LONG ISLAND TOURISM DEVELOPMENT, ABROLHOS ISLANDS, WESTERN AUSTRALIA:

PUBLIC ENVIRONMENTAL REVIEW

JULY 2006

PREPARED FOR

HUMFREY LAND DEVELOPMENTS

BY

MBS ENVIRONMENTAL

4 Cook Street
West Perth WA 6005
Australia

Telephone: (618) 9226 3166
Facsimile: (618) 9226 3177
Email: info@mbsenvironmental.com.au

MARTINICK BOSCH SELL PTY LTD
ABN 60 102 614 479
MBS ENVIRONMENTAL
environmental and water resource consultants

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1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

Humfrey Land Developments (HLD) proposes to develop a tourist resort on Long Island, within the Wallabi Group of the Abrolhos Islands, which are located 60 kilometres west of Geraldton, Western Australia. The resort will be operated by Broadwater Hospitality.

Following a Request for Proposals, HLD were selected in December 2004 by the Department of Fisheries (Western Australia) as the preferred developer and operator of the Long Island tourist resort. In April 2005, the Environmental Protection Authority (EPA) set the level of assessment for the proposed tourism development at Public Environmental Review (PER) and the Commonwealth Department of the Environment and Heritage (DEH) declared the proposal to be a "controlled action" under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*). An Environmental Scoping Document prepared by HLD was accepted by the EPA in November 2005 (see Appendix 1 on CD).

1.2 PROPOSAL

The proposed facility will accommodate up to 60 overnight guests within 30 visitor lodges. Ten staff shall be accommodated within staff facilities. Guest accommodation will be supported by communal facilities, staff accommodation, swimming pool, a deep water jetty, helipad and service and maintenance units. Each guest/staff lodge will be provided with an internal bedroom and bathroom facilities. Small guest gazebos and swimming platforms will be situated around the northern portion of the island and will be accessed via a raised boardwalk.

The proposed resort is located within a development zone designated by Department of Fisheries that occupies the central portion of Long Island. The resort will occupy a footprint of about 0.64 hectares within the development zone and the northern and southern boardwalks will cover areas of 0.11 hectares and 0.14 hectares, respectively. A jetty and helipad will be located over water on the western side of the Long Island and accessed by the southern boardwalk.

1.2.1 Resort Services

Tourists will be transported to the resort by charter boats, plane and helicopter. Provisions will be transported to the island by supply boats.

The primary power supply for the resort will be diesel. This will be augmented with solar power where possible.

Potable water will be produced by a desalination plant, with seawater pumped from a beach bore located on the western side of the island.

Black wastewater from flush toilets and greywater will be combined and treated in a centralised unit before discharge to deep water in Goss Passage on the eastern side of the

island. The hypersaline wastewater produced by the desalination plant will be disposed of via an adjacent pipeline into Goss Passage.

Resort provisions will be pre-prepared and all unnecessary packaging removed on the mainland. All solid wastes generated will be transported back to the mainland for disposal.

1.2.2 Tourist Activities

All activities undertaken will be strictly controlled and monitored by staff. Guests will be required to undergo an induction.

The resort will provide activities that include:

- Nature-based activities including bird watching, glass bottom boat tours, snorkelling and fishing charters.
- Heritage activities associated with the *Batavia* shipwreck and mutiny.
- Recreational activities including kayaking, aqua-aerobics, cruises and rock lobster fishing excursions.

1.3 EXISTING ENVIRONMENT

1.3.1 Regional Setting

The Houtman Abrolhos Islands (the Abrolhos) are an archipelago of 122 low-lying islands and reefs spread over 100 kilometres at the edge of the continental shelf between 28 degrees 15 minutes south and 29 degrees 00 minutes south and comprise three major groups of islands: Wallabi, Easter and Southern Groups. Long Island is situated within the Wallabi Group of islands.

The Geraldton region experiences a Mediterranean-type climate, characterised by hot, dry summers and mild, wet winters. Summer winds at the Abrolhos are most commonly from the south-east and south-west with speeds in excess of 20 kilometres per hour occurring 76 percent of the time and exceeding 32 kilometres per hour 44 percent of the time. The average rainfall experience at the Abrolhos is 333.5 millimetres per year.

1.3.2 Conservation Status

The waters of the Abrolhos Islands are a Class A Reserve (A20253) vested in the Western Australian Minister for Fisheries under the *Land Administration Act 1997* (WA) and managed by the WA Department of Fisheries pursuant to the *Fish Resources Management Act 1994 (FRMA)*. The State Territorial Waters of the Abrolhos Islands are a gazetted Fish Habitat Protection Area (FHPA) under section 115 of the *FRMA*.

Reef Observation Areas (ROAs) were established in 1994 based on criteria contained in the Abrolhos Islands Aquatic Reserve Final Report (1993). The ROA at Beacon Island includes some of the coral areas to the north of Long Island.

The Register of the National Estate includes several listings for the Abrolhos including the Houtman Abrolhos Islands Reserve. This reserve is listed because of the significance of the shipwrecks in the area, the importance of the marine environment and the bird life of the islands. The Register includes other listings, such as the *Batavia* and *Hadda* shipwrecks, which are in the vicinity of Long Island.

On 6 April 2006, an area of the Wallabi Group (including Long Island) was gazetted for inclusion on the National Heritage List (NHL) under the *Batavia* Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos. The proposed tourism development is a "Controlled Action" on the grounds of National Heritage and as such requires approval under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).*

The inclusion of the site on the NHL means that the values as identified by the Australian Heritage Council must be protected, and it is these values, and not necessarily the entire place itself, that is protected through listing. These values are protected under the *EPBC Act 1999* (Department of the Environment and Heritage, 2006, website: www.deh.gov.au/heritage/ national/implications.html). A person cannot take an action that will have a significant impact on the national heritage values of a listed place without the approval of the Australian Government Minister for the Environment and Heritage.

1.3.3 Geology and Landform

Long Island is a Leeward (eastern) island composed of coral rubble and emergent reef foundations which are about 5,000 years old. These modern reefs, formed during the Holocene, occur over the top of ancient Pleistocene reefs.

Long Island is a small island covering 10.5 hectares. It is generally flat, being about two to three metres above mean sea level, with a small central portion extending slightly over four metres above sea level. There are seven tidal ponds scattered across the island, which were studied by Black and Johnson (1997). Tidal Pond 504 is located within the resort development zone and Tidal Pond 503 is north and adjacent to the development zone.

1.3.4 Terrestrial Flora and Vegetation

A total of 38 flora species have been recorded on Long Island, comprising 14 families, of which Asteraceae, Chenopodiaceae and Poaceae constitute 60 percent of the species. One Priority 4 species, *Lepidium puberulum*, was recorded within the development zone, adjacent to Tidal Pond 504. A total of 14 weed species are widespread across Long Island and within the proposed tourism development area.

Fifteen vegetation communities have been mapped and recorded on Long Island by Harvey *et al.* (2001). The vegetation of the resort development area is mainly sparse scrub of *Myoporum insulare* over an *Atriplex* species heath with a mixed species sparse grassland and *Senecio lautus* [sic] herbfield.

1.3.5 Terrestrial Fauna

1.3.5.1 Avifauna

The Abrolhos Islands are among the most important seabird breeding islands in Australia and support significant breeding colonies of some species (Burbidge and Fuller, 2004). The islands are home to 113 species of birds, including large breeding colonies of Sooty Tern, Bridled Tern, Wedge-tailed Shearwater, Roseate Tern, Fairy Tern, Little Shearwater, Lesser Noddy and Common Noddy. They also contain significant numbers of breeding Osprey and White-Breasted Sea Eagles. As such, the islands are of international and national significance for bird watchers. Birds are the most significant terrestrial vertebrate fauna present on Long Island.

Twenty-eight species of birds have been recorded on Long Island (Burbidge and Fuller 2004, Storr *et al*. 1986, Surman 2006a). Of these, 12 species have been confirmed as breeding regularly: White-breasted Sea Eagle, Osprey, Pacific Gull, Silver Gull, Caspian Tern, Crested Tern, Bridled Tern, Eastern Reef Egret, Pied Oystercatcher, Grey Breasted White Eye, Little Shearwater and White-faced Storm-petrel (Surman 2006a).

Eight species of birds that occur within the Houtman Abrolhos are listed under the Wildlife Conservation (Specially Protected Fauna) Notice 2006 (*Wildlife Conservation Act 1950*). Of these, none have been reported from Long Island.

Three species of bird that occur at the Houtman Abrolhos are also listed as Priority Fauna on the CALM Threatened and Priority Fauna Database; the Eastern Curlew, Hooded Plover and Brush Bronzewing. Of these only the Brush Bronzewing has been observed on Long Island (Storr *et al*. 1986). No breeding observations of this species are recorded from Long Island, although this species may visit to feed from time to time.

Ten *EPBC* Threatened Species may occur in the Abrolhos and 32 species are listed as Migratory. Two *EPBC* Threatened Species could potentially be encountered on or near to Long Island: the Lesser Noddy (vulnerable) and the Abrolhos Painted Button Quail (vulnerable), although neither has been sighted nor is known to breed on Long Island. Of the Migratory Species, 11 have been recorded for Long Island and five species are known to breed on Long Island.

1.3.5.2 Other Terrestrial Fauna

Only one species of terrestrial fauna is found on Long Island, the skink *Menetia greyii*. *M. greyii* is known to live under slabs of coral rubble or in vegetation litter.

No amphibians or land mammal species occur on Long Island.

1.3.6 Marine Environment

1.3.6.1 Benthic Habitats

The most widespread habitat surrounding Long Island was deep *Acropora* spp. 'stands', found surrounding and at the bottom of the several deep basins on the western side of the island. Shallow *Acropora* spp. reef, found along the east coast extending out from the island to approximately five metres (Chart Datum) were the next most widespread habitat within the

area surveyed, followed by sand and coral rubble, found extending offshore from just below mean sea level around much of the island.

1.3.6.2 Marine Flora

Habitats surrounding Long Island which exhibited an extensive cover of macroalgae were 'rhodolith beds', 'Bedrock/dead coral platform', 'Coral rubble with *Sargassum* sp.' and 'Coral rubble and sand with live sub-massive corals and brown macroalgae'. The dominant algae in the shallow waters surrounding Long Island were *Sargassum* sp., *Caulocystis* sp. and *Turbinaria* sp., with *Ulva* sp. abundant on some intertidal reef areas.

1.3.6.3 Marine Mammals

Australian Sea Lions (*Neophoca cinerea*) are recorded to use Long Island as a haul-out site. On Long Island, sea lions have been known to use the areas covered in Samphire *Halosarcia* sp. on the northern narrow neck of the island adjacent to Tidal Pond 503.

The Australian Sea Lion is listed under Schedule 4 (other specially protected fauna) of the Western Australian *Wildlife Conservation Act 1950*.

1.3.6.4 Tidal Pond Molluscs

Eleven species of molluscs have been found in the seven tidal ponds of Long Island, consisting of eight gastropods, one bivalve and one to two species of chitons (identification was inconclusive). No unique species have been found in the ponds (Dr. F. Wells, Department of Fisheries, pers. comm.).

One mollusc (*Onchidium sp*.) was found in Tidal Pond 504 that was not recorded for any of the other ponds. This mollusc is not considered to be unique and would also be found in other ponds of the Abrolhos and on the mainland coast (Dr. F. Wells, Department of Fisheries, pers. comm.).

1.3.6.5 Marine Reptiles

No specific records have been found of marine reptiles using Long Island and it is thought that sea turtles do not breed in the islands of the Abrolhos.

1.4 EXISTING SOCIAL ENVIRONMENT

1.4.1 Commercial Fishing and Aquaculture

Three commercial fisheries operate in the Abrolhos (Webster *et al*., 2002) and comprise:

- Western rock lobster (*Panulirus cyngus*). The fishing season runs from 15 March to 30 June each year.
- Mid-west Trawl Fishery - Southern saucer scallop (*Amusium balloti*) and western king prawns (*Penaeus latisulcatus*).
- Wetline Fishery - Finfish (various species).

Commercial aquaculture activities are conducted in the Abrolhos, predominately for the culture of black pearls.

1.4.2 Tourism

The Abrolhos Islands have a long history of tourism and recreation activities. The islands are popular with recreational fishers, snorkellers and scuba divers alike. They are also of national and international importance for bird watching. Other activities that occur in the region include aquatic animal watching (such as whale watching), charter fishing expeditions, surfing, windsurfing, sailing and cruising.

1.4.3 Aboriginal Heritage and Culture

A search of the available literature on the Abrolhos Islands did not indicate that there were any indigenous heritage and cultural issues. A search of the Register of Aboriginal Sites maintained by the Western Australian Department of Indigenous Affairs returned no results.

Consultation with the Yamatji Land and Sea Council indicated that the Abrolhos Islands were not part of the Yamatji Native Title Claim and that Yamatji would be unlikely to have concerns of a cultural nature with the proposed development.

However, legal representatives from Yamatji Marlpa Land and Sea Council advised that formal advice would need to be sought from four coastal native title claimants in the Geraldton region (Hutt River WC00/1, Naaguja WC97/73, Amangu WC04/2 and Nanda) at the next round of official meetings. Two of these meetings (Amangu and Naaguja) have already taken place and were attended by the proponent. The claimants responded that they had no concerns with the proposal. A meeting date has not yet been set for the Nanda meeting. The proponent has been advised by the Yamatji Marlpa Land and Sea Council that it will not be necessary to meet specifically with Hutt River claimants as these individuals are all represented within the other groups and would therefore be consulted within the other three meetings. The issue of Aboriginal Heritage will be concluded after the meeting with the Nanda group.

1.4.4 European Heritage

The Wallabi Group possesses sites of cultural and heritage value associated with the *Batavia* and other shipwrecks (e.g. the *Hadda*), the fishing industry, guano mining and military use during World War II. Long Island has a high heritage value both nationally and internationally through its association with the *Batavia* wreck and mutiny.

Long Island was the location of the second largest slaughter of the mutiny. Approximately 41 people were murdered here. The mutineers were imprisoned, tried and several subsequently hanged on Long Island.

Several small archaeological surveys have been conducted on Long Island. Jack-Hinton *et al.* undertook a surface collection and visual survey of the island in 1967 and recovered a Rhenish beardman jug shard from the northern end of the island (Anderson *et al*., 2005).

Metal detector surveys undertaken by the Western Australia Maritime Museum of the northern and central portions of Long Island, which includes the resort development zone, found no conclusive surface evidence for the location of the gallows or occupation sites. A "morning star" which is a piece of lead sheathing that had been moulded into a ball (and could have been used as a weapon) and three iron fastenings were located within the northern portion of the island. The most notable artefact found within the resort development zone was a ship's fastening, which was found high on the ridge and buried under some coral rubble. It is likely that it could have been used as a weapon during the *Batavia* mutiny, formed part of the gallows or originated from a piece of ship related driftwood.

1.5 COMMUNITY AND GOVERNMENT CONSULTATION

The Department of Fisheries proposes to develop tourism opportunities in the Abrolhos and has conducted consultation with regard to the potential options since 1989.

HLD has undertaken a comprehensive stakeholder consultation process to ensure that relevant environmental and heritage concerns have been addressed in the design and management of the proposed tourist resort on Long Island. These consultations have included:

- Meetings with government agencies and authorities including Department of Fisheries, Department of Conservation and Land Management, the Board of the Environmental Protection Authority, the Department of Environment, WA Museum, WA Maritime Museum, local and Shire Authorities and Tourism WA.
- Meetings with stakeholder groups from tourism, heritage, Aboriginal, fishing, environmental and research organisations.
- Public Notice announcements of the proposed resort in the West Australian, the Geraldton Guardian and the Mid-West Times newspapers.
- Information letter sent to 61 stakeholder groups/individuals to advertise the availability of the Environmental Scoping Document and an invitation to provide comment on the proposal.
- Follow-up letters sent to key stakeholders to ensure comments had been forwarded.

Details of all issues raised and responses made during consultation by HLD are provided and discussed in Chapter 6. The consultations were considered to be all-inclusive and transparent. HLD is appreciative of the time and involvement of all respondents.

1.6 SUMMARY OF ENVIRONMENTAL FACTORS

Table 1.1: Relevant Environmental Factors for EPA Referral

Environmental Factor	Environmental Objective	Existing Environment	Potential Impacts	Environmental Management	Predicted Outcome
Carrying Capacity and Sustainability					
Visitors to the Abrolhos	To ensure the sustainable ecological and recreational carrying capacity of the local and regional environment is not exceeded by the proposed development.	There is no formalised land-based tourist facility in the Wallabi Group or the Abrolhos Islands and it is projected that the Long Island tourism development will attract up to 5,275 guests in a typical year.	**Increased No. of Visitors** Promotes tourism in the area, provides a focal point for visitors and economic benefits. Education of visitors and community on values of the Abrolhos. Increased visitation to Long Island and other islands through an increased number of people may lead to environmental degradation. Increase in the number of boats visiting the island may lead to loss of amenity and increased chance of a sullage spill or an introduced marine pest.	Induction Programme for all guests. Implement monitoring and the Visitor Activity Management Plan (VAMP). Integrate management of the resort with the wider management of the Abrolhos by Department of Fisheries/AIMAC. Implement procedures for dealing with boats landing on the island. Implement procedures to manage the number of boats going to Long Island (e.g. moorings, etc). Implement a Resort Environmental Management and Monitoring Plan during the operation of the resort.	The proposed management measures taking into consideration the management measures proposed for the environmental factors of biodiversity, pollution management and amenity will help to ensure that environmental impacts are minimised.
			Fishing Increase in recreational fishing pressure may lead to a reduction in fish populations.	No fishing permitted on Long Island. Licensed charter fishing operators will be used. Charter fishing 'catch-and-release' basis with the exception of 1 fish per person.	

Biophysical					
Terrestrial Flora and Vegetation	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. Protect declared rare and priority flora, consistent with the provisions of the *Wildlife Conservation Act 1950* and the *EPBC Act 1999.* Protect other flora species of conservation significance.	Main development zone mostly covered by the mSp a2Zc xGr s2Fi association (Sparse scrub of *Myoporum insulare* over an *Atriplex* species heath with a mixed species sparse grassland and *Senecio lautus* [sic] herbfield).	Clearing of vegetation during construction leading to increased wind erosion. Degradation of seabird nesting habitat through removal of vegetation. Trampling of vegetation during construction and by guests during operation. Weed introduction by construction workers, visitors or day visitors.	Buildings and boardwalks raised on supports. This will reduce the total area of clearing required. A Construction Management Plan (CMP) will be implemented. An avifauna expert will be on site during the start of construction. All access ways shall follow the alignment of the boardwalk where possible. Trampling of vegetation will be monitored by resort staff as part of the Operational Environmental Monitoring and Management Plan. Special consideration will be given to the CALM Priority 4 flora species *Lepidium puberulum*. Weed invasion will be controlled through procedures contained in a Weed Management Plan (WMP).	Clearing will be required during construction of the resort. None of the vegetation communities impacted will be taken below the "threshold level" of 30 percent. The environmental objective for terrestrial flora and vegetation will be achieved.

Biophysical					
Terrestrial Fauna (Birds)	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Twenty-eight species of birds have been recorded on Long Island. Of these, 12 species have been confirmed as breeding regularly.	**Habitat and Disturbance** Direct disturbance to habitat within area that is required for the resort infrastructure and alteration to foraging habitat. Increased disruption to roosting or feeding behaviour of *EPBC* listed Migratory Species. Disturbance caused by guest activities.	Implement the Avifauna Management Plan. Disturbance to vegetation will be minimised Construction activities coordinated to reduce impact on the breeding cycle of resident birds, particularly burrow-nesting species. Construction activities monitored by suitably qualified personnel. Movement on the island will be kept to designated pathways. All personnel associated with operations on Long Island will be inducted into Avifauna Management Plan. Tri-annual monitoring surveys will be undertaken.	Given the management and mitigation procedures outlined above and further documented in the Avifauna Management Plan, it is considered that the environmental objective for this factor will be met.
			Lighting Potential injury, disorientation or death to birds from collision with development infrastructure due to inappropriate lighting.	Manage lighting of resort buildings, accommodation units and vessels during construction and operations of the development to reduce attractive powers of lighting.	

Biophysical					
			Vessels and Helicopters Attraction to vessels or injury associated with deep water fishing activities. Impacts associated with helicopter arrivals/departures.	No fish offal, bait or other fishing waste will be disposed of at sea, or in the vicinity of seabirds. Fishing vessels will use methods to avoid capture of seabirds with baited hooks. Speeds of motorised boats will be subject to limits near islands. "No go" areas and seasonal closures implemented. During visits to other islands, resort guides or contractors supply information on minimising impacts. Flight paths of aircraft will be fixed and not over islands. Helicopters will have a fixed flight path around the northern limits of Long Island and approach from the sea. No flights during night.	
Terrestrial Fauna (Birds) (cont'd)			**Nuisance Species** Certain species could become nuisance species through feeding or through the presence of alternative water/food sources. Particularly Silver Gulls.	Implement staff/visitor induction programme and interpretive signage at key points in the resort. Food scraps will be removed from the island and kept secure prior to this time. Silver Gull populations will be monitored as part of the Avifauna Management Plan.	

Biophysical					
Terrestrial Fauna (Non-Bird Fauna)	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Only one species of terrestrial fauna is found on Long Island, the skink *Menetia greyii.* This skink is also found on North Island and composite islands in the Easter and Southern Groups. The skink is also found on the mainland. *M. greyii* is known to live under slabs of coral rubble or in vegetation litter.	**Native Fauna** During construction, operation or decommissioning of the resort, there is potential for habitat of the skink to be trampled. Some other islands may be visited that may host unrecorded populations of fauna of conservation significance. There is potential for damage to habitat to result from these visits.	Clearing of vegetation to be minimised. Resort area raised to facilitate fauna movements. Dust generation and noise will be minimised through the development of the CMP. All personnel will be inducted in the importance of remaining on the boardwalks at all times. Signage will be installed. West Wallabi Island will not be visited for tours. Tours to other islands will be escorted only. Seasonal closures will be implemented. Traversing of islands will be done strictly on existing tracks or beach as appropriate.	Taking into account the management and mitigation measures outlined above, it is considered that the environmental objective for fauna will be achieved.
		There are currently no known species of vermin on Long Island.	**Vermin** Risk of introducing vermin during construction phase. Risk of visitors, including day visitors, introducing vermin to the island. Increased prevalence of vermin species due to food supply and storage and waste generation and storage.	Implement the Vermin/Pest Management Plan prior to construction phase. This will include quarantine procedures.	

Biophysical					
Marine Habitat	To prevent (or limit) significant loss of benthic primary producer habitat (BPPH) and communities and maintain ecosystem integrity.	Long Island is surrounded by coral reefs, mostly *Acropora* spp. 'Stands' of *Acropora* are found surrounding the bottom of the several deep basins on the western side of the island. Shallow *Acropora* spp. reef is found along the east coast. Habitats surrounding Long Island which exhibited cover of macroalgae were 'rhodolith beds', 'Bedrock/dead coral platform', 'Coral rubble with *Sargassum* sp.' and 'Coral rubble and sand with live sub-massive corals and brown macroalgae'.	**Wastewater Outlet** Direct or indirect loss/damage of BPPH expected from proposed wastewater outlet pipeline construction and operation. Direct losses incurred would be approx. 70 square metres coral reef. Indirect losses may be lower reproductive output, altered growth patterns or increased mortality of some species within a radius of approximately 50 metres of the end of the outlet. Effects of the discharge on the other habitats in this area may be a slight increase in the growth of macroalgae on bare rock substrate.	Implement Marine Management and Monitoring Plan. Outlet path will be selected to minimise impacts. Back-filling of trench and rubble/concrete anchoring of pipe would counter the loss of hard substrate and new surfaces likely to be rapidly colonised. Low volume to be discharged. Discharge to highly dispersive environment. Annual monitoring of site.	Cumulative loss of benthic habitats will be expected to be less than two percent of the cumulative loss threshold for Category C under the BPPH guidance statement (EPA 2004). Therefore it is considered that the environmental objectives for this factor have been met.
			Jetty and Helipad Direct impacts through modification of habitats beneath and adjacent to jetty and helipad during construction. Indirect impacts caused by shading (jetty and helipad) and turbidity/suspended sediment/scour (jetty use) effects.	Use of piles to secure jetty will result in minimal habitat loss and minimal turbidity. Piles will act as new substrate for invertebrate colonisation. Annual monitoring of site to ensure corals are not damaged more than 10m from jetty due to vessel operations. If corals are damaged beyond this zone, examine mitigation methods. Helipad is sited predominantly over unvegetated habitat. Offshore edge of jetty over deep (>5m) water to reduce scour effects.	

Biophysical					
Marine Habitat (cont.)			**Tourist Activities** Direct damage due to tourist activities – boat anchors, damage by snorkellers/divers. Could cause physical damage of shallow water sensitive coral habitats surrounding Long Island.	Designation and enforcement of 'no-go zones' around Long Island where shallow coral habitats are located. Diver/snorkeller management plan is part of the Marine Management and Monitoring Plan, including thorough induction for all participants. Boat moorings to be installed to prevent the need to drop anchor.	
			Marine Pests Potential for resort-associated vessels to transport introduced marine pests to the waters of Long Island.	As a precaution, no vessels shall be permitted to purge bilge water within the surrounds of Long Island. Where possible, all vessels shall be required to empty bilge water in the open ocean.	
Vertebrate Marine Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Australian Sea Lions are found at the northern limit of their range. Sea Lions are known to use the islands of the Wallabi Group as haul-out areas but not for breeding. Other marine mammal species known to occur around the Abrolhos are the Humpback Whale, Bryde's Whale, Minke Whale, Bottlenose Dolphin and Striped Dolphin.	**Sea Lions** Increased presence of humans at Long Island and visiting other islands nearby may disturb any Australian Sea Lions attempting to use the islands as a haul-out area. One point in particular is known to be a haul-out site (near tidal pond 503). In addition to disturbance of Sea Lions, there is potential for humans to be injured through interaction with Sea Lions. **Other Mammals/Reptiles** No specific potential impacts on other marine mammals or reptiles have been identified.	The boardwalk will be raised to a height of two metres to avoid the known haul-out area. Resort guests and staff will receive information about Sea Lions as part of their inductions. Interpretive signage will be installed on the boardwalk. Impacts to Sea Lions on other islands will be minimised through the Visitor Activity Management Plan (VAMP). The VAMP includes a section that states that no resort-associated tours will land on islands where Sea Lions are resting at that time.	Taking into account the management and mitigation measures outlined above, it is considered that the environmental objective for fauna will be achieved.

Biophysical					
Vertebrate Marine Fauna (cont.)		The fish fauna species composition at the Abrolhos comprises 389 species. Searches of the CALM Threatened Fauna database and the EPBC Protected Matters Database identified 15 fish species of conservation significance. Three were shark species and twelve species from the seahorse and pipefish family (Sygnathidae).	**Fish** If unregulated, recreational fishing around Long Island could result in a decrease in local populations of fish.	No recreational fishing will be permitted from the Island. Numbers on deep-sea fishing trips will be limited. Fishing will be on a catch-and-release basis, with guests permitted to retain one fish per person.	
Tidal Pond Biodiversity	To maintain the integrity, ecological functions and environmental values of the seabed and coast.	Eleven species of molluscs have been found in the seven tidal ponds of Long Island, consisting of eight gastropods, one bivalve and one to two species of chitons. The number of species per pond ranged from three species to seven species. No unique species have been found in the ponds.	It is proposed to introduce additional seawater to pond 504 during days when environmental conditions (neap tide and low wind) may lead to the generation of an undesirable smell. This additional water may negatively impact on the unusual mollusc fauna of the tidal pond.	Seawater will only be introduced on days where a foul smell is likely to result from exposed decaying algae and low wind conditions. The seawater to be introduced to the pond will flow slowly into the pond in such a way as to not disturb the sediment of the pond.	Impact on the mollusc species in the tidal ponds is expected to be minimal.

Biophysical					
Conservation Areas	To maintain the environmental value of areas identified as having significant environmental attributes.	The Abrolhos Islands are an A-Class Reserve, set aside for the purposes of conservation of flora and fauna, tourism and purposes associated with the fishing industry. The waters of the Abrolhos are a Fish Habitat Protection Area (FHPA) for the appreciation or observation of fish. Four areas in the Abrolhos are Reef Observation Areas (ROAs). All species of fish including molluscs, algae, coral and finfish are totally protected.	**Natural Values** Potential terrestrial impacts on natural values include disturbance of seabirds and vegetation. Impacts on the marine environment could result through the release of sewage into the water, or during construction of the jetty, helipad or outflow pipe. Natural values may also be damaged through a fuel spill or through unregulated tourist activities such as diving. Activities associated with the resort could impact upon the conservation values of the Beacon Island ROA.	The birds of the island will be protected through the measures outlined in Terrestrial Fauna (birds) above and the Avifauna Management Plan. Impacts to vegetation, other fauna, landforms and tidal ponds of the island will be managed as per their respective sections in this table. Impacts on the marine environment will be managed as per the various sections on marine habitat, pollution of the marine environment and tourism and recreation. All diving activities will be in accordance with the Diver/Snorkeller Management Plan which is contained within the Marine Management and Monitoring Plan.	Given the management procedures outlined above, it is considered that the environmental objectives for conservation areas will be met.

Biophysical					
		The Register of the National Estate (RNE) is compiled by the Australian Heritage Commission. The Houtman Abrolhos Islands Reserve is listed on the RNE as are Houtman Abrolhos Marine Area, Ruins of Huts on West Wallabi Island site, and seven shipwrecks in the Abrolhos. An area of the Wallabi Group (including Long Island) was gazetted for inclusion on the National Heritage List under the *Batavia* Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos. The proposed tourism development is a "Controlled Action" on the grounds of National Heritage and as such requires approval under the *EPBC Act 1999.*	**Heritage Values** With respect to land-based heritage, visitors may potentially discover an artefact and damage or steal the artefact. The cultural heritage of the marine conservation areas could potentially be impacted through unregulated diving or damage to the remains of the wreck of the *Batavia*. Damage could potentially occur from unsuitable anchoring near historic sites. The presence of a resort on Long Island could impact upon the identified national heritage values of the Wallabi Group.	Implementation of a Long Island Resort Heritage Management Plan to be developed in conjunction with WAMM and Department of Fisheries to ensure consistency with the Heritage Management Plan to be developed by the Government for the National Heritage Listed place. Interpretive signage will be installed around the resort and boardwalk. Inductions (including all personnel) will give information on the heritage values of the island and procedures to be followed in the event of a chance find. Archaeologists will be on site for a watching brief during any major excavation undertaken during construction. It is an offence for vessel masters/ skippers and tourism operators to damage a historic site or its site environment by directly anchoring on it. All diving activities organised by the resort will be in accordance with the Diver/Snorkeller Management Plan.	

Pollution Management					
Air Emissions	To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	There is very little infrastructure located within the Abrolhos. Existing infrastructure mainly consists of huts used by rock lobster fishers during the rock lobster season and the airstrip on East Wallabi Island. As a result, the air quality of the Abrolhos is expected to be pristine.	Dust generated from clearing and construction activities over sandy areas. Emissions from generators used during construction. Emissions from generators used to supply power during operation.	Disturbance of vegetation will be minimised. Access will be via boardwalks. During construction access will follow the future boardwalk route. Sandy areas will be avoided other than when constructing foundations. Construction activities and dust suppression measures will be implemented in accordance with the CMP. Vehicles and power generating equipment will be regularly maintained. Emissions from generators will be minimised. The helipad has been located over water to preclude any dust generation during operation.	Given the management and mitigation measure above, it is considered that the environmental objective for this factor will be met.

Pollution Management					
Noise	To protect the amenity of the community from noise impacts associated with development or land use by ensuring that statutory requirements and acceptable standards are met. To avoid unacceptable adverse impacts on the natural environment, including native fauna.	As there is currently no infrastructure at Long Island, the only noise at the island is the noise of the natural environment. Occasional boat visits and overflying of aircraft may cause noise impacts.	**Aircraft and Vessels** Potential noise impacts could result from: Overflying or nearby planes and helicopters. Water craft mooring at the jetty and jet skis and other recreational activities using motorised craft.	Flight paths of helicopters/planes will be fixed and will be over water rather than flying over islands. Aircraft will not come within 1000 metres (laterally) of islands (other than when landing). Helicopters will have a fixed flight path around the northern limits of Long Island and approach from the north-west. Flights will not occur during the night. Float planes must land at least 300 metres from Long Island. Speeds of jet skis and motorised boats will be governed by low speed, low noise. Jet skis will be subject to "no go" areas sensitive to birds and sea lions and seasonal closures.	Impacts to local fishing community and residents on Beacon Island are expected to be none or minimal. The design of the resort will minimise the potential impact on fauna such that noise is not expected to have any permanent or adverse impact on fauna.
			Generators and Activities Power generation from generator sets. Resort guests and staff during day-to-day activities (including music). Pedestrian and vehicular trafficking of the boardwalks.	Generators placed in sound-reducing containers with acoustic insulation. Vehicles and generators will be fitted with noise reducing mufflers and will be regularly maintained. No amplifiers or loud music will be allowed. Noise management will be included in guest and staff inductions. Signage will include noise warnings. Bird and sea lion behaviour will be observed to determine if noise is impacting on their presence.	

Pollution Management					
Lighting	To avoid or manage potential impacts from light spill and comply with acceptable standards.	Currently only natural lighting occurs at Long Island. The lights of Big Pigeon, Little Pigeon, Alcatraz and Beacon Islands are visible from the island at night.	Light spillage may attract birds and over water may attract marine fauna to the near shore. Changed light levels may attract or deter animals in the area. Changed light levels can disorientate fauna. Additional lighting at night can lead to bird collisions with objects.	Lighting is to be downcast, and can be shielded, directed and focused, and will be fitted with lower wattage globes. Staff will be trained to reduce lighting as appropriate during critical breeding times (e.g. for shearwater and storm-petrel fledgling periods). Tinted glass on building windows. A lighting plan will be adopted to minimise avoidable light spill from guest rooms and the resort's common facilities, with lighting in the main restaurant and bar being progressively dimmed throughout the night. Yellow (sodium vapour) light will be used wherever practical. Implement the Avifauna Management Plan.	The potential impacts of light overspill from the resort can be managed to minimise any adverse or permanent impacts to birds and other fauna of Long Island.
Solid Waste Disposal	To ensure that waste products do not adversely effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory requirements and acceptable standards.	Although there is no solid waste currently being generated on Long Island, the island does currently contain considerable rubbish. These have been washed up from the sea or left behind by visitors. One full garbage bag of solid waste was collected during the three-day archaeological survey of the central part of the island in October 2005.	**Native and Vermin Species** Attraction of native fauna species to the resort area due to presence of alternative food sources and nesting materials. These species may become a nuisance and/or the balance of fauna species may be disrupted. Attraction of vermin due to the presence of alternative food sources and nesting materials.	Educating all personnel of the impacts of solid waste on the environment of and surrounding Long Island including the fauna such as Silver Gulls. Large mobile garbage bins (MGBs) shall be used to store general wastes prior to removal from the Island. Separate MGB shall be provided for recyclable materials. A waste compactor shall be installed. A bailer unit shall be used for bailing of cardboard and similar wastes. Waste oils, fats and greases originating from the kitchen shall be contained within specific disposal bins. Regular inspections to ensure waste is adequately contained.	The management measures outlined shall ensure that solid waste management is appropriate and that the environmental objective for this issue is achieved.

Pollution Management					
Solid Waste Disposal (cont'd)			**Pollution/Visual Amenity** Pollution and a decrease in visual amenity due to inadequate storage, containment or removal of wastes. Animal deaths through eating or entanglement in wastes.	Reductions where possible in construction wastes. Materials will be pre-cut and/or pre-fabricated in Geraldton to reduce the need for extra materials. Food preparation will be done in Geraldton as much as possible.	
Marine Water Quality – Wastewater Disposal	Maintain ecosystem integrity outside mixing zone (50m) equivalent to at least a high level of protection. Maintenance of seafood for human consumption and aquaculture (outside mixing zone). Maintenance of primary and secondary contact recreation (outside mixing zone). Maintenance of aesthetic values.	The marine water quality results indicate that the waters surrounding Long Island are generally typical of well mixed, ocean waters. The nutrient concentrations, with the exception of nitrate and nitrite (NOx), orthophosphate (Ortho P), were within the range expected for clean ocean waters and the chlorophyll results indicate relatively low primary production within surface waters. The slightly elevated nitrate and nitrite and Ortho P concentrations are likely due to the breakdown of macroalgae along the shoreline of Long island and the surrounding islands.	**Wastewater and Discharge** Pollution of the waters surrounding the wastewater discharge point leading to impacts on benthic marine species. Pollution of the waters surrounding the discharge point leading to decreased amenity and human health risks. System failure leading to overflow of containment facilities, pollution of the area surrounding containment facilities and risks to human health. Discharge of swimming pool water during maintenance has the potential to adversely impact on marine environment.	Treated wastewater shall be discharged into Goss Passage at a depth of ten metres to facilitate dispersal. Water quality will be monitored against ANZECC/ ARMCANZ (2000). Monitoring of the water quality and benthic habitats around the discharge point will be undertaken. Two pumps will run on an alternating cycle, which is a contingency against pump failure. Should both pumps ever fail then collection pits will act as buffer tanks for a minimum of one day. The central collection and treatment tank has been designed to hold seven day's capacity of wastewater output. Should the swimming pool water need to be discharged it will be done during a closed period at the resort and pumped through the wastewater treatment plant.	It is predicted that the environmental objectives for this factor will be met.
			Turbidity Potential impact of turbidity generation during construction.	Construction methods will be designed to minimise turbidity generation. Periods of elevated turbidity during construction are likely to be too brief to affect benthic communities.	

Pollution Management					
Marine Water Quality – Waste Products from Boats	As above	As above	Decrease in visual amenity and visitor enjoyment due to inadequate storage or containment of wastes on vessels. Animal deaths through eating or entanglement in wastes. Loss of marine biodiversity due to pollution of waters leading to decreased abundance, cover or diversity of species. Introduction of marine pests or weeds through emptying of bilge water.	No solid wastes to be dumped into the ocean from boats associated with resort. All solid wastes on vessels will be contained whilst on board and disposed of or recycled on mainland. Sewage generated on board shall be disposed of safely with no disposal of sewage in areas of the Fish Habitat Protection Area that lack satisfactory dilution factors. No vessels shall be permitted to purge bilge water within the surrounds of Long Island. Where possible, all vessels shall be required to empty bilge water in the open ocean.	The implementation of the management and mitigation measures outlined will ensure that the environmental objective in relation to waste products from boats is achieved.
Groundwater and Tidal Pond Water Quality	To maintain the quality of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected.	Other than some isolated, minor perched brackish water lenses in the underlying coral limestone formation, there is no separate groundwater aquifer beneath Long Island. The water underlying Long Island is expressed in the tidal ponds.	Proposal to introduce additional seawater during low tidal range periods to pond 504. This may result in water quality changes that may impact the ecology or amenity of the tidal ponds.	Seawater to be added on occasional days and to be added slowly so as to not disturb sediments. It is not expected that the intermittent introduction of seawater will adversely affect water quality.	The water underlying the island and contained in tidal ponds will not be adversely changed. The ecosystem function provided by the tidal pond will be maintained.

