detail.

For the Access Road, options to be considered against the Road Access performance criteria were:

- 10cm Diamond pattern chain-wire fencing
- Multi-strand plain wire fencing
- Shade-cloth or polypropylene fencing
- Powder coated Aluminium “Pool” fencing: the default height for Powder-coated Aluminium “Pool” Fencing is 1200mm.

## Detailed Evaluation against Performance Criteria

### 2 Resort Residential Precinct Fencing:

The Primary Objective of Village Residential and Resort Precinct fencing is to deter large fauna from entering areas of human habitation whilst allowing movement of smaller fauna such as frogs and reptiles. Its purpose is to enhance the safety of fauna (such as the Cassowary) and people by excluding access to residential precincts and eliminating issues associated with human contact and associated activities.

Other Objectives included meeting social parameters like aesthetics (visual amenity), safety and security for site residents. Economic objectives required the review of the whole of life cost evaluations of each product for its purpose on site.

#### 2.1 Short-list Evaluation Criteria

The fence should meet the following Performance Criteria:

##### ENVIRONMENTAL

- Deterring cassowary access – with height and strength to deter, and withstand assault by, an adult cassowary
- Ability for the Cassowary to escape if trapped – the fence can be designed with an exit (ramp/gate) or scaled
- Cassowary/ Fauna safety – no sharp edges or gaps which can trap cassowary heads, feet and/or feathers
- Deters Cassowary views to potential food or drink sources – can it be screened?
- Allows access for desired fauna other than cassowaries – provides access for smaller fauna like frogs, lizards and small mammals
- Fence will not add to the sediment or erosion potential of site – stable without requiring ongoing ground disturbance

##### SOCIAL – Residential and Community Amenity

- Visual amenity – Fence is not dominant in the landscape due to its colour and size; or the design is inappropriate for its location
- Views from residences to surrounding hills, mountains and golf-course can be seen through the fence. Appropriate for a tropical setting and its location
- Breezes and light – allows passage of air and light
- Security – can be locked to deter unauthorised access
- Safety – not a health hazard to humans – with no sharp edges; deters climbing; and is not wide enough to be walked along
- Privacy – can be screened to deter visual intrusion
- Pool safety – meets criteria to deter children's unauthorised access to water – 1200mm or greater height, no toe hold or central rail to deter climbing over
- Access and Gates – access can be controlled via gates

##### ECONOMIC – COST

- Capital Costs – the whole of life cost of product – construction and initial purchase, installation, demolition and disposal.

## MAINTENANCE AND DURABILITY

- Cyclone durability – able to withstand cyclonic winds to Australian Standard (AS) levels
- General durability – Product life is appropriate in tropical conditions; and is able to withstand 'normal maintenance' like the use of a whipper snipper and occasional chemical application without apparent damage.
- Operating Costs – low or no maintenance – no painting
- Monitoring for damage – able to be visually or electronically monitored
- Constructability – ease of construction – timeliness; preformed materials

An additional column was used to show additional mitigation measures, for example:

- education not to feed or
- ensure there are no cassowary food or drinking sources or
- that the fence could be screened with vegetation without impacting on its integrity and function.

The cumulative scores for each option were collated and the top ranked items evaluated in terms of constructability and maintenance.

Each option was given a rating 0 – 2:

- 0 - meaning it failed to meet the selection criteria
- 1 - meaning that it basically met the selection criteria
- 2 - meaning that it met, and potentially exceeded the requirements of the selection criteria.

## 2.2 Broad-scale scanning of Short-list Fencing Options - Village Residential and Resort Precinct

The Broad-scale scanning of the Fencing Options takes two forms. The first is Table 7 (below) which provides a review of each 'short-listed' option against the performance criteria identified.

**Table 7: Ella Bay Fencing Strategy – Village Residential and Resort Precinct Broad-scale Evaluation**

Ella Bay Resort Fencing Strategy - VILLAGE RESIDENTIAL and RESORT PRECINCT						
SUSTAINABILITY	Criteria for assessment		Options		Ratings: Excellent 2; OK 1; No 0	
And ENVIRONMENTAL Criteria	explanation of terms	1800mm Paling Fence	1200 mm pool fence - powder-coated aluminium	1400 mm Ti-tree (Brush) fencing	comments and mitigation measures	veg planted screen
Deter cassowary access	<i>Deter cassowary access - height and strength to withstand assault cassowary escape possible (if trapped)</i>	2	1	2	pedestrian gates to allow cassowary egress	0
Ability to escape if trapped	<i>either scalable or tearable so trapped cassowary can break through or go over</i>	0	1	0	*need to confirm with Les Moore how high cassowaries can climb - approx 1000mm)	2
Cassowary/ Fauna safety	<i>cassowary safety - no rough edges / spikes etc</i>	0	2	1	Plain wire meets WWF 'safe wildlife fencing' criteria	2
Cassowary visuals to potential food/drink sources	<i>deter cassowary feeding through fence</i>	2	1	2	fence gaps prevent adult hands going comfortably through	2

<b>Ella Bay Resort Fencing Strategy - VILLAGE RESIDENTIAL and RESORT PRECINCT</b>						
<b>SUSTAINABILITY</b>	<b>Criteria for assessment</b>		<b>Options</b>		<b>Ratings: Excellent 2; OK 1; No 0</b>	
<b>And ENVIRONMENTAL Criteria</b>	<b>explanation of terms</b>	<b>1800mm Paling Fence</b>	<b>1200 mm pool fence - powder- coated aluminium</b>	<b>1400 mm Ti- tree (Brush) fencing</b>	<b>comments and mitigation measures</b>	<b>veg planted screen</b>
	<i>deter cassowary seeing food /water sources through fence</i>	2	0	2		1
<b>Access for fauna other than cassowaries</b>	<i>allow access for frogs, lizards, rats, small mammals</i>	0	1	1	all 1's equal comment: ok for frogs, lizards, rats etc but not for pademelons; bandicoots, echidna ....	2
	<i>Prevent access of dogs or pigs</i>	2	1	1	depending on how deep is buried in ground .	0
<b>will not add to sediment or erosion potential of site</b>	<i>to ensure that drainage and siltation issues have been adequately addressed</i>	1	2	1		2
<b>SOCIAL – Residential and Community Amenity</b>						
<b>Visual amenity</b>	<i>aesthetically pleasing - colour, shape, size appropriate to resort experience, standard and visitor expectation</i>	0	1	1		2
<b>Views from residences</b>	<i>*aesthetically pleasing - colour, shape, size *does not look like a prison</i>	0	1	0		2
<b>Breezes and light</b>	<i>amenity - breeze flows through; neat; not visually intrusive</i>	0	2	0		
<b>Security</b>		1	1	1		0
<b>Safety</b>		1	1	0		0
<b>Privacy</b>		1	1	2		2
<b>Pool safety</b>	<i>dual purpose - pool fencing</i>	2	2	0		0
<b>Access and Gates</b>		2	2	2		0
<b>ECONOMIC - COST</b>						
<b>Capital Costs</b>	<i>cost effectiveness in whole of life terms of initial purchase, installation, demolition and disposal</i>	1	1	0	cost efficiencies due to scale of purchase for all pool fencing. Review recyclability of materials	0
<b>Operating Costs</b>	<i>cost effectiveness in terms of maintenance and durability</i>	1	2	1		1
<b>Maintenance and Durability</b>						
<b>Cyclone durability</b>	<i>durable and robust in cyclonic conditions</i>	1	2	1		1
<b>General durability</b>	<i>*durable and robust in tropical rainforest environment *not likely to be undermined by pigs etc *not likely to be easily damaged by whipper snipper or herbicide application</i>	0	2	1		0



<b>Ella Bay Resort Fencing Strategy - VILLAGE RESIDENTIAL and RESORT PRECINCT</b>						
<b>SUSTAINABILITY</b>	<b>Criteria for assessment</b>		<b>Options</b>		<b>Ratings: Excellent 2; OK 1; No 0</b>	
<b>And ENVIRONMENTAL Criteria</b>	<b>explanation of terms</b>	<b>1800mm Paling Fence</b>	<b>1200 mm pool fence - powder-coated aluminium</b>	<b>1400 mm Ti-tree (Brush) fencing</b>	<b>comments and mitigation measures</b>	<b>veg planted screen</b>
	<i>*replacement sections readily available in case of damage</i>					
<b>Operating Costs</b>	<i>low maintenance - no painting; not easily broken or bent; at least 10yrs expected functioning life</i>	0	2	1		0
<b>Monitoring for damage</b>	<i>able to be utilised for monitoring - damage; crossing; by installation of appropriate technology</i>	1	2	2		0
<b>Constructability</b>		1	2	1	using available skills base	1
<b>TOTALS</b>		<b>21</b>	<b>32</b>	<b>23</b>		<b>18</b>

### 2.3 Evaluation of shortlist Fencing Options: Advantages and Disadvantages

The second part of the evaluation of the Shortlist Fencing Options builds on the rating assessment above (Table 7) and discusses the Advantages and Disadvantages of each option in more detail.

#### 2.3.1 1200mm Powder-coated Aluminium “Pool Fence”

The fencing design option that rated highest from this selection process was a 1200mm Powder-coated Aluminium “Pool Fence”. Although this fence option is available in a range of designs, including:

- Flat – ended bar
- ‘Spear-topped’ bar (Figure 20)



- Fleur-de-Lis topped bar, (Figure 21)



- Round-topped bar.

The preferred design for this project is determined to be similar to the image below, with rounded closed top to reduce the risk of damage to either cassowaries or humans.



Figure 22: 1200mm Powder-coated Aluminium Fencing – with closed rounded top

There are a number of clear advantages of this tried and proven fencing option which most effectively addressed the selection criteria, without negatively impacting either Cassowaries or visitors and residents of Ella Bay Resort.

## ENVIRONMENTAL

From an environmental perspective, these fences will

- Deter cassowary access as it has the height and strength to withstand assault by an adult cassowary. Gates or ramps can be included in the design at appropriate locations to allow a cassowary to escape if trapped.
- Protects Cassowary/ Fauna safely as this option, with its closed and rounded top, has no sharp edges or gaps which can trap cassowary heads, feet or feathers yet the base design will allow the passage of smaller fauna – frogs, lizards, rats and mice, and bandicoots through the fence. At the same time, the small gaps between the uprights will deter feeding of, or by the cassowary, through the fence.
- This style of fence can be screened with vegetation (as per the image in Figure 21 below) to discourage attempts by the cassowary to get to potential food or drink sources within the Village Residential and Resort Precinct.



Figure 23: Vegetation screened Pool Fence

- This fence style will not add to the sediment or erosion potential of site. It is stable without requiring or encouraging ongoing ground disturbance. Even if a panel requires changing, the uprights can remain in place. Water will flow below and through the fence, and it will not act as a “dam” if maintained to prevent the build-up of vegetation litter against the fence.
- Although Aluminium has a medium to high environmental footprint to construct, and the product will need to be transported some distance to the site, these fences are made of potentially renewable materials, with a long- life (>10yrs) and require little additional resources to maintain them. They will not rust or require painting so there is little threat of water or soil contamination through their life.

#### **SOCIAL – Residential and Community Amenity**

- This fence option will not be dominant in the landscape from a visual amenity perspective. It is available in a powder-coated range of colours. In the Residential Village and Resort setting, the preference is for a dark colour – Black, Dark Blue, Dark Green or Dark Grey which will ‘fade into the background’ of vegetated hillsides and landscaping.
- The dark colour and size will be appropriate for location and function. The views of, and through the fence, from residences will be minimal and appropriate for the setting.
- The design allows for the passage of air and light, whilst meeting Security (can be locked to deter unauthorised access) and Privacy (can be screened to deter visual intrusion) issues. Access can be controlled via gates that can be locked.
- The existing and proven multi-purpose design of this fence meets Human Safety standards by having no sharp edges and deters climbing by not having a top-rail too narrow to be walked along. It meets Pool Safety Standards, which aim to prevent children’s unauthorised access to water, as it is 1200mm high, provides no toe hold nor has a central rail, which deters climbing over.

#### **ECONOMIC – Cost**

- Capital Costs – The assessment of the whole-of-life cost of the product has included the cost of construction and initial purchase, installation, demolition and disposal and has been found to be acceptable from a financial perspective.
- This fence type is readily available in the market place, and being an established product has a known cost, durability and warranty process. This adds to the confidence of the proponent in the assessment process.

## MAINTENANCE AND DURABILITY

- Of key importance in this region is the Cyclone durability of a design. The preferred option will be better able to withstand cyclonic winds to AS levels than any other option considered.
- The General durability of the fence is high, taking into consideration product life; suitability for tropical conditions; ability to withstand 'normal maintenance' like the use of a whipper snipper and occasional chemical application. It has extremely low Operating Costs, as it requires low or no maintenance and no painting which makes it an appropriate choice.
- The fence can be easily monitored for damage. Visual monitoring can be undertaken and with minor modification, if needed it can be electronically monitored
- Constructability criteria – included the ease of construction, the timeliness and ready availability of fencing panels. This fence type is made from preformed materials that can be constructed using existing skills and methodologies make it an acceptable choice.