Pollution Management					
Dangerous and Hazardous Substances	To ensure that the storage and handling of dangerous and hazardous substances does not effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory requirements and acceptable standards.	Currently there is no infrastructure and no dangerous substances stored on Long Island. The potential exists currently for a fuel spill from a visiting boat.	**Chemicals and Gas** Pollution of the marine environment through improper disposal of chemicals into the sewerage system. Potential for gas leaks from LPG storage tanks (for kitchen use) resulting in risk of ignition, fire and explosion.	All dangerous waste and/or chemicals shall not be disposed of via the sewerage system to prevent their eventual release to the marine environment and shall be returned to the mainland. Refilling of chemicals from bulk containers will be conducted only in the bunded services area compound. Emergency stop valves shall be fitted to the LPG tanks.	Implementation of the DHSMP and the management measures outlined above shall ensure that the environmental objective for this issue is met.
			Fuel Spill Pollution of the marine or terrestrial environment through fuel spills during refilling of bulk supply containers and refuelling of vessels or vehicles. Pollution of the marine environment through accidental spillage as a result of damage to marine vehicles (e.g. collision with reef).	Diesel will be stored within self-bunded storage tanks with spill kits. Ducting used for pumping fuel from diesel supply vessels would be double sheathed. A Dangerous and Hazardous Substances Management Plan (DHSMP) will be implemented and an Oil Spill Environmental Management Plan has been developed. Refuelling of land vehicles in designated refuelling hardstand locations only. The services compound (refuelling area) and jetty shall be equipped with a hydrocarbon spill kit. Staff shall be trained in spill and emergency response procedures. Contractors will be required to carry spill kits onboard their vessels and will be trained in spill response. All chemicals and hydrocarbons shall be stored in accordance with AS1940-2004.	

Landforms and Soils					
Landforms and Soils	To maintain the integrity, ecological functions and environmental values of soil and landform.	Long Island is a low-lying relatively flat island generally about two metres above sea level. The majority of the island is composed of corals, coral gravel and plate-like cobbles, with sandy beaches and low dunes present in some areas.	**Degradation** Over-exploitation of the sandy beaches. Potential to increase erosion of the island. Construction activities have the potential to compact the soil and damage the soil structure. Compaction of the soil by visitors walking over the island. Potential for damage to the seabed during the installation of the jetty, helipad, boat moorings and swimming/diving platforms. Degradation of tidal ponds. Disruption to elevated areas potentially associated with *Batavia* mutineer hangings.	Beach access restricted to designated areas and signage will be installed. Boardwalks to minimise disturbance and fixed routes during construction. A CMP will be implemented, including an Induction Programme. All services will be run suspended underneath the boardwalk. Environmental Monitoring and Management Plan will be implemented. Tidal ponds will be off-limits to all. Signage and inductions will provide information. All persons visiting Long Island will be required to stay on the boardwalks and not disturb any unsurveyed heritage areas. The southern section of the island will be off-limits to all personnel.	Implementation of the infrastructure elements shall ensure that the environmental objective for this issue is met.
			Natural Sedimentation The resort's land based infrastructure interrupts the natural movement of sediment leading to unnatural levels of terrestrial erosion or deposition, affecting fauna and flora. The resort's marine based infrastructure interrupts the natural movement of water currents and therefore leads to unnatural levels of coastal erosion or deposition, affecting fauna and flora.	The jetty will be constructed using open piling. The helipad will be moored through a system of anchors. The main resort area and the entire boardwalk will be raised off the ground. The wastewater outlet pipes will be buried across the inshore reef, and it is expected that corals will grow over this pipeline.	

Landforms and Soils					
Fire	To ensure adequate fire management is undertaken such that the risk to the environment from the proposed development is minimised.	The vegetation on Long Island is low and interrupted by patches of sand and large areas of coral rubble.	Destruction of vegetation. Loss of the CALM Priority 4 species *Lepidium puberulum*. Destruction and/or abandonment of seabird nests and burrows. Death or injury to fauna unable to escape the fire.	Fire extinguishers positioned around the facility. Documented procedure for evacuation will be installed in all rooms. Training and fire drills will be conducted regularly by a professional company. Briefings on procedures to follow, such as evacuation, raising alarm, and location of fire extinguishers.	The management measures outlined will ensure the environmental objective for this issue shall be achieved.
Rehabilitation and Decommissioning	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	The island is composed of corals, coral gravel and plate-like cobbles, with sandy beaches and low dunes present in some areas. It is covered in part with low scrubby vegetation.	**Vegetation and Marine** Trampling or clearing of vegetation around buildings. Inadequate rehabilitation leading to poor reinstatement and recovery of terrestrial vegetation and marine habitat. Weed introduction during decommissioning or rehabilitation activities. Damage to the marine habitat during removal of the jetty, helipad and other marine based infrastructure.	A full decommission and rehabilitation plan (DRP) will be implemented and reviewed every ten years. Use of pylons will minimise the disturbance to the site and therefore the level of reinstatement required. All access ways shall follow the alignment of the boardwalk where possible. Species native to Long Island will be used for reinstatement. Seed shall be sourced from locally occurring populations and will be 'weed free'. Weed control will be used to maximise the likely survival of any plantings undertaken. Monitoring shall be undertaken. Where marine based infrastructure is removed, monitoring shall be continued.	The measures outlined in the DRP together with regular review of the management plan will ensure that the environmental objective for this issue is achieved and that the impacts identified above are minimised.
Rehabilitation and Decommissioning (cont'd)	As above	As above	**Birds and Visual Amenity** Disturbance of nesting seabirds leading to abandonment of nests. Destruction of seabird burrows that have been established beneath the boardwalks. Reduction in visual amenity due to wastes being left on the island.	Decommissioning undertaken in consultation with a suitably qualified avifauna specialist. Locations of seabird burrows around and under the boardwalk shall be recorded. Access paths aligned to avoid disturbance of burrows or nests. All wastes shall be removed from Long Island.	The measures outlined in the DRP will ensure that the environmental objective for this issue is achieved.

Social					
Aboriginal Heritage	To ensure that changes to the biophysical environment do not adversely effect historical and cultural associations and comply with relevant heritage legislation.	No written records have been found of sites of significance to Aboriginal Heritage occurring in the Abrolhos Islands.	Resort development may negatively impact on Aboriginal heritage sites.	Meetings have been held with coastal native title claimants in the Geraldton region. Two meetings have taken place in June 2006 and were attended by the Proponent, with the claimants advising that they had no concerns with the project. Advice on Aboriginal Heritage will concluded after the meeting with the final claimant group.	The environmental objectives for this factor will be met following the outcome of official native title claimant meetings.
European Heritage	To ensure that changes to the biophysical environment do not adversely effect historical and cultural associations and comply with relevant heritage legislation.	Long Island has a high heritage value both nationally and internationally through its association with the *Batavia* wreck, mutiny and murders.	**Damage to Land-based Heritage** Heritage sites, particularly in areas not yet surveyed, could be damaged during the construction of the resort and through uncontrolled access of guests and visitors around the island during the operational phase of the resort. Artefacts may be lost or damaged through souveniring or vandalising by visitors.	A Construction Management Plan (CMP) will be implemented and include heritage issues. During construction a qualified archaeologist shall be employed to undertake a watching brief during major excavation. The Heritage Management Plan (HMP), interpretive signage and educational activities will minimise impacts during operation. It is understood that WAMM is currently seeking Government funding to survey the southern portion of Long Island which will mean there will be no unsurveyed areas.	Implementation of the CMP, HMP, and VAMP and other management procedures shall ensure that the heritage values of Long Island and the Abrolhos Islands are not compromised.

Social					
European Heritage (cont'd)			**Access Issues** The presence of the resort complex on Long Island may result in the impression that those heritage sites on Long Island are only able to be visited by paying guests and are no longer freely accessible to the general public. There is potential for unaccompanied or unauthorised day visitors to land on the island and wander unsupervised.	The HMP will minimise impacts on heritage values together with the VAMP. These plans will control numbers of guests visiting sites and potential impacts will be addressed to ensure visitation does not impact on heritage values of Long Island or the National Heritage Listed place. Signage on the jetty will explain the HLD lease area and the facilities available for day-visitors. The day visitor pavilion will contain interpretive material and artefacts on loan from WAMM. Independent day visitors shall be controlled as far as practicable under the tourism licence and directed to the day visitors pavilion.	
			Increased Visitation Increased visitation to shipwrecks and sites of heritage value on other islands (e.g. Beacon Island) will occur. There is potential for these sites to be damaged. Increased visitation may also result in a reduced quality of the experience for other visitors. Damage could potentially occur from unsuitable anchoring near historic sites.	All diving activities will be conducted by licensed operators and these operators will have a system of communication between themselves to prevent over-crowding of popular dive sites. Visits to other islands will be conducted on an escorted tour basis only, with tour operators using their discretion on the numbers of visitors. Vessel masters/ skippers will not damage a historic site or its site environment by directly anchoring on it as this is an offence.	
			Enhanced Knowledge A potential positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia*.	This impact will be maximised by providing visitors with access to as much information as possible. Visitors will be encouraged to visit the Geraldton Museum prior to arriving on the island. An on-island induction will follow.	

Social					
Landscape Values and Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	Long Island is low-lying with elevations typically varying between two and 3.5 metres AHD. The island is predominantly overlain with coral rubble and sparsely vegetated with coastal scrub. The islands with fisher camps have shacks, numerous jetties and antennae dominate the skyline on these islands.	The potential impact is that the development of the resort will impact negatively on the visual amenity of the area.	The resort will have a low profile and colouring in keeping with the environment as much as possible. When viewed from the air the resort will blend into the surrounding patchwork of dark coloured vegetation from a distance.	Taking into consideration the potential impacts and the design measures proposed, the environmental objective for visual amenity will be achieved.

Abrolhos Islands Access Issues					
Commercial Fishing and Aquaculture	To ensure that existing and planned commercial fishing and aquaculture uses of the environment are not compromised.	The western rock lobster fishery in the Abrolhos account for over 20% of the State's commercial catch in the fishery. Other fisheries in the area are the Wetline Fishery and the Mid-west Trawl Fishery. The nearest aquaculture site is at least three nautical miles away.	Rock lobster fishers sometimes traverse the water very close to the southern tip of Long Island in higher tides. If guests were to swim or conduct water activities in this area, this could result in a safety hazard. The AMWING Pearl Producers' Association have identified a potential for future positive interaction between the tourism operation and their pearl farms, with tours of the farms.	Resort guests will not be permitted to conduct independent boating activities. Swimming and snorkelling areas have been designated and guests will swim only in these areas that are away from passages used by commercial fishers. Guests will not be conducting any fishing from the island and will only be permitted to fish from licensed fishing tour operator's vessels. The southern section of the island is off-limits.	Given the mitigation and management measures outlined above, it is considered that the objective for this factor has been met.
Tourism and Recreation	To ensure that existing and planned recreational uses of the environment are not compromised.	There is no formalised land-based tourist facility in the Wallabi Group or the Abrolhos Islands and it is projected that the Long Island tourism development will attract up to 5,275 guests in a typical year.	There is potential for increased visitation to dive sites and popular tourist sites and for this to impede access by other tourists to these sites. The additional visitors in the area may cause additional environmental impacts on other islands to be visited. There is a potential positive impact of enhanced recreational opportunities and heritage interpretation leading to a much-improved appreciation of the island's values.	Dive operators are expected to have a system of communication between themselves to prevent over-crowding of popular dive sites. Visits to other islands will be conducted on an escorted tour basis only, with tour operators using their discretion on the numbers of visitors. Limits to sensitive areas of 6-12 guests. Visits to other islands will be controlled through the VAMP. No tour visits will be made to East or West Wallabi Islands except Turtle Bay and airstrip. Other points in the VAMP include limiting jet skis and motorised boats. The positive impact associated with increased information will be maximised through inductions and interpretive information.	Given the mitigation and management measures outlined above, it is considered that the objective for this factor has been met.

Abrolhos Islands Access Issues					
Scientific Research	To ensure that existing and planned research uses of the environment are not compromised.	Currently the only research station in the Abrolhos is the Department of Fisheries' Saville-Kent Centre at Rat Island in the Easter Group.	The presence of the permanent facilities of the resort at Long Island may represent an enhanced opportunity for research in the Wallabi Group.	Accommodation may be available to researchers during the off-peak season to conduct research programmes. Resort staff and guests may be able to assist in ongoing research programmes such as those that require regular monitoring.	The objective for this factor will be met.

1.7 SUMMARY OF ENVIRONMENTAL COMMITMENTS

Environmental commitments made by HLD in regards to the construction, operating and decommissioning of the proposed Long Island resort are outlined in Table 1.2.

Table 1.2: Summary of Commitments

No.	Topic	Objective	Action	Timing	Advice
1.	Construction Activities	To manage and minimise the potential impacts of construction activities upon the environment	Implement the **Construction Management Plan**, which includes: • Induction of contractor and personnel. • Management of access, clearing and disturbance, noise, light and dust impacts. • Minimising impacts to avifauna, other fauna, Priority flora species, benthic habitat, water quality, potential land heritage sites and landforms. • Provision of control measures and temporary facilities. • Details of appropriate storage and containment of hydrocarbons and dangerous substances. • Procedures to prevent introduction of weeds and vermin.	During construction	CALM, Department of Fisheries
2.	Terrestrial Fauna	To identify potential impacts of the Tourism Development upon the island's avifauna and monitor and mitigate these impacts.	Implement the **Long Island Avifauna Management Plan**, which includes measures to: • Describe potential impacts associated with construction, operations and visitor activities and their mitigation; • Provide a detailed annual monitoring plan to assess annual changes in the Long Island avifauna.	Prior to operation	CALM, Department of Fisheries, DoE
3.	Marine Environment	To establish and define Environmental Quality Objectives and	Implement the **Marine Management and Monitoring Plan**, which includes measures to: • Provide details of	Prior to operation	Department of Fisheries, DoE

No.	Topic	Objective	Action	Timing	Advice
		the level of protection for ecosystem health for marine waters around Long Island and outline monitoring and management to ensure the Environmental Quality Objectives are maintained in the long-term.	monitoring of benthic habitat for direct impacts such as diver damage to corals; • Provide details of monitoring of benthic habitat for indirect damage caused by activities such as discharge of treated effluent and suggested mitigation; • Provide details of water quality monitoring and suggested mitigation.		
4.	Visitor Management	To raise awareness of all visitors on ways to minimise the impact of their activities on the environment of Long Island and any other islands to be visited.	Implement the **Visitor Activity Management Plan** which includes measures to: • Provide details to day-trippers and overnight guests on the ways to minimise impacts to the natural environment and the heritage of Long Island and other islands visited through resort-associated activities • Includes an Induction for all Visitors • Provide details of areas of Long Island or other islands to be subject to seasonal closures.	Prior to operation	CALM, Department of Fisheries, WAMM, DEH
5.	Oil Spill Management	To identify risks of an oil spill and management measures to avoid a spill	Implement the **Oil Spill Environmental Management Plan** which includes measures to: • Identify the risks of an oil spill. • Provide details of management measures to help prevent oil spills.	Prior to operation	DEH, CALM, Department of Fisheries
6.	Weed Management	To minimise the further spread of weeds onto and around Long Island through implementing weed management	Implement the **Weed Management Plan** which includes measures to: • Describe measures to prevent further spread of weeds to Long Island; • Describe methods to help prevent spread of weeds	Prior to operation	CALM, Department of Fisheries

No.	Topic	Objective	Action	Timing	Advice
		practices.	around the island.		
7.	Vermin Management	To prevent the introduction of vermin onto Long Island or native species becoming nuisance or pest species through implementing vermin/pest management practices.	Implement the **Vermin/Pest Management Plan** which includes measures to: • Describe measures to prevent the introduction of vermin to Long Island including quarantine procedures; • Describe methods to help prevent native species becoming a nuisance or pest species.	Prior to operation	CALM, Department of Fisheries
8.	Environmental Management	To avoid, minimise or mitigate impact to the environment	Prepare environmental procedures and management plans that address the management or avoidance of impacts to the environment during the operation and decommissioning (where relevant) stages of the resort. Plans will comprise the following:		
9.1		To manage the environmental impacts associated with daily operation of the resort including solid waste.	Prepare the **Resort Environmental Management and Monitoring Plan:** • Provide details of solid waste management procedures; • Provide a summary of all operational environmental monitoring requirements.	Prior to operation	CALM, Department of Fisheries, DoE
9.2		To manage the environmental impacts associated with daily operation of the resort including solid waste.	Implement the **Resort Environmental Management and Monitoring Plan** as outlined in commitment 9.1 above.	During operation	CALM, Department of Fisheries, DoE
10.1		To raise awareness of all operational staff of ways to minimise impact on environment including impacts on birds, habitats	Prepare the **Staff Induction Plan:** • Provide information to staff on ways to minimise their own impacts on the environment; • Provide information to staff	Prior to operation	CALM, Department of Fisheries, WAMM, DEH

No.	Topic	Objective	Action	Timing	Advice
		and marine environment.	on ways to control visitors to minimise impacts.		
10.2		To raise awareness of all operational staff of ways to minimise impact on environment including impacts on birds, habitats and marine environment.	Implement the **Staff Induction Plan** as outlined in commitment 10.1 above	During operation	CALM, Department of Fisheries, WAMM, DEH
11.1		To ensure that matters of cultural heritage are not negatively impacted by the resort or its activities.	Prepare the **Long Island Resort Heritage Management Plan:** • Discuss management measures to minimise disturbance to heritage values including induction; • Document procedures for "chance finds" of artefacts.	Prior to operation	WAMM, Heritage Council of WA, DEH
11.2		To ensure that matters of cultural heritage are not negatively impacted by the resort or its activities.	Implement the **Long Island Resort Heritage Management Plan** as outlined in commitment 11.1 above.	During operation	WAMM, Heritage Council of WA, DEH
12.1		To describe the rehabilitation and closure strategies necessary to ensure that a self-supporting system is established and that no long-term maintenance is required.	Prepare the **Decommissioning and Rehabilitation Plan:** • Describe decommissioning processes and how they will minimise impacts on environment and heritage; • Describe revegetation and rehabilitation techniques.	Prior to operation	CALM, Department of Fisheries, WAMM, DEH
12.2		To describe the rehabilitation and closure strategies necessary to ensure that a self-supporting system is established and that no long-term maintenance is	Implement the **Decommissioning and Rehabilitation Plan** as outlined in commitment 12.1 above.	During operation	CALM, Department of Fisheries, WAMM, DEH

No.	Topic	Objective	Action	Timing	Advice
		required.			
13.1		To prevent or minimise the likelihood of dangerous substances impacting on the environment through safe management and appropriate mitigation techniques.	Prepare the **Dangerous and Hazardous Substances Management Plan** • Detail methods for storage and safe usage of hydrocarbons and dangerous substances; • Will contain a risk assessment for the fuels to be stored at Long Island; • Describe methods for spill response.	Prior to operation	Department of Fisheries, CALM, DoE
13.2		To prevent or minimise the likelihood of dangerous substances impacting on the environment through safe management and appropriate mitigation techniques.	Implement the **Dangerous and Hazardous Substances Management Plan** as outlined in commitment 13.1 above.	During operation	Department of Fisheries, CALM, DoE

2. INTRODUCTION

2.1 BACKGROUND

Humfrey Land Developments (HLD) has been working towards a tourist development, land or sea based, in the Abrolhos Islands since 1999. Following the approval of the Management Plan for Sustainable Tourism in the Houtman Abrolhos Islands by the (WA) Minister for Fisheries in March 2001, HLD submitted proposals to the Minister for Fisheries via the Expression of Interest submission in March 2002, the Request for Proposals submission in August 2003 and the Request for Proposals submission in September 2004. An application for a Tourism Licence was submitted in June 2005 to the Minister for Fisheries, who has advised that the licence will be granted following the completion of this PER.

In June 1999 HLD undertook a comprehensive site inspection of the Abrolhos Islands to identify likely sites for land or sea based tourism. At that stage the preferred site was Pelsaert Island in the Southern Group (also known as Pelsaert Group). After meeting with the Abrolhos Islands Management Advisory Committee (AIMAC), HLD was advised that this site was unacceptable for tourism development.

Of the short listed sites nominated by the Abrolhos Islands Tourism Working Party and the Department of Fisheries and following further investigation, Long Island in the Wallabi Group was considered by HLD to be the only suitable island that could be used for a tourism venture. The site selection process is further documented in Section 3.2.1.

As part of the proposed tourism development, HLD is committed to maintaining the environmental integrity of the Abrolhos Islands and to addressing all environmental issues in the design, construction, operation and decommissioning phases of the project.

On 18 April 2005 the WA Environmental Protection Authority (EPA) set the level of assessment for the proposed tourism development at Public Environmental Review (PER) with a six week public review period. There were no appeals on this level of assessment. The letter advising HLD of the level of assessment can be found in Appendix 2.

On 21 April 2005 the Commonwealth Department of the Environment and Heritage (DEH) declared the proposal to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).* The controlling provisions for the action were deemed to be listed threatened species (Sections 18 and 18A *EPBC Act 1999*) and listed migratory species (Sections 20 and 20A *EPBC Act 1999*), particularly seabirds of Long Island. The letter advising HLD of this decision can be found in Appendix 2. Following the National Heritage Listing of a section of the Wallabi Group of islands which includes the project site, a further referral to DEH was required. On 26 May 2006, DEH determined that the proposal would also be a controlling provision under sections 15B and 15C (National Heritage) of the *EPBC Act 1999* (see Appendix 2).

In accordance with the bilateral agreement between the Commonwealth and the State, formal assessment of the proposal under Part 8 of the *EPBC Act 1999* would not be required. Schedule 1 of the bilateral agreement provides accreditation of the State assessment procedure, at the level of PER, by the Commonwealth. A separate approval is required under Part 9 of the *EPBC Act* following completion of the State assessment.

In November 2005, HLD submitted its Environmental Scoping Document to the EPA. The purpose of this document was to provide a basis of understanding between the proponent, the EPA and the DEH regarding the assessment of the proposed development. It established the environmental issues and factors raised by the proposal, set out the Scope of Works for the preparation of the PER, and gave indicative timelines for the assessment. The Environmental Scoping Document was accepted by the EPA on 7 November 2005.

2.2 OBJECTIVES AND STRUCTURE

This PER aims to identify and assess the environmental impacts of the proposed tourism development and to describe the management strategies Humfrey Land Developments will implement in order to manage and minimise any adverse environmental impacts. The objectives of this PER are to:

- Place this proposal in the context of the local and regional environment.
- Adequately describe all components of the proposal, so that the Minister for the Environment can consider approval of a well-defined project.
- Provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, are minimised and can be acceptably managed.
- Communicate clearly with stakeholders (including the public and government agencies), so that the EPA can obtain informed comment to assist in providing advice to the Minister.
- Provide a document which clearly sets out the reasons why the proposal should be judged by the EPA and the Minister for the Environment to be environmentally acceptable.

A number of technical studies and environmental management plans have been completed in preparing this document. The technical studies and management plans are provided as supporting documents in the appendices to this PER.

2.3 TOURISM OPPORTUNITY

The Tourism Forecasting Committee (2005) projects that international visitors to Australia will increase by 5.6 percent in 2006. This growth will be sustained for the next ten years with international visitor numbers expected to reach 9.079 million in 2014. The number of domestic visitor nights is expected to increase by 0.7 percent in 2006, with a total increase of 0.9 percent to 311 million domestic visitor nights by 2014 (Tourism Forecasting Committee 2005). As at June 2005, Western Australia received a 10.6 percent market share of domestic nights (Tourism Research 2005b) and a 12.6 percent market share of international visitors (Tourism Research Australia 2005a).

Approximately 526,000 domestic visitors travelled to the Mid West region in the financial year 2003/04 and about 50,000 international visitors stayed overnight in the same period. International visitation to the region is expected to grow by 6.2 percent annually to 2013 (Tourism WA website: www.westernaustralia.com).

Those visitors coming to the region will be hoping to experience the diverse nature of the area, including the pristine and unique Abrolhos Islands. HLD believes that the unique environment of the Abrolhos Islands has the potential to attract international visitors and the provision of suitable accommodation facilities would provide the opportunity for visitors to enjoy the Abrolhos Islands experience where none presently exists. The creation of the accommodation facility on Long Island will generate interest from new visitor markets that would not have typically been drawn to the region. The facility will be positioned as a low guest capacity lodge resort with facilities of an international standard, equivalent to a four and a half star rating. The low volume high yield market position is considered the only viable development option to ensure the long-term economic, environmental and social sustainability of the resort.

This is the first land based commercial accommodation operation on the islands and no comparable operations in terms of location and standard of facilities exists along the Western Australian coastline. Once the resort is operational it is projected that the resort will attract over 3,400 additional visitors to Western Australia (Jones Coulter Young 2005).

Based on information from Ray Bird & Associates, it is projected that the long-term market breakdown would be 35 percent Western Australians, 15 percent other Australians, and 50 percent international visitors with up to 5,275 guests attracted to the property in a typical year. The proposed facility will therefore contribute in attracting an additional 3,428 out of state visitors to the Midwest region and Western Australia each year (Jones Coulter Young 2005).

The proposed resort is an important development providing benefits to Western Australia both at State and regional levels. The resort development will provide the following benefits:

- The provision of environmentally friendly accommodation facilities to cater for the increase in domestic and international visitors to Western Australia.
- The creation of significant earnings to the regional and state economy.
- The creation of new jobs during construction and operation.
- Allow more people to experience the unique Abrolhos environment in a way that limits the impact on the environment.

Significant employment opportunities would result from the development of the resort. The equivalent of over 100 jobs would be created during the construction of the facilities and 18 new fulltime equivalent jobs during the operation of the resort (Jones Coulter Young 2005).

2.4 PROPONENT DETAILS

Humfrey Land Developments is a privately owned company and has been involved in property development, project management and joint venture partnerships for over 15 years. Managing Director Barry Humfrey was educated and lives in Geraldton.

Proponent's contact details:

Barry Humfrey (Managing Director)
Humfrey Land Developments

Address:
272 Foreshore Drive
The Marina
Geraldton WA 6530

Postal address:
PO Box 1917
Geraldton WA 6531

Telephone: (08) 9964 8028
Facsimile: (08) 9921 4621
Mobile: 0428 648028
Email: barryh@hld.com.au

In accordance with the *EPBC Regulations 2000*, Schedule 4, the proponent is required to report information on his environmental record. There are no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against Barry Humfrey, HLD or any Associated Company.

2.5 TOURISM OPERATOR

Broadwater Hospitality was founded in Western Australia in 1990 and operates landmark resort properties throughout regional and metropolitan Western Australia. Broadwater is recognised as being one of this State's most capable and largest operators of regional resort properties.

Broadwater has extensive experience, infrastructure and resources, and a proven track record in (greenfield) development, management and operation of resort-style properties in regional locations. In addition, Broadwater's senior management team has extensive experience and expertise in the development and operation of island based and remotely sited resorts - particularly resorts located in ecologically sensitive (marine park) environments.

Broadwater operates seven resort-style (four to five star) properties in Western Australia, with an eighth property currently under development. Broadwater's senior management team of five senior executives has over 100 years cumulative experience in the tourism and hotel industries, having held executive management or general management responsibility for many world renowned resorts in the Asia-Pacific region.

In addition, Stage 1 of Broadwater's new Geraldton property has already opened (24 luxury apartments opened in October 2004) with Stage 2 of this development to soon commence. Stage 2 will add a further 80 guest rooms, meeting and conferencing facilities, food and beverage outlets, a marina in front of the hotel, and a range of first class hotel facilities and amenities located on the boardwalk on the marina foreshore and directly adjacent to the WA Museum in Geraldton.

The new Broadwater Resort Hotel in Geraldton will form an integral part of the Houtman Abrolhos Islands guest experience, in that many guests will stay in Geraldton on the way to/from the island and will enjoy the convenience of the high calibre hotel and marina

facilities, while also being taken on familiarisation and educational tours about the Abrolhos Islands within the museum. All food and beverage requirements will be sourced from the Broadwater Resort, Geraldton. This will help to minimise staffing levels required at the island.

Additionally, Broadwater has sought input from the academic and scientific community on many planning issues for the resort and its future operations, including that Broadwater intends that the development and operation of the resort becomes a working case study to improve the body of knowledge about such high calibre island based resort developments.

2.6 LOCATION

The Houtman Abrolhos Islands are a complex of 122 low-lying islands and reefs spread over 100 kilometres of ocean located at the edge of the continental shelf between 28º 15' S and 29º 00' S. The Abrolhos Islands are located approximately 60 kilometres offshore from Geraldton on the mid west coast of Western Australia and Geraldton is located 424 kilometres north of Perth (Figure 1). A map of the Abrolhos Islands is shown at Figure 2.

The Abrolhos Islands are divided into three island groups, the Wallabi Group, Easter Group and Southern Group, with North Island sometimes considered a fourth 'group' and sometimes included with the Wallabi Group. Long Island is situated in the Wallabi Group of Islands (Figure 3).

Long Island is surrounded by shallow coral reef along its northern, western and southern fringes while the eastern edge of the island abuts Goss Passage. This north-south oriented channel is an area of deep water with fast flowing currents, which separates Long Island from Beacon Island, approximately one kilometre to the east.

The following coordinates denote the approximate centre of Long Island:

Latitude:	28 degrees	28 minutes	24 seconds	south
Longitude:	113 degrees	46 minutes	24 seconds	east

The island is 1.65 kilometres long and typically between 20 to 60 metres wide, although there are two areas on the northern and central sections of the island in excess of 100 metres wide. The 10.5 hectare island is orientated along a north-south axis.

The western side of Long Island is generally well protected from waves by shallow coral reefs and other islands. The deeper, open waters of Goss Passage does allow significant wave energy to reach the eastern side of the island under prevailing wind and storm conditions.

2.7 ZONING

2.7.1 Land Tenure

The Abrolhos Islands are an A Class Reserve (A20253) vested in the Minister for Fisheries and any proposals to conduct commercial activities at the Islands must be approved by the

Minister. The Abrolhos Islands Management and Advisory Committee (AIMAC) is the body responsible for reporting to the Minister on matters concerning the Abrolhos Islands.

HLD will operate the resort under a Tourism Licence to be granted by the Minister for Fisheries.

The Tourism Licence will permit a maximum of 60 guests and 10 staff to stay overnight at the resort. The Tourism Licence will be granted for an initial 21 year licence period, with the option of renewing the licence for an additional 21 year period at the sole discretion of the Lessee. Following the end of the second 21 year lease period, a third 21 year licence period would be negotiated with the Department of Fisheries to continue to operate the resort.

The Tourism Licence for the Land Based Tourism Development will also cover the separate licences required for the marine and charter boat based activities proposed and the usage of the Crown Land to the north of the island. Key activities that will require separate licences will include:

- Recreational activities such as wind surfing, surfing, sailing, kayaking as well as scuba diving, snorkelling, swimming and a game fishing licence.
- Nature based activities such as nature tours for observing the marine and terrestrial fauna and flora, especially bird watching.
- Historical and cultural activities including visiting the *Batavia* wreck site off Morning Reef.

2.7.2 Existing Land Use of Long Island

There is currently no permanent human land use on Long Island, although public access is permitted and it is known that visitors to the Abrolhos do land on the island. A number of land uses exist on the other islands of the Abrolhos, including the islands that are used by Rock Lobster fishers who stay in houses on the islands during the 3.5 month lobster fishing season. Other uses include the airstrip on East Wallabi Island, tourists visiting the historic Wiebbe Hayes Trail on West Wallabi Island, and the Department of Fisheries research station on Rat Island. Historically, some of the islands were used for guano mining.

There is currently no organised, centralised tourism development within the Abrolhos. A number of tour operators carry out various charters from deep sea fishing to SCUBA diving and whale watching within and around the Abrolhos.

2.7.3 Existing Access to Long Island

There is currently no formalised access point to Long Island. There is no jetty and only two mooring points on the North end of the island for Charter Boat operators. The Long Island Dive Trail was developed by the Department of Fisheries to the north of Long Island within a Reef Observation Area (see Section 4.1.3). Two fixed boat moorings are in place at this site. Visitors wishing to land on the island at present beach their boats on the island or drop anchor around the island on an ad-hoc basis. Access to the island can be difficult at low tide due to the shallow reefs surrounding the island. Visitors are not restricted and are able to access all areas of the island. No interpretive signage is in place.

The airstrip on East Wallabi Island also provides access to the islands of the Wallabi Group and the wider Abrolhos area.

2.8 RELEVANT LEGISLATION, POLICIES AND STRATEGIES

The PER is being assessed under Part IV of the *Environmental Protection Act 1986* (WA). The proposal was also determined to be a controlled action by the Commonwealth Department of the Environment and Heritage. As such it is subject to the provisions of the Agreement between the Commonwealth of Australia and the State of Western Australia under Section 45 of the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* Relating to Environmental Impact Assessment.

There are a number of State and Commonwealth Acts and Regulations that HLD will need to comply with during construction, operation and decommissioning of the proposed resort. Relevant legislation includes those listed in Table 2.1 and includes a range of State and Commonwealth policies and guidelines pertinent to the proposal.

Table 2.1: Regulatory and Policy Framework

Jurisdiction	Title	Applicability
Commonwealth Legislation	*Environmental Protection and Biodiversity Conservation Act 1999*	Protects the environment with regard to matters of National Environmental Significance. The proposed tourist resort on Long Island is subject to approval under the Act. Historic shipwreck areas of the Wallabi Group of the Abrolhos have been proposed for inclusion on the National Heritage List under the *EPBC Act 1999.*
	Australian Heritage Commission Act 1975	Provides the mechanism for the listing of places on the Register of the National Estate.
	Australian Heritage Council Act 2003	Establishes the Australian Heritage Council, its roles and responsibilities and matters relating to the Register of National Estate. The Abrolhos Islands are listed on the Register of the National Estate.
	Commonwealth Historic Shipwrecks Act 1976	Provides for the protection of historic shipwrecks and all associated artefacts that have either been Gazetted by the Minister or are mentioned in Schedule 2 of the Act or Article 1 of the Agreement between Australia and the Netherlands Concerning Old Dutch Shipwrecks. Both the Hadda and the Batavia wrecks and associated relics are protected by this Act.
	Protection of Movable Cultural Heritage Act 1986	Provides for the protection of objects that are of importance to Australia, or to a particular part of Australia, for ethnological, archaeological, historical, literary, artistic, scientific or technological reasons.
	Environmental Protection (Sea Dumping) Act 1981	Laws relating to the disposal of wastes in the ocean
	Protection of the Sea (Prevention of Pollution from Ships) Act 1983	Covers pollution by oils, noxious substances, packaged goods, sewerage, and garbage.
Commonwealth Guidelines	National Water Quality Management Strategy No. 4. Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.	Outlines the principles, objectives and management framework of the guidelines. Provides advice on designing and implementing water quality monitoring programmes.
Western Australian Legislation	*Aboriginal Heritage Act 1972*	Provides for the protection of sites and artefacts used by and/or of significance to the original inhabitants of Australia. The Act also provides for the recording of the location of these sites and artefacts.

Jurisdiction	Title	Applicability
	Environmental Protection Act 1986	The proposed Long Island tourism development is being assessed under Part IV of the Act.
	Environmental Protection (Noise) Regulations 1997	Provides advice on safe noise levels
	Bush Fires Act 1954	Makes provisions for the prevention, control and extinguishment of bush fires and for diminishing the dangers from bush fires. Under section 28 of the Act the occupier of the land is responsible for extinguishing any bush fires that occur on their land.
	Conservation and Land Management Act 1984	Established the Department of Conservation and Land Management (CALM), which is responsible for administering the Wildlife Conservation Act 1950 and Regulations 1980.
	Dangerous Goods (Transport) Act 1998 *Dangerous Goods (Transport) (General) Regulations 1999* *Dangerous Goods (Transport) (Dangerous Goods in Ports) Regulations 2001*	Provides provisions for the safe transport of dangerous goods
	Explosives and Dangerous Goods Act 1961 *Explosives and Dangerous Goods (Handling and Storage of Dangerous Goods) Regulations 1992*	Provides guidance and regulations for the safe handling and storage of dangerous goods.
	Fish Resources Management Act 1994	Provides for the management of fish resources. Provides for management and regulation of the Abrolhos Islands reserve and for the establishment and management of Fish Habitat Protection Areas.
	Heritage Act 1990	Established the Heritage Council of Western Australia. Encourages and provides for the protection and conservation of places that have significant cultural heritage value to the State.
	Health Act 1911	Provides for the management and regulation of Public Health including sanitation, water supply, restaurants/eating houses, food and drugs.
	Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974	Regulates the disposal of wastewater and construction of sewerage systems.

Jurisdiction	Title	Applicability
	Land Administration Act 1997	Under the Act the Minister may amend the area or purpose of a Class A Reserve, subject to the provisions of the Act.
	Occupational Health and Safety Act 1984	Sets out the duties and responsibilities of employers and employees and allows for the regulation and management of occupational health and safety in the workplace.
	Maritime Archaeology Act 1973	Provides for the protection and preservation of shipwrecks and all associated relics lost prior to 1900. Both the Hadda and the Batavia wrecks and relics are protected under this Act.
	Museum Act 1969	Provides for the management of the WA Museum and the preservation of areas and objects of historic interest.
	Pollution of Waters by Oil and Noxious Substances Act 1987	Covers pollution resulting from oils and noxious substances.
	Wildlife Conservation Act 1950	Applies to the protection of wildlife in Western Australia. Within the Abrolhos this primarily relates to the native flora and fauna including seabirds, marine mammals and reptiles.
Western Australian Policies and Guidelines	Hope for the Future: The Western Australian State Sustainability Strategy (September 2003).	Illustrates how the State government will respond to the sustainability agenda, outlines the sustainability framework and gives an action plan for sustainability.
	State Water Quality Management Strategy No. 6. Implementation Framework for Western Australia for the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and Water Quality Monitoring and Reporting.	Provides a framework for implementing the National Water Quality Management Strategy.
	Strategy for Management of Sewerage Discharge from Vessels into the Marine Environment (Department of Planning and Infrastructure, October 2004)	Put together by a State Government Working Party to manage the pollution risk of sewage discharge from vessels.

Jurisdiction	Title	Applicability
EPA Position Statements	Environmental Protection of Native Vegetation in Western Australia. EPA Position Statement No. 2 (December 2000).	Applies to all proposals to clear native vegetation in Western Australia and aims to protect biodiversity. Key criteria applied include: The 'threshold level' below which species loss appears to accelerate exponentially at the ecosystem level is regarded as being at the level of 30 percent of the pre-clearing extent of the vegetation type. A level of ten percent of the original extent is regarded as being a level representing 'endangered' and should be avoided.
	Terrestrial Biological Surveys as an Element of Biodiversity Protection. EPA Position Statement No. 3 (March 2002).	Highlights the significance of biodiversity and the need to implement best practice in terrestrial biological surveys.
	Towards Sustainability. EPA Position Statement No. 6 (August 2004).	Applies to all proposals. It discuses the concept of sustainability and draws attention to a range of global issues. Discusses sustainability in a number of sectors including natural resource management, transport and sustainable communities.
	Principles of Environmental Protection. EPA Position Statement No. 7 (August 2004).	Applies to all proposals. It discusses the principles of intergenerational equity, the precautionary principle, environmental, economic and social considerations, conservation of biological diversity and ecological integrity.
EPA Guidance Statements	Draft Environmental Guidance for Planning and Development. EPA Draft Guidance Statement No. 33 (June 2005).	Provides information and advice on the environmental protection and impact assessment processes in the State to assist land use planning and development. Also provides advice on a range of environmental factors to assist in participants in land use planning and development to protect, conserve and enhance the environment.
	Guidance Statement for Minimising Greenhouse Gas Emissions. EPA Guidance Statement No. 12 (October 2002).	Addresses and provides advice on the minimisation of greenhouse gas emissions from significant new or expanding operations.
	Prevention of Air Quality Impacts from Land Development Sites. EPA Guidance Statement No. 18 (March 2000).	Gives guidelines on acceptable air quality parameters

Jurisdiction	Title	Applicability
	Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment. EPA Guidance Statement No. 29 (June 2004).	Provides guidance for the protection and maintenance of ecosystem integrity by applying a risk-based environmental protection framework. This includes quantitative cumulative loss thresholds and is linked to the ecological, conservation and social values of the environment.
	Guidance Statement for Management of Mosquitoes by Land Developers. EPA Guidance Statement No. 40 (June 2000).	Provides guidance for the management of mosquitoes.
	Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. EPA Guidance Statement No. 51 (June 2004).	Provides advice on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial flora and vegetation and their ecosystems.
	Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. EPA Guidance Statement No. 56 (June 2004).	Provides advice on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna biodiversity, its habitats and ecosystems.
	Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process. EPA Guidance Statement No. 55 (December 2003)	Provides guidance on what the EPA means by the term 'best practice' when used in the EIA process.
	Rehabilitation of Terrestrial Ecosystems. EPA Draft Guidance Statement No. 6 (January 2006).	Promotes the use of completion criteria and definitions for the rehabilitation of natural ecosystems which (i) allow success to be measured within realistic timeframes, (ii) are sufficiently precise to allow outcomes to be affectively audited, but are also flexible when required, (iii) are based on sound scientific principles and (iv) acknowledge the consequences of permanent changes to landforms soils and hydrology.
	Assessment of Aboriginal Heritage, EPA Guidance Statement No. 41 (April 2004).	Provides information which the EPA will consider when assessing proposals where Aboriginal heritage is a relevant environmental factor. This Guidance Statement has been prepared in consultation with staff of the Department of Indigenous Affairs with a view to developing a common approach for proponents where Aboriginal heritage issues are important.