### 2.3.2 1400 mm Ti- Tree (Brush) Fencing

The second ranked option for within the Residential Village and Resort Precinct component was: 1400 mm TI- TREE (Brush) FENCING



Figure 24: Ti-Tree (Brush) Fencing

**Ti-tree fencing** can be sourced from renewable forestry operations and can be recycled at the end of its life. It can be designed to safely deter cassowaries from entering the site as it would not be easily climbed by either cassowaries or humans.

## ENVIRONMENT

From an Environmental perspective, these fences will

- Deter cassowary access as it has the height and strength to withstand assault by an adult cassowary. Gates or ramps can be included in the design at appropriate locations to allow a cassowary to escape if trapped.
- Cassowary/ Fauna safety: the fence is 'soft' but care would be needed to ensure that the wire that holds the ti-tree together was well maintained and had no sharp edges or gaps which can cut or trap cassowary heads, feet or feathers. The fence is usually constructed flush to the ground so would prevent the passage of smaller fauna – frogs, lizards, rats and mice, and bandicoots through the fence.
- The lack of gaps in the fence will deter feeding of, or by the cassowary, through the fence.
- These fences are a visual screen that could be supplemented with vegetation, if desired, to discourage attempts by the cassowary to get to potential food or drink sources within the Residential Village and Resort Precinct.



- This fence style will not add to the sediment or erosion potential of site if well maintained. It is stable without requiring or encouraging ongoing ground disturbance. Water will flow through the fence, and it is unlikely to act as a “dam” if maintained to prevent the build-up of vegetation litter or sediment against the fence.

### **SOCIAL – Residential and Community Amenity**

- These fence options will be dominant in the landscape from a visual amenity perspective, their solid colour and size will prevail in the location. There will be no views through the fence, from residences, which makes it inappropriate for the Residential Village and Resort Precinct.
- The design allows for little passage of air and light.
- It will meet Security (can be locked to deter unauthorised access) and Privacy (can be screened to deter visual intrusion) requirements. Access can be controlled via gates that can be locked.
- The design of this fence meet Human Safety standards by having no sharp edges and deters climbing. It meets Pool Safety Standards, which aim to prevent children’s unauthorised access to water, as it is greater than 1200mm high, provides no toe hold nor has a central rail, which deters climbing over.

### **ECONOMIC – Cost**

- Capital Costs – The whole of life cost of product has included the cost of construction and initial purchase, installation, demolition and disposal and has been found to be acceptable from a financial perspective.

### **MAINTENANCE and DURABILITY**

- Of key importance in this region is the Cyclone durability of a design. The Ti-tree fence should be able to withstand cyclonic winds to AS levels.
- These fences are made of renewable and recyclable materials, with a long- life in non-tropical environments (>10yrs) and require little additional resources to maintain them. There is no verifiable information regarding this fences durability in tropical environments. This fence will not require painting so will have a very small environmental footprint once constructed. Maintenance will need to monitor whether the tie wire will rust. There is very little threat of water or soil contamination through its use.
- General durability of the fence, taking into consideration product life; and ability to withstand ‘normal maintenance’, for example, use of a whipper snipper and occasional chemical application. It has extremely low Operating Costs, as it requires no painting make it an appropriate choice.
- The fence can be easily monitored for damage, through visual monitoring.
- Constructability criteria – the pre-formed nature of this produce aids ease of construction. It can be constructed using existing skills and methodologies making it an acceptable choice.

### 2.3.3 Paling Fence

The third ranked option considered for use within the Village Residential and Resort Precinct was an 1800mm Timber paling fence.



Figure 25: Timber Paling Fence

## ENVIRONMENT

From an Environmental perspective, these fences will

- Deter cassowary access as it has the height and strength to withstand assault by an adult cassowary. Gates or ramps can be included in the design at appropriate locations to allow a cassowary to escape if trapped.
- Cassowary/ Fauna safety: This type of fence has no sharp edges or gaps which can trap cassowary heads, feet or feathers. A Paling fence is usually constructed flush to the ground so would prevent the passage of smaller fauna – frogs, lizards, rats and mice, and bandicoots through the fence.
- The lack of gaps in the fence will deter feeding of, or by the cassowary, through the fence.
- These fences are a visual screen, that could be supplemented with vegetation if desired, to discourage attempts by the cassowary to get to potential food or drink sources within the Village Residential and Resort Precinct
- This design will not add to sediment or erosion potential of site. It is stable without requiring ongoing ground disturbance.

## SOCIAL – Residential and Community Amenity

- These fence options will be dominant in the landscape from a visual amenity perspective. Their colour and size will prevail in the location. There will be no views through the fence, from residences, which makes it inappropriate for the setting.
- The design allows for the no passage of air and light.
- It will meet Security (can be locked to deter unauthorised access) and Privacy (can be screened to deter visual intrusion) issues. Access can be controlled via gates that can be locked.
- The design of these fences meet Human Safety standards – not a health hazard to humans having no sharp edges and meets Pool Safety Standards: it meets criteria to prevent children's unauthorised access to water being 1200mm or greater height and has no toe hold. However, depending on construction, the presence of a central or upper rail could be a risk if it fails to deter climbing.

## ECONOMIC – Cost

- Capital Costs – The whole of life cost of product has included the cost of construction and initial purchase, installation, demolition and disposal and has been found to be acceptable from a financial perspective.

## MAINTENANCE and DURABILITY

- Of key importance in this region is the Cyclone durability of a design. The Paling fence is not expected to be able to be cyclone rated to AS levels based on its performance during cyclones in this region.
- These fences can be made of renewable and recyclable materials, with a long- life in non-tropical environments (>10yrs) There is not a lot of information regarding durability in tropical environments however, especially its resistance to white-ant predation. They will not rust but will require painting and potentially preservative and white-ant deterrent application so will potentially have a high environmental footprint, with threat of water or soil contamination through their use and disposal.
- General durability of the fence is appropriate, taking into consideration product life; and able to withstand 'normal maintenance', such as use of a whipper snipper and occasional chemical herbicide application.
- The fence can be easily monitored for damage, through visual monitoring.
- Constructability criteria – the timber paling fence can be constructed using existing skills and methodologies making it an acceptable choice.