Jurisdiction	Title	Applicability
Abrolhos Islands Policies and Guidelines	Management of the Houtman Abrolhos System. Fisheries Management Paper No. 117 (Fisheries WA, December 1998).	Outlines the proposed management strategies for the Abrolhos Islands including fisheries management, recreational management and tourism management.
	Sustainable Tourism Plan for the Houtman Abrolhos Islands. Fisheries Management Paper No. 146 (Fisheries WA, February 2001).	Outlines the management strategies and proposed directions for tourism development in the Abrolhos Islands.
	Abrolhos Islands Draft Waste Management Strategy. Report and Recommendations for Public Comment (Department of Fisheries, 2005)	Department of Fisheries strategy describes the current practices for disposal of solid, liquid and hydrocarbon wastes, briefly indicates the impacts of these practices and provides solutions and strategies for implementing better environmental practice in relation to waste disposal and management.
International Guidelines	World Health Organisation Guidelines for Air Quality (2000)	Provides air quality guidelines and acceptable parameters.
Australian Standards	Australian Standard AS 4282-1997 *Control of the Obtrusive Effects of Outdoor Lighting*	Outlines a range of management measures that can be used to assist in reducing the amount of diffusion and spill lighting throughout the resort.
	Australian Standard AS 1940-2004 *The storage and handling of flammable and combustible liquids*	Sets out the requirements for the storage and handling of dangerous goods such as fuel, solvents and oils.

3. PROJECT DESCRIPTION

3.1 KEY CHARACTERISTICS OF THE PROPOSAL

The key characteristics of the Long Island tourist resort are presented in Table 3.1 and the proposed layout is presented in Figures 4 and 5.

Table 3.1: Key Characteristics of the Long Island Tourist Resort Proposal

Element	Description
Proposal description	Development of a tourist resort on Long Island in the Wallabi Group of the Houtman Abrolhos Islands, Western Australia
<u>Footprint areas of resort infrastructure:</u> Within development zone Outside development zone: • Northern boardwalk to diving/swimming platforms and beach gazebos • Southern boardwalk to jetty and helipad • Jetty (over water) • Helipad (over water)	 0.64ha (does not include the northern and southern boardwalks) 750m long by 1.5m wide: 0.11 ha. 470m long by 2.5m wide overall, but 3.0m wide at the jetty and up to 4.5m wide at key turning points: Approx. 0.14 ha. 420m^2 (approx). 64m^2 (approx) + area of boardwalk (90m^2).
Services unit compound area	448m^2.
Function rooms/restaurants	1 restaurant. 1 lounge bar + 1 day visitor pavilion and kiosk. 1 conference/function room. 1 internet room. 1 resort shop.
Guest lodges	28 standard rooms. 2 premium rooms. Each room sleeps 2 people.
Staff facilities	Staff bedrooms, infirmary, housekeeping facilities, communal kitchen/dining/lounge room with external deck area.
Day visitor facilities	Day visitor pavilion at southern entrance to resort. Provides refreshments, inductions and interpretive information.
Manager/Head Chef residence	Separate two bedroom lodge with own kitchenette and deck.
Power supply	Diesel operated generator augmented with passive solar energy use.
Water supply	Desalination plant (sized to supply 17 kilolitres per day of potable water)
Solid waste disposal	Compaction prior to disposal on mainland
Wastewater disposal	Central treatment of black and grey water prior to discharge into Goss Passage (seven days storage capacity)

Element	Description
Swimming pool and spa (set below ground)	One 15m by 8m pool. One 5m by 5m spa.
Moorings	May be installed and managed by Department of Fisheries. HLD may also apply to Department of Fisheries to install a maximum of three private moorings.
Jetty	A berthing area of 30m by 8m. Accessed via a 30m by 6m walkway. Total area of 420m^2
Helipad	8m by 8m anchored pontoon located south of the resort over water. Accessed by a 3m wide, 30m long boardwalk.
Transport	Visitors will arrive at Long Island via: • Boat from the mainland to Long Island. • Aeroplane to East Wallabi Island then boat to Long Island. • Float plane from mainland to Long Island • Helicopter from mainland to Long Island. On Long Island golf buggy style vehicles will be used to transport guests not wishing to walk and a quad-bike and trailer will be used to transport baggage, freight, etc.

The proposed facility will accommodate up to 60 overnight guests within 30 visitor lodges. Ten staff shall be accommodated within staff facilities. Guest accommodation will be supported by communal facilities, staff accommodation, swimming pool, sea diving platforms, a deep water jetty, helipad and service and maintenance units. Each guest/staff lodge will be provided with an internal bedroom and shower/toilet facilities. Small guest gazebos and swimming/diving platforms will be situated around the northern portion of the island and shall be accessed via a raised boardwalk.

The proposed facilities will include a multi-function room where induction courses will be held for all visitors on arrival at the island. A day visitor pavilion and kiosk will be located at the southern end of the development area.

3.2 SITE OF DEVELOPMENT

3.2.1 Background and Site Selection Process

There were two stages for selecting Long Island as the site for the proposed tourist development. During the first stage, the Abrolhos Islands Consultative Council (AICC) established the Abrolhos Islands Tourism Working Party ("the Working Party"). The membership of the Working Party consisted of representatives from the following bodies (AICC, 1995):

- AICC.
- Mid-west Development Commission.
- Rottnest Island Authority.
- An Abrolhos Islands Fishing Representative.

- Department of Conservation and Land Management.
- Fisheries Department of WA.
- WA Tourism Commission (now Tourism Western Australia).
- Geraldton Professional Fishermen's Association.
- WA Museum.
- University of WA.

The Working Party conducted extensive research and community consultation to determine the preferred alternatives for tourism development in the Abrolhos. The second stage consisted of a site inspection and comparison of alternative sites nominated by the Working Party and other sites by Humfrey Land Developments (HLD). The processes relating to each stage are outlined below (Fisheries WA, 2001).

3.2.1.1 Island Short-Listing by the Working Party

The Abrolhos Islands Tourism Working Party conducted extensive research and community consultation in order to determine the preferred alternatives for tourism development in the Abrolhos. The results of these investigations are presented in Tourism at the Abrolhos Islands, Final Report, (AICC, 1995), and form an important part of the Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands (Fisheries WA, 1998b) and the Sustainable Tourism Plan for the Houtman Abrolhos Islands (Fisheries WA, 2001). The community consultation conducted during these processes is documented in Section 6.2.1. These reports recommended a number of types of commercial tourism that could be developed in the Abrolhos, including Charter Boats, Moored Accommodation facilities and Shore-based facilities.

For the shore-based facilities, it was recommended that only small scale (accommodating up to 40 guests), low impact facilities be developed. Of the shore-based facilities it was recommended that islands that are already inhabited be avoided due to potential incompatibility between fishers and tourists. The Sustainable Tourism Plan for the Houtman Abrolhos Islands (Fisheries WA, 2001) states that:

> "*The final report of the Abrolhos Island Tourism Working Party (AICC 1995) considered the interests of rock lobster fishers and tourism operators to be largely incompatible. Huts on the inhabited islands are very close together, much more so than in mainland communities. The fishers leave early (usually at 4:00-5:00 a.m.) to pull their pots and accordingly have a very early night. There is concern amongst the fishers that tourists visiting the islands would be wandering through their camps and disrupting the community by wishing to party at night. In addition, there is concern about loss of property. Should tourist facilities be considered for presently inhabited islands, a process of consultation with the islands' fishing community, AIMA* (Abrolhos Islands Management Authority) *and other interested parties would be undertaken. The final report of the Abrolhos Island Tourism Working Party (AICC 1995) left open the possibility of a shore-based tourism facility on an inhabited island if the operator and fishers agree……..This possibility is maintained in the present draft tourism management plan*."

Fisheries WA (2001) suggested two possible uninhabited islands for consideration for shore-based tourism facilities. These were Long Island in the Wallabi Group and Little Roma Island in the Easter Group. Long Island was the only island identified by the Working Party in 1995 (AICC, 1995). Long Island was considered particularly suitable for small-scale tourism development by the Working Party for the following reasons:

- It is centrally located in the Wallabi Group, where the *Batavia* was wrecked.
- Beacon Island, one kilometre to the east and Long Island itself played an important role in the *Batavia* story. The Wiebbe Hayes forts on West Wallabi Island are also close.
- Long Island has less significant bird breeding activity that other islands in the Wallabi Group (AICC, 1995, citing Fuller *et al.*, 1994).
- Long Island is suitable for shore dives, including diving on the three *Porites* coral bombies and the Long Island dive trail just off the northern tip of the island. The adjacent Beacon Island platform is a reef observation area, and offers the possibility of diving among coral reef fish, which have not been hunted by spear for several years. In good weather, the *Batavia* wreck site can be dived. Other dive sites, including those on the front of the reef, can be easily reached by small boat from Long Island.
- The central position of Long Island means that there are a variety of fishing opportunities.
- Long Island is near the airstrip on East Wallabi Island, and can be easily reached by small boats.
- In good weather East Wallabi Island can be used for day trips and picnics, and
- To the west of Long Island, the lagoon offers safe anchorages. A jetty could easily be built onto this side of Long Island or onto Goss Passage.

Fisheries WA (1998b and 2001) also lists Little Roma Island, located in the Easter Group to the south of Rat Island as being potentially suitable for shore-based tourism development for the following reasons:

- It is uninhabited, and thus separated from fishers, but near enough to Rat Island to have ready access to its airstrip.
- It is located in the heart of the Easter Group, with access to a wide variety of fishing and dive sites, including the Reef Observation Area of the Leo Island Platform, which has the Anemone Lump – one of the premier dive sites in the Abrolhos.

Several islands were not considered suitable by the Working Party for the development of shore-based facilities, namely West Wallabi, East Wallabi and North Islands in the Wallabi Group, and Leo's Island in the Easter Group.

West Wallabi Island was not considered suitable for development mostly because it has by far the greatest concentration of seabirds in the Abrolhos, with an estimated 1,030,000 pairs of shearwaters, both wedge-tailed and little shearwaters, breeding on the island. It was noted that some fishers have huts on the island although it is planned that these will eventually be removed, due to the high conservation value of the island. It would be inconsistent with this policy to open the island to land-based tourist accommodation. In addition, there is no anchorage and boats are moored well offshore. No jetties are currently permitted on the island, this policy is to minimise risk of introduction of vermin (Fisheries WA, 2001).

North Island has only restricted anchorage and jetty space, which is already occupied by commercial fishers. There are presently 25 resident fishers on the island during the rock lobster season (Fisheries WA, 2001). The presence of fishers raises the aforementioned potential conflict issues.

Turtle Bay on East Wallabi Island is an attractive position in which to base a tourist facility. However, the island was not considered suitable by the working party as it has a very high conservation value, particularly since it has never been occupied by fishers. A fossil site at one end of the bay is reported to be of international significance. Seagrasses that are important nursery areas for fish and rock lobsters occur in the bay and these may be damaged by development. The bay is exposed during northerly conditions and therefore does not provide an all weather anchorage. The Working Party noted that development may prove appropriate in the intermediate term, following environmental assessment and taking into account any issues which arise from the experience gained from the monitoring of tourism operations in other parts of the Abrolhos (Fisheries WA, 2001).

Leo's Island in the Easter Group was considered unsuitable for development by the Working Party as it has a high conservation value because of the large breeding seabird populations. There is a single fisher living on Leo's Island at present, although it is planned to move this camp to another island in the future.

3.2.1.2 Humfrey Land Development's Site Selection Process

With respect to choosing a site, HLD did consider the option of proposing an inhabited island. However, given the concerns of rock lobster fishers, HLD did not believe that agreement would be reached with the fishers to have a resort built on an island they were occupying. In addition, the concerns of the Department of Fisheries (1998b, 2001) were noted and HLD agreed that the lifestyles of fishers and tourists would not be compatible. It was considered that fishers needed to be given the respect and privacy to go about their business, uninterrupted by tourists' activities. Instead, HLD favoured proposing the use of an island that was not already inhabited.

As part of the initial stages of preparing a proposal for sustainable tourism in the Abrolhos, HLD undertook a comprehensive site inspection and comparison of alternative sites in 1999. Initially, the site preferred by HLD for tourism development was Pelsaert Island in the Southern Group. However, Pelsaert Island was not considered suitable for development by the Working Party, as the island is extremely environmentally sensitivity due to the location of seabird breeding colonies. Of the sites nominated and following further investigation, Long Island was considered to be the only suitable island that could be used for a tourism venture. Long Island has deep water to the west of the island in the lee of the prevailing winds. In addition, it was considered that of the islands short-listed by the working party, Long Island would provide the best opportunity for tourists to be occupied for several days whilst having the least amount of impact on the surrounding area.

Little Roma Island in the Easter Group was discounted by HLD on account of not having appropriate sheltered anchorage for boats and being too small to easily accommodate a resort. In addition, it was considered that the potential for onshore activities were not as great as those onshore at Long Island as there were no historical points of interest and the proximity to shipwrecks was not as favourable. Little Roma Island was also considered too close to the inhabited Rat Island and that this might lead to visitor/fisher conflicts.

Selection of Long Island as the preferred site included consideration of:

- Potential for environmental management and education.
- Although Long Island is of importance as a bird breeding colony, it has lower conservation values than other islands which have seabirds and breeding colonies that have been assigned higher conservation values (Department of Fisheries, 2003).
- Protection through management of historical areas.
- Extent of sheltered waters and anchorage.
- Areas of varied interest enhancing the tourist experience, including proximity to the *Batavia* wreck and the importance of Long Island in the historic *Batavia* event.
- Proximity to diving reefs and wrecks.
- Accessible to shore dives and proximity to some of the best diving reefs in the Abrolhos Islands, including a nearby Reef Observation Area.
- Appropriate separation distances from inhabited islands.
- Proximity to Geraldton and travel time.
- Proximity to the East Wallabi Airstrip.

Initially, the Department of Fisheries requested proposals from interested parties to develop a resort with a maximum accommodation for 40 people (Department of Fisheries, 2001). In response to the Department of Fisheries/AIMAC request for proposals in 2001, HLD submitted an Expression of Interest in March 2002, followed by a more detailed Notice of Intent in August 2003. This document included a viability study that demonstrated that for the resort to be commercially viable, the minimum capacity of the resort would need to be greater than the initial 40 guests proposed by the Department of Fisheries in 2001 in their Sustainable Tourism Plan for the Houtman Abrolhos Islands and that a viable number of guests would be 60.

Following review of the Notice of Intent, the Department of Fisheries reissued its Request for Proposals in August 2004, requesting proposals for a resort development accommodating up to 60 guests. In September 2004, HLD submitted a second proposal for a Tourism Development on Long Island to the Department of Fisheries/AIMAC in response to its Request for Proposals. The proposal was for a resort that could accommodate 60 guests and 10 staff. Advice was received from the Fisheries Department in December 2004 that HLD had been selected as the preferred candidate to develop a nature based tourism operation on Long Island. An application for a Tourism Licence was submitted to the Department of Fisheries in June 2005. It is understood that the Minister for Fisheries will grant the Tourism Licence following the completion of this PER and it's acceptance by the Minister for the Environment.

The siting of the development zone on Long Island was set by the Department of Fisheries as part of the Request for Proposals. Figures 4 and 5 show the extents of this development zone. An exclusion zone has also been established around a tidal pond that is located within the boundaries of the development zone. The site for the development zone includes a requirement that development on the eastern side of the island will be restricted to high ground (two metres or greater above sea level). This measure follows on from the advice of engineering consultants MP Rogers and Associates who recommended that any construction

be undertaken on higher ground to avoid potential storm surge damage (MP Rogers and Associates, 1997).

3.2.2 Layout of Site

The conceptual design of the development is organised on a north-south axis with the staff accommodation and the service units located at the southern end of the development site and the visitor accommodation at the northern end (Figure 5). All the facilities are linked via a network of raised boardwalks across the site. Interconnection of site services is achieved by running all service conduits suspended below the boardwalks. Boardwalks will extend to the northern tip of the island and south of the development as far as the helipad (see Figure 4).

The communal facilities are organised around the open seating area and barbeque and orientated to provide a view over the ocean to the other islands of the Wallabi Group. Gazebos and swimming/diving platforms will be provided at locations around the northern portion of Long Island.

The conceptual design sees guest lodges organised in pairs running up the island with each pair separated from the others giving an element of privacy to each lodge. The northern-most pair would provide an exclusive aspect looking across the Wallabi Islands.

The jetty has been located outside the southern end of the development area taking advantage of the deep water in the bay close to the island's western shore. The helipad is also located to the south of the development. These facilities will be accessed via a raised boardwalk and positioned so as to minimise damage to living coral.

3.2.3 Area of Disturbance

The main area of disturbance will be within the central third of Long Island, identified by the Department of Fisheries as the Development Zone for the tourism development. Minor areas of disturbance will occur to the north and south of this area associated with the boardwalks, beach gazebos, and access to the jetty and helipad. There will also be some disturbance in the waters surrounding Long Island due to the installation of the jetty, helipad, moorings and diving/swimming platforms. The total footprint of the tourist development on Long Island, including the jetty and helipad is approximately 0.89 hectares. Of this, 0.64 hectares occurs within the main development area. Due to the boardwalk and buildings being raised off the ground it is estimated that up to 30 percent of the total footprint will be disturbed by construction. There will however be shading impacts relevant to the entire footprint area.

3.3 RESORT DEVELOPMENT CONSIDERATIONS

3.3.1 Alternative Resort Scales Considered

Potential market demand and financial sensitivity analysis was carried out for the proposed venture under a range of scenarios with varying bed capacities, expected occupancy levels and average rates to be achieved. Facility style, scope, and scale were variables considered and these alternatives included:

- An exclusive, deluxe style, small capacity (up to 12 guests per night), high rack rate facility;
- "Multi-level" commercial accommodation facilities with capacities ranging from 20 to 50 guests per night with a focus upon nature based and special interest recreational enthusiast groups; and
- Larger capacity (up to 75 guests per night) multi purpose tourist facility catering to a wide range of market needs and standards.

Each of these alternatives was assessed according to the environmental, operational, and financial impacts that would be received. The most sustainable alternative remains the 60 guests per night capacity scenario and this has been developed as the proposed numbers for the venture.

3.3.2 Transportation

Access to the island will be via a combination of fixed wing aircraft (utilising the existing airstrip on East Wallabi Island), helicopter, float plane, and boats from Geraldton. The number of helicopter and fixed wing aircraft flights will be tied to commercial flights into Geraldton by both the current commercial airlines. The helicopter landing and take off flight path will be from the north-west of the helipad. An expression of interest will be called throughout Australia for helicopter, fixed wing aircraft and charter boat operator services once HLD has received their necessary tourism licences.

HLD has been in discussions with Geraldton based charter boat companies with respect to the transportation of guests, day-visitors, staff, fuel and provisions to and from the island, whilst also carrying waste back to Geraldton for disposal or recycling.

Vehicular transport on the island will comprise of one quad bike to be used for transportation of bulk goods and up to three hybrid electric golf buggies, which will be used to transport guests to and from the jetty and helipad. The quad bike will be fuelled by petrol and the buggies will be electric powered. All vehicles will be confined to the boardwalks, except in emergencies.

3.3.3 Seasonality

The major factor contributing to seasonality in the Abrolhos is the presence and speed of wind, though air temperature also plays a role. In order to determine the seasonality of the proposed resort the air temperature, wind speed and direction affecting the Islands as well as a wider review of the tourist seasonality trends for the region were assessed. On this basis it was determined that the peak period for the resort would be during April and May with shoulder periods being from the start of June to the end of September, low periods occurring during October to February and another shoulder period occurring in March (market demand study by Ray Bird & Associates, cited in Jones Coulter Young, 2005).

Although seasonal variations will be expected, there is opportunity to undertake highly focused marketing activities to attract special interest visitor types all year round.

3.4 INFRASTRUCTURE

3.4.1 Buildings

The resort facilities are conceptually organised on a north-south axis with the guest lodges organised into groups providing an element of privacy to each lodge. The Day Visitor Pavilion, Services Compound and Staff Accommodation are located at the southern end of the Development Area with the Central Facilities located centrally to the guest lodges, to the north of the tidal pool on the west of the island.

The buildings have been designed maximise Environmental Sustainable Design (ESD), including orientation, passive solar heating, cooling and daylighting strategies. Views 1, 2 and 3 demonstrate the conceptual design of the proposed resort facilities. The roof has been designed to provide afternoon shade in the summer, whilst allowing maximum exposure to the lower sun in the winter months. Floors and walls will also be insulated to provide a cool interior in the hotter months and a warm interior in the cooler periods. The buildings will also be constructed above ground level on a raised floor to allow sub-floor and cross ventilation for natural cooling. Raising the buildings off the ground will also minimise the impact of construction on Long Island.

All structures, where possible, will be constructed from sustainable materials, which will be predominately prefabricated and/or pre-cut and transported to the Island. All buildings will be designed and constructed in accordance with the relevant Australian Standards, Local Authority Standards and the Building Code of Australia. Materials will be selected where possible from sustainable sources by evaluating characteristics such as reused and recycled content, zero or low off gassing of harmful air emissions, zero or low toxicity, sustainably harvested, highly recyclable, durability, longevity and local production.

3.4.1.1 Foundations

The current preferred foundation system for the boardwalks and the dwelling units is an alternative compact steel piling system. This system is currently being assessed for its suitability in an attempt to minimise the handling of concrete on the island. If this innovative foundation system proves unable to cope with the design loads of the structures it has to support over the life of the resort facility, then as a contingency a more conventional foundation system such as concrete footings will have to be considered.

It is proposed that concrete pad footings will be used for all utility areas such as the services compound and access points to this area. This area is of high importance as it houses plant and equipment to keep the resort facility running. Additionally concrete footings may be considered for use for all other areas that will serve as emergency assembly areas during extreme weather events due to the inherent requirement to withstand high loads while maintaining a safe space for guests and staff to endure extreme weather events.

3.4.1.2 Guest Lodges

The 30 guest rooms at the resort are divided into 28 standard and two premium rooms. All rooms will have reverse cycle air conditioning, ensuite bath facilities, television, internet services and a private deck that will provide guests with uninterrupted views of the islands.

Plate 1 shows a computer-generated image of the room design. The premium rooms will have a separate sitting room and a two-person spa bath sunk into the private deck.

3.4.1.3 Guest Common Areas

The central facilities will comprise the reception, multi-function room, shop, restaurant with barbecue deck, lounge bar and external deck area with swimming pool and spa. Plate 2 shows an image of the restaurant area. The multi-function room can seat 40 people and will include high quality audio-visual equipment. This room can be used for lectures, conferences, functions, cinema and the welcome/induction message to guests and visitors on arrival at the islands. The central facilities are organised around the outdoor deck and have been orientated to provide the reception, multi-function room, restaurant and lounge bar with panoramic ocean views.

3.4.1.4 Staff Accommodation and Facilities

The staff facilities comprise the infirmary and housekeeping facilities, staff bedrooms and large kitchen/dining/lounge room with external deck area. Each member of staff will have their own bedroom with en-suite bathrooms shared between two staff rooms. The resort manager and chef are provided with separate rooms away from the main staff lodge, which will include a kitchenette and a private deck.

3.4.1.5 Day Visitor Reception

The day visitor pavilion provides guests and day visitors with a separate lounge bar with dive-shop. All day visitors to Long Island will be required to register at reception and undertake an induction to Long Island. Day visitors will not be permitted to enter the main resort area unless be prior arrangement.

3.4.1.6 Services Compound

The services compound will house the desalination plant, power plant, combined wastewater treatment unit, garage, maintenance workshop, bin storage area and compactors for solid waste and recycling facilities for cardboard, plastic, glass and cans.

An area for a self-bunded storage tank containing a small quantity of petrol for the resort's buggies, quad bike and small vessel/s will be located in the services compound.

3.4.1.7 Reticulation of Services

All piping and cabling will be laid into cable trays and service ducts suspended beneath the boardwalk and attached with a bracket system to minimise corrosion and making the reticulation services readily accessible.

The inlet pipeline from the desalination bore to the plant and the wastewater and desalination outlet pipelines to Goss Passage will be buried in trenches excavated into the ground.

3.5 CONSTRUCTION PHASE ACTIVITIES

3.5.1 Building Logistics

HLD have been in discussion with Crothers Construction, in regard to the construction and programming of the proposed facilities. Crothers Construction has extensive experience in the Geraldton area.

The key criteria in constructing the proposed facilities will be the logistics of co-ordinating supplies, materials, accommodation and tradesmen on an island with no existing facilities and respecting the environmental considerations.

The concept for the construction of the facilities is for a prefabricated and modular construction in order to minimise disturbance to the island environment. The buildings are to be assembled offsite and transported to the island by sea and positioned on foundations designed for minimal disturbance. Materials will be pre-cut and/or pre-fabricated in Geraldton to reduce the need for extra materials, minimise packaging and avoid wastage. All materials will be portaged from the boat to the work area.

All building waste will be removed from the island for disposal at Geraldton. No burying of waste during construction (or at any time) will be permitted.

Excess cuttings from excavations for foundations and trenches will be placed in low stockpiles in designated areas within the development zone for future use in rehabilitation.

3.5.2 Construction Workers

Long Island specific inductions will be undertaken to inform the construction crew of the specific environmental requirements of the island and to ensure the site is left in its natural state as at commencement of project, as far as possible. The content of the Construction Induction Program is detailed in the Construction Management Plan (Appendix 3).

The construction crew will comprise an estimated 35 workers at the Islands and 65 in Geraldton. An agreement has been reached with the local rock lobster fishers such that construction workers may be accommodated in the fisher's huts on nearby islands and ferried by boat to the island daily. If construction should need to take place during the Rock Lobster fishing season, construction workers would need ensure the Staff Quarters were completed on the island prior to this time and workers would be accommodated on the island in the staff quarters.

3.5.3 Access Pathways

Where walking on the Island surface is required during construction, designated tracks will be used which have the least impact on vegetation and coral. Where possible, these tracks will follow the alignment that will be used for the boardwalk. A tractor or four-wheel drive, with wide wheels, will be the only vehicle used on the island during construction. The southern boardwalk between the jetty and resort will be constructed during the initial stage of construction once the heavy items for the services compound have been placed in position. The boardwalk will then be used for all other construction.

3.5.4 Timing of Project

The construction is proposed to be undertaken in two phases, the forward works (Phase 1) will comprise the construction of the jetty, southern boardwalk, helipad and services compound followed by the main resort construction (Phase 2).

Construction will commence as soon as the necessary approvals are received. The current construction programme allows 12 weeks for the Phase 1 works and 38 weeks for the Phase 2 works. Ideally, Phase 1 construction works would commence in July (jetty and island connection), Phase 2 in October with the resort opening in the following year. The Construction Management Plan shows the construction schedule in detail.

3.6 OPERATIONAL RESORT SERVICES

3.6.1 Sewage and Effluent Disposal

3.6.1.1 Volume of Wastewater

A maximum daily desalination wastewater volume of 140 kilolitres is predicted at full resort capacity and approximately 17 kilolitres of treated wastewater effluent.

3.6.1.2 Toilet System

A number of options were considered in relation to the type of toilet to be installed in the guest lodges. Both composting toilets and more conventional flushing toilet systems were considered. Due to the nature of the project, and the expectations of tourists to the area, it was decided that low flow flush toilets attached to a vacuum sewer system would be the minimum standard acceptable to paying guests.

3.6.1.3 Treatment and Disposal Methods Considered

The re-use of grey water from showers, hand basins, kitchen sinks and laundry was considered during the preliminary design phase. In most instances, grey water re-use in Western Australia has been a key criteria in sustainable design but has generally been limited to toilet flushing and subsurface disposal. However, neither of these options exists for Long Island due to the island's low topography, proximity to seawater level, substrate composition and the expectations of guests.

Once it was established that grey water re-use was not an option for the resort, three wastewater management options were considered for wastewater treatment and disposal:

- Option 1: The first option is to separate the grey water (comprising mainly of water from guest showers and from cleaning activities), and black water (i.e. raw sewage). The grey water will then be collected into a central processing unit, to be processed and released into the surrounding ocean. The black water on the other hand can be collected (separately) into another central processing unit and processed for appropriate disposal of liquid effluent and any remaining solids. This option allows for full above ground installation, requiring no significant earthworks.

- Option 2: Combined collection, treatment and disposal of black and grey water at a centralised point and treated wastewater released into the ocean. Option 2, the preferred option, is described in Section 3.6.1.4.
- Option 3: Separate collection, treatment and disposal of black and grey water in a decentralised manner with grey water, either treated or untreated, released into the ocean. It was considered that disposal of untreated grey water to the ocean would be unacceptable from an environmental perspective and not in keeping with the ethos of the resort. Therefore grey water would be collected, treated and disposed of in a treatment unit similar to Option 2 but with a smaller capacity. Black water can either be treated using:
    - A conventional septic system for black water only;
    - A hybrid system at the source that could be buried under the lodges; or
    - Alternatively all the wastewater can be combined and treated in small conventional septic systems. If a more conventional septic unit (ATU) were utilised then given the minimum size of such systems each unit can be installed to serve two to three living units (pedestals).

Options 2 and 3 avoid duplication of wastewater collection services as they do not require grey and black water to be kept separate at all times, unlike Option 1. Thus these two options were investigated further for preliminary design purposes.

Further investigation revealed that Option 3 required significantly more earthworks than Option 2. Therefore, due to the nature of Long Island it was decided that Option 2 was the most viable.

3.6.1.4 Treatment and Disposal

The wastewater management system to be implemented for the resort involves the combination of wastewater (both black and grey water) and then collection of this for processing in one centralised treatment unit. This will then yield a treated effluent, which will be released into Goss Passage for dispersal. The treatment unit will be designed to ensure water quality outside the mixing zone meets Australian guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000). The treatment unit allows for aboveground installation requiring no significant earthworks. However due to the island's flat and low topography, a vacuum sewer system will be required to effectively and efficiently transport the wastewater to the processing unit. This vacuum sewer system entails gravity connections from the wastewater source to plastic or steel lined (and fully sealed) collection "pits" which in turn are connected to the pressurised vacuum pump system. There are controlled access points which allow access for maintenance purposes only. The centralised treatment tanks are contained within either 1x40ft sea container or 2x20ft sea containers. The sea-container within which the digester tanks are held can itself be spray sealed (on the inside) with fibre glass and hence act as the bunding.

This avenue for wastewater management has been chosen over the several other options discussed during the preliminary design process due to various uncertainties associated with the constructability of the other options. The choice of treatment system also takes into account calculations of the quantity of expected discharge.

Grease traps in the restaurant kitchen will capture fats and oils and prevent them entering the wastewater treatment plant. These contaminants will be disposed of via the solid waste collection methods proposed.

Treated wastewater will be discharged into Goss Passage at a depth of ten metres. The wastewater outfall will comprise a pipeline from the treatment plant to an outfall point located approximately level with the southern boundary of the development area. This pipeline will be approximately 0.05 metres in diameter. Details regarding the pipeline placement and anchoring are yet to be finalised, but the current proposal is that the inshore section of the outlet pipe will be placed within a one metre wide excavated trench, to be back-filled by rubble or concrete, to minimise the visual impact from the island as it runs across the shallow bedrock. The offshore portion of the outlet pipe, to the east of the shallow reef area, will be laid directly onto the seabed and either pinned in place or held by a rubble/concrete blanket. Figure 6 shows the conceptual design of the wastewater outlet pipe.

It is envisaged that the treated wastewater will be discharged at a constant (very slow) rate to Goss Passage, provided that sufficient pressure can be generated in the pipeline. If this sufficient pressure cannot be maintained, the wastewater may need to be discharged in short "bursts" on a regular basis (for example, every hour). The details of the discharge method will be determined during the detailed design phase of the project.

From the manufacturer's specifications the estimated upper limits for the various parameters of wastewater disposal can be summarised as follows:

Given the assumption of approximately 17 kilolitres per day (see section 3.6.3.1) with biological oxygen demand (BOD) of 300 parts per million:

- The extended aeration system proposed would reduce the BOD from about 300 parts per million by 90% to approximately 30 parts per million.
- Suspended solids in the treated effluent (at the outfall) are likely to be in the order of 30 parts per million.
- The total nitrogen (TN) levels in the outflow will be around 30 parts per million.
- The total phosphorous (TP) levels in the outflow will be around 12 parts per million.
- The pH of the outflow will remain in the 6.5-8 range, provided the inflow to the treatment system is maintained at approximately 7.
- Following chlorine treatment of the effluent, the faecal coliform count is likely to be reduced to less than 200 coliform units per litre. A residual chlorine level of 0.5 parts per million will be present in the outflow.

The treated wastewater will be rapidly dispersed and diluted due to depth of discharge (10 m) and the currents in Goss Passage.

Wastewater from the desalination plant will also be discharged to Goss Passage, through a 0.10 metre diameter pipe running alongside the treated wastewater discharge pipe. The desalination wastewater pipe will have a 1-metre riser on the end of the pipe to ensure efficient mixing of the more saline water. The saline discharge will be negatively buoyant but will rapidly disperse following discharge.

3.6.1.5 Wastewater Treatment Contingencies

The vacuum pump station will comprise two pumps that run on an alternating cycle (one pump is functioning while the other is on standby), which provides a significant contingency against pump failure. In the unlikely event of both pumps failing then collection pits will act as buffer tanks for a minimum of one day (at maximum wastewater outputs). In addition, the central collection and treatment tank has been designed to hold seven day's capacity of wastewater output.

3.6.2 Solid Waste Disposal

Solid wastes can be disposed by various methods. These include burial, incineration and disposal at sea. None of these methods were considered appropriate or in keeping with the ethos of the proposed tourist resort on Long Island. All solid waste generated by the resort will be removed from the island and transported to the mainland for disposal in approved facilities.

Given the nature of the resort the solid waste will comprise mainly of food and kitchen wastes, in addition to cardboard and other recyclables (e.g. plastic and glass bottles). All waste is to be collected and temporarily stored at a transfer station before being regularly transported back to the mainland for disposal at the Geraldton-Greenough Regional Council landfill. A general wet/dry trash compactor and also a small baler unit for cardboard will be used. General waste is to be stored in 1,000/1,100 litre mobile garbage bins (MGBs), which are to be transported off the resort for appropriate disposal and/or recycling on the mainland.

Surplus waste will be minimised. Some food items will be pre-trimmed and other resort provisions will have some packaging removed prior to shipping from Geraldton.

Grease traps from the restaurant will also be regularly cleaned and taken to the mainland for disposal.

3.6.3 Water Supply

3.6.3.1 Water Requirements

The limited availability of fresh water on the island has been recognised as a potential limitation to development. The proposed development will focus on minimising water consumption. The current predicted maximum daily demand for fresh water is 17 kilolitres per day. This is based on a full occupancy of 60 guests, 10 staff and 60 day visitors. The daily water demand for guests and staff is estimated at 160 litres per person per day while the water demand for day trippers is estimated at 96 litres per person per day (60% of a resort guest per day). No areas of irrigation will be required, as it is not proposed that any garden or planted areas be provided. In addition to this, bottled drinking water will be available to guests and staff.

A strong water conservation management regime will be integral to the operation of the facility, with the intent to minimise water usage as much as possible. To this end, visitors

and staff will be educated as to the scarcity of water within the Abrolhos Islands and encouraged to reduce their water consumption as much as possible.

3.6.3.2 Supply Methods Considered

It was initially proposed that winter rainfall would be collected and stored to supply the bulk of fresh water requirements. However, rainfall at the Abrolhos is insufficient to supply the needs of the development, supplying only 25 percent of the predicted required amount and would lead to the need for a supplementary water supply. The collection of some rainwater to supplement desalination may be considered at a later date. Rainwater harvesting would require large withholding storage tanks, possibly needing to be located below ground.

Groundwater as a source of water supply was dismissed, as it is expected to be brackish to saline, as observed in the tidal ponds, and of limited resource. Any utilisation of the groundwater resource would result in intrusion of saline water and possible drawdown on the tidal ponds.

Desalination of seawater was considered a feasible, low impact water supply option, which would meet the operational requirements of the resort. There are a number of such facilities operating on islands within Australia including Western Australia.

3.6.3.3 Desalinated Water Supply System

All potable and raw water used on the island will be sourced from the desalination unit. The installation of a seawater desalination unit is considered essential to meet the water requirements of the proposal.

The desalination plant will be mounted on a skid. This will then be placed within a room inside the services compound. The desalination plant runs off mains electricity (3-phase). The generators on the island will supply this electricity to the plant.

The desalination unit will be capable of supplying approximately twice the capacity of the daily maximum water requirement. The unit will have to produce around 30 to 35 kilolitres of freshwater in a 24-hour period. This will then provide adequate redundancy in the system to allow operation for only part of the day (12 to 14 hours maximum). A shallow well will be installed in the water west of and adjacent to the service compound. A submersible pump will pump the water to the desalination plant via a pipeline. The hypersaline wastewater (approximately 45 psu) will be discharged into Goss Passage. In addition, an ultraviolet steriliser offers additional protection for water quality and will be included as part of the fresh water treatment process.

3.6.3.4 Water Supply Contingency

The design will allow for 100 kilolitres of storage, approximately six days worth of peak usage, for the combined effect of down time and inclement weather preventing vessels from reaching the facility. This can be achieved with four 25-kilolitre tanks situated above the ground next to the services compound. Water distribution around the facility will occur under pressure, using two pumps running on an alternating cycle. Bottled water will also be stockpiled, in case of a prolonged failure of the desalination system.

3.6.4 Power Supply

3.6.4.1 Electrical Power Requirements

The maximum demand for the resort at any one time has been estimated at 171 kilowatts. This has been based on *AS3000-2000: Non-domestic Electrical Installations* using preliminary design assumptions. The daily energy demand has been estimated using the following:

- Four hours of consumption at 75 percent of maximum demand giving 511 kilowatt hours. This is predicted to occur during periods around meal times.
- Six hours of consumption at 30 percent of maximum demand giving 307 kilowatt hours. This is predicted to occur during early morning and evening periods.
- 14 hours of consumption at 10 percent of maximum demand giving 239 kilowatt hours. This is predicted to occur during sleeping hours, for a period after breakfast, and for a period after lunch.

This gives an estimated total energy consumption of 1,057 kilowatt hours per day.

3.6.4.2 Primary Power Generation Fuel Source

Following completion of the preliminary design phase, Origin Energy advised HLD that it potentially had the capability of providing a reliable supply of containerised Liquefied Petroleum Gas (LPG) to the island.
However the supply, storage and distribution of LPG to the island has raised significant logistical issues and Deutz Australia Pty Ltd has advised that it is unable to supply LPG powered engines to meet the electrical load profile required. Issues associated with boats to supply large quantities of LPG and the storage of the large tanks on the jetty mean that the use of LPG for primary power supply is not practical.

LPG will still be used to supply the fuel for the hot water systems for the guest dwelling units and for cooking. This is proposed to be supplied using 45 kilogram gas bottle arrays situated in the vicinity of the dwelling clusters and outside the kitchen area.

Diesel is considered as a viable power source due to its reliability and wide spread application in remote and stand-alone power infrastructure. In addition, diesel supply vessels and refuelling infrastructure is readily available and vessels are already servicing the rock lobster fishing industry at the Abrolhos in the fishing season. The rate of diesel usage at the resort is forecast to be 370 L per day in peak season based on current forecast electricity demands. Tanks accommodating up to a total of 2500 L of diesel will be constructed on the island, giving over 6 days of storage. It is anticipated that the vessels bringing regular supplies to the island will also be bringing diesel every few days, so a storage capacity of over six days of diesel gives ample storage capacity in the case of bad weather.

Diesel will be stored within self-bunded storage tanks fully augmented with spill kits. Standard ducting used for pumping fuel from supply vessels into the shore based storage tanks (which already have spill/leak prevention redundancies built in as standard) would be double sheathed as an additional spillage risk mitigation measure.

Wind power was considered as an additional power source given the windy conditions found in the Abrolhos Islands. The use of wind power was rejected for the following reasons:

- Potential for interference with the birds in the area. Wind turbines are typically very large structures with most being between 10 and 20 metres tall. Aside from the potential for direct collision with this structure, the turbine would also cause disturbance to seabirds that are particularly sensitive to changes in the landscape. Resultant noise from the turbine would also disturb fauna species.
- This size of structure would result in a decrease in visual amenity of the area, and is not consistent with the height limit on structures established during the Department of Fisheries' request for proposals process.
- A turbine such as this requires a substantial deep footing, in order to withstand the wind loads acting on the structure. This footing may not be secure enough on an island composed of coral rubble.
- Wind turbines can also create high noise levels, especially during windy conditions. This would further decrease the amenity of the resort.

Solar photo-voltaic cells (PV) were also considered due to the area's inherently large amount of sunshine. However when calculations were conducted to assess the number of PV cells required, the resultant quantity (by area) was too large given the roof space available and the general limitations of the development area. This was compounded by the fact that in order to use PV as the primary source of electricity the cost when compared to more conventional sources was 10 times larger.

Additionally both wind and solar forms of energy, if used, would require a significant storage bank of conventional lead acid batteries, in order to regulate the power and ensure supply during night in the case of solar which may not be desirable on the island.

3.6.4.3 Generation Scenarios

Given the peak electrical power demand and the overall daily electrical energy draw as stated above, the following generation scenarios have been proposed to meet the facility's electrical power requirements.

Scenario 1: Two larger generators (approx 110~120 kVA output) are used to supply the majority of power needs with an additional smaller third generator (approx 60-70 kVA output) added for additional redundancy.

Scenario 2: Three generators of equal capacity (approx 110-120 kVA output) utilised and run on a paired rotational basis. This scenario provides the highest level of redundancy against machine failure.

Both of the generator combinations described above would be operated using common automated power generator regulation units. This is standard technology and is always required as power demand for the facility (or any facility) will fluctuate over time (i.e. changes in demand due to number of guests present, time of day, the weather etc.). Furthermore the above generation scenarios will not vary greatly depending on the final choice of fuel as they are both based on fossil fuel internal combustion units.

3.6.5 Communications

UHF and VHF radios will be used for communications with planes and charter operators. Television will operate via satellite and telephones and computers will operate via a wireless system and a satellite link to Geraldton.

3.6.6 Lighting

All boardwalk lighting will be solar powered downlights so that birds will not be attracted to them. Solar lighting will be used wherever possible. All other lighting will be powered conventionally.

Lighting is to be downcast, and can be shielded, directed and focused, and will be fitted with lower wattage globes. Staff will be trained to reduce lighting as appropriate during critical breeding times (e.g. for shearwater and storm-petrel fledgling periods). Tinting glass on building windows and installing lights in tubes will aid in reducing the impacts of internal lights.

A lighting plan will be adopted to minimise avoidable light spill from guest rooms and the resort's common facilities, with lighting in the main restaurant and bar being progressively dimmed throughout the night. Lighting after the dinner period will be greatly reduced but remain at a level which is suitable for the safety requirements of resort guests and employees.

Yellow (sodium vapour) light will be used wherever practical to minimise impacts on birds. These lights give off red wavelengths and have been tested in Hawaii with favourable results. Lighting will be directed vertically where possible and focussed toward resort buildings and featured areas, to minimise ambient light levels outside the main resort compound. Details of the lighting measures adopted to minimise impacts on birds are found in the Avifauna Management Plan (see Appendix 4).

3.6.7 Operational Resort Workforce

3.6.7.1 Management and Staff

One of the primary determinants of the future success and viability of the resort will be the quality and stability of its management and employees, so a great deal of attention will be paid to the recruitment, training and development of all resort employees.

The sustainable and profitable operation of an island based resort, more so than any mainland based equivalents, requires very thoughtful matching of the desired guest experience (product) with the best use and minimisation of the required human resources (services). The resort has permanent accommodation for a maximum of ten live-on employees at any one time, so the rostering and allocation of employee tasks and hours of work is critical.

During peak periods the resort's staffing will comprise 13 (full time equivalent) employees, 10 of whom are accommodated on the island. The resort General Manager and Executive Chef will be provided with their own stand alone accommodation, while two housekeeping employees, a receptionist, two food and beverage attendants, two additional chefs and the resort engineer will be accommodated in a centralised staff accommodation facility.

Staff accommodation on the resort will work under a job-share arrangement. When one staff member returns to the mainland for their rostered break it is expected that they will pack away all personal belongings that will remain on the island as the alternate person for that position will occupy the same sleeping quarters.

Staff will bear an ongoing responsibility for the environmental protection of Long Island and implementation of the various Management Plans. Resort staff will work on a rotation basis with long shifts worked whilst on the island, followed by an extended break on the mainland. Human and other resources will be shared between Broadwater's property on the Geraldton foreshore and the island in order to maximise the operating efficiency of the resort.

Most staff will be required to multi-task whilst on the island. Selected staff will also be trained to fulfil 'ranger' type duties and environmental/cultural interpretation. Ranger duties will include ensuring the rules of the resort are being followed, that guests and day visitors are not infringing on the animals on the island and providing information to guests and day visitors. These staff will undergo a special induction that will be conducted in consultation with relevant experts such as Department of Fisheries and/or CALM staff members and the resort's avifauna consultant.

3.6.7.2 Tour Operators

Licensed tour operators will operate the majority of activities, particularly those occurring away from Long Island. These operators will be contracted by the resort under strict contract conditions, which shall incorporate environmental performance standards. Expressions of Interest will be called for charter operators once the Minister for the Environment has approved the PER and the Minister for Fisheries has granted the Tourism License. Charter operators will then be controlled by the resort operator.

3.6.7.3 Staff Induction and Training

All resort staff and contractors will be educated and inducted in the environment and cultural heritage of both Long Island and the wider Abrolhos Islands to increase their awareness, enjoyment and understanding of the islands. Inductions shall cover:

- History and heritage values of the Abrolhos Islands, in particular Long Island and the Wallabi group.
- The *Batavia* story.
- The history of other shipwrecks in the vicinity (e.g. the *Hadda* and *Zeewijk*).
- Procedures to be followed when visiting heritage sites.
- What to do if a suspected historical artefact is found.
- Terrestrial environment of the Abrolhos Islands, in particular Long Island and the Wallabi group.
- Weed Management.
- Pest Management.
- Seabirds of the Abrolhos Island, paying particular attention to those found on Long Island and other islands guests may visit.
- Code of Conduct for visiting seabird colonies and breeding areas.

- The marine environment of the Abrolhos Island, paying particular attention to the environment around Long Island and at other sites guests may visit.
- Emergency response and safety and first aid training.

The full details of these procedures will be included in the Staff Induction Plan, which will be developed prior to resort operation.

3.6.8 Swimming Pool

A swimming pool and spa will be built above ground on the western edge of the barbecue deck in the guest common area and surrounded by timber decking. The pool will measure approximately 15 x eight metres, and be up to 2.4 metres deep, while the spa will be approximately five x five metres and up to 1.2 metres deep.

Desalinated water will be used to maintain pool levels and chlorinated using a salt chlorinate. The pumps will be housed in a purpose built room on the north-western corner of the barbecue deck between the spa and the toilets/change rooms. All plant associated with the pool and spa will be powered by electricity.

The swimming pool will not be emptied into the ocean. Should the swimming pool water need to be discharged for maintenance it is envisaged that this will be done during a closed period at the resort and therefore the water will be pumped through the wastewater treatment plant.

A buffer tank will be installed to receive the water discharged during routine backwashing of the filters. This backwash water can then be held within the tank until chlorine levels have dropped to an acceptable level to allow the water to be slowly introduced into the wastewater treatment unit (via the sewer system). This buffer tank will also allow backwashed swimming pool water to reach ambient temperature before treatment and subsequent discharge.

3.6.9 Swimming Platform

Swimming platforms are located around the north of Long Island to allow controlled access and egress to the Long Island Dive Trail, to minimise any potential damage to the coral and beach areas.

3.6.10 Boardwalk

An elevated walkway will be constructed to the north of the island to provide access to the swimming areas and give guests the opportunity to walk around the northern portion of Long Island. A southern boardwalk will provide access for visitors and staff to the jetty and helipad to the south of the resort and allow for general services of the resort. The route of the boardwalk is shown in Figure 4.

An elevated boardwalk design is to be used as it will minimise ground disturbance and will also minimise disturbance to any surface water flow and allow access for maintenance. The raised boardwalk will also allow birds to pass underneath.

The use of recycled plastic lumber (RPL) products is being investigated for the boardwalks. RPL was considered due to its significantly higher durability and therefore lower maintenance requirements, particularly as this area has high exposure to the elements. The use of recycled materials is also in keeping with the nature-based ethos of the resort. The products sourced to date are only load rated for pedestrian traffic and hence the areas of boardwalk that are going to be trafficked by the resort buggies and quad bike at present are unable to be clad with RPL decking. RPL is proposed to be used for the northern boardwalks as these will only be for pedestrian traffic.

The route of the boardwalks has been designed to minimise disturbance to the island environment. The route of the boardwalk was walked out during site visits and the most appropriate route was plotted using a GPS. The aim of plotting the boardwalk route was to avoid vulnerable bird breeding sites and vegetation where possible. The boardwalk will be constructed in an environmentally friendly manner. Appropriate signage will be erected along the boardwalk route to enhance visitors understanding of the historic and natural values of the island. The boardwalk will also provide access to diving and swimming areas as well as areas of high scenic value. The establishment of a boardwalk will formalise access on the island and will therefore minimise uncontrolled access and unauthorised disturbance. The boardwalk will be a maximum of 500 millimetres from the surrounding ground level. Footings are likely to be typically two to three metres apart. One section of boardwalk will be raised to avoid possible contact between people and Australian sea lions that have been known to haul-out in the area near the northern end of the development area, near Tidal Pond 503. The area will be raised to a level to allow sea lions to safely pass beneath. This area will have handrails for guest and staff safety.

3.6.10.1 Southern Boardwalk

The southern boardwalk, approximately 470 metres long, will be used to service the resort and will need to be three metres wide to allow vehicular transport and service pipelines and cabling to be installed beneath the boardwalk. The design will also allow for higher loadings. The southern boardwalk will have a clearance of 500 millimetres.

3.6.10.2 Northern Boardwalk (with Gazebos and Swimming Platforms)

The northern boardwalk, approximately 750 metres long and two metres wide will be used to formalise access to the northern section of Long Island and the gazebos and swimming platforms in this area.

The northern boardwalk will be similar to the southern boardwalk. The boardwalk will not require hand rails due to its low height, except for a raised portion 1.5 metres high and 10 metres long which will allow access for sea-lions to tidal pond 503.

The gazebos will provide guests with sheltered pavilions to enjoy private lunches/dinners, cocktails at sunset and to enjoy views across the islands. Figure 7 shows a conceptual plan of the gazebos. Presently two gazebos are proposed to be positioned off the northern boardwalk at locations shown in Figure 4.

3.6.11 Helipad

The proposed site for the helipad is over water. Locating the helipad over water reduces the amount of dust generated and will help minimise adverse impacts on the bird breeding colonies. Initially, the preferred site for the helipad was over shallow water just to the north of the development site. After careful consideration the helipad was moved to a site to the south of the development area, also over shallow water. There were a number of reasons for this decision. Firstly it was noted that the corals and the reef generally, in the vicinity of the northern site is in very good condition with very little degradation. A site to the south was closely examined during the October 2005 site visit. The southern site was found to be located over a sandy area devoid of coral reef. It was also noted that locating the helipad to the south of the development area would reduce the levels of noise for guests.

The helipad platform is to be constructed from steel and will be eight by eight metres in dimension. Underneath the helipad platform will be floats to support the deck. The floating platform will be anchored to the sandy sea floor beneath using four anchors, one at each corner. The anchors will be attached to each corner of the helipad. The helipad will be constructed to take a three kPa bearing, which is required to accommodate the larger "medivac" helicopters in case of emergency. A floating walkway of approximately 30 metres in length and three metres wide will link the helipad to a fixed point on the island and join up to the southern boardwalk (see Figure 8). This floating walkway will utilise several anchors and these will be positioned either side of the floating walkway. The anchoring system to be utilised will be designed for minimal impact on the surrounding habitats. The system used for anchoring the helipad will attempt to prevent the anchoring chains from dragging on the sea floor.

3.6.12 Jetty

Included within the Request for Proposals document was a map of Long Island that indicated the preferred jetty site south of the development site. HLD's initial proposals had the jetty located further north with a direct link into the development site, thus reducing the apparent distance to the facilities when guests first arrive. However, after discussions with the Department of Fisheries and further investigations by HLD, it was decided that the jetty should be located to the south of the development area with a raised boardwalk linking it to the resort.

The major factor contributing to this decision was the condition of the coral communities in the two areas. To the north of the development zone the corals are in a better condition with little evidence of impact and degradation. To the south of the development zone however, the corals are in a much more degraded state and show significant evidence of historical damage due to anchor drops as this area has been used as a boat landing zone by day-visitors and fishers.

Another advantage of the southern jetty site was the deeper water, which is located at a minimal distance from the shore. This is important for boat access to the jetty.

The jetty will have a berthing face of 30 metres in length to accommodate the largest vessels servicing the island, which may be 25 metres in length. This area will be eight metres wide to allow for unloading of equipment. This deck will be accessed via a 30 by six metre walkway. The length of the jetty needs to be 30 metres to allow access to deep water. This

deep water will prevent damage to corals caused by the wash of the boats. The walkway width of six metres is designed to allow the passing of two golf buggies during unloading of supply and service vessels. Figure 8 shows a conceptual figure of the jetty and helipad.

The construction of the jetty will need to be very secure so as to withstand extreme weather conditions and to accommodate the significant serviceability loads from the relatively large supply and passenger vessels serving the proposed resort facility. The deck of the jetty is currently proposed to be constructed from pre-cast concrete members. The water depths (water surface to seabed/corals) below the jetty walkway range from zero to eight metres below Chart Datum. The water depths (water surface to seabed/corals) below the jetty berthing face range from approximately four (at Southern end) to eight metres (at Northern end) below Chart Datum.

The foundation system for the jetty will consist of driven steel piles. This type of foundation system is required due to the serviceability and ultimate load requirements of the jetty. The piles used to support the jetty will be approximately 450 millimetres in diameter and will have "teeth" on the end to be driven into the seabed. These piles will be rotated into the seabed to a depth of three to four metres using a barge. This is the best method for the least disturbance of surrounding area and generation of turbidity. No spoil is created during installation, as no excavation is required before installing the piles. It is also the quickest technique, using medium to high resolution rotations. This technique is relatively quiet and vibration free.

The use of the floating barge, the rotating technique suggested for the piles and the short duration of this work will minimise the generation of turbidity. Activities that generate high turbidity will not occur over the predicted coral spawning periods.

As the jetty is being constructed and managed by HLD, the jetty will be a private jetty, not open to the public unless by prior arrangement. Information from the Department of Fisheries indicates that a private jetty under these circumstances would be permitted, even though the land adjacent to the jetty is not part of the leased development site (R. Dyson, Regional Manager, Department of Fisheries, pers. comm. 20/12/2005).

3.6.13 Boat Moorings

Boat moorings may be installed by HLD to the west of Long Island in order to provide safe anchorage for resort boats at Long Island and to avoid coral damage by anchor drops. Any boat moorings will be installed over areas of sandy bottom rather than coral. It is understood that these would be private moorings only for use by the resort and approved vessels (R. Dyson, Regional Manager, Department of Fisheries, pers. comm. 20/12/2005).

The moorings would be constructed to the design currently used on all Department of Fisheries public moorings, which involves securing the mooring to the seabed with pins rather than anchors. This is a method causing minimal disturbance to the seabed.

Boat moorings may also be installed by the Department of Fisheries around Long Island. If the Department installed moorings at or around Long Island it is understood that the installation would be in concert with the resort requirements. These moorings would be managed by the Department of Fisheries rather than controlled by the resort and would be

available to the public (R. Dyson, Regional Manager, Department of Fisheries, pers. comm. 20/12/2005).

3.7 OPERATIONAL PHASE TOURIST ACTIVITIES

3.7.1 Public Access

Currently, the public may access all of Long Island in an unrestricted manner. The approval of this resort would only prevent access by the public to the development zone beyond the day visitor pavilion. The public would still be permitted to access the rest of the island outside of the leased area, just as they could access any other island in the Abrolhos.

However, HLD considers it undesirable for the public to access and utilise all of the Long Island in an unrestricted manner as this may lead to trampling vegetation, disturbing nesting birds and other environmental degradation. To this end, interpretive signage will be installed on the jetty and in the day visitor pavilion regarding the appropriate code of conduct for visiting Long Island. The staff of the resort will also point out to members of the public the reasons why it is so desirable to adhere to these guidelines. The signage will include the following:

- Request for visitors to stay on the boardwalk areas and not walk on the rest of the island to protect the bird life.
- Dive/snorkel in the designated areas only to protect the corals that occur in shallow waters.
- Minimising weed spread by checking their person and any belongings are free of visible weed seeds.

Should inappropriate behaviour occur on Long Island that cannot be controlled by the resort staff, the Department of Fisheries will be contacted as the authority in charge of the Islands. It is understood that eventually the Department of Fisheries intends to have a presence on the island.

The General Manager of the resort is responsible for monitoring and responding to any event of inappropriate behaviour by a guest, employee, day visitor or contractor to the resort and will take appropriate action to have such behaviour ceased, or to remove such person from the resort if they do comply with a lawful directive from the General Manager or their nominee. In the event of serious misbehaviour or a material breach of any law by a guest, employee, day visitor or contractor to the resort, the General Manager will contact the Department of Fisheries and/or the Police to arrange removal of such person from the island.

3.7.2 Day Visitors

The resort will attract day visitors that may use add-on services such as food and beverage facilities, island tours, glass bottom boat tours, recreational activities such as kayaking, diving and snorkelling. These visitors will not be permitted to enter the main resort area unless by prior arrangement. However, these visitors will be welcomed into the day visitor pavilion, which will include a kiosk, toilet facilities and interpretive material showcasing the natural and historical values of the island.

3.7.3 Resort Guest Induction

Prior to visiting Long Island, all guests will be encouraged to visit the WA Museum in Geraldton. An introductory talk will be developed and given by the Museum (in collaboration with the resort operator) and this will provide guests with an enhanced appreciation of the region, particularly the story of the *Batavia* and the heritage values of Long Island.

Immediately upon arrival at Long Island all guests and day visitors shall be required to go through a short (approximately five minute) induction. This will focus on the major environmental and heritage issues relating to Long Island to ensure no damage is done to the Island Day visitors will be given a short induction upon arrival, the content of which can be found in the Visitor Activity Management Plan (Appendix 5)
.

For resort guests a full induction to the Abrolhos Islands is planned to take place during their first evening at the resort (see Visitor Activity Management Plan, Appendix 5). The induction will include a code of conduct for visitors, information about the protection of the environment from human activity, an educational programme about the heritage sites and their history and how to enjoy the islands while assisting in their protection. The full induction programme for guests and day visitors will be developed prior to operation.

Information brochures will be produced on the environmental risks for each specific activity to inform the visitor of environmental consequences and promote understanding of the potential impact the activity could have on the environment. Visitors will be requested to abide by the information provided in the induction whilst visiting the islands and to 'take nothing but photographs and leave nothing but footprints'.

Visitors will be instructed on an appropriate code of conduct for visiting seabird breeding colonies. The code will be developed from local experts and the Great Barrier Reef Marine Park Authority Guidelines for Managing Visitation to Seabird Breeding Islands (WBM Oceanics Australia and Gordon Claridge, 1997).

An information programme will be provided prior to any tours. This will include information about the sites including history and minimising environmental impacts. Where appropriate, exclusion areas will be discussed and agreed with relevant authorities, whilst appropriate signage will be located around the boardwalks to enhance visitors' knowledge and understanding of the historic and cultural values of the islands and surrounding region.

3.7.4 Nature Based Activities

Nature tours of the islands will provide a unique educational experience in observing the animals, plants and landscapes of the Abrolhos Islands.

Nature based activities will include:

- Bird watching.
- Island based nature tours (learning about local fauna, flora).
- Glass bottom boat tours.

- Snorkelling and SCUBA diving.
- Escorted tandem jet ski tours.
- Kayak tours.
- Fishing on charter vessels.
- Star watching (night telescope, astronomy).
- Environmental interpretation sessions (climate, topography, rainfall, wind, ocean currents).

3.7.5 Heritage Activities

In addition to the obvious marine and terrestrial based assets, the Abrolhos Islands boast a number of sites with significant historical and cultural value.

The Abrolhos Islands are famous for their historic shipwrecks, the best known of which is the Dutch East India Company vessels *Batavia* (1629), on Morning Reef near Beacon Island. Cultural heritage activities will include:

- *Batavia* shipwreck history interpretive session.
- Long Island and the history of the surrounding area.
- Guided visit to sites of historical significance.
- Museum interpretative sessions pre/post Long Island stay (Geraldton).

3.7.6 Recreational Activities

The Abrolhos Islands offers some of the best snorkelling, diving and deep sea fishing opportunities in the world. The Long Island Dive Trail is located just inside the Beacon Island Reef Observation Area to the north of Long Island. The huge diversity of life along the Long Island Dive Trail can be appreciated equally well by scuba or snorkel. Dive sites will be provided for novices and advanced divers. Dive and snorkel tours will be operated by a licensed operator under strict contract conditions with the resort. Details of diver and snorkeller management strategies to minimise environmental impacts are included as an attachment to the Marine Management and Monitoring Plan (see Appendix 6).

The opportunity of enjoying some of the best deep-sea fishing areas in Australia will ensure the popularity of charter fishing with guests. A policy of catch and release will be operated, with the exception that each guest can retain one fish for consumption that day. No recreationally caught fish will be stored on the island. The operator of the venture will liaise closely with the Department of Fisheries to ensure that sustainable fishing is maintained at the Abrolhos Islands.

Education packages will be provided to visitors who participate in water sports, which will highlight both safety and environmental aspects associated with their chosen activity.

Swimming/diving platforms are located at strategic points at the north of the island with dedicated access and egress points to minimise damage to coral and beach areas.

Guided sea kayak tours will be operated from the resort. These tours will visit islands such as Dick Island and Second Sister during seasons when surface nesting birds and Osprey are not nesting. First Sister may be a good island to paddle past, as sea lions have been known to haul out on the beach here. However, if sea lions are present, guests will not be permitted to land on the island to minimise disturbance to sea lions and to maintain personal safety.

Escorted jet-ski tours will also be operated. Tandem jet skis will be used and the jet skis will only be used in the presence of a guide. No independent Jet Ski use will be permitted. The tours will be a half or full day tour incorporating a picnic lunch. Islands to be visited will be the same as those for the sea kayak tours, Dick Island and Second Sister in periods when surface nesting birds and Osprey are not nesting. When jet skis are within 200m of islands they will be required keep their speed below 5 knots. This measure is to reduce noise impacts on birds. The same rules apply with respect to sea lions on the jet-ski tours. No landing will be permitted on a beach where a sea lion is present. No tours will operate from the resort to West Wallabi Island due to the environmental sensitivity of the site and problems associated with accessing the beach.

Jet boat tours of the islands surrounding Long Island will also be operated. These tours will operate under the same rules outline for the guided jet-ski tours above.

Windsurfing will be permitted in designated areas only and may depend on tides, bird breeding and wind conditions. As windsurfers present a high profile and the sails can be noisy as they flap in the wind, they can be disturbing to birds. Therefore a map will be issued to windsurfers showing the designated areas for the activity. This activity may be subject to seasonal closures. Details are supplied in the Avifauna Management Plan (Appendix 4).

Other recreational activities that may operate from the resort include:

- Surfing.
- Aqua aerobics.
- Board games.
- Cruise through island group and to nearby islands.
- Sunset cocktails, poolside events.
- Tai Chi, yoga, massage.
- Rock lobster fishing boat excursions (discover what happens on a working rock lobster fishing boat).

3.7.7 Research

The unique environment of the Abrolhos Islands, as the southern most coral reef formation in the world provides an opportunity for intensive marine research. It scores very highly in terms of habitat diversity and species richness, with a unique blend of tropical and temperate species. Research opportunities may attract participants from research and industry organisations from within Australia and overseas outside the peak tourist season. There may also be opportunities for guests to participate in suitable research activities, such as assisting with monitoring of corals or bird surveys.

3.7.8 Interaction with Tourist Operators

All recreational fishing will be conducted through licensed charter operators. Fish for the restaurant will only be purchased from licensed fishers. Charter boat operators will handle all aspects of the diving and boat related activities at the Islands. It is important to note that the operators of the development will dictate the controls and on-site management for all activities undertaken by the charter operators. Charter operators will be requested to use the specified anchorage points around the Abrolhos Islands or moorings once they are established. All operators will operate under strict contract conditions with the resort that will include environmental as well as safety and performance standards.

3.8 EMERGENCY OPERATION

3.8.1 Cyclone Protection

In the event of a cyclone threat, the early evacuation of the resort may be necessary and will be assessed by the General Manager in communication with the Bureau of Meteorology or relevant emergency services. Early evacuation will be essential as both air and sea transport will be difficult during a cyclone. Any cyclone that may potentially impact the resort within 48 hours will be closely monitored. A formal advice will be issued to all resort guests and employees in any such event, along with public notice boards in key guest and employee areas to keep all resort residents informed of the situation.

All buildings and structures on the island will be designed to meet Australian standards AS 1170.2 (Australian Standards: Structural Design Actions – Part 2: Wind Actions). In the event that early evacuation of the island is not possible, the staff facilities will be designed to appropriate Australian Standards for occupancy during extreme events. The proposal is for guest dwelling units to be designed to meet extreme event conditions under the assumption that they will be unoccupied for the duration of the event. This is only permissible if the facility has an explicit safety management plan that stipulates that guests will be assembled into the staff facilities for the duration of an extreme weather event. Finally the service compound will be designed with the appropriate importance factors to withstand extreme weather events given the requirement for the protection and continued operation of the plant and equipment housed within this area.

Guests will not be permitted to remain in their own units if there is a risk of a cyclone and they will be directed to an appropriate muster area for either evacuation or to sit out the storm in the staff area. It is desirable to have all residents in one location for communication and safety reasons and for ready access to any necessary first aid. Resort employees with suitable nursing and/or first aid qualifications will be available and first aid kits will be regularly checked and provisioned.

3.8.2 Emergency Evacuation

Emergency evacuation will be via helicopter and/or aeroplane, utilising the local airstrip on East Wallabi Island. It is intended that non-critical evacuations will be transported via boat to the airstrip, while critical evacuations will be via helicopter direct from the island. The

helipad will have the capacity to receive medivac helicopters and as such will provide a useful emergency facility for the surrounding area.

3.8.3 Prevention and Handling of Fuel Spills

Refuelling of recreational or tour vessels will not occur at Long Island. A self bunded tank will store diesel for primary power production. Petrol for the resort's buggies, quad bike and small vessel/s will also be stored within the services compound. No aviation fuel will be stored at the resort.

Fuelling will be scheduled to minimise the need for handling and the potential for spills. Hydrocarbon spill kits will be provided on the Island located at the jetty and the services compound. The procedure for dealing with a fuel spill will be detailed in the Dangerous and Hazardous Substances Management Plan.

The Long Island Oil Spill Environmental Management Plan (see Appendix 7) has been designed to identify the likelihood and potential consequences of a fuel spill associated with the resort. This document also proposes management strategies to minimise the risks and documents the sensitivity of the environment in the highest risk area near the jetty.

3.8.4 Power Failure

The stand-alone power generator systems are highly reliable often being used as the backup facility in hospitals and other essential services if mains grid power fails. The generator units could only fail totally if they run out of fuel, or if there is a mechanical fault with all of the generator units, however this is highly unlikely situation.

The energy requirements for the resort are to be served by at least two and possibly three generators. If one generator were to fail the other(s) would serve as a backup.

The generators would be rigorously tested for mechanical faults, and resort staff would closely monitor fuel supply to minimise the risk of failure due to these mechanisms.

3.8.5 Waste Control System Failure

The solid and liquid waste systems have all been designed with excess capacity in the event of a system failure. This is discussed fully in Sections 3.6.1 and 3.6.2.

3.8.6 Fire

All buildings have been designed such that there are no fire compartments that exceed 500 square metres. This allows the facility to meet Building Code of Australia (BCA) (2005) requirements such that fire servicing for the facility can be achieved using fire extinguishers strategically positioned around the facility and appropriate to the nature of the fire that may be generated.

A documented procedure for evacuation will be installed in all rooms. Training and fire drills will be conducted regularly with the assistance of a professional company that offers emergency procedures training.

4. EXISTING BIOPHYSICAL ENVIRONMENT

4.1 REGIONAL SETTING

The Houtman Abrolhos Islands (the Abrolhos) are an archipelago of 122 low-lying islands and reefs spread over 100 kilometres at the edge of the continental shelf between 28 degrees 15 minutes south and 29 degrees 00 minutes south. They are located approximately 60 kilometres offshore from Geraldton on the mid west coast of Western Australia and approximately 430 kilometres north of Perth (Figure 1).

The Abrolhos are divided into three major groups of islands: the Wallabi, Easter and Southern Groups (Figure 2). Long Island is situated within the Wallabi Group of islands (Figure 3). East Wallabi and West Wallabi Islands, the two largest islands of the Wallabi Group, are located approximately five kilometres to the north-west and seven kilometres to the west of Long Island, respectively. The nearest islands are Beacon Island (one kilometre east), Traitor Island (one kilometre south-east) and Dick Island (two kilometres south) (Figure 9).

4.1.1 National Heritage List

On 10 January, 2006, information was sent to HLD by the Australian Heritage Council explaining that the area of the Wallabi Group that is associated with the wreck of the *Batavia* was being assessed as to whether it meets any of the National Heritage criteria and which would trigger its inclusion on the National Heritage List (NHL).

On 6 April 2006, an area of the Wallabi Group (including Long Island) was gazetted for inclusion on the National Heritage List under the *Batavia* Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos (Figure 10). The proposed tourism development will now be a "Controlled Action" on the grounds of National Heritage and as such requires approval under Section 4 of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) in relation to the provisions of sections 15B and 15C of the *EPBC Act*.

The inclusion of the site on the NHL means that the values as identified by the Australian Heritage Council must be protected, and it is these values, and not necessarily the entire place itself, that is protected through listing. These values are protected under the *EPBC Act 1999* (Department of the Environment and Heritage, 2006, website: www.deh.gov.au/heritage/ national/implications.html). A person cannot take an action that will have a significant impact on the national heritage values of a listed place without the Australian Government Minister for the Environment and Heritage.

The National Heritage values as identified by the Australian Heritage Council against the National Heritage Criteria are as follows (Department of the Environment and Heritage, 2006, website: www.deh.gov.au/heritage/ national/html):

a. the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history

The *Batavia* and its associated sites hold an important place in the discovery and delineation of the Western Australian coastline. The wreck of the *Batavia*, and other Dutch ships like her, convinced the VOC (Dutch East India Company) of the necessity of more accurate charts of the coastline and resulted in the commissioning of Vlamingh's 1696 voyage.

Wrecked on 4 June 1629, it is the oldest of the known VOC wrecks on the WA coast and has a unique place in Australian shipwrecks. The sites consists of the wreck itself on Morning Reef, the survivors camps and gravesites on Beacon Island, and the enclosures on West Wallabi Island.

Because of its relatively undisturbed nature the archaeological investigation of the wreck itself has revealed a range of objects of considerable value to the artifact specialist and historian investigating material in use by the Dutch in the first half of the 17th Century.

The reconstruction of the hull has taught us much about 17th Century shipbuilding techniques. The remains of the cargo carried by the vessel have provided economic and social evidence of the operation of the Dutch port at *Batavia* in the early 17th Century.

The two ruined 'huts' on West Wallabi Island are the oldest structure built by Europeans in Australia.

As a result of their being marooned on the mainland, Wouter Loos and Jan Pelgrom de Bye are regarded as the first known European residents of the Australian continent.

The human skeletal material recovered from Beacon Island has proved to be of considerable research significance. As the date and circumstances of most of the deaths on the island are known, the osteological evidence collected from the island has proved important as reference data for comparative osteological studies for other 17th and 18th Century Dutch burials.

No other Australian shipwreck has the same associations with mutiny and murder such as the *Batavia* and this has fired public imagination.

> *c. the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history*

The number of archaeological discoveries made at Wallabi Islands sites indicate that they may still have potential to yield further information. The Western Australian Maritime Museum believe that there is still undiscovered skeletal material on Beacon Island as well as on West Wallabi Island. Continued investigation of the sites may have capacity to contribute further detail on 17th century Dutch lifestyle, diseases, and the hardships of the journey and the mutiny.

d. the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:

i. *a class of Australia's natural or cultural places; or*

ii. a class of Australia's natural or cultural environments

The *Batavia* provides one of the best Australian examples of the characteristics of a shipwreck site, including:

- The wreck occurred after a long and arduous voyage where considerable hardship had already been experienced by the passengers and crew.
- The vessel was wrecked at night on a coral reef that provided little by way of shelter and sustenance to the survivors.
- The wreck contained what was for its time vast wealth in the form of silver coins and jewels of great value.
- The survivors only hope of assistance was from an isolated Dutch outpost 900 nautical miles away, and to fetch this assistance required a superb feat of seamanship in open boats under considerable hardship.

The wreck of the *Batavia* is unique in the annals of Australian shipwrecks because of the consequential events of the Cornelisz-led mutiny and murders after the departure of Pelsaert to fetch assistance.

> *g. the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

The *Batavia* wreck sites have social and cultural significance to members of the wider Australian community due to their role in defining the archetypal Australian shipwreck story. The places on which the events unfolded during and after the wreck of the ship, are associated with a nationally important story which graphically illustrates the dangers inherent in sea travel to Australia. The hardships inherent in this travel have become part of Australia's cultural traditions, expressed through books like Hugh Edwards' *Island of Angry Ghosts* and Henrietta Drake-Brockman's *Voyage to Disaster* and music, such as Richard Mill's opera '*Batavia*'.

The Department of Environment and Heritage has advised that the management of the listed site is the responsibility of the Western Australian Government. Management would normally include a management plan to be developed by the WA State Government in consultation with DEH, although at the time of writing this had not been developed. This management plan will take into account the National Heritage Management Principles and would set out how the significance of the site will be protected and conserved (www.deh.gov.au/heritage/national/managing.html).

4.1.2 A Class Reserve

The waters of the Abrolhos Islands are a Class A Reserve (A20253) vested in the Western Australian Minister for Fisheries under the *Land Administration Act 1997* (WA) and managed by the WA Department of Fisheries pursuant to the *Fish Resources Management Act 1994 (FRMA)*. The Reserve is set aside for the purposes of conservation of flora and fauna, tourism and purposes associated with the fishing industry. The Abrolhos Islands Reserve extends to the limit of the State Territorial Waters, which are three nautical miles from

established baselines as shown in Figure 2. These State Territorial Waters comprise a declared rock lobster fishing area and is known as "Zone A" (Fisheries WA, 1998a).

4.1.3 Fish Habitat Protection Area

The State Territorial Waters of the Abrolhos Islands are a gazetted Fish Habitat Protection Area (FHPA) under section 115 of the *FRMA*. The FHPA is designated for the following purposes:

- The conservation and protection of fish, fish breeding areas, fish fossils or the aquatic eco-system.
- The culture and propagation of fish and experimental purposes related to that culture and propagation.
- The management of fish and activities relating to the appreciation or observation of fish.

Management of a FHPA must be carried out to achieve the purposes outlined above and cannot be used to achieve other objectives. For example, the Minister could not regulate to control tourism activity unless it could be demonstrated that regulation was required to protect fish or their habitats (Fisheries WA, 1998a). Indeed, the promotion of sustainable tourism in the Abrolhos is entirely consistent with the objectives of a FHPA: "*Increasing the availability of the natural values for appreciation by a wider section of the community, in such a manner that those values are not impaired, is a primary goal of management of the Abrolhos ecosystem. Management of the biological system and of activities relating to the appreciation and observation of its corals, finfish and other components are therefore purposes of the FHPA*" (Fisheries WA, 1998a).

4.1.4 Reef Observation Areas

Reef Observation Areas (ROAs) were established in 1994 based on criteria contained in the Abrolhos Islands Aquatic Reserve Final Report (1993). The ROAs were determined by one or more of the following criteria:

- An identifiable area.
- A whole reef platform.
- Representative good quality reef habitat.
- Popular use area.
- Suitable for research.
- Safety aspects of an area.

All species of fish including molluscs, algae, coral and finfish are totally protected in the ROAs, with the exception of western rock lobster which may be taken by recreational and commercial fishers using pots during the season (Fisheries WA, 1998a).

Four ROAs have been set aside for the conservation and study of resident reef fish species and their habitats, one in each island group:

- Leo's Island.
- Coral Patches.
- Beacon Island.
- North Island.

The ROA at Beacon Island includes some of the coral areas to the north of Long Island (Figure 11). The proponent is liaising with the Department of Fisheries to investigate the feasibility of extending the ROA at Beacon Island to incorporate all of the area surrounding Long Island. This is desirable in order to ensure a legal basis for the protection of the marine environment surrounding the proposed development. This extension would approximately double the existing ROA.

4.1.5 Register of the National Estate

The Register of the National Estate (RNE) is compiled and maintained by the Australian Heritage Commission and consists of more than 13,000 places of natural, historic and indigenous significance. The Houtman Abrolhos Islands Reserve is listed on the Register of the National Estate because of the significance of the shipwrecks in the area, the importance of the marine environment and the bird life of the islands.

There are seven shipwrecks in the Abrolhos that are all listed separately in the RNE. These shipwrecks sites are significant for their heritage values and they are namely:

- Batavia (RNE Place ID: 9287).
- Ben Ledi (RNE Place ID: 9285).
- Hadda (RNE Place ID: 9288).
- Marten (RNE Place ID: 9284).
- Ocean Queen (RNE Place ID: 9286).
- Windsor (RNE Place ID: 9289).
- Zeewijk (RNE Place ID: 9283).

The shipwrecks of the Abrolhos are discussed in Section 5.6.1.

There are several other listings on the RNE in the Abrolhos and these are discussed below.

Houtman Abrolhos Islands Reserve (RNE Place ID: 9291)
The Houtman Abrolhos Islands Reserve is significant for its processes, richness and diversity, its significance for future research, its aesthetic values and its social values (Collette Barton, DEH, pers. comm., November, 2005).

Houtman Abrolhos Marine Area (RNE Place ID: 14863)
The Houtman Abrolhos Marine Area is significant for its natural and cultural rarity, its research potential, its representational value, its aesthetic value and its social value (Collette Barton, DEH, pers. comm., November, 2005).

Ruins of Huts on West Wallabi Island site (RNE Place ID: 9290)
The Ruins of Huts on West Wallabi Island is significant for its cultural (historic) processes (Collette Barton, DEH, pers. comm., November, 2005). The ruins on West Wallabi Island are discussed in Section 5.6.2.

4.2 CLIMATE

The Geraldton region experiences a Mediterranean-type climate, characterised by hot, dry summers and mild, wet winters. The climate of the Abrolhos Islands is similar to that of Geraldton although milder. Seasonal sea and air temperature ranges are less extreme than those experienced on the mainland. The Leeuwin Current brings warm water from Indonesia along the Western Australian coast between April and October, maintaining the winter water temperature at the islands between 20 and 22 degrees Celsius (Fisheries WA, 1998a).