### 2.4 Summary of shortlist evaluation - Residential Village and Resort Precinct:

Table 8: Summary of Shortlist Evaluation –Residential Village and Resort Precinct

	<b>Cassowary protection</b>	<b>Human Safety and Amenity</b>	<b>Whole of life cost</b>	<b>Suitability in a Resort Residential Setting</b>	<b>Conclusion</b>
Aluminium powder coated pool fence 1200mm	✓	✓	✓	✓	1
Ti-Tree (Brush) fencing 1400mm	✓	✓	✓		2
Paling Fence 1800mm	✓				3



## 2.5 The Proponents Preferred Option:

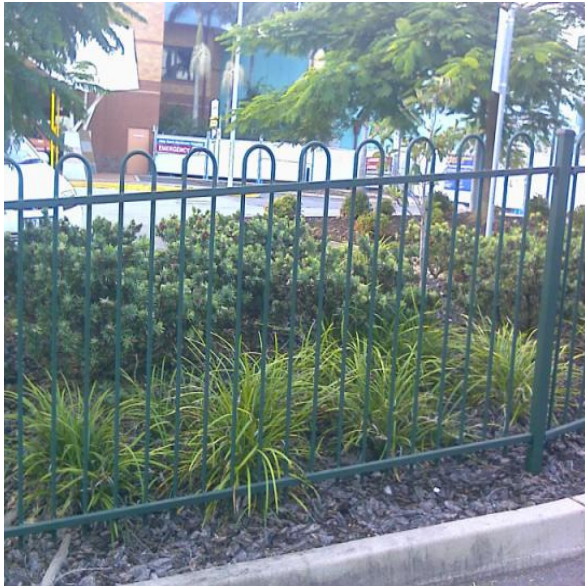


Figure 26: Preferred Option Fence



Figure 27: Fence in Pool setting

**Within the Village Residential and Resort Precinct, the preferred option is the installation of a dark coloured, 1200mm high powder-coated aluminium fence (with a 200 mm gap at the bottom) as per Figure 26 and 27 above.**

The 1200mm high fence is considered at an acceptable height to deter cassowary and human access. The fence would be least visually intrusive from a resort perspective both in height and because it will be powder coated in a dark colour (dark blue; dark green, dark grey or black).

It is strong enough to withstand an attempt by the cassowary to push through, and tall enough to deter it from trying to climb over. The pre-cast "Pool" fence means that there will be no sharp edges to trap or cut the cassowary if it pushes against the fence. The spacing between the uprights, will prevent a Cassowary from entering but will allow small mammals and amphibians to cross safely through. If, in the unlikely instance, a cassowary chick were to pass through the fence, it should be able to safely cross back to its father when called.

This fence will not be a potential contaminant source or a safety risk to cassowaries as there are no areas where the bird can be 'hooked' on the fence. It can also be screened with vegetation in key areas where water or other attractants are present, without compromising the integrity of the fence or its ongoing maintenance regime. If sprayed with small quantities of herbicide, needed to deter vine growth during regular maintenance activities, this will not negatively impacting on the strength, durability, maintenance or functionality of the fence.

The proposed option will allow the passage of air and light through the 1200mm high powder-coated aluminium bars. The design is widely used in public and private places, is proven technology, easily verifiable to be cost-effective to purchase, low maintenance and durable (at least 10yrs. It is strong enough to withstand cyclone winds better than a solid fence and it is white-ant resistant in a tropical environment whilst serving the dual purpose of cassowary deterrent and providing safety and security for residents as it also meets design requirements for pool fencing. It will reduce the risk of anyone feeding cassowaries or the bird feeding through the fence as the distance between the bars is too small for a cassowary's head to pass through or most adult hands, if holding food, to pass through.

As the construction across the site will be staggered over a period of years, the preferred fencing option has the capacity to be reviewed for effectiveness and an alternative (potentially higher) fence

installed if it is determined to be less effective than anticipated in deterring cassowary access or its operation identifies as yet unanticipated safety implications for the birds or humans.

Should a panel be damaged, or should it be determined that a taller fence is required, fence panels are light enough to be handled so that individual panels can be removed and replaced quickly. Rapid repair time is advantageous for the site as it minimises the time taken to reinstate the integrity of the fence and its purpose of reducing opportunities for negative cassowary and human interaction.

## 2.6 Implementation, Monitoring, Feedback and Continuous Improvement

The Fencing Strategy provides for regular appraisal and review of its success by site Environmental staff with the aid of specialist Cassowary, or other fauna and flora consultants. The on-going responsibility for fencing maintenance and repairs will ultimately be the responsibility of the Ella Bay Body Corporate.

All fencing options will to be monitored from construction and over time, from a number of aspects:

- Ensuring that it is deterring cassowary access to areas where the interaction with humans places either the cassowary or the people at risk of harm – that it is the correct height and strength for its purpose.
- Ensuring that no cassowaries are being hurt by interaction with the fencing option – trapped inside, or damaged by pushing against the fence
- Ensuring that cassowaries are using the 'funnels' to the tunnels or designated crossing points (footprint and scat monitoring; observations from the road; possibly movement sensor cameras placed in the tunnels during 'high use' times like when breeding, chick dispersal, fruiting of key food species or dry periods of the year are occurring. Long-term monitoring of these aspects will build a picture of the use and movement dynamics for site cassowaries, adding to the regional picture.
- Ensuring that the fence is being maintained by the regular removal of vines or inappropriate vegetation from the fence; and remains undamaged and intact.
- Monitoring to determine whether smaller fauna are safely crossing through the fence if appropriate. Depending on the fauna type, it may be appropriate to block access through the bottom of the fence, to exclude them. The Aluminium Pool fence would be suitable to do this.
- Ensuring that no other activity is compromising the integrity or intent of the fence – appropriate choice and placement of vegetation to ensure that there are no 'cassowary food' plants in the rehabilitation or screening plantings; materials not being placed against the fence that would allow crossing or compromise the long term viability of the fence; appropriate type and time of maintenance is occurring; no human is 'jumping the fence' to shortcut to another aspect of the site.

The Environmental Management System (EMS) proposed for implementation at the site will provide a mechanism for regular monitoring and reporting on the effectiveness of the fencing in meeting its performance criteria and for feedback and continuous improvement of the process.

It will also be a mechanism to ensure that any research project outcomes or advances in technology for fencing or fauna monitoring are analysed appropriately and the implications fed into management decision making.