4.2.1 Wind

Summer winds at the Abrolhos are most commonly from the south-east and south-west with speeds in excess of 20 kilometres per hour occurring 76 percent of the time and exceeding 32 kilometres per hour 44 percent of the time. High wind speeds are consistently recorded in the afternoons on the Islands from September through to March, with the months of strongest wind being December, January and February. Calm conditions are most likely to occur in winter (Fisheries WA, 1998a).

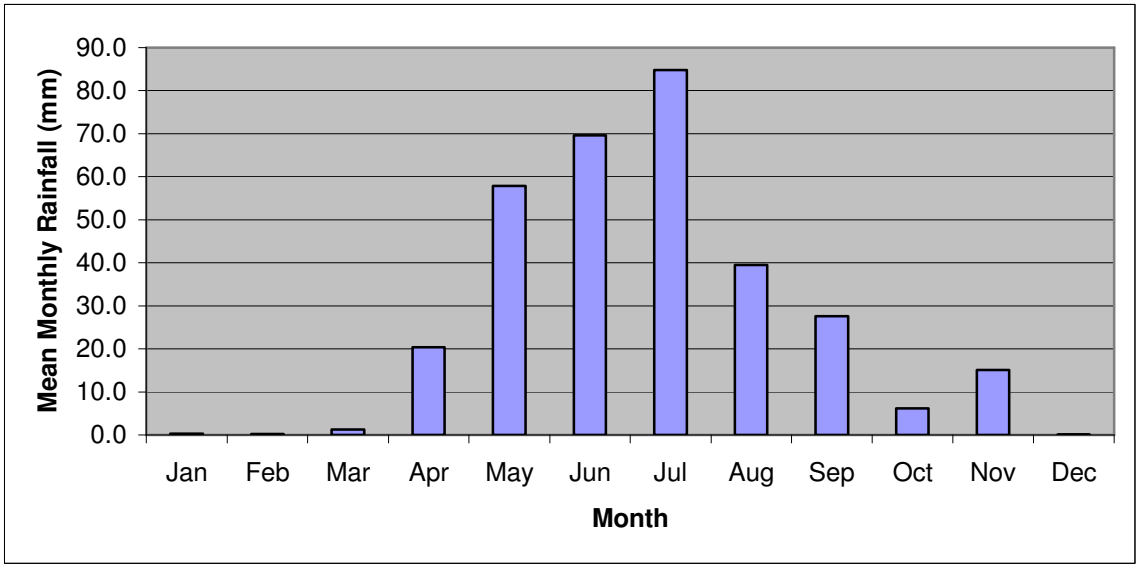
Storms generally occur during the winter months however tropical cyclones may occur during the summer months. On average, cyclones occur once every five years (Webster *et al.,* 2002). The possibility of wind speeds reaching 165 kilometres per hour during cyclones occurs once every 50 years, with the possibility of 176 kilometres per hour winds once every 100 years (Fisheries WA, 1998a).

The Bureau of Meteorology (BoM) records wind data at the Abrolhos wind station situated on North Island, to the north of the Wallabi Group. Appendix 8 shows the wind roses and wind frequency data tables for the site using data collected between June 1990 and November 2005. The wind roses show the average wind speed at 9am and 3pm during each month of the year (BoM, 2005).

4.2.2 Rainfall

Data on rainfall for Long Island is not available, however the weather station at North Island has been recording rainfall since 2001. The average rainfall during these years is 333.5 millimetres per year. Most of this rainfall occurs during the colder months of May to August (see Chart 4.1 below). Historically, rainfall data has been recorded for Pelsaert Island in the Southern Group between the years 1888 to 1895 and also from 1944 to 1950. These data also confirm the general trends described above with most of the rainfall occurring from May to August each year (BoM, Climate and Consultative Services Section, February 2006).

Chart 4.1: Mean Monthly Rainfall Data for North Island (2001 – 2006)

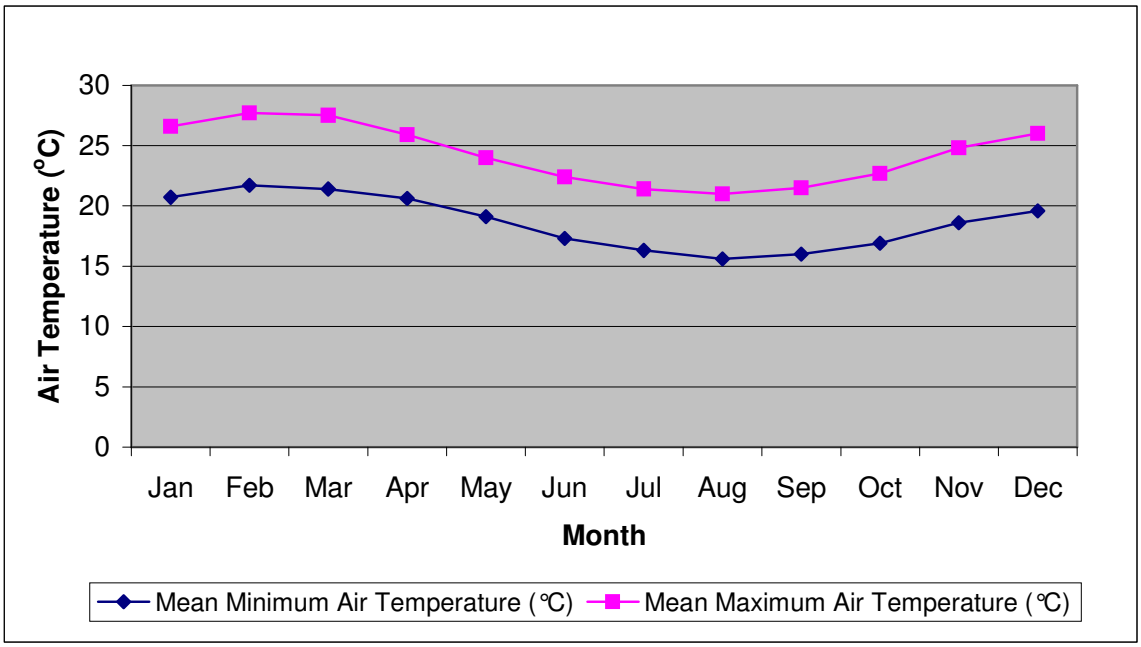


Source: (BoM, Climate and Consultative Services Section, February 2006).

4.2.3 Air Temperature

The data collected from the weather station on North Island gives a good indication of air temperatures at Long Island. For the years 2000 to 2003, the coldest month was August, with average daily air temperatures ranging from 15.6 to 21 degrees Celsius. The warmest month was February, with average daily air temperatures ranging from 21.7 to 27.7 degrees Celsius (BoM, Climate and Consultative Services Section, 2003). Chart 4.2 shows the average air temperatures on a monthly basis for North Island between 2000 and 2003.

Chart 4.2: Mean Air Temperature at North Island (2000 – 2003)



Source: BoM, Climate and Consultative Services Section, 2003.

4.3 GEOLOGY AND GEOMORPHOLOGY

4.3.1 Regional

The Southern, Easter and Wallabi Island Groups typically comprise a windward reef, leeward reef and lagoon with a central platform (Webster *et al*., 2002). The eastern sectors of each island group contain a distinct 'blue hole' terrain comprising submerged reef platform with steep-sided circular-shaped depressions, usually 15 to 25 metres deep with a sand floor (Collins *et al.* 1996, cited in Webster *et al*., 2002). A typical cross-section of an island group is shown in Figure 12.

The islands consist primarily of Pleistocene and Holocene limestones and are geomorphologically diverse, with some major islands (North, East and West Wallabi, and Rat Island) being of 'continental origin' (i.e. they were joined to the mainland during the lowered sea levels of the last ice age over 7,000 years ago). Other islands were formed more recently by the erosion and deposition of sediments during the rise and fall of sea levels, and by cyclical storms, waves, winds and swell (Fisheries WA, 1998a). The limestones predominantly formed as coral reefs and in back-reef lagoons, with the reefs initially developing on an eroded substrate of Tertiary sediments (Fisheries WA, 1998a).

The Central Platform islands (North, East and West Wallabi Islands in the Wallabi Group; the Rat Island chain in the Easter Group; Gun, Middle and Murray Islands, and the numbered islands in the Southern Group) all contain emergent reef which formed during the Late Pleistocene around 125,000 years ago (during the Last Interglacial). During this Last Interglacial period, sea levels were up to six metres higher than present levels (Zhu *et al.* 1993, cited in Fisheries WA, 1998a).

The Leeward (eastern) islands, composed of coral rubble and present in all three groups, are much younger, and have emergent reef foundations which are about 5,000 years old (Collins *et al.* 1992, 1993, 1996, 1997; Wyrwoll *et al.* 1995; Zhu *et al.* 1993, cited in Fisheries WA, 1998a). These modern reefs, formed during the Holocene, occur over the top of the ancient Pleistocene reefs.

Oscillating sea levels during the Quaternary have repeatedly drowned and re-exposed the continental shelf. A sea level fall of 40 metres would be required today to expose the shelf between the islands and the mainland. The Leeward islands recorded a relatively high stand of sea approximately 5,000 years ago. At 18,000 years ago, sea levels around Australia stood at -130 metres, rising to initiate Holocene reef growth beneath the Leeward islands at about 11,000 years ago, at which time the Central Platform islands would have also lost their land connection (Fisheries WA, 1998a).

The geology of the Abrolhos provides no evidence of Late Quaternary tectonism (Collins *et al.*, 1993).

The Wallabi Group is dominated by the two large islands, East and West Wallabi, and lacks the geomorphological organisation of the other Island Groups. Windward reefs are relatively poorly defined. A submarine ridge extends north from the western Wallabi platform to connect with North Island. Late Quaternary eolianites in the Wallabi Group reach elevations of 15 metres above mean sea level, differing to most of the islands, which are generally low

in elevation and often amount to little more than tabular platforms, rising some three to five metres above present sea level (Collins *et al.*, 1993).

The Abrolhos has a number of important geological features which include pavement limestone, sand dunes and consolidated dunes on North, East and West Wallabi Islands which are unusual, easily disturbed structures that have a slow rate of regeneration (Fisheries WA, 1998a). A fossil site of international significance occurs on a small headland of coralline limestone on East Wallabi Island and is believed to date from the Last Interglacial period of the Late Pleistocene, some 125 to 130,000 years ago (Fisheries WA, 1998a).

There are over 50 tidal ponds on the Abrolhos Islands, ranging from small depressions to one that is over 100 metres in length. Seven of these ponds occur on Long Island. Tidal Pond 504 occurs within the Development Zone on Long Island (Plate 3). Except during major storms, the ponds are separated from the sea, but seawater seeps through the rock shingle into, and out of, some ponds. The ponds are thus tidal, with the tides in them lagging behind that of the adjacent sea by up to several hours (Fisheries WA, 1998a).

4.3.2 Stratigraphy and Lithology of the Leeward (Eastern) Islands

Long Island is a Leeward (eastern) island consisting of modern reef formed during the Holocene over the top of the older Pleistocene reef.

The exposed uppermost part of this emergent Holocene reef lacks calcrete and is relatively poorly lithified. It is an upward-shallowing sequence consisting of 0.5 metres of coral framestone (reef facies); 0.1 to 0.3 metres of well lithified, bedded coral rudstone which is frequently coralline algal bound (peritidal facies); and one to four metres of unconsolidated coral rudstone, forming linear storm ridges on low islands (Collins *et al.*, 1993).

Lithostratigraphic sequences indicate that the reefs of the Abrolhos were constructed by growth of corals and coralline algae in both the Late Pleistocene and Holocene. The Late Pleistocene reef limestones are dense and calcretised and the Holocene litho-facies are more porous (Collins *et al.*, 1993).

A major part of leeward reefs are formed of porous branching coral framestone grading into coral framestone with minor rudstone fabric. Corals are frequently encrusted and bound by coralline algae, and vugs commonly contain skeletal grains and Mg-calcite and aragonite cement. The interbedded framestones of the leeward reefs are up to 26 metres thick (Collins *et al.*, 1993).

The oldest coral shingle storm ridges on leeward Holocene reef platforms were formed at about 2,300 years before present (B.P.), and progradation of these platforms is still in progress (Collins *et al.*, 1993).

4.4 HYDROLOGY OF LONG ISLAND

4.4.1 Surface Water

Long Island is formed of free-draining, unconsolidated coral rubble and sands overlying mostly porous coral framestone and rudstone formation.

The island has three geomorphic areas with the central portion of the island, the area of proposed resort development, comprising a ridge with steep east and west slopes allowing unimpeded drainage to the sea. In the immediate vicinity of the tidal ponds, water runoff captured in the pond catchment will drain by surface and subsurface flows into the ponds, temporarily raising water levels and diluting the saline water, as recorded in the Black and Johnson study (1997).

4.4.2 Groundwater

Fresh to brackish water has previously been noted to occur in isolated perched lenses and pools within near surface vugs and hollows associated with the thin layer of framestones and rudstone above sea level.

Due to the porous nature of the underlying geology and the narrow linear shape of the island, the water table beneath the island is expected to be tidal, similar to that observed in the tidal ponds. The water will be saline.

4.4.3 Tidal Ponds

In 1994, the physical characteristics, tidal ranges and molluscan fauna of the seven ponds that occur on Long Island were examined by Black and Johnson (1997). The molluscan fauna of the tidal ponds are described in Section 4.7.6. The locations of the tidal ponds are identified in Figure 13 with the numbering of the ponds corresponding to the numbering system used by Black and Johnson (1997). These ponds range from a small depression just beyond the high tide line of the shore, to one pond (507), which is nearly 100 metres in length. All the ponds are tidal, but they vary in their connections to the sea. On a spring tide, tidal maxima in the ponds lagged from 16 minutes to almost two hours behind the sea. While some ponds drain rapidly with the decreasing tide, three of the ponds were found to hold water above sea level even during neap tides (Black and Johnson, 1997).

A difference of salinities between the ponds and the ocean was also observed. All of the ponds were found to be normally slightly saltier than the ocean, although in periods of extended dry weather the salinities increased further. After heavy rain, the salinity of the ponds was found to drop slightly below that of the surrounding seawater (Black and Johnson, 1997).

Tidal Ponds 504 and 507 are different to the other ponds because they are relatively large, hold water, and have sediments on the bottom (Black and Johnson, 1997). Tidal Pond 504, which occurs within the proposed resort development area, is elliptical in shape and is approximately 42 metres long (north to south) and 26.5 metres wide (east to west). The pond occurs in a steep-sided depression in one of the highest points of the island.

The edges of the Tidal Pond 504 (Plate 3) are vegetated down to the waterline, with *Sarcocornia* sp. along the south-west end where the island is lowest and the separation from the sea is a vegetated berm overlying the solid rocky seashore. There are no obvious inflows of water into this pond. The edge of the pond consists of coral slabs, and the base is comprised of rock, overlain by up to eight centimetres of fine tan sediment and a few loose coral slabs. Concentrations of filamentous algae occur around the edge of the pond and over the surface of the water, which varies in extent at different times of the year.

The mid-tide depth as recorded during the Black and Johnson study (1997) was 38 centimetres and estimated mid-tide volume was 323 cubic metres. The tidal level of the bottom of the pond is recorded as 0.4 metres. Water is saline and water quality measurements taken by the study team in October 2005 are discussed in Section 4.7.2.3.

Studies by Black and Johnson (1997) recorded that the water level of Tidal Pond 504 responded to the high tide within 20 minutes and that the water level experienced a range of 0.5 metres over a possible total tidal range of 0.8 metres (taking into account average tides including neap and spring tides). Water levels in the pond declined quickly soon after peak tides, but much more slowly five hours after high tide on the shoreline. The smaller range in level of water of Tidal Pond 504 compared to the surrounding ocean appeared to indicate that the water gained during high spring tides was held in the pond.

4.5 TERRESTRIAL VEGETATION AND FLORA

The vegetation of the islands and islets of the Wallabi group was surveyed by Harvey and others during 17 to 22 November 1999. This survey included Long Island. Flora specimens were opportunistically collected during the survey. Harvey *et al.* (2001) used this survey and the work of Harvey and Alford (1987), Blythe and Fuller (1999) and other unpublished works to develop vegetation maps for the islands of the Abrolhos. The vegetation map derived for Long Island has been comprehensively field verified by Harvey and Longman (Harvey *et al.*, 2001).

During the site visit of October 2005, MBS Environmental undertook opportunistic sampling of a variety of flora specimens from within the proposed resort development area. The specimens were pressed and brought back to Perth for later identification by botanist Dr Eleanor Bennett.

4.5.1 Regional Context

Harvey *et al.* (2001) states that the flora of the Abrolhos Islands is typical of the coastal flora of the mainland. Exceptions to this are the mangrove community and the salt lake and saltbush flats. Keighery *et al.* (2002) undertook a vegetation survey of the islands of the Turquoise Coast, the area between Dongara and Lancelin. Comparisons of the flora list compiled by Harvey *et al.* (2001) and that compiled by Keighery *et al.* (2002) show that the vegetation on the Abrolhos is similar to that of the islands of the Turquoise Coast. Approximately 67 percent of those species recorded by Keighery *et al.* (2002) were also recorded from the Abrolhos by Harvey *et al.* (2001).

4.5.2 Flora

A total of 38 flora species have been recorded on Long Island, comprising 14 families, of which Asteraceae, Chenopodiaceae and Poaceae constitute 60 percent of the species. Table 4.1 lists the flora species for Long Island. Fourteen of these species are weed species.

The Harvey *et al.* survey (2001) recorded 33 species from 13 families. The MBS Environmental survey in October 2005 recorded 27 species from 11 families. Five species not previously recorded for Long Island were collected during the site visit including the Priority 4 species *Lepidium puberulum* (see Section 4.5.4). *Atriplex semilunaris* (Annual Saltbush), *Chenopodium gaudichaudianum* (Cottony Saltbush) and *Tetragonia implexicoma* (Bower Spinach) were also collected during the site visit. These species are all weed species and had not previously been recorded from either Long Island or the Abrolhos Islands in general. They are however present on the mainland around Geraldton and it is possible that *A. semilunaris, C. gaudichaudianum* and *T. implexicoma* were unintentionally brought to the Island by birds, other animals, fishers or visitors from Geraldton. *Muellerolimon salicorniaceum* was also collected during the October 2005 site visit, though this is a common species found on another ten islands within the Wallabi group.

Table 4.1: Flora Species Recorded for Long Island

Species	Recorded By	
	Harvey *et al.* (2001)	**MBS Site Visit (2005)**
Aizoaceae		
Carpobrotus virescens	X	X
**Mesembryanthemum crystallinum*	X	X
**Tetragonia implexicoma*		X
Asteraceae		
Actites megalocarpa	X	
Olearia axillaris	X	X
Senecio pinnatifolius	X	X
**Sonchus oleraceus*	X	X
**Urospermum picroides*	X	X
Brassicaceae		
**Cakile maritima*	X	X
**Hornungia procumbens*	X	
Lepidium puberulum (Priority 4)		X
Chenopodiaceae		
Atriplex cinerea	X	X
Atriplex paludosa	X	
Atriplex paludosa subsp. moquiniana		X
Atriplex sp.	X	X
**Atriplex semilunaris*		X
**Chenopodium gaudichaudianum*		X

Species	Recorded By	
	Harvey *et al.* (2001)	MBS Site Visit (2005)
Enchylaena tomentosa	X	X
Salsola kali* (sic)/Salsola tragus*[+]	X	X
Sarcocornia quinqueflora	X	X
Suaeda australis	X	X
Threlkeldia diffusa	X	
Crassulaceae		
Crassula colorata	X	
Geraniaceae		
**Erodium cicutarium*	X	X
Malvaceae		
Lavatera plebeia (sic)/*Malva australiana*[+]	X	X
Myoporaceae		
Myoporum insulare	X	X
Plumbaginaceae		
Muellerolimon salicorniaceum		X
Poaceae		
Austrostipa elegantissima	X	X
Bromus arenarius	X	
**Bromus diandrus*	X	
**Bromus hordeaceus*	**X**	
**Polypogon monspeliensis*	X	
Setaria dielsii	X	X
Spinifex longifolius	X	X
Santalaceae		
Exocarpos aphyllus	X	X
Solanaceae		
Nicotiana occidentalis subsp. hesperis	X	
Urticacea		
**Urtica urens*	X	
Zygophyllaceae		
Nitraria billardierei	X	X
Zygophyllum simile	X	

*Weed Species

[+] Species name change

4.5.3 Vegetation

The vegetation mapping of Long Island undertaken by Harvey *et al.* (2001) identified 15 vegetation communities (Figure 14). These communities are listed in Table 4.2 together with brief descriptions. Three of these vegetation communities (a2,nZr uFi; m,nSr a2Zc and mSp a2Zc xGr s2Fi) cover 43 percent of the island with coral, beach and tidal pond areas covering 30 percent and the remaining vegetation communities covering 27 percent of Long Island.

Table 4.2: Vegetation Communities of Long Island

Vegetation Community	Vegetation Description
a2,mZi cCi	Dwarf Scrub of *Atriplex* spp and *Myoporum insulare* over a *Carpobrotus virescens* succulent mat
a2,nZr uFi	Open Dwarf Scrub of *Atriplex* spp and *Nitraria billardierei* over *Urospermum picroides* herbfield
a2,m,nSc	Thicket of *Atriplex* spp, *Myoporum insulare* and *Nitraria billardierei*
eZi s3Ci	Dwarf Scrub of *Enchylaena tomentosa* over a *Sarcocornia quinqueflora* succulent mat
m,nSr a2Zc	Open Scrub of *Myoporum insulare* and *Nitraria billardierei* over a *Atriplex* spp heath
m,nZp sGi uFi	Sparse Dwarf Scrub of *Myoporum insulare* and *Nitraria billardierei* over a *Spinifex longifolius* grassland and *Urospermum picroides* herbfield
m,oZi sGr	Dwarf Scrub of *Myoporum insulare* and *Olearia axillaries* over a *Spinifex longifolius* Open Grassland
mSi	*Myoporum insulare* Scrub
mSp a2Zc xGr s2Fi	Sparse Scrub of *Myoporum insulare* over a *Atriplex* spp heath with a mixed sparse grassland and *Senecio lautus* [sic] herbfield
nZr s3Ci	Open Dwarf Scrub of *Nitaria billardierei* over a *Sarcocornia quinqueflora* succulent mat
oZr sGr	Open Dwarf Scrub of *Olearia axillaries* over a *Spinifex longifolius* open grassland
s3Ci	*Sarcocornia quinqueflora* succulent mat
tZi s3,s6Ci	Dwarf Scrub of *Threlkeldia diffusa* over a *Sarcocornia quinqueflora* and *Scaevola crassifolia* succulent mat
tZi s6Ci	Dwarf Scrub of *Threlkeldia diffusa* over a *Scaevola crassifolia* succulent mat
tZi s3,s5,Ci	Dwarf Scrub of *Threlkeldia diffusa* over a and *Suaeda australis* succulent mat

Source: Harvey *et al.* (2001)

4.5.4 Significant Flora

A search of the CALM *Threatened (Declared Rare) Flora* database was undertaken on 8 March 2005 between 28 degrees 12 seconds south 113 degrees 21 seconds east and 29 degrees five seconds south 114 degrees 14 seconds east. This search identified the Priority 3 species *Calocephalus aervoides* and the Priority 4 species *Lepidium puberulum*. A search of the EPBC Protected Matters database was undertaken on 9 September 2005 between 28.4796 degrees south, 113.7728 degrees east and 28.4642 degrees south, 113.7758 degrees east.

This search did not identify any flora species of conservation significance. The full results of these searches are provided in Appendix 9.

Harvey *et al*. (2001) identified five flora species within the Abrolhos Islands that were listed as Priority species by CALM. These species, their status, the islands on which they occur and other known populations are outlined in Table 4.3. Since the publication of the Harvey *et al.* (2001) report *Acacia didyma* has been removed from the Priority list. Harvey *et al.* did not record any of these Priority species on Long Island. In October 2005, MBS Environmental recorded the Priority 4 species *Lepidium puberulum* (see Plate 4). CALM describes Priority 4 species as being "species which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors" (WA Herbarium, 2005). It is recommended that these species are monitored every five to ten years.

Lepidium puberulum was collected from near Tidal Pond 504. This species occurs on two other islands within the Wallabi group (Eastern Island and First Sister Islet) as well as a further ten islands in the Easter Group (Harvey *et al*., 2001). *L. puberulum* has also been recorded from North Boulanger Island and Sandland Island, near Jurien Bay (Keighery *et al*., 2002). *L. puberulum* is an erect annual herb that grows between 10 and 35 centimetres tall. It has white or green flowers with flowering occurring between July and November. This species prefers sandy soils.

Table 4.3: CALM Priority Flora of the Abrolhos Islands

Species	CALM Priority Status (P)	Abrolhos Island	Other Known Populations
Acacia didyma	Listed as P3 by Harvey *et al.* but since removed	East Wallabi Island (W)	Dirk Hartog Island, Tamala Station
Calocephalus aervoides	P3	East Wallabi Island (W), West Wallabi Island (W)	Port Gregory, Dorre Island, Balladonia
Chthonocephalus tomentellus	P2	West Wallabi Island (W)	Shark Bay, Denham
Galium migrans	P3	East Wallabi Island (W)	Eucla, Caiguna, Cape Leeuwin, Margaret River, Cape LeGrand National Park, Eastern States
Lepidium puberulum	P4	Alexander Island (E), Bynoe Island (E), Campbell Island (E), Eastern Island (W), First Sister (W), Gilbert Island (E), Keru Island (E), Leo Island (E), Little North Island (E), Morley Island (E), Serventy Island (E), White Island (E)	Rottnest Island, Dorre Island, Boullanger Island, Garden Island, Zuytorp Cliffs, Dirk Hartog Island

Source: Harvey *et al.* (2001)

W = Wallabi Group; E = Easter Group

4.5.5 Significant Vegetation

Five vegetation communities of special conservation interest were described by Harvey *et al.* (2001) within the Wallabi Group islands. These are the *Avicennia marina* mangrove community or 'mangal', *Atriplex cinerea* dwarf shrubland, pavement limestone, dunes and consolidated dunes on North Island and East and West Wallabi Islands, *Eucalyptus oraria* grove on East Wallabi Island and the salt lake and saltbush flats on islands such as North and West Wallabi.

The mangal community of the Abrolhos is significant in that it is one of the southernmost populations of this species. *Avicennia marina* only occurs south of the Abrolhos in Western Australia at Bunbury. There are 33 islands within the Abrolhos that support mangal communities. Eight of these are islands of the Wallabi group and includes West Wallabi Island. There is no mangal present on Long Island.

Atriplex cinerea dwarf shrubland is common throughout the Abrolhos Islands. Harvey *et al.* (2001) indicate that this community forms an important habitat for burrowing seabirds (such as shearwaters) that burrow into the sand underneath *A. cinerea*, where it is deep enough. On Long Island *A. cinerea* occurs in combination with other species such as *A. paludosa* subspecies *moquiana*, *Nitraria billardierei* and *Myoporum insulare* as heathland and dwarf scrubland. These communities are found along the length of the island with the central portion, and main development area, covered by sparse scrub of *M. insulare* over an *Atriplex* species heath with mixed sparse grassland and *Senecio lautus* [sic] herbfield.

The sandy beaches and dunes of North Island and East and West Wallabi Islands are generally quite unstable and exposed to the prevailing winds. These areas are easily eroded after disturbance. The consolidated dunes are slow to recover from disturbance, as is evidenced by the slow rate of regeneration of the old airstrips (Harvey *et al*., 2001). The pavement limestone communities of East and West Wallabi Islands are often quite degraded but still retain an abundance of flora species. Harvey *et al.* (2001) noted that the pavement limestone communities often occurred in areas that had been highly settled by local fishers.

Harvey *et al.* (2001) note that the *Eucalyptus oraria* grove on East Wallabi Island is of particular interest. There are no eucalypts occurring on any other islands south of Dirk Hartog Island and west of Albany in Western Australia.

The salt lake and low salt flats of North Island and West Wallabi Island do not occur extensively throughout the Abrolhos Islands. Salt lakes and their associated communities are rare on the islands of south-western Australia (Harvey *et al*., 2001). Though there are several tidal ponds present on Long Island there are no salt lakes. Additionally, the communities associated with the salt lakes on North Island and West Wallabi Island are not present on Long Island.

4.5.6 Weeds

A total of 14 weeds have been recorded from Long Island. Three of the species recorded by MBS Environmental in the October 2005 survey were not previously recorded by Harvey *et al.* (2001) from within the Abrolhos Islands at all. Sixty weed species have been recorded from islands within the Wallabi Group with the most dominant weed family being the grasses (Poaceae) with 21 species (Harvey *et al*., 2001). On Long Island the most dominant weed

families are Chenopodiaceae with three species and Asteraceae and Aizoacea with two species each. Weed species are widespread across Long Island and within the proposed tourism development area.

4.6 TERRESTRIAL FAUNA

4.6.1 Avifauna

Halfmoon Biosciences was engaged by MBS Environmental to assess the habitats and populations of avifauna on Long Island. As part of this assessment a desktop literature search was undertaken (Surman 2005), and two four-day field surveys were completed in September/October and December 2005 (Surman 2006a, Appendix 10). This document also contains details of the breeding schedule for the birds of Long Island.

Searches of the CALM Threatened Fauna database and the EPBC Protected Matters Database were undertaken on 8 March 2005 and 18 January 2005, respectively. These searches identified 39 bird species of conservation significance, which are further discussed in Section 4.6.1.6. The full results of these searches are provided in Appendix 9.

4.6.1.1 Background

The first naturalist to report on the wildlife of the Houtman Abrolhos was John Gilbert who visited the islands in 1843 as part of the *Beagle* expedition. Subsequently, there have been occasional reports. Of particular note were the visits of Helms (1902), Gibson (1908), Conigrave (1916), Dakin (1919), Alexander (1922) and more recently Serventy (1943), Ealey (1954), Tarr (1949) and Warham (1956). In the last twenty years there have been further assessments of breeding seabird numbers at the Houtman Abrolhos (Fuller *et al*. 1994, Burbidge and Fuller 2004) and a review of the birds at the Houtman Abrolhos by the Western Australian Museum (Storr *et al*. 1986). Most reports on the status and timing of breeding and behaviour of breeding seabirds have been based on short visits (one to two days) to the islands. The first protracted research project into seabird breeding biology at the Houtman Abrolhos was undertaken during the 1991/1992 breeding season and concentrated on the endemic Lesser Noddy *Anous tenuirostris melanops* (Surman 1992, Surman and Wooller 1995, 2000, 2003). More recently, studies have focused on the ecology of seabird communities, their diets and timing of breeding (Surman 1997, Surman 1998, Surman and Wooller 2000, Gaughan *et al.* 2002).

4.6.1.2 Birds of the Region

Birds of the Houtman Abrolhos

The Houtman Abrolhos avifauna is dominated by marine species. Of the total 113 species recorded from the Houtman Abrolhos, 46 are seabirds, 23 are migratory waders, 28 are land birds, 12 are water/shorebirds and four are raptors (Table 4.4). Twenty eight species breed regularly at the Houtman Abrolhos, comprising 16 seabirds, two raptors, four shorebirds, one wader and five land birds (Storr *et al.* 1986). Most non-breeding species reported are summer migrants or vagrants.

A relatively recent assessment of the breeding seabirds of Australia has highlighted the significance of the Houtman Abrolhos as a seabird breeding area. Based on Fuller's *et al.* (1994) population estimates and a review of Australian seabird numbers (Ross *et al.* 1995), Surman (1997) found that the Houtman Abrolhos contain significant breeding populations of seabirds. The Houtman Abrolhos are home to 80 percent of Brown Noddies, 40 percent of Sooty Terns, 85 percent of Wedge-tailed Shearwaters, 88 percent Little Shearwaters and 55 percent of Roseate Terns that nest within Australia's territorial waters. The Houtman Abrolhos contain some of the most significant populations and breeding islands of seabirds in Australia.

The avifauna of the Houtman Abrolhos is significant for a number of reasons.

- The Houtman Abrolhos comprise one of the most significant seabird breeding assemblages in Australia in terms of diversity and biomass.
- Several species breeding at the Houtman Abrolhos do so at the limits of their range. For example, islands within the Wallabi Group represent the northern most breeding range of White-faced Storm-petrels, Little Shearwaters and Pacific Gulls. Several other species breed no further south, including the Sooty Tern and Lesser Noddy.
- The Houtman Abrolhos contain the largest aggregation of White-breasted Sea Eagles and Osprey in Western Australia.
- The Houtman Abrolhos contain the largest breeding populations of Roseate Terns, Fairy Terns and Caspian Terns in Western Australia.
- The Houtman Abrolhos contain the only breeding population of the EPBC listed species the Lesser Noddy.
- The Houtman Abrolhos provide source populations for species undertaking range extensions further south. It is likely that Brown Noddies, Roseate Terns and Bridled Terns that have colonised islands south of the Houtman Abrolhos since the 1950's were originally from Houtman Abrolhos stock.
- Most Wedge-tailed Shearwaters, Sooty Terns, Brown Noddies, Little Shearwaters and Roseate Terns that breed in Australia do so at the Houtman Abrolhos.

The land bird fauna of the Houtman Abrolhos is particularly small, reflecting the restricted plant and invertebrate diversity found on small continental islands when compared with the adjacent mainland. Only five species of land birds nest, all of which do so at the Wallabi Group.

The Houtman Abrolhos provide a summer feeding location for moderate numbers of migratory waders. At least 23 species of migratory waders regularly visit the Houtman Abrolhos. This includes the resident Red-capped Plover, which breeds on West Wallabi Island and possibly elsewhere within the archipelago. Also, there are smaller populations of Ruddy Turnstones that remain during the winter months.

Table 4.4 gives a complete list of the birds of the Houtman Abrolhos Islands. The list includes breeding, migratory, resident and vagrant species since records began in 1843. A comparison to the bird species from Long Island, Wallabi Group is included.

Table 4.4: A Complete List of the Birds of the Houtman Abrolhos

Common Name	Species	Houtman Abrolhos	Long Island	Source
Little Penguin	*Eudyptula minor*	X		1, 8
Wandering Albatross	*Diomedea exulans*	X		1, 8
Tristan Albatross	*Diomedea dabbenena*	X		9
Indian Yellow-nosed Albatross	*Thalassarche carteri*	X		1,8, 3
Grey-headed Albatross	*Thalassarche chrysostoma*	X		1
Southern Giant Petrel	*Macronectes giganteus*	X		1, 3, 8, 10
Northern Giant Petrel	*Macronectes halli*	X		9
Cape Petrel	*Daption capense*	X		1, 8, 10
Great-winged Petrel	*Pterodroma macroptera*	X		1, 8
White-headed Petrel	*Pterodroma lessonii*	X		1
Soft-plumaged Petrel	*Pterodroma mollis*	X		1
Blue Petrel	*Halobaena caerulea*	X		8
Broad-billed Prion	*Pachyptila vittata*	X		8
Lesser Broad-billed Prion	*Pachyptila salvini*	X		8
Slender-billed Prion	*Pachyptila belcheri*	X		1, 8
White-chinned Petrel	*Procellaria aequinoctialis*	X		1
Hutton's Shearwater	*Puffinus huttoni*	X		8
Streaked Shearwater	*Calonectris leucomelas*	X		1
Little Shearwater	*Puffinus assimilis*	X	X	1, 2, 3, 8
Wedge-tailed Shearwater	*Puffinus pacificus*	X	X	1, 2, 3, 8
Flesh-footed Shearwater	*Puffinus carneipes*	X		1, 8
Wilson's Storm-petrel	*Oceanites oceanicus*	X		1, 8
White-faced Storm-petrel	*Pelagodroma marina*	X	X	1, 2, 3, 8
Australasian Gannet	*Morus serrator*	X		1, 3, 8
Red-tailed Tropicbird	*Phaethon rubricauda*	X		1, 2, 3, 8
White-tailed Tropicbird	*Phaethon lepturus*	X		1
Australian Pelican	*Pelecanus conspicillatus*	X		1, 3
Pied Cormorant	*Phalacrocorax varius*	X	X	1, 2, 3, 8
Little Pied Cormorant	*Phalacrocorax melanoleucos*	X		1, 2, 3, 10
Great Cormorant	*Phalacrocorax carbo*	X		1, 10
Darter	*Anhinga melanogaster*	X		1
Eastern Reef Egret	*Egretta sacra*	X	X	1, 3, 8, 10
White-faced Heron	*Ardea novaehollandiae*	X		1, 3, 10
Black Swan	*Cygnus atratus*	X		1
Grey Teal	*Anas gibberifrons*	X		1, 3, 10
Mountain Duck	*Tadorna tadornoides*	X		1, 3

Common Name	Species	Houtman Abrolhos	Long Island	Source
Osprey	*Pandion haliaetus*	X	X	1, 2, 3, 8, 10
White-breasted Sea Eagle	*Haliaeetus leucogaster*	X	X	1, 2, 3, 10
Marsh Harrier	*Circus aeroginosus*	X		3
Australian Kestrel	*Falco cenchroides*	X		1, 3
Stubble Quail	*Coturnix novaezelandiae*	X		1, 3
Painted Button-quail	*Turnix varia scintillans*	X		1, 8, 10
Banded Land Rail	*Gallirallus philippensis mellori*	X		1, 3
Spotted Crake	*Porzana fluminea*	X		1
Spotless Crake	*Porzana tabuensis*	X	X	1, 3, 8, 10
Pied Oystercatcher	*Haematopus longirostris*	X	X	1, 3, 8, 10
Sooty Oystercatcher	*Haematopus fuliginosus*	X		1, 3, 8, 10
Bar-tailed Godwit	*Limosa lapponica*	X	X	1, 3, 8, 10
Black-tailed Godwit	*Limosa limosa*	X		1, 3
Banded Plover	*Vanellus tricolor*	X		1
Grey Plover	*Pluvialis squatarola*	X	X	1, 3, 10
Eastern Golden Plover	*P. fulva*	X		1, 3, 8, 10
Red-capped Plover	*Charadrius ruficapillus*	X	X	1, 3, 8, 10
Hooded Plover	*C. cucullatus*	X		1, 3
Large Sand Plover	*C. leschenaultii*	X		1, 3, 10
Lesser Sand Plover	*C. mongolus*	X		3
Whimbrel	*Numenius phaeopus*	X		1, 3, 8, 10
Eastern Curlew	*Numenius madagascariensis*	X		1, 3, 8
Greenshank	*Tringa nebularia*	X	X	1, 3, 8, 10
Terek Sandpiper	*Xenus cinareus*	X		1, 3, 8, 10
Common Sandpiper	*Tringa hypoleucos*	X		1, 3, 8, 10
Marsh Sandpiper	*Tringa stagnatilis*	X		10
Grey-tailed Tattler	*Tringa brevipes*	X	X	1, 3, 8, 10
Ruddy Turnstone	*Arenaria interpres*	X	X	1, 3, 8, 10
Great Knot	*Calidris tenuirostris*	X		1, 3, 10
Red Knot	*Calidris canutus*	X		10
Sanderling	*Calidris alba*	X	X	1, 3, 10
Sharp-tailed Sandpiper	*C. acuminata*	X		1, 3
Curlew Sandpiper	*C. ferruginea*	X		1, 3, 10
Red-necked Stint	*C. ruficollis*	X	X	1, 3, 8, 10
Black-winged Stilt	*Himantopus himantopus*	X		1
Banded Stilt	*Cladorhynchus leucocephala*	X		1
Red-necked Avocet	*Recurvirostra novaehollandiae*	X		1, 3
Oriental Pratincole	*Glareola maldivarum*	X		1, 3

Common Name	Species	Houtman Abrolhos	Long Island	Source
Great Skua	*Catharacta skua*	X		1, 2, 8
Pomarine Skua	*S. pomarinus*	X		10
Pacific Gull	*Larus pacificus*	X	X	1, 3, 8, 10
Silver Gull	*L. novaehollandiae*	X	X	1, 3, 8, 10
Crested Tern	*Sterna bergii*	X	X	1, 3, 8, 10
Caspian Tern	*Sterna caspia*	X	X	1, 3, 8, 10
Bridled Tern	*S. anaethetus*	X	X	1, 3, 8, 10
Sooty Tern	*S. fuscata*	X	X	1, 3, 8, 10
Roseate Tern	*S. dougallii*	X	X	1, 3, 8, 10
Fairy Tern	*S. nereis*	X	X	1, 3, 8, 10
Little Tern	*S. sinensis*	X		1
Brown Noddy	*Anous stolidus*	X		1, 3, 8, 10
Lesser Noddy	*Anous tenuirostris*	X		1, 3, 8, 10
White Tern	*Gygis alba*	X		8
Brush Bronzewing	*Phaps elegans*	X	X	1, 8, 10
Galah	*Cacatua roseicapilla*	X		1
Little Corella	*C. sanguinea*	X		1
Horsefield's Bronze Cuckoo	*Chrysococcyx basalis*	X		1, 10
Barn Owl	*Tyto alba delicatula*	X		1
Spine-tailed Swift	*Hirundapus caudactus*	X		1
Sacred Kingfisher	*Halcyon sancta*	X		1, 8
White-backed Swallow	*Cheramoeca leucosterna*	X		1
Welcome Swallow	*Hirundo neoxena*	X	X	1, 3, 8, 10
Rainbow Bee-eater	*Merops ornatus*	X		8
Richard's Pipit	*Anthus novaeseelandiae australis*	X		1
Australian Pipit	*Anthus cervinus*	X		10
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X		1
Red-capped Robin	*Petroica goodenovii*	X		1
Rufous Whistler	*Pachycephala rufiventris*	X		1
Willie Wagtail	*Rhididura leucophrys*	X		1
Spotted Scrub-wren	*Sericornis frontalis*	X		1,8,10
White-winged Triller	*Lalage tricolor*	X		10
Little Grassbird	*Megalurus gramineus*	X		1, 3
Rufous Songlark	*Cincloramphus mathewsi*	X		1, 3
Brown Songlark	*C. cruralis*	X		1
Grey-breasted White Eye	*Zosterops lateralis gouldii*	X	X	1, 3, 8, 10
Magpie-Lark	*Grallina cyanoleuca*	X		8

Common Name	Species	Houtman Abrolhos	Long Island	Source
Australian Raven	*Corvus coronoides*	X		1

Sources: 1. Storr *et al*. (1986), 2. Fuller *et al.* (1994), 3. Fuller and Burbidge (1981), 4. CALM SBID, 5. O'Loughlin (1966), 6. Johnstone and Storr (1994), 7. Surman (1997), 8. Surman *unpublished records*, 9. EPBC list, 10. Coate (2005)

Birds of the Wallabi Group

The Wallabi Group contains most of the regular visiting and breeding birds found throughout the Houtman Abrolhos. Significant exceptions include the Lesser Noddy, Red-tailed Tropicbird, Brown Noddy and Sooty Tern. Of the 28 breeding species of birds in the islands, 22 species breed within the Wallabi Group. Eleven seabird species, three shorebirds, two marine raptors, one wader and five land birds breed at the Wallabi Group.

There have been few published accounts of the avifauna of the Wallabi Group, although some detail is included in Storr *et al*. (1986) and Burbidge and Fuller (2004). Johnstone and Storr (1994) published an account of birds on West Wallabi Island, and Storr (1965) an account of the vertebrate fauna of the Wallabi Group.

The avifauna of the Wallabi Group is dominated by the large populations of Wedge-tailed Shearwaters and Little Shearwaters that breed on West Wallabi Island. Approximately one million pairs of Wedge-tailed Shearwater (91 percent of Houtman Abrolhos total) and 9,000 pairs of Little Shearwaters (30 percent of Abrolhos total) nest in sandy areas throughout the island (Fuller *et al*. 1994). West Wallabi also contains one of the largest breeding colonies of Fairy Terns. Alexander (1922) reported several hundred nesting on the eastern side of West Wallabi Island; similarly Surman (*unpublished obs*) observed several hundred breeding at the inland fort on West Wallabi Island in November 1987.

4.6.1.3 Birds of Long Island

Twenty-eight species of birds have been recorded on Long Island (Burbidge and Fuller 2004, Storr *et al*. 1986, Surman 2006a). Of these, 12 species have been confirmed as breeding regularly: White-breasted Sea Eagle, Osprey, Pacific Gull, Silver Gull, Caspian Tern, Crested Tern, Bridled Tern, Eastern Reef Egret, Pied Oystercatcher, Grey Breasted White Eye, Little Shearwater and White-faced Storm-petrel (Surman 2006a). Two other species not recorded during surveys in 2005, have been reported as breeding: Roseate Terns (Burbidge and Fuller 2004) and Wedge-tailed Shearwater (CALM SBID).

Of the 28 species recorded from Long Island, 20 were reported during surveys conducted in September and December 2005 including two new records, the Sooty Tern and White-faced Storm-petrel (Surman 2006a). Sooty Terns were recorded prospecting over the northern end of the colony in association with Bridled Terns, and have not been previously observed on Long Island. No formal estimate of the White-faced Storm-petrel has been undertaken previously, although Kirsten (2001) reported this species as breeding. Species not recorded in the 2005 surveys were mainly migratory waders and include; Bar-tailed Godwit, Greenshank, Grey Plover, Sanderling, Spotless Crake and Brush Bronzewing (Storr *et al*. 1986, Coate 2005).

There have been no published studies specific to the avifauna of Long Island. However, two publications include observations of birds from Long Island (Storr *et al.* 1986, Burbidge and Fuller 2004), and two unpublished accounts list bird observations from Long Island (Kirsten 2001 and Coate 2005):

- Little Shearwater (*Puffinus assimilis*) (700 pairs);
- Bridled Tern (*Sterna anaethetus*) (350 to 700 pairs);
- Crested Tern (*Sterna bergii* (60 pairs);
- Roseate Tern (*Sterna dougallii*) (136 pairs); and
- A single pair for White-breasted Sea Eagle (*Haliaeetus leucogaster*), Eastern Reef Egret (*Egretta sacra*) and Pacific Gull (*Larus pacificus*).

In addition, a single pair of Osprey (*Pandion haliaetus*) was recorded nesting on the islet to the north-east of Long Island.

A previous review by Storr *et al*. (1986) provided a fuller list of breeding species for Long Island based on a summary of previous literature and unpublished observations. In addition to the seven species above, Storr *et al*. (1986) included as breeders the:

- Caspian Tern (*Sterna caspia*);
- Silver Gull (*Larus novaehollandiae*); and
- Grey-breasted White eye (*Zosterops lateralis gouldi*).

However, no indication of the size of these populations was reported. Included in this report were the observations taken by Alexander (1922) during a visit in November 1913. Interestingly, he reported Sooty Terns *Sterna fuscata* breeding in large numbers on the smaller islands of the Wallabi Group including Pigeon Island and Long Island. This species no longer breeds in the Wallabi Group.

Long Island in a Regional Context

Of the 28 species of birds breeding at the Houtman Abrolhos, 22 (78 percent) breed at the Wallabi Group and 14 breed (50 percent) on Long Island. Of the 16 species of seabirds that breed at the Houtman Abrolhos, 11 (69 percent) species do so at the Wallabi Group and nine (56 percent) on Long Island. Given the diversity of the seabird fauna based on previous records, Long Island has a diverse avifauna relative to its land area.

In the Wallabi Group Long Island is the third most significant seabird breeding island in terms of biomass after West Wallabi and Beacon Islands. It is also the second largest breeding colony of Bridled Terns and the third largest colony of Little Shearwaters in the Wallabi Group.

The populations of breeding seabirds based on recent estimates in Surman (2006a), rank Long Island as the third largest White-faced Storm-petrel colony, fifth largest Bridled Tern colony as well as being significant in terms of the numbers of Pied Oystercatchers and Pacific Gulls. It must be noted that the Houtman Abrolhos are data deficient for early spring breeding species, notably the Pacific Gull and Pied Oystercatcher, and is most likely data deficient for White faced Storm-petrels, which are likely to breed in higher numbers and on more islands than previously identified.

Table 4.5 describes the breeding species and population size (number of breeding pairs) on Long Island and the rank of the relative importance of the Long Island breeding colony in the Houtman Abrolhos context based on reported breeding population sizes. Data after Burbidge and Fuller (2004), Fuller *et al*. (1994) and Surman (2006a).

Table 4.5: Breeding Species on Long Island

Long Island Breeding Species	Breeding Population (No. of Pairs)	No. of Breeding Islands	Rank (Relative Importance of Long Is. Breeding Colony)
Wedge-tailed Shearwater	?	11	11
Little Shearwater	376	26	13
White-faced Storm-Petrel	612	15	3
Pacific Gull	3	39	3
Silver Gull	47	17	3
Crested Tern	60	9	5
Caspian Tern	1	10	= 10
Bridled Tern	250	66	5
Roseate Tern	136	20	8
Eastern Reef Egret	1	11	= 11
Pied Oystercatcher	3	7	3
Osprey	1	41	= 37
White-breasted Sea eagle	1	15	= 15
Grey-breasted White-eye	>1	8	= 8

Source: Burbidge and Fuller (2004), Fuller *et al*. (1994) and Surman (2006b)

4.6.1.4 Habitat

Long Island is best described geologically as a composite island, typical of the more recently formed leeward islands found throughout the eastern portions of the Houtman Abrolhos (Collins *et al*. 1997). Long Island is composed of emergent reef foundations formed approximately 5,000 years before present (BP) atop a Pleistocene (125,000 years BP) reef platform. The emergent reef foundations are covered in shallow coral framestone and relatively recent (<2,000 years BP) storm ridges of unconsolidated rudstone (Collins *et al*. 1993). Nestled between storm ridges within the mid-portions of the island are deposits of sand forming low dunes.

Five main habitats used by avifauna have been identified on Long Island. Habitats are predominately defined by vegetation communities and underlying landforms. Definitions follow those set out in Harvey *et al*. (2001). Figure 15 shows the main terrestrial habitats of Long Island.

Habitat utilised by seabirds at the Houtman Abrolhos is dominated by three species of plants: *Myoporum insulare, Nitraria billardierei* and *Atriplex cinerea*. More disturbed sandy areas due to the diggings of burrow-nesting shearwaters and petrels are clearly defined by larger clumps of *Nitraria billardierei.*

Low Sand Dunes
Several areas of sand dunes are found on Long Island. Relatively fine sands deposited in swales between storm ridges in central portions of the island, as well as low primary dunes on coral ridges in northern portion of the island situated along the eastern shore. The vegetation is dominated by a sparse scrub of *Myoporum insulare* and *Nitraria billardierei* over an *Atriplex* species heath with a mixed sparse grassland. Little Shearwaters and White-faced Storm-petrels nest in deep burrows in all sandy areas of the island. Burrows are excavated in open sandy areas as well as below dense woody shrubs of *Myoporum insulare* and *Nitraria billardierei*.

Coral Ridges
Storm cast unconsolidated rudstone form north-south linear coral ridges, with older coral ridges higher and more centrally located on the island. The ridges are generally devoid of vegetation except where they form shallow gullies. Where they are vegetated, it is dominated by open dwarf scrub of *Atriplex cinerea* and *Nitraria billardierei* over *Urospermum picroides*. Several seabird species may potentially nest amongst the coral ridges. Crested Terns, Roseate Terns and Fairy Terns at the Houtman Abrolhos typically nest on coral ridges, the latter two species preferring the peak of older coral ridges where finer coral rubble is located. Crested Terns prefer expanses of flat areas with finer coral rubbles and sand, typical of those areas found to the north of Tidal Pond 504, and to the south west of Tidal Pond 507. The single pair of Caspian Terns nest on shell grit and finer coral sand adjacent to the extensive Samphire *Sarcocornia quinqueflora* just north of Tidal Pond 503.

Tidal Ponds
There are seven tidal ponds on Long Island (Black and Johnson, 1997). They provide feeding habitat and shelter for the small numbers of migratory waders that visit Long Island as well as the residential Red-capped Plover. The larger ponds, Tidal Pond 504 and Tidal Pond 507, typically have higher aggregations of waders than other ponds on the island, and this is due to the presence of sediments on the bottom, which are exposed between high tides. Wader numbers are very low compared with other areas of the Houtman Abrolhos (Storr *et al*. 1986, Surman *pers. obs*.).

Vegetation
The vegetation of Long island is dominated by low coastal shrubs. Where there are no sand dunes but enough soil between coral framestone exists, extensive sparse scrublands occur of Myoporum *insulare* and *Nitraria billardiere* over patchy herbfields or heath lands of *Atriplex cinerea* and *Urospermum picroides*. Bridled Terns nest under any object that provides some shading and camouflage, particularly favouring the dense cover afforded by the occasional larger shrubs of *M. insulare* and *N. billardierei*. Silver Gulls also nest amongst these species, as well as the small areas of the dwarf scrub *Olearia axillares* over *Spinifex longifolius* grassland.

Shoreline
Several seabirds construct their nests along the shoreline, typically just above the high water mark. Pacific Gulls construct nests of brown algae usually overlooking the sheltered western shore. Pied Oystercatchers construct a nest consisting of a cryptic nest scrape located a few metres from the waters edge. The nests are difficult to locate.

4.6.1.5 Results of Bird Survey

A total of 20 species of birds were recorded on Long Island during the September and December 2005 field surveys and presented in Table 2 of Surman 2006a, (Appendix 10 of this report). Of these, 12 species (seven seabirds, two marine raptors, two shorebirds and one passerine) were recorded as breeding or had recently bred, as presented in Table 3 of Surman (2006a, Appendix 10 of this report). Figure 16 shows the breeding colonies on Long Island as observed in the October 2005 and December 2005 surveys. Breeding species in order of descending population size were: Bridled Tern, White-faced Storm-petrel, Little Shearwater, Silver Gull, Pacific Gull, Pied Oystercatcher, Caspian Tern, Crested Tern, Osprey, White-breasted Sea Eagle, Grey-breasted White-eye and Eastern Reef Egret. Observed (or estimated) breeding populations for the 2005 breeding season are presented in Table 3 of Surman 2006a, (Appendix 10 of this report). The locations of bird colonies and nests on Long Island are shown in Figure 16.

Significantly, this report confirms unpublished data indicating that a medium-sized population of White-faced Storm-petrels breed on Long Island. This report also confirms the breeding records reported by Storr *et al*. (1986), Fuller *et al*. (1994) and Burbidge and Fuller (2004), as well as significantly adding to the sizes of these populations.

Approximately 612 burrows of the White-faced Storm-petrel were estimated to occur on Long Island, the majority of which were located in low sandy dunes along the eastern shore north of the proposed development. Approximately 376 Little Shearwater burrows were estimated to occur throughout all sandy areas of the island. The Houtman Abrolhos is the northern most breeding range of the White-faced Storm-petrels. This discovery increases the known White-faced Storm-petrel population of the Houtman Abrolhos by 15 percent based on a total population estimate by Fuller *et al*. (1994) of 4,227 pairs.

4.6.1.6 Threatened and Priority Bird Species

A summary of the conservation status of all birds that occur at the Houtman Abrolhos is recorded in Appendix 11. This appendix presents a list of all birds and their occurrence in the region and on Long Island and their status under the Western Australian and Commonwealth legislation. The results of the search conducted of the *EPBC* Protected Matters Database are also included.

Birds Protected Under Western Australian Legislation

Eight species of birds that occur within the Houtman Abrolhos are listed under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2006 (*Wildlife Conservation Act 1950*) and are Declared Threatened Fauna. The species and their status are shown below:

- Tristan Albatross - Endangered
- Southern Giant Petrel – Endangered
- Lesser Noddy - Vulnerable
- Wandering Albatross - Vulnerable
- White-chinned Petrel - Vulnerable
- Indian Yellow-nosed Albatross - Vulnerable

- Grey-headed Albatross - Vulnerable
- Abrolhos Painted Button Quail - Vulnerable

Of these, none have been reported from Long Island, although some species (principally the Yellow-nosed Albatross and Southern Giant Petrel) are relatively common during winter months in the surrounding waters (Storr *et al*. 1986). Other listed species are typically vagrant or rare winter visitors to the seas west of the Houtman Abrolhos, occasionally being driven to shore by cold fronts (Storr *et al.* 1986, Surman *pers. obs.*). Storr *et al*. (1986) notes that many records of albatross and petrels originate from badly decomposed remains discovered in the nests of White-breasted Sea Eagles or Osprey.

A further three other species of bird that occur at the Houtman Abrolhos are also listed as Priority Fauna on the CALM Threatened and Priority Fauna Database. Although not specified in the legislation, these birds have been assigned a "Priority 4 status" by CALM, meaning they are species that require monitoring. They are the:

- Eastern Curlew
- Hooded Plover
- Brush Bronzewing

Of these only the Brush Bronzewing has been observed on Long Island (Storr *et al*. 1986). The Brush Bronzewing is confined to the Wallabi Group and North Island. No breeding observations of this species are recorded from Long Island, although this species may visit to feed from time to time.

Birds Protected Under Commonwealth Legislation

EPBC Threatened Species

Ten species of birds that occur within the Houtman Abrolhos are protected through the *EPBC Act 1999* as Threatened Species. The names of these species and their status is presented below:

- Tristan Albatross – Endangered
- Southern Giant-Petrel – Endangered
- Australian Lesser Noddy – Vulnerable
- Wandering Albatross – Vulnerable
- Northern Giant Petrel - Vulnerable
- Soft-plumaged Petrel – Vulnerable
- Indian Yellow-nosed Albatross – Vulnerable
- Shy Albatross – Vulnerable
- Grey Headed Albatross - Vulnerable
- Painted Button-quail (Houtman Abrolhos) - Vulnerable

Two of these *EPBC* Threatened Species could potentially be encountered on or near to Long Island: the Lesser Noddy and the Abrolhos Painted Button Quail. Lesser Noddies breed on three islands over 30 kilometres to the south of Long Island. A group of six birds was

observed flying past in October 2005, 700 metres west of Long Island. There have been no records of the Abrolhos Painted Button Quail on Long Island, and whilst there is little suitable habitat for this species on Long Island, some birds may visit from West and East Wallabi Islands. Neither species is known to breed on Long Island.

EPBC Migratory Species

Of the birds that occur within the Houtman Abrolhos, 32 species are protected through the *EPBC Act 1999* as Migratory Species, which provides protection for species listed under the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention. The names of these species is presented below:

- Australian Kestrel
- Brown Noddy
- Ruddy Turnstone
- Sharp-Tailed Sandpiper
- Sanderling
- Red Knot
- Curlew Sandpiper
- Red Necked Stint
- Great Knot
- Large Sandplover
- Lesser Sandplover
- Wandering Albatross
- Tristan Albatross
- Eastern Reef Egret
- Oriental Praticole
- White-breasted Sea-Eagle
- Caspian Tern
- Bar-Tailed Godwit
- Black-Tailed Godwit
- Southern Giant Petrel
- Northern Giant Petrel
- Rainbow Bee Eater
- Eastern Curlew
- Whimbrel
- White-chinned Petrel
- Wedge-tailed Shearwater
- Bridled Tern
- Grey-tailed Tattler
- Common Sandpiper
- Greenshank
- Marsh Sandpiper
- Terek Sandpiper

The Bar-tailed Godwit *Limosa lapponica*, Grey-tailed Tattler *Tringa brevipes*, and Ruddy Turnstone *Arenaria interpres* were recorded at Long Island by Storr *et al*. (1986). Other species protected as Migratory Species and known to occur on Long Island are the Bridled Tern, the Eastern Reef Egret, and Caspian Tern.

During the 2005 survey, (Surman 2006a), a total of three migratory waders were observed (Grey-tailed Tattler, Ruddy Turnstone, Red-necked Stint) as well as the resident the Red-capped Plover. Previous reports indicate that a further four species visit Long Island intermittently; Greenshank, Bar-tailed Godwit, Grey Plover and Sanderling (Coate 2005, Storr *et al.* 1986).

Of the 32 species *EPBC* Migratory Species identified for the Abrolhos as a whole, the following 11 species have been recorded for Long Island. Table 4.6 presents a summary of those Migratory Species known to occur and breed at Long Island.

Table 4.6: *EPBC* Listed Migratory Species Known to Occur and Breed at Long Island

Common Name	Occurrence at Long Island	Breeding at Long Island
Wedge-tailed Shearwater	X	X
Eastern Reef Egret	X	X
White-breasted Sea Eagle	X	X
Bar-tailed Godwit	X	
Greenshank	X	
Grey-tailed Tattler	X	
Ruddy Turnstone	X	
Sanderling	X	
Red Necked Stint	X	
Caspian Tern	X	X
Bridled Tern	X	X

During the 2005 Long Island surveys, three areas of importance to waders were identified. These are the tidal ponds 506, 507, and coral ridge areas adjacent to Tidal Pond 507. These areas are utilised by waders as foraging areas and as shelter during high tides from the prevailing southerly winds.

The intertidal reef flats located along the eastern shore of Long Island also provide important foraging opportunities for migratory waders. Similarly, the intertidal reef that joins Long Island to Short Island provides foraging habitat and roosting habitat for a number of birds, principally terns and some migratory waders. Table 4.7 summarises the numbers of migratory waders observed, and regions observed during the two surveys undertaken.

Table 4.7: Numbers of Migratory Waders and Regions Observed

Species	September 2005	December 2005	Locations
Ruddy Turnstone	18	36	Pond, northern point, all western shorelines
Grey-tailed Tattler	0	11	Pond 507, coral ridges near Pond 507, eastern

			shoreline
Red-capped Plover	11	12	Ponds 503, 504, 507, northern narrow neck
Red-necked Stint	18	7	Ponds 504, 506, 507, coral ridges near pond 507

Searches of the CALM Threatened Fauna database and the *EPBC* Protected Matters Database were undertaken on 8 March 2005 and 18 January 2005, respectively incorporating Long Island and at least a 10km buffer. Although the results of these searches did not necessarily reflect the species found in the field surveys discussed above, the listed threatened and migratory bird species are presented in Table 4.8. Of this list, five species are known to occur at Long Island and four species are known to breed at Long Island. These species have been previously identified above.

Table 4.8: Search Results for CALM and *EPBC* Listed Threatened and Migratory Bird Species

Species	**(WA) *Wildlife Conservation Act 1950* and *Wildlife Conservation (Specially Protected Fauna) Notice 2006* Status**	***EPBC Act 1999* Status**	**Occurrence at Long Island**	**Breeding at Long Island**
Anous tenuirostris melanops Australian Lesser Noddy	Schedule 1 - Vulnerable	Vulnerable		
Diomedea dabbenena Tristan Albatross	Schedule 1 - Endangered	Endangered Migratory		
Haliaeetus leucogaster White-breasted Sea-Eagle		Migratory	X	X
Macronectes giganteus Southern Giant-Petrel	Schedule 1 - Endangered	Endangered Migratory		
Macronectes halli Northern Giant-Petrel	Schedule 1 - Vulnerable	Vulnerable Migratory		
Pterodroma mollis Soft-plumaged Petrel		Vulnerable		
Puffinus pacificus Wedge-tailed Shearwater		Migratory	X	X
Sterna anaethetus Bridled Tern		Migratory	X	X
Sterna caspia Caspian Tern		Migratory	X	X
Thalassarche carteri Indian Yellow-nosed Albatross	Schedule 1 - Vulnerable	Vulnerable		
Thalassarche cauta Shy Albatross	Schedule 1 - Vulnerable	Migratory		

Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Schedule 1 - Vulnerable			
Turnix varia acintillans Painted Button-quail (Houtman Abrolhos)	Schedule 1 - Vulnerable	Vulnerable		
Phaps elegans Brush Bronzewing (Abrolhos pop.)	CALM Priority 4		X	
Charadrius cucullatus Hooded Plover	CALM Priority 4			
Numenius madagascariensis Eastern Curlew	CALM Priority 4			

A summary of the conservation status of all birds that occur at the Houtman Abrolhos is recorded in Appendix 11.

4.6.2 Other Terrestrial Fauna

4.6.2.1 Background

Several studies have been conducted on the (non-bird) terrestrial fauna of the Abrolhos. Some of the earliest observations were made by Dakin (1919) and Alexander (1922). Storr (1965) conducted a survey of the Wallabi Group in 1964 in order to observe the reptiles, land-birds, mammals and plants of the islands. Abbott and Burbidge (1995) also reported on the mammals of the Abrolhos including a description of the introduced species to the islands.

Searches of the CALM Threatened Fauna database and the EPBC Protected Matters Database were undertaken on 8 March 2005 and 18 January 2005, respectively. These searches identified one species of conservation significance, excluding bird species, which is further discussed in Section 4.6.2.6. The full results of these searches are provided in Appendix 9.

4.6.2.2 Fauna of the Region

Land Mammals

Two species of indigenous land mammals are known to occur in the Abrolhos Islands. The Tammar Wallaby (*Macropus eugenii derbianus*) and the Southern Bush Rat (*Rattus fuscipes*) (Department of Fisheries, 2003). The Tammar Wallaby is known to occur on East and West Wallabi Islands as well as North Island, where it was introduced from the Wallabi Islands (Abbott and Burbidge, 1995). The Southern Bush Rat occurs on East and West Wallabi Islands.

Land Reptiles and Amphibians

The total reptile fauna of the Abrolhos comprises 23 species, 20 of which are known from the Wallabi Group of islands with 19 of these from West and 16 from East Wallabi Islands (How *et al.* 2004). Recent pitfall trapping survey of both East and West Wallabi islands has added a further two species to the list of known reptiles from the Abrolhos (How, 2005). The Abrolhos islands are the type locality of six reptiles, the Abrolhos Dwarf Bearded Dragon

(*Pogona minor minima*), Bynoe's Gecko (*Heteronotia binoei*), the Marbled Gecko (*Christinus marmoratus*), Soft Spiny-tailed Gecko (*Strophurus spinigerus*), Spiny-tailed Skink (*Egernia stokesii stokesii*) and Broad Banded Sand Swimmer (*Eremiascincus richardsonii*).

How *et al.* (2004) suggest that while there have been historical records of the presence of amphibians on the Abrolhos Islands (Alexander, 1922 and Storr, 1983) the lack of recent records indicates that these specimens were either "incorrectly attributed or are now locally extinct".

4.6.2.3 Fauna of Long Island

Personal communication with the Western Australian Museum indicates that there are no amphibians or land mammal species found on Long Island (Dr. R. How, WA Museum, pers. comm.) and this is also confirmed in the literature (Department of Fisheries, 2003) and personal observations by the study team.

One species of reptile is currently recorded in the literature as being found on Long Island (Dr. R. How, WA Museum, pers. comm.). The species is the King Skink (*Egernia kingii*), which is also found on many other islands and on the mainland.

A reptile survey of Long Island was conducted in November 2005 by herpetologist, Dr Ric How of the WA Museum (How, 2005). The report of this study is attached in Appendix 12. In summary, the survey found one species of reptile, the skink *Menetia greyii*. The six individual skinks found on Long Island were observed living under slabs of coral rubble or in vegetation litter (How, 2005). This skink has not previously been observed on Long Island although it has been recorded for North Island and composite islands in the Easter and Southern Groups (How, 2005). The skink is also found on the mainland. Interestingly, no signs were found of the King Skink, which was originally recorded for Long Island in 1970. It is considered very unlikely that the King Skink is still persisting on Long Island (How, 2005).

4.6.2.4 Introduced Species

There are several records of introduced fauna species occurring in the Abrolhos. The Department of Fisheries (2003) reports that cats (*Felis catus*) and rats (*Rattus rattus*) have contributed to the local extinction of Wedge-tailed Shearwaters, Sooty Terns and Common Noddy on Rat Island. The cats and rats are thought to be absent from Rat Island now although one cat may still be remaining.

Black rats were also introduced to Pigeon Island, but are now absent (Abbott and Burbidge, 1995). House mice (*Mus musculus*) are living on Rat Island and North Island and periodically occur on other islands (Abbott and Burbidge, 1995). Rabbits have previously been recorded on Leo Island, Wooded Island, Middle Island and Pelsaert Island but are now not present.

Rabbits are recorded as being present on Long Island (Department of Fisheries, 2003). However, personal observations of the study team indicate this is not the case. The Department of Fisheries has subsequently advised there are no rabbits on Long Island and

that the document is in error (R. Dyson, Regional Manager, Department of Fisheries, pers. comm.).

4.6.2.5 Threatened and Priority Fauna

Terrestrial (non-bird) fauna identified from CALM and *EPBC* database searches (Appendix 9) that may occur within the Abrolhos Islands list one CALM Priority 5 mammal species [Tammar Wallaby (*Macropus eugenii derbianus*)]. The Tammar Wallaby is known to occur on East Wallabi, West Wallabi and North Islands (Abbott and Burbidge, 1995) but does not occur on Long Island.

In addition to the Tammar Wallaby found in the CALM Threatened Fauna database search, three reptile species of particular conservation significance have been recorded from the islands of the Abrolhos (Department of Fisheries, 2003). These are the Carpet Python (*Morelia spilota imbricata*), the Houtman Abrolhos Spiny-tailed skink (*Egernia stokesii stokesii*) and the Abrolhos Dwarf Bearded Dragon (*Pogona minor minima*). These are described in more detail below. None of these have been recorded from Long Island.

The Carpet Python is listed under Schedule 4 (otherwise specially protected fauna) of the *Wildlife Conservation Act 1950* (WA). It is also classified as Lower Risk (near threatened) in the 2000 IUCN Red List of Threatened Species and as Vulnerable in the Action Plan for Australian Reptiles (Cogger *et al*., 1993). The Carpet Python has been recorded from West Wallabi Island and there is evidence that it also occurs, or has historically occurred, on North Island and East Wallabi Island (How *et al*., 2004).

The Carpet Python is generally found in semi-arid coastal and inland habitats, *Banksia* or *Eucalyptus* woodlands and grasslands. This species feeds on a variety of mammals, reptiles and birds and on Garden Island near Perth, has been recorded feeding on geckoes, house mice, and small Tammar Wallabies (CALM, not dated).

The Houtman Abrolhos Spiny-tailed Skink is endemic to the Abrolhos Islands. It is classified as a Priority 4 species by CALM. Priority 4 species are those that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. This species is listed as Vulnerable in the Action Plan for Australian Reptiles (Cogger *et al*., 1993).

The Houtman Abrolhos Spiny-tailed Skink has been recorded from Pigeon Island, Tattler Island and East and West Wallabi Islands within the Wallabi group. It has also been recorded from Middle Island and Murray Island in the Southern Group and Rat Island in the Easter Group (How *et al*., 2004).

The Abrolhos Dwarf Bearded Dragon is endemic to the Abrolhos Islands and is also classified as a Priority 4 species by CALM. It has been recorded by How *et al.* (2004) on North Island and East and West Wallabi Islands.

4.7 MARINE ENVIRONMENT

4.7.1 Physical Marine Environment

4.7.1.1 Background and Regional Context

The Abrolhos Islands are located at a temperate latitude yet are situated within the warm Leeuwin Current and exhibit a unique blend of both temperate and tropical marine species and communities. The Abrolhos Island groups extend over 90 kilometres from north to south. The islands are located on the edge of the continental shelf and rise from a surrounding water depth of approximately 40 to 60 metres.

Strong southerly winds persist in the area over much of the year, driving the local surface water currents. The large swells generated over the winter months, generally arising from the south-west, have influenced the morphology of the islands and the marine habitats which surround them (Webster *et al*., 2002).

Tides at the Abrolhos Islands are very similar to those occurring at the mainland; dominated by a diurnal component (maximum daily tidal range of one metre) but with a semi-diurnal component (maximum daily tidal range 0.4 metre) (Department of Fisheries, 1998a). During storm events, barometric and wind effects can cause significant storm surges, exceeding one metre above the tide level (Port and Harbour Consultants, 1989).

The sea-surface temperatures around the islands are relatively stable, with a mean monthly maximum of 23.7 degrees Celsius in March and a minimum of 20.0 degrees Celsius occurring in September.

4.7.1.2 Long Island Environs

Long Island, on the eastern side of the Wallabi Group, is approximately 88 kilometres north-west of Geraldton. Long Island is approximately linear with a north-south length of 1.65 kilometres and an east-west length ranging from approximately 15 metres to 130 metres. Long Island is located towards the south-eastern side of the Wallabi Group and is located immediately west of Goss Passage. The island has formed towards the northern end of Noon Reef (Plate 5). Long Island is in effect an emergent reef formation and is likely to be approximately 5,000 years old (Collins *et al*., 1993).

Long Island is relatively well sheltered from the direct impact of swell waves by islands and reefs in all directions. The area immediately west of Long Island forms a complex mosaic of shallow reef (Plate 6).

Towards the southern half of the island a pocket of deep water (with a maximum depth of approximately 20 metres) extends to within 100 metres of the western shoreline of Long Island. The eastern shore of Long Island is fringed by a shallow inshore reef approximately 100 metres in width. Beyond this, the reef slopes steeply into Goss Passage which has a depth of approximately 40 metres. Consequently, the eastern shore of the island is generally more exposed to wave energy than the western shore.

The island is composed of unconsolidated coralline rubble that ranges in size from gravel to boulder size (Plates 7 and 8). Small isolated areas of carbonate sands also occur at the shoreline in several locations (Plates 9 and 10).

The coralline rubble and sands overlie areas of weakly consolidated coralline limestone. This limestone is exposed at several locations along the shoreline and in places forms a low coastal cliff (Plate 11). The coralline rubble forms a complex series of low ridges across the island with a maximum height of four metres above mean sea level. These ridges are likely to have formed by marine processes during moderate to strong storm events (Plate 12). It is noteworthy that some modification to the configuration of rubble ridges were observed at some shoreline locations between site visits conducted in January and October 2005. A number of tidal ponds have formed in the swales of these ridges at an elevation of approximately 0.4 to 0.5 metres above mean sea level (Plate 13).

4.7.1.3 Shoreline Change History

A comparison of aerial photography from 1964 and 1987 indicated little net change in the shoreline position of Long Island (M.P. Rogers & Associates, 1997) during the intervening period of the photography. Preliminary calculations of the possible erosion due to severe storms were undertaken by M.P. Rogers & Associates (1997) and indicated that the western side of Long Island could retreat approximately 10 to 15 metres and the eastern side by approximately 20 metres. It was therefore suggested that any buildings be set back from the shoreline a distance of at least 20 metres.

4.7.1.4 Surge Inundation

Storm surge may be defined as a rise in water levels during storm events due primarily to the effects of winds and reduced atmospheric pressure. A coastal vulnerability assessment of Long Island by M. P. Rogers & Associates (1997) notes that during extreme storms, surge levels at the mainland shore near Geraldton may exceed one metre above the astronomical tide level (Port and Harbour Consultants, 1989). They also note that the highest water level recorded at Geraldton was greater than 1.5 metres above mean sea level (MSL) and was recorded in 1970. M. P. Rogers & Associates state that storm surges of similar magnitude are likely to be experienced at the Abrolhos Islands.

An analysis of the long-term water level records from Geraldton Port shows the following recurrence of total water levels (tides and surge) may be experienced at the Abrolhos Islands (M. P. Rogers & Associates, 1997):

- Once every 10 years +1.4 metres above MSL;
- Once every 25 years +1.5 metres above MSL; and
- Once every 50 years + 1.7 metres above MSL.

An assessment of the risk of inundation on Long Island (using design life of 25 years) suggests that the buildings should be located with their finished floor levels at a level of at least 2.5 metres above mean sea level (M. P. Rogers & Associates, 1997).

4.7.1.5 Sea Level Change

The State Planning Policy No. 2.6 (Western Australian Planning Commission, 2003) recommends that planning for future sea level change should be based on the mean of the median model of the Assessment Report of the Intergovernmental Panel on Climate Change

Working Group (Intergovernmental Panel on Climate Change, 2001). This provides a predicted sea level rise of 0.38 m between 2000 and 2100. Due to the relatively low elevation of Long Island, it is likely that an immediate sea level rise of 0.38 m would have a significant impact on the stability and morphology of the Island.

It is noted that coral reefs are living structures and continue to grow and therefore may have the capacity to keep up with a slow sea level rise. However, estimates of coral reef growth rates are complex and vary widely. If the reef growth is able to keep up with sea level rise then natural erosion of the reefs may continue to supply material to maintain the coral islands. It is also noted than changes in future sea level is only one element of future climate changes which will likely also include changes in: sea temperature; storm frequency/intensity; and direction and intensity and direction of prevailing winds and waves. Changes in any of these elements will have a direct impact on the stability and configuration of Long Island. The exact nature of these changes depends on a suite of complex interactions and cannot be readily determined.

4.7.2 Marine Water Quality

A survey of water quality in the marine waters surrounding Long Island and the tidal ponds on the island was conducted in October 2005.

4.7.2.1 Methods

Seawater samples were taken from the surface at six sites surrounding Long Island to provide baseline water quality data (Figure 17). Water samples were also collected from Tidal Ponds 503, 504 and 507 on Long Island (Figure 13). The following samples were collected at each water quality site and tidal pond:

- Two 125mL unfiltered samples in Whirl-pak sterilised bags for total phosphorus (TP) and total nitrogen (TN) analysis;
- Two 10mL filtered (through a 45µm filter on site) samples in PP tubes for ortho-phosphate (Ortho-P), ammonium [as ammonia (NH_3)] and nitrate + nitrite analysis (NO_x); and
- From sites 'Proposed outlet, WQ1 and WQ2', one 2L sample for chlorophyll-a, b and c analysis (to be filtered through a GF/C filter in the laboratory).

All the sample containers were flushed with seawater at each site prior to filling. Immediately after collection all the samples were placed on ice out of direct sunlight.

4.7.2.2 Marine Water Quality Results

The marine water quality results (Table 4.9) indicate that the waters surrounding Long Island are generally typical of well mixed, ocean waters. The nutrient concentrations, with the exception of nitrate and nitrite (NOx), orthophosphate (Ortho P), were within the range expected for clean ocean waters and the chlorophyll results indicate relatively low primary production within surface waters. The slightly elevated nitrate and nitrite and Ortho P concentrations are likely due to the breakdown of macroalgae along the shoreline of Long

island and the surrounding islands. The elevated nutrient (TP, TN, NH_3 and Ortho-P) concentrations at site WQ1, along the shoreline, support this hypothesis.

Marine Science Associates (1998) similarly reported slightly elevated nutrient concentrations adjacent to the shoreline at Rat Island, Easter Group, compared to further offshore, and suggest that this could be due to the entrapment of organic detritus, originating from algal-dominated reef fronts, and its subsequent breakdown. The importance of nutrient inputs to nearshore waters from the numerous nesting birds present on Long Island during this survey is unknown.

The results of water quality sampling around Long Island and comparisons to Rat Island sampling (Marine Science Associates 1998), ANZECC/ARMCANZ (2000) trigger values and to ranges expected for clean ocean waters (Lord and Hillman 1995) are presented in Table 4.9.

Table 4.9: Baseline Marine Water Quality Results

Site	TP	TN	NH_3	NO_x	Ortho -P	Chloro-a	Chloro-b	Chloro-c
	µg/L							
ANZECC/ ARMCANZ (2000) trigger values[A]	20	230	5	5	5	0.7	na	na
Range expected for clean ocean waters*	5.9-12.0	158-308	2.9-36.3	0.8-6.1	1.7-4.9	0.0-0.14[#]	-	-
Range recorded from Rat Island[+]	9-19	13-223	-	2-20	3-6	-	-	-
Proposed outlet	13	170	3	7	6	0.2	<0.1	<0.1
WQ1	29	280	17	9	16	1.3	<0.1	0.2
WQ2	14	160	4	8	7	0.1	<0.1	<0.1
WQ3	13	100	<3	6	6	-	-	-
WQ4	14	180	4	7	7	-	-	-
WQ5	14	190	4	8	6	-	-	-

Notes: *Baseline data show the maximum range between the 10th percentile and 90th percentiles. Results were collected from offshore sites within Northern Metropolitan Waters, during summer and winter, between 1993 and 1994 (Lord and Hillman 1995).