### 3. External to Ella Bay - Directional and Access Road Fencing:

The objective of Directional fencing is to deter ground-dwelling and arboreal fauna from accessing the road surface, and to guide fauna to dedicated safe crossing points.

#### **Supplementary EIS P59 B. Outside Ella Bay Solutions**

The road to Flying Fish Point from Little Cove has been assessed in terms of the type of risks it poses to the Cassowary. The principle objective is to slow traffic on the access road at Cassowary crossing points, and establish fences along the side of the road elsewhere. The fencing will protect Cassowaries in adjacent or nearby habitat from traffic flows. At the crossing points, traffic calming measures will be put in place. Traffic calming measures will include:

- designing bends in the road at appropriate places to help slow traffic flows;
- using humps and artificially rutted sections of road to make it uncomfortable for a car to exceed 20 kilometres per hour as it approaches a crossing section; and
- educating drivers of the need to slow down and drive responsibly

#### 3.1 Short-list Evaluation Criteria

Section 1.7 concluded that Short-list Fencing options for the Access Road, to be considered against the Access Road Performance Criteria were:

- 10cm Diamond pattern chain-wire fencing
- Multi-strand plain wire fencing with Shade-cloth covering
- 500mm wide Polypropylene fencing: This option has been used as a cassowary funnel and deterrent fence on the Kuranda Range for more than 10 yrs. It is suspended between 400mm and 600mm above the ground on either a multi-strand wire fence or star pickets

The Shade-cloth and Polypropylene fences would look very similar once constructed. Their significant differences are likely to be in their durability and strength in a tropical environment. Assessment will clarify this.

The proponent chooses to consider the preferred option for the Village Residential and Resort Precinct – the 1200mm powder-coated Aluminium “Pool Fence” along with the Access Road options, as there may be instances where this type of fencing would be appropriate along the Access Road. This will be discussed in the evaluation process.

The fence should meet the following specific Performance Criteria, in addition to operational and economic criteria:

#### **ENVIRONMENT**

- Height and strength that the Cassowary can not scale
- Allow for an escape mechanism for the cassowary
- On-going monitoring and maintenance program to be implemented
- The lower part of the fencing should be designed to allow or restrict the passage of small species including reptiles and frogs as required to protect the species from specific threats.
- The fencing should be designed to allow the passage of climbing species without exposing them to additional risk (ie: wildlife friendly fencing – without barbed wire).
- Designed to ensure that drainage and siltation issues have been adequately addressed.

## SOCIAL and COMMUNITY AMENITY

- Visual amenity – Fence is not dominant in the landscape due to its colour and size; or inappropriate for its location

## MAINTENANCE and DURABILITY

- Accessible for maintenance
- Durable and robust to with-stand Cyclonic conditions

For the Access Road Section 1 – Flying Fish Point Bypass, an added Performance Criteria for this section of road would include Noise attenuation measures to be included in parts of this fencing.

Access Road Section 2 – Balance of road to Heath Point. The purpose of fencing design in this section is to ensure the safety of the fauna such as the Cassowary and other fauna from being hit by vehicles or being trapped on road ways.

Each option was given a rating 0 – 2:

0 - meaning it failed to meet the selection criteria

1 - meaning that it basically met the selection criteria

2 - meaning that it met, and potentially exceeded the requirements of the selection criteria.

### 3.2: Broad-scale Scanning of Short-listed Fencing Options - Access Road

The Broad-scale scanning of the Fencing Options takes two forms. The first is Table 9 (below) which provides a review of each 'short-listed' option against the performance criteria identified.

Table 9: Ella Bay Fencing Strategy – Access Road Fencing Options

Ella Bay Fencing Strategy		ACCESS ROAD FENCING OPTIONS				
SUSTAINABILITY Criteria for assessment	Explanation of terms	1800mm chain mail fence	1400mm pool fence	1200mm shadecloth screen on 4 wire fence - raised 200mm/ 300mm off ground	polypropylene cloth only cassowary funnel fence (as per Kuranda Range) 600mm / 400mm above ground on star pickets	Comments and mitigation measures
ENVIRONMENTAL						
prevention of cassowary access to road	prevention of cassowary access - height and strength to withstand assault cassowary escape possible (if trapped)	2	2	1	1	
ability to escape if trapped	either scalable or tearable so trapped cassowary can break through or go over	0	0	2	2	
Cassowary/ Fauna safety	cassowary safety - no rough edges / spikes etc	0	1	2	1	pad or cap tops of fences

Ella Bay Fencing Strategy		ACCESS ROAD FENCING OPTIONS				
SUSTAINABILITY Criteria for assessment	Explanation of terms	1800mm chain mail fence	1400mm pool fence	1200mm shade cloth screen on 4 wire fence - raised 200mm/ 300mm off ground	polypropylene cloth only cassowary funnel fence (as per Kuranda Range) 600mm / 400mm above ground on star pickets	Comments and mitigation measures
Ensure the safety of the fauna such as the Cassowary and other fauna from being hit by vehicles or being trapped on road ways. Heath Pt Road Section:	Combination of first two criteria above	2	2	3	3	
Access for fauna other than cassowaries	allow access for frogs, lizards, rats, small mammals	1	1	2	2	all 1's equal comment: ok for frogs, lizards, rats etc but not for pademelons; bandicoots, echidna ....
	prevention of access for dogs/ pigs	2	1	0	0	
will not add to sediment or erosion potential of site	to ensure that drainage and siltation issues have been adequately addressed	1	1	0	0	options 1,2 and 3 might be erosion risk if twigs, litter block up behind fence in sediment movement prone areas
<b>SOCIAL – Residential and Community Amenity</b>						
Visual amenity	aesthetically pleasing - colour, shape, size, standard and visitor expectation	0	1	1	1	all can be screened by planting appropriate local vegetation
Views from road	*aesthetically pleasing - colour, shape, size *does not look like a prison	0	2	1	1	as above
Noise Attenuation – Flying Fish Pt Road section	Limits noise impacts on nearby houses.	0	0	0	1	ALL can be designed or veg screened without impacting on the integrity of fence type
Safety						road design
Access and Gates		1	1	2	2	not significant . Fence will limit access