[#] *Data collected in Abrolhos Islands in 1983 by Dr Bruce Hatcher (Helleren and Pearce 2000).*

[+] *Sampling along six transects at Rat Island and Sandy Island (Easter Group) in October 1998 (Marine Science Associates 1998).*

[A] *Values given are default trigger values for slightly disturbed inshore waters in SW Australia.*

4.7.2.3 Tidal Ponds Water Quality

The water from three of the tidal ponds on Long Island was sampled during the October 2005 survey. Tidal Ponds 503 and 504 were selected due to the proximity to the proposed resort. Tidal Pond 507 was sampled as it is another large pond with permanent water and it may be useful for future comparison. The results of water quality sampling are presented in Table 4.10.

The shallow (less than 10 centimetres) water within the tidal ponds was found to be more saline than seawater, with Tidal Pond 504 being the most saline (42.1 PSU). This is within the broad range of surface salinity of pond water recorded by Black and Johnson (1997), which was reported to vary between 34.4 and 37.10 PSU.

The ponds were relatively nutrient rich. Tidal Pond 504 exhibited the greatest TP and TN concentrations. Concentrations of dissolved nutrients were within the range recorded from the marine waters surrounding Long Island. Tidal Ponds 503 and 504 supported a thick carpet of green alga (*Enteromorpha* sp. and *Ulva* sp.).

Table 4.10: Tidal Pond Water Quality Results

Site	TP	TN	NH_3	NO_x	Ortho-P	Salinity
	µg/L					PSU
503	84	580	14	21	64	38.3
504	350	1900	8	4	10	42.1
507	45	370	30	33	20	38.7

4.7.3 Benthic Habitats

4.7.3.1 Background and Regional Context

Hatcher *et al*. (1998) identified six hierarchical units of classification within the Abrolhos Islands ranging from broad reef group ecosystems to more specific ecological units (Webster *et al*., 2002). The areas surrounding Long Island were categorised, in terms of geomorphological units, as complex karst platform (shallow limestone platform with a veneer of sediments, rubble and algae), drowned doline field (limestone platform characterised by high coral cover), storm rubble field (dead coral rubble dominated by algal cover) and exposed reef slope (ancient limestone reef supporting rich, high biomass communities of algae, seagrasses and scattered corals). Drowned doline fields and complex karst platform were identified as being the most sensitive to physical disturbance from lobster pots, jet boats and anchors (Webster *et al*., 2002).

Murdoch University researchers are currently carrying out the mapping of habitats surrounding Long Island, using satellite imagery and spectral classification systems, but no results were available for inclusion within this report or will be available within the timeframe for the assessment process (Dr Halina Kobryn, Murdoch University, October 2005, pers comm.).

4.7.3.2 Long Island Benthic Habitat Survey

Groundtruthing of habitat types surrounding Long Island was undertaken to map benthic habitats from aerial imagery and to provide information required for the environmental impact assessment. Groundtruthing of habitats was undertaken within approximately 200 m of the east and west coasts of Long Island, in water depths up to approximately 10 m (Chart Datum). Further details of the study including habitat types, photos of specific habitat types and notes on particular areas surveyed are provided in Appendix 13, Long Island Benthic Habitat Survey (Oceanica Consulting, 2006). Coverage of mapped habitats surrounding Long Island is presented in Table 4.11.

In summary, the most widespread habitat surrounding Long Island was deep *Acropora* spp. 'stands', found surrounding and at the bottom of the several deep basins on the western side of the island. Shallow *Acropora* spp. reef, found along the east coast extending out from the island to approximately five metres (Chart Datum) were the next most widespread habitat within the area surveyed, followed by sand and coral rubble, found extending offshore from just below mean sea level around much of the island.

Table 4.11: Coverage of Mapped Habitats Surrounding Long Island

Habitat Type	Habitat Class (Webster *et al*., 2002)	Area (ha)	Proportion of mapped habitats (%)
Sand	Static sediments	4.48	7.3
Rhodolith beds	Complex karst platform	0.01	0.0
Sand and coral rubble	Mobile sediment sheets	7.65	12.5
Intertidal reef	Emergent limestone platform	0.57	0.9
Bedrock/dead coral platform	Emergent limestone platform	1.68	2.7
Coral rubble	Storm rubble field	0.68	1.1
Coral rubble with *Sargassum* sp.	Storm rubble field	3.21	5.2
Bedrock/coral rubble with *Acropora* spp.	Complex karst platform	3.51	5.7
Coral rubble & sand with corals/algae	Complex karst platform	5.20	8.5
Branching *Acropora* spp. 'stands'	Drowned doline fields	6.97	11.4
Shallow *Acropora* spp. reef	Drowned doline fields	8.77	14.3
Sub-massive coral communities	Drowned doline field	0.77	1.3
Deep *Acropora* spp. 'stands'	Drowned doline fields	17.87	29.1
Porites sp. bommie	Exposed reef slope	0.01	0.0
TOTAL		**61.3**	**100**

4.7.4 Marine Flora

4.7.4.1 Background

Brearley (1997) studied seagrasses and isopod borers within the Wallabi Group of the Abrolhos Islands whilst Huisman (1997) carried out a review of benthic algae throughout the Abrolhos. Crossland (1981) discussed the algae of the Abrolhos in a study of the growth of corals of the Abrolhos.

4.7.4.2 Regional Context

Ten species of seagrass have been recorded from the Abrolhos. These are mainly temperate species, possibly due to the relatively low winter water temperatures. No extensive seagrass meadows are present in the Abrolhos (Webster *et al*. 2002). However, *Posidonia* spp. are found in sheltered bays and lagoons (e.g. Turtle Bay at East Wallabi Island and bays of West Wallabi Island) and *Amphibolis* spp. occur in some bays (e.g. Turtle Bay). These seagrasses are the most widespread both within the Abrolhos and throughout Western Australia.

Environmental conditions at the Abrolhos, including high nutrient concentrations in comparison to tropical reef systems and moderate water temperatures, are favourable for algal growth. Two hundred and sixty species of macroalgae have been identified in the Abrolhos and 178 of these are red algae species. The algae are predominantly temperate, with some tropical species also present. Algae which dominate protected reefs include

Turbinaria, *Sargassum*, *Eucheuma*, *and Laurencia* whilst *Ecklonia radiata* is common on outer reef slopes in areas of higher water turbulence (Webster *et al*. 2002).

4.7.4.3 Long Island Marine Flora

Abundant macroalgae were recorded within a large proportion of the benthic habitat surveyed during the mapping of Long Island marine habitats (Appendix 13). Habitats surrounding Long Island which exhibited an extensive cover of macroalgae were 'rhodolith beds', 'Bedrock/dead coral platform', 'Coral rubble with *Sargassum* sp.' and 'Coral rubble and sand with live sub-massive corals and brown macroalgae'. The dominant algae in the shallow waters surrounding Long Island were *Sargassum* sp., *Caulocystis* sp. and *Turbinaria* sp., with *Ulva* sp. abundant on some intertidal reef areas.

During the October 2005 survey, the tidal ponds of Long Island were found to contain *Enteromorpha* sp. and *Ulva* sp. drying on the surface of the ponds at low tide. Black and Johnson (1997) also report large patches of the succulent halophyte *Sarcocornia* sp. occurring around the edges of most tidal ponds and patches of another succulent halophyte, *Threlkeldia* sp. were found in Tidal Ponds 505, 506, and 507.

4.7.5 Marine Mammals

4.7.5.1 Background

Various authors have studied marine mammals at the Abrolhos Islands. Gales 1984, Gales *et al.*, 1992 and Campbell 2005 reported on various aspects of the Australian sea lion. Fisheries WA (1998a) and Department of Fisheries (2003) briefly discuss the other marine mammals of the Abrolhos Islands.

Searches of the CALM Threatened Fauna database and the *EPBC* Protected Matters Database were undertaken on 8 March 2005 and 18 January 2005, respectively. These searches identified 15 species of conservation significance which are further discussed in Section 4.7.9. The full results of these searches can be found in Appendix 9.

4.7.5.2 Australian Sea Lions

Australian Sea Lions (*Neophoca cinerea*) are known to inhabit the islands and the Abrolhos represents the northern limit of its range. Current estimates of the numbers of sea lions found in the Abrolhos ranges from 76 to 96 animals, with around 20 pups produced approximately every 18 months (Campbell, 2005). It is thought that the group of sea lions present today is a remnant of a much larger colony (Gales *et al.*, 1992).

Breeding Islands

The most important islands from a conservation perspective are the islands where sea lions are breeding (defined as the islands where pups have been sighted). The highest concentration of breeding islands is found in the Easter Group. The islands known to be used as breeding islands are Serventy Island, Gilbert Island, Alexander Island, Campbell Island, Helm Island, White Island, Stokes Island and Suomi Island in the Easter Group (Campbell, 2005, Gales *et al.* 1992). In the Southern Group, Stick Island and Square Island are recorded as breeding islands (Campbell, 2005). Other islands have been anecdotally reported as being used for breeding, namely: Keru Island, Gibson Island, Morley Island and Wooded Island, all

in the Easter Group, and Gun Island in the Southern Group (Suckling, pers com, cited in Department of Fisheries, 2003). No records have been found of sea lions breeding at Long Island or in the Wallabi Group (Campbell, 2005; Department of Fisheries, 2003).

Haul-Out Sites
A haul-out site is a site that is used for resting during the non-breeding season. Sea lions may use virtually any of the islands in the Abrolhos as haul-out sites (Department of Fisheries, 2003). The Department of Fisheries (2003) notes that islands of particular importance as haul-out sites are Morley Island and Wooded Island in the Easter Group and Coral Patches in the Southern Group. Campbell (2005) cites West and East Wallabi Islands as well as Long, Beacon and Seal Islands as being islands "of significance" (but not breeding islands) to sea lions and seven other islands across the Easter and Southern Groups.

In addition to the islands listed above, sea lions were opportunistically observed to haul-out on Dick Island, Dakin Island, Eastern Island, First Sister Island and Third Sister Island in the Wallabi Group (Dr. C. Surman *pers. obs*.).

Long Island Environs
Sea lions are recorded to use Long Island as a haul-out site. On Long Island, sea lions have been known to use the areas covered in Samphire *Halosarcia* sp. on the northern narrow neck of the island adjacent to Tidal Pond 503. Figure 15 shows the approximate location of the site where sea lions have been observed to haul-out. Sometimes three to four sea lions are present. The sea lions will be disturbed when approached too closely, although behavioural response varies with individuals (Kirsten, 2001). During in the January 2005 site visit, the study team observed an individual sea lion using this area (Plate 13). A path was visible through the coral shingle between the sea and Tidal Pond 503 and it is presumed this was made by the sea lion traversing the area. During the October 2005 site visit, the study team did not observe any sea lions using Long Island as a haul-out site. The coral shingle had reformed into a ridge in the area and no pathway was visible.

4.7.5.3 Other Marine Mammals of the Region

The Humpback Whale (*Megaptera novaeangliae*) can be found in the waters of the Abrolhos during their migration between April and November each year. Bryde's Whale (*Balaenoptera acutorostrata*) and Minke Whale (*Balaenoptera acutorostrata*) are also occasional visitors.

Bottlenose Dolphins (*Tursiops truncatus*) and the Striped Dolphin (*Stenella coeruleoalba*) can also be found in the Abrolhos (Fisheries WA, 1998a, Dr. R. How, Senior Curator, WA Museum, pers. comm.).

In addition to those listed above, the *EPBC* Protected Matters database lists a number of other marine mammals that may occur or whose habitat may occur in the area (Appendix 9). These are namely the Southern Right Whale (*Eubalaena australis*), Blue Whale (*Balaenoptera musculus*), Dugong (*Dugong dugon*), Dusky Dolphin (*Lagenorhynchus obscurus*) and Killer Whale (*Orcinus orca*).

Anecdotal evidence indicates that the New Zealand Fur Seal (*Arctocephalus forsteri*) and Common Dolphin (*Delphinus delphis*) are also visitors to the Abrolhos Islands (Dr. C Surman, pers. comm.).

Of particular conservation value are those marine mammals that are "threatened listed species" or "migratory species" under the *EPBC Act, 1999*. Further baseline information is provided on these species below:

Southern Right Whale (*Eubalaena australis*)

EPBC status - Endangered Listed Cetacean

Regional Status – Listed on Schedule 1- Fauna that is rare or likely to become extinct. Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006.

Population Size – An estimated 600-800 animals use the Australian coastline each year (Bannister *et al*., 1996).

Distribution within Project Site - Extremely rare visitations. Distribution range occurs along southern Australian coastline from Perth to Sydney. This species has been sighted in Shark Bay and North West Cape in recent times leading to possible range extensions, which may result in rare sightings at the Abrolhos Islands (Bannister *et al*., 1996).

Likely Impact of Resort on Habitat – Negligible (D. Holley, Marine Mammal Biologist, pers. comm).

Blue Whale (*Balaenoptera musculus*)

EPBC status - Endangered Listed Cetacean

Regional Status - Listed on Schedule 1- Fauna that is rare or likely to become extinct. Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006.

Population Size – Current southern hemisphere estimates suggest <1000 'True' Blue whales and up to 6000 Pygmy blue whales (Bannister *et al*., 1996).

Distribution within Project Site- Rare visitations. Most common sightings in WA occur off Rottnest Island, Dampier Archipelago and adjacent to the Capes Leeuwin and Naturaliste (Bannister *et al*., 1996).

Likely Impact of Resort on Habitat – Negligible (D. Holley, Marine Mammal Biologist, pers. comm).

Humpback Whale (*Megaptera novaeangliae*)

EPBC status - Vulnerable Listed Cetacean.

Regional Status - Listed on Schedule 1- Fauna that is rare or likely to become extinct. Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006.

Population Size – West Coast Humpbacks constitute Group IV population estimated at 3000-4000 animals (Bannister *et al*., 1996).

Distribution within Project Site – Migrating animals are likely to pass through the Abrolhos Islands including adjacent to Long Island during June – November each year (Bannister *et al*., 1996).

Likely Impact of Resort on Habitat – Minimal, although Humpbacks are susceptible to direct disturbance to migration patterns from vessels operating whale watching tours, other pleasure craft, swimmers and divers ((Bannister *et al*., 1996). All interactions with any cetacean species emanating from the resort or during travelling periods to or from will follow the guidelines set out in 'Australian National Guidelines for Whale and Dolphin Watching 2005' (http://www.deh.gov.au/coasts/publications/conservation-smaller-whales-dolphins.html)

Bryde's Whale (*Balaenoptera acutorostrata*)

EPBC status - Migratory Listed Cetacean.

Regional Status – Not listed in the WA protected species legislation.

Population Size – Bannister *et al.* (1996) report little information is available on population numbers although some small levels of catches occurred in the commercial whaling years. This was thought to have minimal impact on populations. Confusion exists around the nomenclature of Bryde's whale. A smaller form and a larger more oceanic form may constitute different species or subspecies and this point further contributes to the lack of certainty on population size (IUCN website 2006, http://www.iucnredlist.org/search/details.php/2476/summ).

Distribution within Project Site – This species is less migratory than other baleen whales and is found within the tropical and temperate waters between approximately 40° south and north. The species has been recorded from several coastal Australian localities, e.g. the Abrolhos Islands and north of Shark Bay, WA, and off Queensland. Likely to be found along either east or west coast of Australia rather than southern coast (Bannister *et al.,* 1996).

Likely Impact of Resort on Habitat – The threats to the species include pollution, overfishing depleting food sources and entanglement in fishing gear (Bannister *et al.,* 1996). These threats have been addressed elsewhere in this PER. The likely impact of the resort on the habitat of the Bryde's whale is considered negligible.

Killer Whale (*Orcinus orca*)

EPBC status - Migratory Listed Cetacean.

Regional Status - Not listed in the WA protected species legislation.

Population Size – No population estimates for continental Australian waters are available (Bannister *et al.,* 1996). In Antarctic south of 60°S, a preliminary population estimate of at least 70 000 has been recorded. Reported concentrations of animals occur off Macquarie Island, where it is believed some animals return each year (Ross, 2006).

Distribution within Project Site – Killer whales are a cosmopolitan species and have been recorded for all states of Australia. No specific information is available on sightings in the Abrolhos. The preferred habitat of the species includes oceanic, pelagic and neritic regions in warm and cold waters although it is thought that the species may be more common in cold, deeper waters. In Australian waters killer whales are often sighted along the continental slope and on the shelf (Ross, 2006).

Likely Impact of Resort on Habitat – Major threats to killer whales include illegal killing by fishermen, entanglement in fishing nets, or a reduction in food sources through overfishing (Bannister *et al*. 1996). Since none of these threats will eventuate from the proposed resort, the likely impact of the resort on killer whale habitat will be negligible.

Dusky Dolphin (*Lagenorhynchus obscurus*)

EPBC status - Migratory Listed Marine Species

Regional Status - Not listed in the WA protected species legislation.

Population Size – Numbers of the species are not known for Australian waters. The species rarely occurs in Australia and is known in Australian waters from 13 sightings only (Ross, 2006). It is considered abundant within its range in New Zealand (Bannister *et al*. 1996).

Distribution within Project Site – Occurs only in the southern hemisphere, mostly in temperate and subantarctic zones, but with extensions well north of this in association with cold currents. The species is not known to be migratory, although there may be small seasonal movements (Bannister *et al*. 1996). Resident inshore for much of year but may also be pelagic. May seek out colder water (<18°C) as inshore temperatures rise in summer.

Likely Impact of Resort on Habitat – Potential threats to the Dusky Dolphin include entanglement in drift nets and pollution (Bannister *et al*. 1996). The impact of the resort development on the habitat of the Dusky Dolphin is considered negligible.

Dugong (*Dugong dugon*)

EPBC status - Migratory Listed Marine Species

Regional Status - Listed on Schedule 4 – Other specially protected fauna. Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006.

Population Size –Nearest population centre is Shark Bay, which during last aerial survey in 2002 returned a population estimate of 11,021 animals (Holley *et al* 2006).

Distribution within Project Site – Unlikely to occur. Dugongs are generally located in inshore regions, however are capable of extended journeys and have been sighted off Dongara and Ashmore Reef. There are no known sightings from the Abrolhos (D. Holley, Marine Mammal Biologist, pers. comm).

Likely Impact of Resort on Habitat – Given that the habitat generally does not occur around Long Island, impact considered negligible (D. Holley, Marine Mammal Biologist, pers. comm).

4.7.6 Tidal Pond Invertebrates

Eleven species of molluscs have been found in the seven tidal ponds of Long Island, consisting of eight gastropods, one bivalve and one to two species of chitons (identification was inconclusive). The number of species per pond ranged from three species in Tidal Pond 502 to seven species in Tidal Pond 504 (Black and Johnson, 1997). No unique species have been found in the ponds (Dr. F. Wells, Department of Fisheries, pers. comm.).

Following studies of the tidal pond biota, it was found that two of the snail species in the ponds *Bembicium vittata* and *Austrocochlea constricta* usually occur in temperate environments such as the south coast of Western Australia or the coasts around Perth. *Bembicium vittata* and *A. constricta* are extremely abundant within suitable habitats such as sheltered lagoons throughout the Abrolhos Islands and can reach densities of up to 100 per square metre (Black and Johnson, 1997). Despite being prevalent on the sheltered shores of the Abrolhos Islands, these molluscs are not found on the coasts in between the Abrolhos and Perth and therefore the Abrolhos represents the extreme northern limit of their range. In addition, the molluscs are showing signs of genetic divergence, with the molluscs in the ponds found to be significantly larger than the individuals found in nearby shore habitats. This is thought to be caused by partial genetic isolation from the shore populations of the same species (Johnson and Black, 1997).

Tidal Pond 504 is of particular relevance to the tourism development as it is within the area of proposed tourism development on Long Island (Plate 3). Amongst other molluscs, one mollusc (*Onchidium sp*.) was found in Tidal Pond 504 that was not recorded for any of the other ponds. This mollusc is not considered to be unique and would also be found in other ponds of the Abrolhos and on the mainland coast (Dr. F. Wells, Department of Fisheries, pers. comm.).

4.7.7 Marine Reptiles

4.7.7.1 Background and Regional Context

No specific literature has been found on marine reptiles occurring at the Abrolhos Islands. However, Webster *et al*. (2002) report it is likely that sea turtles use the waters surrounding Long Island from time to time. The marine Green Turtle *Chelonia mydas* is known from the waters of the Abrolhos (How *et al*., 2004). The Loggerhead Turtle (*Caretta caretta*) is also reported to be found in low numbers (Webster *et al*., 2002) and the Leatherback Turtle (*Dermochelys coriacea*) is also recorded on the EPBC Protected Matters database as potentially occurring in the area (Appendix 9). None of these species is known to breed at the islands on account of being at the southern extent of their range.

Two sea snakes, namely the Spectacled Seasnake (*Disteira kingii*) and Yellow-bellied Seasnake (*Pelamis platurus*) are recorded by the EPBC Protected Matters database as species that may occur or whose habitat may occur in the area. Fisheries WA (1998a) reports that sea snakes are not resident at the Abrolhos Islands, but during strong winter storms they may be transported south to the Abrolhos from Shark Bay and further north.

Searches of the CALM Threatened Fauna database and the EPBC Protected Matters Database were undertaken on 8 March 2005 and 18 January 2005, respectively. These searches

identified three species of conservation significance, which are discussed in Section 4.7.9. The full results of these searches can be found in Appendix 9.

4.7.7.2 Long Island Environs

No specific records have been found of marine reptiles using Long Island and it is thought that sea turtles do not breed in the islands of the Abrolhos.

Of particular conservation value is the Leatherback Turtle, which is listed under the *EPBC Act, 1999* as a vulnerable species. Further baseline information is provided on this species below.

Leatherback Turtle (*Dermochelys coriacea*)

EPBC status – Vulnerable and Migratory Species.

Regional Status – Listed on Schedule 1- Fauna that is rare or likely to become extinct. Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006.

Population Size – The IUCN Red List of Threatened Species website reports that the most recent worldwide population estimate (1996) of Leatherbacks was 20,000 to 30,000 female turtles (IUCN website, 2006; www.iucnredlist.org/search/details.php?species=6494&tab=all). Data from the coast of South Africa indicates that in the Indian Ocean, populations are increasing but cannot be considered to be a large population with around 100 nests per season in 56km of coastline in South Africa. No information is available on the numbers of Leatherbacks in Western Australian waters.

Distribution within Project Site – Leatherback Turtles are found in oceans worldwide. They are found in all Australian waters although mostly in temperate and tropical waters from Perth to the northern Victorian coastline. No major breeding occurs in Australia and Breeding in Western Australia is not known to occur (DEH Species Profile and Threats database - DEH website 2006). Leatherback turtles spend most time in the open ocean or passing through the waters of the continental shelf (Environment Australia, 2003). No specific records are available for Leatherback Turtles in the Abrolhos.

Likely Impact of Resort on Habitat – As Leatherback Turtles are not nesting in Western Australia and are mostly found in the open ocean, the impact on their habitat is considered negligible.

4.7.8 Fish

4.7.8.1 Fish of the Region

Hutchins (1997) reports that whilst two unpublished lists have been prepared previously, only one other published list exists of the fish species at the Abrolhos (Hutchins, 1994). The species composition was found to comprise 389 species, with 257 (66 percent) of these being tropical species, 74 (19 percent) of species being warm temperate species and 50 (13 percent) being subtropical species. Another two percent of species were of uncertain origin. Over 70 percent of the tropical species found were in very low abundance, and were likely to be not maintaining breeding populations. This was considered unusual by the author, who speculated that this phenomenon may be due to the largely non-diverse coral habitats, which

are dominated by branching *Acropora* spp., and thus limits the abundance of fish species requiring other coral types. It was suggested that some species may rely on the Leeuwin current to supply recruits to the population and some other species may be seasonal visitors to the islands.

The Abrolhos is home to populations of large coral inhabiting species such as the Baldchin Groper (*Choerodon rubescens*) and Coral Trout (*Plectropomus leopardus*) (the only area of high abundance of Coral Trout on the west coast of WA). The temperate species such as Pink Snapper and Westralian Dhufish occur on deep water limestone reefs and in the shallower coral areas (Fisheries WA, 1998a).

4.7.8.2 Fish of Long Island

No studies specific to the fish fauna of Long Island have been found. However, Nardi et al. (2004) conducted a study to monitor the changes in the Baldchin Groper and Coral Trout populations within the ROAs (including the Beacon Island ROA) and adjacent control sites. Results indicate that the ROAs appear to have not had any effect in increasing the abundance of localised populations of Baldchin Grouper. However, the ROAs have been effective in leading to increased abundance of Coral Trout in all size classes after six years of the operation of the ROAs.

Of particular conservation value are those fish that are "threatened species" or "migratory species" under the *EPBC Act, 1999*. Further baseline information is provided on these species below:

Great White Shark (*Carcharodon carcharias*)

EPBC status – Vulnerable and Migratory Species.

Regional Status – Listed on Schedule 1- Fauna that is rare or likely to become extinct. *Wildlife Conservation Act 1950* Specially Protected Fauna Notice 2006. Also protected under the *Fish Resources Management Act, 1994*.

Population Size – The IUCN Red List of Threatened Species website reports that data on population size of Great White Sharks worldwide is not available. The DEH website (2006) states that the population of Great White Sharks in Australia is estimated to number fewer than 10,000 mature individuals, and is thought to have undergone a continuing decline of at least 10% over the past three generations (http://www.deh.gov.au/coasts/species/sharks/greatwhite/cites-and-cms/index.html). No specific studies have been conducted on Great White Shark numbers in the Abrolhos Islands (J. Chidlow, Shark Research Scientist, WA Department of Fisheries, pers. comm.).

Distribution within Project Site – Great White Sharks are widely distributed in temperate and sub-tropical oceans worldwide and have been known to travel large distances. In Australian waters they are most commonly found off the southern coasts although they may be found from Moreton Bay in southern Queensland to North West Cape in Western Australia (Environment Australia, 2002a). Within its range, the Great White Shark is often reported close inshore to the surfline and even penetrates shallow bays in continental coastal waters. Along the continental shelf, Great White Sharks generally occur near the surface or at the bottom rather than mid water depths. No specific studies have been conducted on Great

White Shark distribution in the Abrolhos Islands (J. Chidlow, Shark Research Scientist, WA Department of Fisheries, pers. comm.).

Likely Impact of Resort on Habitat –Given the low-impact nature of the resort, the impact on habitat is considered negligible.

Grey Nurse Shark – west coast subpopulation (*Carcharias taurus*)

EPBC status – Vulnerable Species.

Regional Status – Listed on Schedule 1- Fauna that is rare or likely to become extinct. *Wildlife Conservation Act 1950* Specially Protected Fauna Notice 2006. Also protected under the *Fish Resources Management Act, 1994*.

Population Size – The IUCN Red List of Threatened Species website reports that data on the population size of the Grey Nurse Shark west coast population is not available, although populations are thought to be more stable than the east coast population. Commercial fishing ceased for the species in 1997, which has given a degree of protection to the species but has also lead to less data being available to indicate population trends.

Distribution within Project Site – The west coast population appears to be widely distributed along the west coast of Australia between Augusta and Exmouth (Chidlow *et al.*, 2005), although the species is found all the way around Australia. It is rare in the Northern Territory and the southern extent of its range. In general, the shark can be observed from the surf zone and shallow bays to approximately 200 m depth on the outer continental shelf (IUCN Red List of Threatened Species website, 2006). Grey Nurse Sharks are often observed just above the sea bed in or near deep sandy-bottomed gutters or rocky caves in the vicinity of inshore rocky reefs and islands (Environment Australia, 2002b). No data is available on the distribution of the species within the Abrolhos, although reports have been made of the species occurring in the Abrolhos (J. Chidlow, Shark Research Scientist, WA Department of Fisheries, pers. comm.). No aggregation sites have been observed for the species in the Abrolhos or Western Australia (Chidlow *et al*., 2005).

Likely Impact of Resort on Habitat – Given the low-impact nature of the resort, the impact is considered negligible.

Whale Shark (*Rhincodon typus*)

EPBC status – Vulnerable and Migratory Species.

Regional Status – Whale sharks are fully protected under the *Wildlife Conservation Act 1950* and the *Fish Resources Management Act 1994.*

Population Size – The IUCN Red List of Threatened Species website did not list population estimates for the species, although populations are noted as declining. Current information on whale sharks is inadequate to enable an estimate of abundance to be made for this species (Pogonoski *et al.,* 2002).

Distribution within Project Site – Whale sharks have a broad distribution in tropical and warm temperate seas, usually between latitudes 30°N and 35°S. They are known to inhabit

both deep and shallow coastal waters. This species is most common at Ningaloo Marine Park in WA (and to a lesser extent at Christmas Island), although rare sightings have been confirmed further south than Kalbarri. Whale sharks are highly migratory (DEH website, 2006; www.deh.gov.au/coasts/species/sharks/whaleshark/index.html#status). No data exists on whale shark numbers in the Abrolhos, although the sharks would usually be restricted to more northern areas such as the Ningaloo Marine Park (J. Chidlow, Shark Research Scientist, WA Department of Fisheries, pers. comm.).

Likely Impact of Resort on Habitat – Whale sharks are infrequent visitors to the Abrolhos. Given the low-impact nature of the resort, the impact on whale shark habitat is considered negligible.

4.7.9 Threatened and Significant Marine Fauna

The CALM Threatened Fauna database search did not identify any threatened marine species within the search area. However Australian Sea Lions (*Neophoca cinerea*) are listed under Schedule 4 (other specially protected fauna) of the *Wildlife Conservation Act 1950*. The Australian Sea Lion is one of the world's rarest pinnipeds (Gales *et al*., 1994) and is discussed in Section 4.7.5.2.

The *EPBC* search (Appendix 9) identified a number of threatened and migratory listed marine species that may occur in the area.

5. EXISTING SOCIAL ENVIRONMENT

5.1 COMMERCIAL FISHING AND AQUACULTURE

Three commercial fisheries operate in the Abrolhos (Webster *et al*., 2002) and comprise:

- Western rock lobster (*Panulirus cyngus*).
- Mid-west Trawl Fishery - Southern saucer scallop (*Amusium balloti*) and western king prawns (*Penaeus latisulcatus*).
- Wetline Fishery - Finfish (various species).

Commercial aquaculture activities are conducted in the Abrolhos, predominately for the culture of black pearls.

5.1.1 Western Rock Lobster Fishery

The western rock lobster (WRL) fishery in WA is Australia's most valuable single species fishery being worth over AUD300 million annually. For management purposes this fishery is divided into three localities, the north coastal, south coastal and Abrolhos Islands. Catches in the Abrolhos Islands (~1,700 tonnes per year) account for over 20% of the State's commercial WRL catch. At the Abrolhos Islands the commercial WRL fishing season runs from 15 March to 30 June each year, during which time ~1.2 million pot lifts occur (Rossback *et al*., 2005).

Webster *et al*. (2002) report that around 52% of pot lifts (~568,000 lifts) occur in relatively shallow waters (0 to -20 metres), and that the highest average number of pot lifts occurs in the Wallabi/North Island area (273,000 pot lifts) compared to the Easter Group (196,600) and the Southern Group (98,300). The months of the highest fishing effort are March, April and May, with fishing effort declining in June. No data is available on specific rock lobster fishing around Long Island.

All types of reef habitats are fished with a relatively low intensity of less than 15 pots per hectare during the lobster fishing season (Webster *et al*., 2002). Of fishing that occurs in the shallows of each group, submerged platforms and exposed reefs comprised 45 to 65 percent of the fishing effort. These habitats tended to occur in the western and central parts of the island groups and these habitats are largely resistant to pot damage due to a lesser abundance of corals and higher abundance of limestone reef and stands of macroalgae. In the Wallabi/North Island Group and Easter Group, only 2.4 to 5.4 percent of shallow water pot lifts were conducted in habitats that were deemed to be sensitive. This figure rose to 23.8% in the Southern Group.

5.1.2 Mid-west Trawl Fishery

The Mid-west Trawl Fishery operates in the Abrolhos Islands. The fishery is based mainly on the southern saucer scallop, with a small component targeting the western king prawn. The fishery operates under an input control system and boat numbers are restricted. Trawl gear size as well as seasonal closures are in place. Significant spatial closures protect all

near-shore waters. Currently there are 16 vessels that operate in the fishery (N. Sarginson, Fisheries Management Officer, Department of Fisheries, pers. comm.).

The recruitment of scallops is known to be highly variable in numbers and in location. The areas to be fished are determined each year in a pre-season research survey. The scallop fishing season normally runs for three months, between the months of April and July. The season opening and closing dates vary each year depending on the results of the pre-season surveys. It is noted that most fishers only fish for the first few weeks of the season due to declining catch rates thereafter. Fishing usually occurs in waters greater than 30 metres in depth and to the east of the Islands Groups or between groups (Webster *et al*., 2002, N. Sarginson, Fisheries Management Officer, Department of Fisheries, pers. comm.).

Information received from the Department of Fisheries Research Division confirmed that most scallop trawling activity for the years 1999 to 2003 and 2005 was concentrated to the east of the island groups. The closest trawl activity to Long Island was recorded for the area north of the Beacon Island Reef Observation Area (ROA), at least one nautical mile from the northern tip of Long Island. Trawl areas were also recorded to the east of the Beacon Island ROA, approximately three nautical miles from Long Island (E. Sporer, Senior Technical Officer, Department of Fisheries Research Division, pers. comm.).

5.1.3 Wetline Fishery

Wetline commercial fishing for various finfish species in the Abrolhos is highly variable with the fleet usually comprising of around 30 boats, based on averages between 1996 and 2001 (Webster *et al*., 2002). Species that are targeted included pink snapper (*Pagrus auratus*), baldchin groper (*Choerodon rubescens*), Westralian dhufish (*Glaucosoma hebraicum*), and coral trout (*Plectropomus leopardus*) (Fisheries WA, 2000). Most vessels tended to fish for several weeks per year, although the number of days fished was reported to range from one to 195 days (Webster *et al*., 2002). Only three to five boats reported regularly fishing within the Fish Habitat Protection Area, with most vessels fishing away from the islands in deeper water.

For the purposes of reporting fish catch, the wetline fishery at the Abrolhos is divided into five areas or "blocks". In the 2004/2005 financial year, the block that contains the Wallabi Group of islands was fished by 30 boats. The total catch reported in that year for the same block was 86,126 kilograms of scalefish. The total catch for all of the blocks in the Abrolhos Islands for the year 2004/2005 was 329,438 kilograms of fish (K. Saville, Senior Fisheries Management Officer, Department of Fisheries, pers. comm.).

5.1.4 Aquaculture

Currently there are nine licensed aquaculture sites in the Abrolhos Islands. Eight of these licences permit the culture of black pearls (*Pinctada margaritifera*) and other pearl shell species other than *Pinctada maxima* (B. Sheridan, Department of Fisheries, pers. comm.). These licensed areas are mostly over areas of a sandy bottom although some of the area covers areas of coral (Webster *et al*. 2002). One site in the Southern Group is licensed for the grow-out of yellowfin tuna, although at the time of writing this site was not being utilised (B. Sheridan, Department of Fisheries, pers. comm.).

In the Wallabi Group, two aquaculture sites are licensed. One site is located immediately to the north of West Wallabi Island and the other consists of two small separate sites immediately to the east of West Wallabi Island. These sites are at least three nautical miles from Long Island. Two aquaculture sites are licensed for the Easter Group, located to the east and west of Rat Island. The majority of aquaculture activity takes place in the Southern Group (Webster *et al*. 2002). Four sites are licensed for the production of black pearls whilst one site, as mentioned above is licensed for the production of yellowfin tuna (B. Sheridan, Department of Fisheries, pers. comm.).

Fisheries Management Paper No. 137 addresses the management of aquaculture in the Abrolhos (Fisheries WA, 2000). This management paper outlines areas that would not be suitable for aquaculture licences. All waters that are within two kilometres of Long Island fall into the categories of "sites which cannot be used for aquaculture" or "sites where approval of aquaculture is unlikely". The reasons for this are the presence of the *Batavia* shipwreck, the Reef Observation Area, the frequently used vessel routes around the island and the high usage of the area for commercial fishing (which applies to most of the Wallabi Group).

5.2 TOURISM AND RECREATIONAL ACTIVITIES

5.2.1 Number of Tourists and Visitors

Visitors to the Abrolhos come from diverse backgrounds and groups and may include fishing/diving/wildlife enthusiasts, school/educational groups, church groups, and visitors sailing on board the tall ship *Leeuwin*.

Little research has been conducted to date on numbers of people at the Abrolhos Islands. Information on visitors and tourists is not easy to access and relies on the results of charter operator surveys. Emily Stoddart (2005c) reported on visitor numbers using the results of an aerial tour operator survey conducted by the University of WA, aquatic tour operator survey results and off-season notification records held by the Department of Fisheries. . It was noted that the number of visitors that were recorded as visiting relatives and friends of rock lobster fishers far outweighed the visitors that were purely tourists. The overall trends of the surveys show that visitors and tourists to the Abrolhos are increasing in all categories. Table 5.1 below presents the recorded visitor numbers and trends for the years 2003 to 2005 (Stoddart, 2005a and c).

Table 5.1: Visitor Numbers to the Abrolhos Islands 2003-2005

Visitor Transport	2003-2004	2004-2005	Percent Increase
Fishers and friends/relatives of fishers by Air Charter	1,880	2,189	16%
Tourists by Air Charter	561	707	26%
Charter Boat Tourists	2,066	n/a	n/a
Recreational Boat Visitors	817	952	17%
Total	5,324	n/a	n/a

Sources: Stoddart, 2005a and c

For the "Air Charter" categories above, the passengers were all flown to the islands with airstrips, namely East Wallabi Island and to a much lesser extent, Rat Island and North Island. All of the tours contained a "scenic flight" component and this is currently unregulated with respect to minimum distance from bird colonies (Stoddart, 2005c).

Most visits to the Abrolhos Islands occur during the rock lobster fishing season of 15 March to 30 June each year ("in season"). This is due to the presence of the fishers and their visitors and also the calmer weather experienced at that time, making recreational boating a more favourable proposition. Around two-thirds of all visits to the Abrolhos occur in season, with the other one third of visits being conducted throughout the rest of the year (Stoddart, 2005a).

Easter is traditionally a particularly busy time for tourists and visitors to the Abrolhos as the public holidays coincide with the rock lobster season and the weather being relatively calm. Webster *et al*. (2002) noted that the overall numbers of people visiting the Abrolhos tended to be low, but in the busy Easter period, the numbers were estimated to be as high as 4000, consisting of fishers as well as their families and friends. Given that Easter is the busiest time at the Abrolhos and given the estimated total number of visitors for the year 2004 in Table 5.1 above, this figure seems entirely plausible.

The number of recreational boats visiting the Abrolhos at Easter is thought to be on the increase, with 61 boats counted by aerial survey on Easter Sunday in 2005 (Stoddart, 2005b).

Published information on the origin of the visitors to the Abrolhos was not found. However, information was supplied by Wendy Mann, of Geraldton Air Charters Pty Ltd. Geraldton Air Charters operates tours and charters including air tours to the Abrolhos Islands. Table 5.2 presents the breakdown of visitor origin for 2005 on Wendy Mann's tours (Wendy Mann, Air Tour Operator, pers. comm.).

Table 5.2: Origin of Visitor on Air Tours to the Abrolhos Islands, 2005

Origin of Visitor	Number of Visitors in 2005
Other States of Australia (not WA)	66
Perth	48
United Kingdom	47
Local (Geraldton area)	34
The Netherlands	17
WA regional (not Perth)	12
Germany	9
France	5
Italy	5
Poland	4
New Zealand	3
Canada	2
USA	2
Finland	2

Origin of Visitor	Number of Visitors in 2005
Sweden	2
Switzerland	2
Belgium	1
Latvia	1

Source: Wendy Mann, Air Tour Operator, pers. comm.

Whilst the largest visitor groups were from Australia, it is interesting to note that a large proportion of the visitors come from Europe or the United Kingdom, with the Dutch being well represented. This interest may be due to the importance of the area's history with respect to the Dutch shipwreck *Batavia*.

5.2.2 Recreational Activities

Webster *et al*. (2002) reported on the recreational activities of the Abrolhos through interviews conducted, primarily with charter boat operators. At the time of the survey, there were around 15 charter boat operators. It is noted that the numbers of private vessels visiting the islands was not quantified. The most popular activity conducted by charter boat operators was reported to be SCUBA diving. Diving tended to be centred in the eastern part of the island groups as the sea conditions tended to calmer, which also lead to more interesting corals such as tabulate and branching forms. The Reef Observation Areas are very popular areas for recreational usage.