Ella Bay Fencing Strategy		ACCESS ROAD FENCING OPTIONS				
<b>SUSTAINABILITY Criteria for assessment</b>	<b>Explanation of terms</b>	<b>1800mm chain mail fence</b>	<b>1400mm pool fence</b>	<b>1200mm shade cloth screen on 4 wire fence - raised 200mm/300mm off ground</b>	<b>polypropylene cloth only cassowary funnel fence (as per Kuranda Range) 600mm / 400mm above ground on star pickets</b>	<b>Comments and mitigation measures</b>
<b>ECONOMIC - COST</b>						
<b>Capital Costs</b>	<i>cost effectiveness in whole of life terms of initial purchase, installation, demolition and disposal</i>	1	1	2	1	
<b>Operating Costs</b>	<i>cost effectiveness in terms of maintenance and durability</i>	0	1	0	0	
<b>MAINTENANCE and DURABILITY</b>						
<b>Cyclone durability</b>	<i> durable and robust in cyclonic conditions</i>	1	1	0	1	
<b>General durability</b>	<i>*durable and robust in tropical rainforest environment *not likely to be undermined by pigs etc *not likely to be easily damaged by whipper snipper or occasional herbicide application *replacement sections readily available in case of damage</i>	1	2	0	1	
<b>Operating Costs</b>	<i>low maintenance - no painting; not easily broken or bent; at least 10yrs expected functioning life</i>	1	2	0	0	
<b>Monitoring for damage</b>	<i>able to be utilised for monitoring - damage; crossing; by installation of appropriate technology</i>	1	2	1	0	
<b>Constructability</b>		1	1	2	2	
<b>TOTALS</b>		<b>15</b>	<b>22</b>	<b>19</b>	<b>19</b>	



### 3.3 Evaluation of Short-List Fencing Options: Advantages and Disadvantages

The second part of the evaluation of the Shortlist Fencing Options builds on the rating assessment above (Table 9) and discusses the Advantages and Disadvantages of each option in more detail.

#### 3.3.1 1200mm Powder-coated Aluminium “Pool Fence”

The fencing design option that rated highest from this selection process was a 1200mm Powder-coated Aluminium “Pool Fence”, for many of the same reasons which saw it ranked highest for the Village Residential and Resort Precinct.

The preferred design for this project is determined to be similar to the image below, with rounded closed top to reduce the risk of damage to either cassowaries or humans.



Figure 28: 1200mm Powder-coated Aluminium Fencing – with closed rounded top

## ENVIRONMENTAL

From an environmental perspective, these fences will

- Deter cassowary access as it has the height and strength to withstand assault by an adult cassowary.
- Protects Cassowary/ Fauna safety as this option, with its closed and rounded top, has no sharp edges or gaps which can trap cassowary heads, feet or feathers yet the base design will allow the passage of smaller fauna – frogs, lizards, rats and mice, and bandicoots through the fence. At the same time, the small gaps between the uprights will deter feeding of, or by the cassowary, through the fence.
- This style of fence will ensure the safety of the fauna such as the Cassowary and other fauna, preventing them from being hit by vehicles on the Heath Pt Road Section. Gates or ramps can be included in the design at appropriate locations to allow a cassowary to escape if trapped on the roadway.
- This fence style will not add to the sediment or erosion potential of site. It is stable without requiring or encouraging ongoing ground disturbance. Even if a panel requires changing, the uprights can remain in place. Water will flow below and through the fence, and it will not act as a “dam” if maintained to prevent the build-up of vegetation litter against the fence.
- Although Aluminium has a medium to high environmental footprint to construct, and the product will need to be transported some distance to the site, these fences are made of potentially renewable materials, with a long- life (>10yrs) and require little additional resources to maintain them. They will not rust or require painting so there is little threat of water or soil contamination through their life.



### **SOCIAL – Residential and Community Amenity (Ella Bay Village residents)**

- This fence option will not be dominant in the landscape from a visual amenity perspective. It is available in a powder-coated range of colours. In the Village Residential and Resort setting, the preference is for a dark colour – Black, Dark Blue, Dark Green or Dark Grey which will ‘fade into the background’ of vegetation along the roadside.
- The dark colour and size will be appropriate for location and function. The views of, and through the fence, from Ella Bay Road residences will be minimal and appropriate for the setting.
- The design allows for the passage of air and light.
- The 1200mm high Fence provides no toe hold nor has a central rail, which deters climbing over.
- Noise attenuation: Although not being used for the purpose in this image, it illustrates how the fence could be screened by vegetation to reduce noise impacts on nearby houses without impacting on the functionality or integrity of the fence.



Figure 29: “Pool” Fence option screened by vegetation

### **ECONOMIC – Cost**

- Capital Costs – The assessment of the whole-of-life cost of the product has included the cost of construction and initial purchase, installation, demolition and disposal and has been found to be acceptable from a financial perspective.
- This fence type is readily available in the market place, and being an established product has a known cost, durability and warranty process. This adds to the confidence of the proponent in the assessment process.
- This would be the most costly option of those being reviewed. Limiting its use to the most appropriate and visible areas would limit cost.

### **MAINTENANCE AND DURABILITY**

- Of key importance in this region is the Cyclone durability of a design. The preferred option will be better able to withstand cyclonic winds to AS levels than any other option considered.
- General durability of the fence, taking into consideration product life; suitability for tropical conditions; able to withstand ‘normal maintenance’ – whipper snipper and occasional chemical application. It has extremely low Operating Costs, as it requires low or no maintenance and no painting make it an appropriate choice. Where located close to the road, care would need to be taken to limit damage from ‘slope mowers’ and slashers used for roadside maintenance.
- The fence can be easily monitored for damage. Visual monitoring can be undertaken.
- Constructability criteria – included the ease of construction, the timeliness and ready availability of fencing panels. This fence type comprises preformed materials that can be constructed using existing skills and methodologies make it an acceptable choice.

### 3.3.2 Polypropylene Cloth Fence

Polypropylene is an extremely durable rubber based product, commonly used as conveyor belting in industrial situations. It is commonly recycled as lining or barriers for horse-training round yards, as it can withstand being kicked or pushed against by horses without harming the horse. With this historical safe use around animals, it was considered for trial as a cassowary funnel fence on the Kennedy Highway (Kuranda Range) adjacent to Streets Creek, Kuranda. Four fences were constructed of this material in 1997. Those cassowary fences still exist and monitoring by Dr Miriam Goosem of James Cook University (JCU) has indicated that it has been successful in 1) deterring the cassowaries from crossing within 200mm of Streets Creek Bridge, and 2) funnelling cassowaries to use the culvert under the Kennedy Highway. The culvert design (a series of 4m x 3m pre-formed concrete culverts butted together) has also been implemented on the East Evelyn Road by Dept of Main Roads, with success, and is recommended to be included as part of the road design for the Ella Bay Road.

#### ENVIRONMENT

- This fence is normally constructed at a height that the Cassowary can not scale, yet its short constructed length allows escape mechanisms for the cassowary
- Polypropylene is strong and resilient to being pushed by an adult Cassowary.
- On-going monitoring and maintenance program can be implemented to ensure that the fence remains intact and upright. One of the observations of the Kuranda Range fences is that it has only had minimal maintenance over the past 10 years, annual re-staking of the star pickets, which retains its integrity and function.
- The lower part of the fencing could be designed to allow or restrict the passage of small species including reptiles and frogs as required
- This fencing would allow the passage of climbing species without exposing them to additional risk (ie: wildlife friendly fencing – without barbed wire).
- Its constructed (existing) design ensures that drainage is not impacted and that the fence will not act as a “silt fence”, forcing silt to build up or be moved due to the fences presence.

#### SOCIAL and COMMUNITY AMENITY

- Visual amenity – This Fence style is not dominant in the landscape due to its usual location approximately 10m from the road edge. Its colour and size are not intrusive from this perspective. It is appropriate to being located along the road edge.
- For the Flying Fish Point Bypass section, this fencing style has limited Noise attenuation potential, and it would not be considered to meet this criterion. Additional measures would need to be applied.

#### MAINTENANCE and DURABILITY

- This option is particularly durable and robust, as evidenced by the Kuranda Range fence. Its location away from the edge of the road and amongst the vegetation reduces the risk that it would be damaged in Cyclonic conditions. Its additional advantage is that it would be easy to reconstruct if a tree fell over it, whether in cyclone or normal forest conditions.



Figure 30: Polypropylene fence

### 3.3.3 1200mm Shade-cloth screen on 4 wire fence

The Shade-cloth screen on a 4wire fence, would look very similar in its road setting to the polypropylene fence.

#### ENVIRONMENT

- A Shade-cloth screened 4-wire fence is of a height and strength that the Cassowary can not scale, and can be designed to allow for escape mechanisms for the cassowary.
- This fence is designed to that the shade-cloth is placed approximately 300mm above, or flush to the ground, as required to allow or restrict the passage of small species including reptiles and frogs depending on the species to be protected. It could similarly be designed to allow the passage of climbing species without exposing them to additional risk. Although wire, this option does not include any barbed-wire strings so would be considered “wildlife friendly fencing” according to the World Wildlife Fund criteria.
- No drainage or siltation issues would be associated with this design.

#### SOCIAL and COMMUNITY AMENITY

- Visual amenity – The Fence is not dominant in the landscape due to its colour or size. Only this design would be utilised in, and is appropriate for this roadside location.

#### MAINTENANCE and DURABILITY

- A Shade-cloth screened wire fence could be designed to be accessible for maintenance.
- This design is unlikely to be durable and robust enough to with-stand Cyclonic conditions in the open, however, inside the vegetation line, however is easy to reconstruct after such events.
- The wire backing of this fence option would allow for On-going monitoring and a maintenance program can be implemented

### 3.3.4 1800mm Chain Mail Fence (Diamond Pattern)

The Chain Mail Fence option already exists along some sections of Ella Bay Road. It is the Option requested for further consideration by Qld government regulators, despite failing the ‘first pass’ classification, based on recent evidence from Mission Beach of cassowaries being injured by trapping feathers or toes in fence structure.



Figures 31 and 32: 10cm Diamond pattern chain-wire fencing - with barbed wire top

## ENVIRONMENT

- The fence height would be a barrier which would deter any animal or human from crossing.
- For the Access Road Section 2 – Balance of road to Heath Point, the purpose of fencing design in this section is to ensure the safety of the fauna such as the Cassowary and other fauna from being hit by vehicles or being trapped on road ways, so should allow for escape mechanisms for the cassowary. This could be achieved through allowing breaks in the fence where safe to implement them. Without breaks, this fence would not meet the criterion.
- A Chain-wire fence could be designed to allow the passage of small species including reptiles and frogs as required, however, would restrict any larger fauna unable to get through its 10cm diamond shaped openings.
- The fencing, in its 'normally' constructed methodology – with 3-barbed wire strands at the top would be a significant hazard to climbing species, like possums or larger lizards, and potentially to flying foxes and bats by exposing them to the additional risk of being hooked on the barbs. It would fail against World Wildlife Fund's "wildlife friendly fencing" criteria.
- Monitoring would be required to ensure that drainage and siltation are not negatively impacted by the fence's construction and operation.

## SOCIAL and COMMUNITY AMENITY

- Visual amenity – This fence is dominant in the landscape due to its size; although it can be seen through, and allows the passage of air and light.
- For the Access Road Section 1 – Flying Fish Point Bypass, an added Performance Criteria to include Noise attenuation measures is required. The fence itself provides no noise attenuation, however, it could be screened with vegetation in a similar manner to other options.

## MAINTENANCE and DURABILITY

- As evidenced during Cyclone Larry in 2006, this fence design will with-stand Cyclonic conditions because it allows air to move through, however it can be severely damaged by trees falling on it. If damaged, sections of the fence cannot be easily repaired or replaced.
- As evidenced on Ella Bay Road, this fence is high maintenance to remove vines and other scrambling vegetation, the weight of which may act to pull down sections of the fence.
- On-going visual monitoring can be implemented
- A regular and intensive maintenance program must be implemented to ensure that this fence remains functional. A similar chain-wire fence is used at the 'Fish Farm' on the approach road to the Ella Bay Resort site, and the difficulty of preventing this sort of fence being smothered by vines and weeds is evident. Difficulty of maintenance and lack of strength of such a fence under the weight of such vines or vegetation are significant issues. The lack of ability to easily replace small sections of the fence if damaged would be another deterrent.

From a 'wildlife friendly', and an aesthetic perspective the chain-mail fence, with or without the barbed wire on the folded back section, is considered inappropriate for the Wet Tropics World Heritage Area and leading to a resort facility in this location. This chain-link wire fence style has recently contributed to injury of a cassowary in the Mission Beach Area when its feathers were caught in the fence causing it to hurt itself trying to escape. The Dept of Main Roads "Roads in the Wet Tropics" Manual (2006) states:

"Southern Cassowaries react badly to wire mesh fences as they can see the habitat on the other side and will continually attempt to push through the fence, damaging both themselves and the fence."

Therefore, although this was recommended for further consideration in the EIS, this evidence removes it from further consideration.

### 3.4 Summary of Shortlist Evaluation - Access Road

Table 10: Summary of Shortlist Evaluation – Access Road

	<b>Cassowary protection</b>	<b>Human Safety and Amenity</b>	<b>Whole of life cost</b>	<b>Suitability in a Access Road Setting</b>	<b>Conclusion</b>
Aluminium powder coated pool fence 1200mm	✓	✓	✓	limited	1
Polypropylene and Wire fence	✓	✓	✓	✓	2
Shade-cloth lined wire fence	✓	✓		✓	2
1800mm Chain-mail wire fence	limited			limited	3

This shortlist of options has not limited the selection process to only one option. This is because along the road alignment there will be locations where one option may be better suited than another.

Fencing along the entire section of road from Flying Fish Point to Ella Bay would not be appropriate from an environmental, economic or social perspective. Ideally, fencing would be located:

- in short (maximum 50m long) “high-risk” sections with the intent of ‘funnelling’ fauna to an appropriately safe road crossing destination; and
- in sections where a cassowary might safely cross the road, and has previously done so.

Locating fencing in these sections would be to deter the bird from crossing only where other strategies cannot be implemented to sufficiently reduce the risks to the bird from traffic, ie: traffic speed limitation; road design; traffic ‘calming’; education of drivers.

### 3.5 The Proponents Preferred Option(s)

A combination of the Pool fence and the Polypropylene options should be considered for deterring the cassowary from crossing the road in areas where access is available but where it is dangerous for them to cross. The preferred option would be the majority of fencing to comprise the Polypropylene type, with the judicious use of the Pool Fence option where prevention of access is required and where the fence is visible from the road.



Figure 33: Polypropylene fence at Streets Creek, Kuranda.



As at Streets Creek on the Kuranda Range Road (Figure 31 previous page), the placement of the Polypropylene fence an appropriate distance (approx 10m) from the road would meet its function of deterring Cassowaries from crossing at that point and 'funnel' them to an appropriate crossing point, reducing its visual impact yet still make it accessible for maintenance. The short length and appropriate location of these fences would provide 'exit' points for cassowaries that might be trapped inside the fence. This fence would also be appropriate to funnel the cassowary toward designated natural and constructed crossing points.

Noise attenuation along aspects of this fence closest to housing can be achieved through the use of either fence type and screening with thickly planted appropriate vegetation or by the implementation of earth bunds created from fill material which are then revegetated and or fenced appropriately.

The pool fence option could be constructed in key areas to restrict access of smaller fauna to the road by placing (or even burying) the polypropylene fencing to ground level against it. The pool fence is still scalable by climbing fauna yet able to deter being climbed by other fauna or people as it has only a bottom and top rail separated by 1200mm powder-coated Aluminium uprights.

### 3.6 Implementation, Monitoring, Feedback and Continuous Improvement

The Fencing Strategy provides for regular appraisal and review of its success by specialist Cassowary, fauna and flora consultants. On-going responsibility for fencing maintenance and repairs will ultimately be the Cassowary Coast Shire Council as it is a Council road.

Each of these fencing options needs to be monitored from construction and over time, from a number of aspects:

- Ensuring that it is deterring cassowary access to areas where the interaction with humans places either the cassowary or the people at risk of harm – that it is the correct height and strength
- Ensuring that no cassowaries are being hurt by interaction with the fencing option – trapped inside, or damaged by pushing against the fence
- Ensuring that cassowaries are using the 'funnels' to the tunnels for crossing access road (footprint and scat monitoring; observations from the road; possibly movement sensor cameras placed in the tunnels during 'high use' times like when breeding, chick dispersal, fruiting of key food species or dry periods of the year are occurring. Long-term monitoring of these aspects will build a picture of use and movement dynamics for site cassowaries, adding to the regional picture.
- Ensuring that the fence is being maintained by the regular removal of vines or inappropriate vegetation from the fence; and remains undamaged and intact.
- Monitoring to determine whether smaller fauna are safely crossing through the fence if appropriate. (depending on the fauna type – it may be appropriate to block access through the bottom of the fence – the steel fence would be suitable to do this)
- Ensuring that no other activity is compromising the integrity or intent of the fence – appropriate choice and placement of vegetation to ensure that there are no 'cassowary food' plants in the rehabilitation or screening plantings; materials not being placed against the fence that would allow crossing or compromise the long term viability of the fence; and that the appropriate type and time of maintenance is occurring.

The Environmental Management System (EMS) proposed for implementation at the site will provide a mechanism for regular monitoring and reporting on the effectiveness of the fencing in meeting its performance criteria and for feedback and continuous improvement of the process.

It will also be a mechanism to ensure that any research project outcomes or advances in technology for fencing or fauna monitoring are analysed appropriately and the implications fed into management decision making.



#### 4. Conclusion

The Fencing Strategy is only one aspect of a range of solutions proposed as part of the Cassowary Management Strategy. All of these solutions are part of an integrated, holistic approach to the design of Ella Bay as a sustainable community. Individually, these solutions will not be sufficient on their own and they should be seen as a package of measures. The preferred fencing options proposed in this strategy meet the maximum number of performance criteria possible, with an emphasis on meeting the environmental aspects and reducing the environmental risks identified.

Regardless of the engineering solutions applied to protect and enhance the viability of cassowaries on this site, the success measure of “no cassowary deaths associated with activities related to the Ella Bay Resort” will be as a result of the education of, and application of, those key messages by staff, residents, visitors and construction crews who travel to and utilize the site. Their commitment to:

- slow down whilst driving and the imposition and enforcement of speed limits on the access and internal roads,
- road rumble strips
- appropriately placed ‘cassowary exclusion and directional fences’;
- appropriately placed and interpreted signage;
- the strict imposition of a ‘no feeding’ rules;
- the encapsulation and regular removal of rubbish that the cassowary could consider as food;

are just a few of the control measures that are committed to be implemented.

One of the key attractions of a site like this is that the locals COULD see a cassowary. It is a rare and special experience, which this site has the opportunity to share with visitors and residents by its commitment to implementing, and continuously improving on, the most appropriate range of management options over time. This requires an ongoing commitment to education and leading by example for Satori staff at all levels and a dedication to monitor and review the effectiveness of proposed mitigation methodologies and continuously improve environmental management.

In this manner, the Ella Bay Fencing Strategy will be part of an effective solution to ensure the safe co-existence of the Ella Bay community with the local fauna and, in particular the Cassowary.

#### 5. References

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