The most popular activities conducted by visiting family and friends of lobster fishers were fishing, diving and visiting other islands. These activities were mostly conducted by dinghy or sometimes by lobster fishing vessel (Webster *et al*., 2002).

Stoddart (2005b) reports that fishing is the most popular recreational activity in the Abrolhos, with 84 percent of all recreational vessels visiting the Abrolhos in the off-season of 2004/2005 reporting "fishing" as their purpose of visit.

Of the private vessel owners, the most popular activities were the same as the above although private vessel owners may use small dinghies (in the case of yacht owners) or they may tour around the islands in power boats, tending to return to the same mooring each night (Webster *et al*., 2002). The most popular points for recreation tended to be areas with a safe anchorage throughout the island groups. In the Wallabi Group, the most popular points for recreation were Turtle Bay (East Wallabi Island), Fish Point (a dive site near Turtle Bay), Long Island, Beacon Island and the *Batavia* wreck site.

The activities being undertaken by tourists on boat charters to the Abrolhos for 2002 and 2003 are reported below in Table 5.3 (Stoddart, 2005c).

Table 5.3: Breakdown of Activities Conducted from Boat Charters 2002-2003

Activity	No. of Participants 2002	No. of Participants 2003	Percent Change
Fishing	2,538	4,254	68% ↑
Diving	1,119	1,140	2% ↑
Snorkelling	923	842	9% ↓
Wildlife observation	306	518	70% ↑
Sightseeing	249	419	68% ↑

Source: Stoddart, 2005c

The increase in participation in recreational activities correlates with an outright increase in charter boat operations (Stoddart, 2005c). As most charter operators are reporting almost 100 percent booking rates on available trips, future increases in charter boat activity is likely to be the result of additional operators entering the market. Sightseeing activities typically included land visits to Beacon Island, West Wallabi Island (the Wiebbe Hayes Trail), Turtle Bay and the Guano Jetty at Pelsaert Island.

5.2.3 Aquatic Tour Operators

The number of operators offering aquatic tours has increased around the Abrolhos Islands Fish Habitat Protection Area in recent years. Table 5.4 shows the increase in various tours operated between the years 2002/2003 (Stoddart, 2005c).

Table 5.4: Numbers of Aquatic Tour Operators by Activity 2002-2003

Number of Tour Operators by Tour Type	2002	2003	Percent Increase
Fishing	19	24	26%
Diving	7	14	100%
Snorkelling	12	14	17%
Wildlife observation	5	8	60%
Sightseeing	5	9	80%

Source: E. Stoddart, unpublished report, 2005c

In addition to an increase in the number of boats visiting the Abrolhos, there is also a trend for boats visiting the Fish Habitat Protection Area to stay for longer. Results from the Department of Fisheries Off-Season Notification records, 2002 to 2005 indicate an increase in the average length of stay for each recreational or charter vessel from 4.7 days per vessel in 2002/2003 to 6.3 days in 2004/2005. This increase in the length of stay is thought to reflect the increasing fuel storage capacity of the boats visiting the area and the improved navigational aids and GPS that are now widely used (Stoddart, 2005b).

5.3 SCIENTIFIC RESEARCH

Every year various fisheries and environmental research programs are conducted at the Abrolhos. Research is conducted by the Department of Fisheries, CALM, tertiary institutions, the Western Australian Museum and other State agencies (Fisheries WA, 1998). The Abrolhos Islands are of interest to marine scientists due to the diversity of species and the presence of both tropical and temperate species.

The islands have been the subject of scientific research for many years, with international scientists and researchers visiting the Abrolhos to undertake projects in a range of areas, including:

- Fisheries research;
- Maritime archaeology and maritime history;
- Geological history;
- Oceanography (Leeuwin Current);
- Ecosystem processes;
- Taxonomy and systematics; and
- Birds (Department of Fisheries, 2006, website: www.fish.wa.gov.au).

Saville-Kent is thought to have led the first investigations to the islands in 1897 and compared the marine biota of the Abrolhos Islands with the mainland coastline near Geraldton. These investigations found sea surface temperatures in the Abrolhos Islands to be about two degrees Celsius warmer than at Geraldton, and this led to speculation of the existence of the southward current that is now known as the Leeuwin Current (Fisheries WA, 1998a). The Leeuwin Current has been the subject of much research but was not formally described until 1980.

W.J. Dakin led expeditions to the Abrolhos Islands in 1913 and 1915 and collected a wide range of information on the marine biota of the Abrolhos Islands. Other researchers on the marine environment since the 1950s have included the Fisheries Department, CSIRO, the Western Australian Museum, and universities.

A marine biological workshop was held in 1994 by the Western Australian branch of the Australian Marine Sciences Association. Scientists attended from WA, the other States and several other countries. The results of the workshop were published (Wells 1997) and these workshop proceedings contain a brief history of marine research in the Abrolhos Islands. CALM has conducted an occasional census of seabird populations since 1981. Similarly, a long-term study into the community ecology of seabirds on Pelsaert Island, initiated by Dr Surman in 1991 (formerly Murdoch University), continues to this day.

Research at the Abrolhos is supported by the Department of Fisheries. In 1998 it was stated that an AIMAC research sub-committee would be established to determine research priorities, recommend particular programs, encourage funding applications to other bodies, and support research efforts as fully as possible (Fisheries WA, 1998a).

In mid-2003 the Department of Fisheries opened its new research facility, the Saville-Kent Centre at Rat Island in the Easter Group (Department of Fisheries, 2006, website:

www.fish.wa.gov.au). The Centre consists of accommodation of 10 units, ablutions block, kitchen, administration centre, laboratory and deep-water jetty. This Centre is available to scientists wishing to study the Abrolhos environment.

5.4 VISUAL AMENITY

Several of the islands have been 'settled' by rock lobster fishermen who, during the rock lobster fishing season, live in houses they have constructed on these islands. The inhabited islands have camps comprising multicoloured shacks and transportables. These structures are generally of a low profile with occasional two storey structures. Aerials and antennas dominate these structures. Jetties are numerous and radiate from the islands with boats moored during rock lobster season.

Long Island, which is uninhabited, is generally flat, being about two to three metres above mean sea level. A small central portion of the island rises to just over four metres above mean sea level.

5.5 ABORIGINAL HERITAGE AND CULTURE

5.5.1 Aboriginal Heritages Sites

A search of the Register of Aboriginal Sites maintained by the Western Australian Department of Indigenous Affairs was undertaken on 1 September 2005. The search area encompassed Long Island and was bounded by latitude 28.4642 degrees south - 28.4798 degrees south and longitude 113.7708 degrees east - 113.7764 degrees east. The search returned no results from the Register.

A search of the available literature on the Abrolhos Islands [including Fisheries WA (1998a), Department of Fisheries (2003), Gray (1993), Harvey *et al.* (2001) and Wells (1997)] did not indicate that there were any indigenous heritage and cultural issues. In fact Gray (1993) states "no evidence has been found to indicate aboriginal fishing activities". Following consultation with the Department of Indigenous Affairs it was recommended that HLD consult with Yamatji Land and Sea Council. Consultation with the Yamatji Land and Sea Council on 7 February 2006 indicated that the Abrolhos Islands were not part of the Yamatji Native Title Claim and that Yamatji would have no concerns of a cultural nature with the proposed development.

Legal representatives from Yamatji Marlpa Land and Sea Council advised that formal advice would need to be sought from four coastal native title claimants in the Geraldton region (Hutt River WC00/1, Naaguja WC97/73, Amangu WC04/2 and Nanda) at the next round of official meetings. Two of these meetings (Amangu and Naaguja) have already taken place and were attended by the proponent. These meetings were held on 8th June and 23rd June 2006 respectively. The claimants responded that they had no concerns with the proposal. A meeting date has not yet been set for the Nanda meeting. The proponent has been advised by the Yamatji Marlpa Land and Sea Council that it will not be necessary to meet specifically with Hutt River claimants as these individuals are all represented within the other groups and would therefore be consulted within the other three meetings. The issue of Aboriginal Heritage will be concluded after the meeting with the Nanda group which will also be attended by the proponent.

5.5.2 Native Title

The National Native Title Register and Register of Native Title Claims (http://www.nntt.gov.au/applications/index.html) was searched in January 2005. There is currently no native title or native title claim active over the Abrolhos Islands in general or Long Island specifically.

5.6 EUROPEAN HERITAGE

5.6.1 Shipwrecks

There are a number of shipwrecks scattered throughout the Abrolhos Islands, the majority of which have not been found (Western Australian Maritime Museum, 2005). Those that have been found include the *Batavia* (1629), *Zeewijk* (1727), *Hadda* (1877), *Marten* (1878), *Ben Ledi* (1879), *Ocean Queen* (1842) and the *Windsor* (1908). Both the *Batavia* and the *Hadda* are situated close to Long Island and are likely to be of particular interest for dive tours due to their history and/or proximity (Figure 10).

The *Hadda*, a three-masted barque of 334-tons under the command of John L. Parker had sailed to the Lacepede Islands (off the Kimberly Coast) to take on a load of guano. However, the captain lacked the necessary license and the ship was forced to return to Fremantle without a cargo. On the return journey, unfavourable currents and stormy conditions forced the *Hadda* aground in the Abrolhos on 30 April, 1877. The crew was not able to free her and in two days, after the water level reached the wheelhouse, they had to abandon the ship. Captain Parker and his crew of 11 saved all their personal effects and moved to nearby Beacon Island. They remained there till 7 May when favourable seas enabled them to safely travel to Geraldton in their two small boats (Bevacqua, 1974).

The history of the *Batavia* shipwreck and mutiny is one of the best-known stories in Australian maritime history. On 4 June 1629, the VOC ship *Batavia* struck Morning Reef, south of Beacon Island. Four days after the wreck the ship's captain (Pelsaert) and a company of mainly officers and soldiers set out in a ship's boat to seek help from Indonesia. This left 268 people marooned on the waterless islands of the Wallabi Group. A week later the senior officer amongst the survivors and the leader of the impending mutiny, Officer Jeronimus Cornelisz, sent soldier Wiebbe Hayes and a group consisting primarily of soldiers to the High (Wallabi) Islands in search of water. At the same time he shifted 45 people from Beacon Island to nearby Long Island.

The first murders occurred on Beacon Island and soon spread to Long Island. Some survivors managed to escape to the safety of Hayes' camp and warn him of the situation. The mutineer's goal was to capture the rescue vessel and use it as a privateer. On 17 September the mutineers launched an attack on Hayes' camp, which was located on West Wallabi Island. During the fighting the rescue vessel Sardam appeared. The combatants disengaged and Hayes rowed to the ship to warn Pelsaert of the mutineers' intention. The conspirators were then apprehended. Cornelisz was detained on Beacon Island and the others held on Long Island. After their trials, which Pelsaert conducted, nine of the leaders, including Cornelisz, were executed on Long Island. Of the 268 people Pelsaert left in the islands, 40 had drowned while swimming from the wreck, 20 had died from illness and disease, and 125 had been the victims of the mutineer's murders (Bevacqua, 1974).

All of the above mentioned shipwrecks are gazetted Historic Shipwrecks under the Australian Government's *Historic Shipwrecks Act 1976*. With the exception of the *Windsor*, these wrecks are also protected under the State *Maritime Archaeology Act 1973*. The State Act provides protection for all ships that were wrecked, lost, abandoned or stranded off the coast of Western Australia prior to 1900.

The *Historic Shipwrecks Act 1976* also provides protection for all wrecks and artefacts that are deemed to be Dutch Shipwrecks or Dutch Artefacts as defined by the *Agreement between Australia and the Netherlands concerning Old Dutch Shipwrecks* (The Agreement). The Agreement recognises that the Netherlands Government is the successor to the property and assets of the VOC and that the Netherlands transfers all rights, title and interest in vessels of the VOC wrecked on or off the Western Australian coast to the Government of Australia. It is also recognised that the Netherlands has a continuing interest (particularly historical and cultural) in artefacts recovered from these wrecks. The Agreement goes on to establish a Committee made up of two people each from the Netherlands and Australia. The Committee is responsible for determining the ownership and disposition of artefacts recovered from VOC wrecks. The Committee members must have scientific and cultural expertise to be considered appropriate for this role.

5.6.2 Island-based Heritage Sites

Long Island, Beacon Island, Traitors Island and East and West Wallabi Islands are all of high historical value due to their association with the *Batavia* wreck and mutiny. Beacon Island was the site of the largest slaughter of the mutiny. About 180 people reached the island after the *Batavia* was wrecked on Morning Reef and were subsequently murdered by Cornelisz and his followers. A small group of people had been marooned on Traitors Island and were also murdered by the mutineers. Cornelisz was imprisoned on Beacon Island while awaiting his trial.

Sites of historic value on West Wallabi Island include Wiebbe Hayes' encampment site and two limestone structures or huts which may or may not have been built by Hayes (Stanbury, 1991). Historic sites on East Wallabi Island include wells where water was obtained by the survivors (Stanbury, 1991).

Long Island was the location of the second largest slaughter of the mutiny. Approximately 41 people were murdered here. On Pelsart's return, the mutineers were imprisoned (except Cornelisz who was imprisoned on Beacon Island), tried and several subsequently hanged on Long Island. The exact slaughter and gallows sites have never been located despite several surveys of the Island (Anderson *et al*., 2005).

There are other island-based heritage sites, particularly on West Wallabi Island, which relate to the more recent history of the Abrolhos. West Wallabi Island was the site of guano mining operations during the late 1800s and early 1900s. All that now remains of these operations are the stone foundations of the guano loading jetty on the north side of the island. During 1931 two hectares of land were leased by Mr TC Hopkins next to the guano loading jetty. Here he established The Cove Packing Company, a small rock lobster cannery. The cannery appears to have operated until mid 1933. All that visibly remains of these operations are some stone fireplaces for the retorts and some iron boilers (Gray, 1993).

During World War II, an advanced spotting post was maintained on West Wallabi Island. The base was manned by about six aircrew trainees from the Royal Australian Air Force in a round the clock vigil to give radio warning of any enemies approaching the mainland. The exact location of the post was not recorded (Gray, 1993).

5.6.3 Results of Long Island Heritage Survey

Several small archaeological surveys have been conducted on Long Island. Jack-Hinton *et al.* undertook a surface collection and visual survey of the island in 1967 and recovered a Rhenish beardman jug shard from the northern end of the island (Anderson *et al*., 2005). In 2001 a metal detector survey was undertaken by the Western Australian Maritime Museum (WAMM) of the northern third of the Island. This survey located a "morning star" which is a piece of lead sheathing that had been moulded into a ball (and could have been used as a weapon) and three iron fastenings. Several items were also located that originated from the Grundy film set during the filming of the *Batavia* story in the early 1990s (Anderson *et al*., 2005). Between 30 September and 3 October 2005 personnel from WAMM undertook a surface survey of the main development area on Long Island (Anderson *et al*., 2005). This survey included visual and metal detector examination of the area. The entire report is provided in Appendix 14 (Anderson *et al*., 2005) and a summary is presented here.

A number of methods for surveying Long Island were discussed during the initial consultations with WAMM. The use of Ground Penetrating Radar was discussed however it was not considered the best option as most of Long Island is composed of coral rubble with very little sand or guano deposits (Dr J Green, WAMM, pers. comm.). Long Island is also difficult to investigate as the coral rubble is constantly moving. The most likely artefacts to be found would be iron fastenings from timbers used to make rafts or the gallows, or from ship's timbers. The timbers themselves would be unlikely to be still intact but the iron fastenings would be detectable with a metal detector survey (Dr M Stanbury, WAMM, pers. comm.). Furthermore, any bodies are likely to have been thrown into the sea or, if left on land, eaten by sea-eagles and it would be unlikely that any skeletal remains would be found (Dr M Stanbury, WAMM, pers. comm.).

During the 2005 survey, four artefacts that could not de discounted as modern rubbish were recovered from along the central ridge of Long Island. The most notable of these is artefact A11, a ship's fastening, which was found high on the ridge and buried under some coral rubble. It is likely that it could have been used as a weapon during the *Batavia* mutiny, formed part of the gallows or originated from a piece of ship related driftwood. The other artefacts recovered were A6 – a thin square head ferrous nail, A7 – a section of twisted ferrous nail and A10 – a small piece of nail or wire. There was no conclusive surface evidence found for the location of the gallows or occupation sites (Anderson *et al*., 2005). All artefacts found during the survey were relocated to the WAMM in Fremantle.

6. COMMUNITY AND GOVERNMENT CONSULTATION

6.1 BACKGROUND

Since at least 1989, the various Ministers for Fisheries have conducted a substantial amount of consultation with regard to the options for development of tourism at the Abrolhos. A number of committees via the Department of Fisheries have been responsible for making recommendations to the Minister for Fisheries in relation to these options following consultation with stakeholders. Consultation was carried out through the development of Fisheries Management Papers released for public comment, specific stakeholder meetings (e.g. conservation groups, fishing industry), public forum meetings and advertisements inviting public comment in local and State newsprint media. This process culminated in the publishing of the Sustainable Tourism Plan for the Houtman Abrolhos Islands (Fisheries Management Paper 146) in February 2001.

The Abrolhos Islands Management and Advisory Committee (AIMAC) is the body responsible for reporting to the Minister for Fisheries on matters concerning the Abrolhos Islands. AIMAC has been an integral part of the consultation process conducted to date.

With respect to the consultation conducted by the proponent, the EPA requires evidence of a satisfactory consultation mechanism that demonstrates the proponent has undertaken consultation and that relevant environmental concerns have been addressed in the design and management of the proposed resort.

A public consultation programme was undertaken by HLD to consult with:

- State and Commonwealth Government departments, regulatory authorities, agencies and organisations.
- Fishing industry.
- Local and Shire authorities.
- Special interest groups (e.g. conservation, avifauna and heritage).
- Local tourism operators.
- University and research groups.
- Indigenous groups.
- The general public.

The public consultation programme was designed to:

- Inform the public about the proposed development of the resort.
- Record potential concerns, issues and recommendations.
- Aid in preparing the design and management of the resort, ensuring the public concerns were addressed.
- Provide feedback to stakeholders.
- Establish meaningful and ongoing dialogue.

The public consultation included:

- Meetings with government agencies.
- Establishment of a list of relevant stakeholders.
- Newspaper announcement of the proposed resort with an invitation to discuss the resort proposal.
- Information letters, faxes and emails to all identified interested parties.
- Invitations to key stakeholders to attend meetings to discuss the resort proposal.
- Discussions and correspondence with stakeholders who had further questions or concerns.

6.2 RECORD OF PUBLIC CONSULTATION

A detailed list of the individuals, organisations, groups and agencies that were consulted is summarised in Table 6.1. This list was established from ongoing public consultation with stakeholders.

Table 6.1: Stakeholders Consulted on the Long Island Tourism Proposal

Stakeholder Sector	Organisations
State Government and Regulatory Authorities	Department of Conservation and Land Management (CALM) Department of Fisheries Department of Environment (DoE) Department of Health (Commonwealth) Department of Environment and Heritage (DEH) Environmental Protection Authority (EPA) Department of Indigenous Affairs (DIA) Tourism WA Conservation Commission Heritage Council of Western Australia
Fishing Industry	Aquaculture Council of WA Recfishwest Western Rock Lobster Council Wallabi Rock Lobster Fishing Association Professional Fishers
Local Authorities/ Agencies	Shire of Greenough Midwest Development Commission Midwest Chamber of Commerce and Industry Geraldton-Greenough Regional Council

Stakeholder Sector	Organisations
Environmental Groups	Wilderness Society Marine and Coastal Community Network Friends of the Abrolhos Conservation Council of Western Australia Inc. Wildflower Society of WA WA Naturalists' Club Birds Australia (WA) Avicultural Society of WA Geraldton Avicultural Society
Heritage/History Groups	Rotary - Geraldton, Geraldton North and Geraldton Central Committee members of "Australia Nederlands Agreement Concerning Old Dutch Shipwrecks" Batavia Coast Replica Longboat Association Batavia Coast Marine Heritage Association History Council of WA Royal Western Australian Historical Society Geraldton Historical Society Maritime Archaeological Association of WA
Aboriginal Groups	Yamatji Land and Sea Council
University/Research Groups	Department of Fisheries Research Division WA Museum Natural Science Division WA Maritime Museum Southern Ocean Seabird Study Assoc. Inc University of Western Australia Murdoch University Curtin University
Tourism Related Groups and Businesses	Tourism Council of WA Kalbarri Sports and Dive Batavia Coast Dive Academy Frank O'Connor's Birding WA Coate's Wildlife Tours Birdwatching Aficionados Abrolhos Islands Escape Charters Shine Aviation Services Pelican Charters Abrolhos Islands Charters Geraldton Air Charter Batavia Coast Air Charters Batavia Cruising Abrolhos Adventures Wild West Charters

Stakeholder Sector	Organisations
Individuals	John Fitzhardinge (Professional Fisher/AIMAC Representative) Indre Kirsten Asmussen (Abrolhos Bird Researcher)
General Public	Newsprint media advertisements, editorial newsprint articles and features on television and radio

6.2.1 Consultation Conducted by Department of Fisheries/AIMAC

6.2.1.1 Tourism Options and Selection of Long Island

This section discusses the consultation that took place in relation to the consideration of tourism options and the selection of Long Island. Section 3.2.1.1 discusses the islands short listed by the Abrolhos Islands Tourism Working Party ('the Working Party') and Section 3.2.1.2 discusses the selection of Long Island by HLD.

As the regulatory authority, The Department of Fisheries together with AIMAC [and previously the Abrolhos Islands Consultative Committee (AICC)/Abrolhos Islands Taskforce (AITF)] have considered the development of tourism at the Abrolhos for at least 16 years.

In January 1989, an initiative to facilitate air/sea based tourist visits to Abrolhos was outlined in the Abrolhos Islands Planning Strategy Final Report. The report stated that the dominant form of tourism should be boat based, together with aerial tours (AICC 1989, cited in AICC 1995). The AICC and the Minister for Fisheries sought public comment on this initiative in May 1992, together with proposals for Reef Observation Areas and safe mooring sites, through the release of the Abrolhos Islands Planning Issues, Proposals for Public Comment (AICC, 1993). The initiative was referred to as the fly/boat concept and was considered a sound management tool for allowing for the controlled access of tourists to the Abrolhos.

In May 1993, the AICC summarised the issues raised during the 1992 public comment period and made recommendations to the Minister for Fisheries in the Abrolhos Islands Aquatic Reserve Final Report. The fly/boat concept received sound discussion and of the 48 submissions received, 54% discussed the concept in some form. Tourism interests submitted 15% of the submissions, following private individuals (34%) and fishing interests (23%) (AICC, 1993). The concept was considered favourably, with 88% of submissions asserting support for the concept and many respondents suggested there should be a call for Expressions of Interest to trial the concept (AICC, 1993).

Prior to 1994, the most preferable option for tourism at the Abrolhos was considered to be water based, facilitated by charter boats and fly/boat trips, and any consultation undertaken by the AICC centred around this option. However, in November 1994, the Abrolhos Islands Tourism Working Party ('the Working Party') was formed to consult and advise the AICC on the scope for the development of tourism at the Abrolhos, taking into account impacts on the marine and terrestrial environment and interaction with existing user groups (AICC, 1995). The Working Party investigated further options for tourism at the Abrolhos and explored the possibility of low-key, land-based tourism.

Initial public consultation on a range of land and sea based options took place in December 1994 (44 submissions), followed by the release of a draft report for further consultation in May 1995 (75 submissions). The Working Party presented its final report to the AICC in

June 1995 and recommended mostly water-based options, including daily and long visits by charter vessels, the fly/boat concept and moored accommodation facilities. However, the report suggested that a low density, low impact land-based site could be established at Long Island in the Wallabi Group (AICC, 1995). The Working Party recommended that a management plan for tourism be finalised prior to a call for Expressions of Interest to develop any tourism venture at the Abrolhos.

In April 1996, AIMAC was established to provide advice to the Minister for Fisheries and it initiated the development of a management plan for the Abrolhos. One of the first tasks conducted in the process was the public consultation. Approximately 50 groups were consulted at this time and issues relating to tourism, fishing, environmental, cultural and island facilities were raised. Public submissions were called for in local and State newspapers in late 1996 (Henry and Ruiz-Avila, 1997a). The submissions received during this consultation requested that any tourism be locally managed, eco-friendly, controlled and educational. The submissions suggested that both boat and/or small-scale land based tourism would be preferable. However, there was a conflict in relation to island selection and differences of opinion were based on inhabited versus uninhabited islands and the benefits or otherwise of an existing airstrip. There was also a call for any land based accommodation to be small scale and sympathetic to the environment.

Charter boat operators were generally in favour of land based accommodation, noting that it would provide a better service to tourists and would encourage more people with interests other than fishing (Henry and Ruiz-Avila, 1997b). Commercial fishers were very concerned with regard to the conflict of lifestyles between tourists and fishers, use of fisher's facilities and security of their property (Henry and Ruiz-Avila, 1997b).

The final version of the Management of the Houtman Abrolhos System was released in December 1998 (Fisheries Management Paper 117) and outlined strategies for developing sustainable tourism including the need to finalise a tourism management plan, investigation of the potential of marine and land-based tourism sites and the development of application guidelines and performance criteria (Fisheries WA, 1998a).

Subsequently, a draft Management Plan for Sustainable Tourism at the Houtman Abrolhos Islands and a draft Future Directions for Tourism at the Houtman Abrolhos Islands (Fisheries Management Papers 120 and 121) were developed as a subset of the overall management of the Abrolhos and released for public comment in December 1998, with a closing date for submissions in March 1999. These documents recommended several types of commercial tourism for the short and medium term including charter boat operations, shore based facilities on specific uninhabited or inhabited islands and moored accommodation facilities (Fisheries WA, 1998b). In the short term, small scale, low impact shore based facilities at Long Island (Wallabi Group), Little Roma Island (Easter Group), Middle Island and Murray Island (Southern Group) were suggested. In the medium term, East Wallabi Island (Wallabi Group) and presently inhabited islands were also options open for discussion (Fisheries WA, 1998b).

Based on the consultation carried out in December 1998 to March 1999 in relation to Fisheries Management Papers 120 and 121, Fisheries Management Paper 146 The Sustainable Tourism Plan for the Houtman Abrolhos Islands ('the Plan') was published in February 2001. The Plan outlined charter boat operations (including fly/boat travel), moored accommodation facilities and low density, low impact shore based tourism as the three

preferable options for development of tourism. The Plan also named both Long and Little Roma Islands as the most preferable islands on which to develop low density, low impact shore based tourism and West Wallabi Island as a secondary option due to a high abundance of bird populations.

In response to the Department of Fisheries/AIMAC request for proposals as part of this document in 2001, HLD submitted an Expression of Interest in March 2002, followed by a more detailed Notice of Intent in August 2003.

6.2.2 Consultation Conducted by Proponent Prior to Award of "Preferred Tenderer" Contract

HLD sought to meet with a number of private and Government representatives prior to the awarding of the preferred tenderer contract by the Minister for Fisheries in September 2004. Table 6.2 shows when the meetings took place and attendees.

Table 6.2: Meetings Held with Individuals/Organisations prior to September 2004

Individual	Organisation	Issue Discussed	Date
Julie Phelps	WA Department of Health	Waste management and grey water treatment	2004
Neil Taylor	Department of Conservation and Land Management – Busselton	Composting toilets and grey water treatment	2004
Terry Penn	Tourism Co-ordinates	Tourism issues	24 Aug 1999
Ron Boucher	Geraldton - Greenough Regional Council	Waste management	2004
Paul Byleveld	NSW Department of Health	Grey water treatment	2004
AIMAC	AIMAC	Various issues	21 Jan 2000
Peter Millington	Department of Fisheries	Development process	27 Jul 2000

6.2.3 Consultation Conducted by Proponent Following Award of Contract

In September 2005, an initial information letter was sent to all stakeholders with a potential interest in birds at the Abrolhos, inviting them to contact HLD in relation to the proposed resort and planned bird studies. Following the EPA's endorsement of the Environmental Scoping Document on 7 November 2005, all stakeholders were sent a letter, the general text of which is provided in Section 6.2.5. This letter drew the stakeholder's attention to the availability of the Environmental Scoping Document, which aimed to identify all of the environmental issues associated with the proposal and gave a brief outline of the suggested management response to each issue. Stakeholders were invited to comment or to arrange a meeting if required.

The general public was notified of the availability of the Environmental Scoping Document in November and December 2005 by way of advertisements in newsprint media. Advertisements were placed in the two newspapers in the Geraldton area and the West

Australian. The text of the advertisements is provided in Section 6.2.4. ABC Radio ran a projected status update of the proposed resort in January and February 2005 and Channel 9 Television ran a segment on Postcards WA in September 2005.

Those stakeholders considered to have a primary interest in the proposed resort were contacted and invited to meet with the study team following the release of the Environmental Scoping Document in late 2005. Those meeting dates are outlined in Tables 6.3 and 6.4.

Issues raised by stakeholders relating to the Environmental Scoping Document and the proposed resort are provided in Section 6.3, together with HLD's management response.

Appendix 15 presents a detailed summary of the consultation conducted to date on the proposal.

6.2.3.1 Consultation with Regulatory Authorities and Government

HLD invited representatives from all key Government departments and Regulatory Authorities identified as having a regulatory and/or legislative involvement to meet to discuss all aspects of the proposed resort and to identify potential issues. Table 6.3 outlines when the meetings took place and attendees.

Detailed updates on the PER and the Environmental Scoping Document by way of letter, email or fax were provided to those listed in Table 6.3 (with the exception of the members of Parliament) and in addition, representatives from the Department of Indigenous Affairs, Department of Health and the Department of Environment and Heritage.

Table 6.3: Meetings Held with Regulatory Authorities and Government Representatives

Individual	Position/Organisation	Meeting Date
Kim Chance	Minister for Fisheries (previous)	6 January 2005
Jon Ford	Minister for Fisheries (current)	2 July 2005
Matt Birney	Opposition member of Parliament (previous)	28 July 2005
Murray Criddle	Opposition member of Parliament	28 July 2005
Paul Omodei	Opposition member of Parliament	28 July 2005
Russell Dyson	Department of Fisheries	5 April 2005 26 April 2005
Peter Millington	Department of Fisheries	23 June 2005
Andrew Hill	Department of Fisheries	7 December 2005
Lynda Bellchambers	Department of Fisheries	7 December 2005
Peter Driscoll	AIMAC	23 June 2005 9 November 2005
Leonie Noble	AIMAC	23 June 2005
Dr Fred Wells	Department of Fisheries/AIMAC	23 June 2005 24 November 2005
Colin Ingram	CALM	7 December 2005

Individual	Position/Organisation	Meeting Date
Tracy Churchill	CALM	7 December 2005
Norm Caporn	CALM	7 December 2005
	CALM - Geraldton	26 April 2005
Board	EPA	20 October 2005
Emma Glencross	DoE	23 June 2005
Emma Glencross	DoE	14 July 2005
Alan Bradley	DoE - Geraldton	26 April 2005
Mike Flood	Tourism WA	26 April 2005
Colleen Henry	Tourism WA	23 June 2005

6.2.3.2 Preliminary Consultations with Other Stakeholders

HLD invited representatives of other stakeholder groups to meet in an effort to identify and discuss potential issues associated with the proposed resort. In these cases, the particular stakeholders were identified as having a more specific interest in the project, either from their responses to initial contact or by virtue of their professional position. Table 6.4 outlines the dates the meetings took place and attendees.

Table 6.4: Meetings Held with Stakeholder Groups

Organisation/Individual	Meeting Date
Tourism Co-Ordinates	4 February 2005
Heritage Council	31 May 2005 6 December 2005
WA Museum	7 December 2005
WA Museum - Geraldton	7 January 2005 16 March 2005
WA Maritime Museum	2 June 2005 6 December 2005
Recfishwest	7 December 2005
Wallabi Rock Lobster Fishing Association (Chair)	6 January 2005
Wallabi Rock Lobster Fishing Association (Members)	11 May 2005
Colin Kelly (fisher/charter boat operator)	11 February 2005
Midwest Chamber of Commerce and Industry	18 March 2005
Marine and Coastal Community Network	31 May 2005
Conservation Council	31 May 2005 7 December 2005
Indre Kirsten Asmussen (Abrolhos bird researcher)	26 July 2005 7 December 2005
Kevin Coate (bird watcher/tour guide)	7 December 2005
Rotary Geraldton	13 July 2005
Rotary Geraldton North	20 July 2005

Organisation/Individual	Meeting Date
Rotary Geraldton Central	17 August 2005
Midwest Economic Summit	9 September 2005
Batavia Coast Longboat Association	16 February 2005
Royal Western Australian Historical Society	6 December 2005
Maritime Archaeological Society of WA	6 December 2005
Murdoch University (Halina Kobrin)	31 May 2005
University of Western Australia (Robert Black)	28 July 2005 24 November 2005
University of Western Australia (Mike Johnson)	24 November 2005
University of Western Australia (Jane Prince)	24 November 2005

6.2.4 Newspaper Advertisements

The availability of the Environmental Scoping Document was advertised in three newspapers as follows:

- The West Australian – Public Notices, Saturday 19 November 2005;
- The Geraldton Guardian – Public Notices, 16 December 2005; and
- The Mid-West Times – Public Notices, 24 November 2005.

The text of the advertisement was as follows:

NOTICE OF LONG ISLAND RESORT PROPOSAL
WALLABI GROUP, HOUTMAN ABROLHOS ISLANDS

Humfrey Land Developments is currently seeking approval to develop a small scale nature based resort at Long Island, in the Wallabi Group of the Abrolhos Islands, located approximately 60 kilometres west of Geraldton. The resort proposal is being formally assessed by the Environmental Protection Authority (EPA). The Environmental Scoping Document has been approved by the EPA on 7 November 2005. This document aims to identify all of the environmental issues associated with the project and can be viewed on the EPA website at www.epa.wa.gov.au in the "Proponent Documents" section or the Humfrey Land Developments website at www.hld.com.au. Should you wish to comment on, or discuss the project, please contact Ms Carolyn Beasley of MBS Environmental on 08 9226 3166 or email cbeasley@mbsenvironmental.com.au before 8 December 2005.

Please note, the closing date for comments varied with each newspaper advertisement as appropriate.

6.2.5 Information Letter to Stakeholders

A letter was sent to stakeholders and potential stakeholders to advertise the availability of the Environmental Scoping Document. The letter was sent by mail or transmitted via email or fax. The general text of the letter was as follows with some variations depending on the recipient:

"As you may be aware, a nature based tourism operation has been proposed for Long Island in the Wallabi Group of the Houtman Abrolhos Islands, Western Australia.

The facility, as proposed by Humfrey Land Developments of Geraldton, would occupy approximately two hectares of the central portion of the island and accommodate 60 overnight guests within 30 visitor lodges. Guest accommodation would be supported by communal facilities, staff accommodation, swimming pool, jetty and helipad. Access around the island would be via a raised boardwalk.

The Environmental Protection Authority (EPA) set the level of assessment for the proposed tourism development at Public Environmental Review (PER). Some of the main issues of concern for the EPA and the proponent are:

- *Protection of the prolific bird life and bird habitats of the area;*
- *Ensuring sustainable use of the marine environment which supports important coral reef communities; and*
- *Preventing interference with the heritage values of the island and surrounding marine waters, such as the Batavia shipwreck or associated artefacts.*

The Environmental Scoping Document aims to identify all of the environmental issues associated with the proposal and gives a brief outline of the suggested management response to each issue. This document has been presented to the EPA Board and has now been endorsed as an acceptable Scoping Document for the project. The next stage in the environmental approvals process is to prepare the PER document, which will address the environmental issues and management responses in detail.

The Environmental Scoping Document is a useful source of information for anyone wishing to obtain more information on the project, particularly with respect to environmental issues. Should you wish to view the document, it is available on the EPA website (www.epa.wa.gov.au) in the "Proponent Documents" section or the Humfrey Land Developments website (www.hld.com.au). Alternatively, if you would like to receive an electronic copy of the report on CD, please contact me by email on cbeasley@mbsenvironmental.com.au.

Following a review of this document, I would be very grateful to receive any comments or feedback you may have on the proposal. If you would like to discuss the proposal or arrange a meeting, please contact me via the email address above or by telephone on (08) 9226 3166.

Many thanks for your interest in the project."

6.2.6 Follow-up Consultations and Correspondence

Follow up letters were sent by mail, email and/or fax to key stakeholders who had not yet provided comment on the proposed resort. In the case of key stakeholders, if no comment was received, a follow up phone call was conducted to receive and document a verbal response.

6.3 ISSUES RAISED DURING STAKEHOLDER CONSULTATIONS

The environmental issues raised during the stakeholder consultation programme are listed in Table 6.5.

Table 6.5: Environmental Issues Raised during Stakeholder Consultations

Issues and HLD Response
Site Selection
Issue (Indre Asmussen, Kevin Coate) Choice of island should be reviewed, with the view to moving the proposed development to an island with existing infrastructure (e.g. Rat Island). **HLD Response** The Department of Fisheries has recommended that islands already inhabited be avoided due to potential incompatibility between fishers and tourists. Commercial fishers were concerned with regard to the potential conflict of lifestyles between tourists and fishers, use of fisher's facilities and security of their property. Section 3.2.1 outlines the site selection process carried out by both the Department of Fisheries and HLD.
Site Selection for Proposal and Conflict of Interest with Department of Fisheries
Issue (WA Maritime Museum, Indre Asmussen) Long Island site approved by Department of Fisheries, who also has an area set aside for development on Long Island. **HLD Response** The Minister for Fisheries and the AICC/AIMAC have been considering a small scale, land based tourism site on Long Island since 1994. Long Island was chosen for a variety of ecological and cultural reasons outlined in Section 3.2.1.1. The Department of Fisheries' choice of island on which to build a research station is out of the control of HLD and not a matter for this PER.
European Heritage - *Batavia*
Issue (Kevin Coate, Indre Asmussen, Royal Western Australian Historical Society) Impacts of proposed development on heritage sites associated with the *Batavia* wreck and mutineer events. **HLD Response** The exact site of the gallows on Long Island has never been located despite several surveys, though there is potential for the site to be in the unsurveyed southern portion of the island. It is understood that this southern section will be surveyed in 2006 by WA Maritime Museum (WAMM) through Government funding. HLD contracted WAMM to carry out an archaeological survey of the main development area and a small number of metal objects were found (refer to Section 5.6.3 and Appendix 14 for full report). Nevertheless, HLD will be vigilant in educating and restricting resort guests and day visitors' movements and access will not be permitted to the southern area of Long Island. A Long Island resort heritage management plan will be developed in consultation with WAMM. All resort guests, day visitors and staff will undergo an induction (to be developed in

Issues and HLD Response
conjunction with the WAMM). This will provide advice on procedures to be followed in case of chance finds of artefacts. During any construction work that involves major excavation, a qualified archaeologist will be on site on a watching brief.
Issue (The Royal Western Australian Historical Society) Proposed tourism development would affect the historical evidence and transform the ambience of Long Island, in relation to the construction of the lighthouse and Lighthouse Keeper's cottage. **HLD Response** All resort guests, day visitors and staff will undergo an induction (to be developed in conjunction with the WA Maritime Museum). This will provide advice on procedures to be followed in case of chance finds of artefacts. There is no lighthouse or Lighthouse Keeper's cottage located on Long Island (Wallabi Group).
Issue (Heritage Council of WA, Department of Environment and Heritage) Ground probing radar not used during archaeological survey of Long Island in favour of visual and metal detection. **HLD Response** Metal detector is the preferred methodology adopted by WA Maritime Museum. Ground Probing Radar has the capacity to disturb rookeries and other flora and fauna. As the main soil and sediment type is very shallow and dynamic coral gravel, it is very unlikely that skeletal remains would be present. Victims' bodies may have been thrown into the sea and, if buried, may have been subsequently exposed and scavenged, or disintegrated over the past 400 years. Intact artefacts are most likely metal and the detector will find items up to a metre below the surface.
Issue (Heritage Council of WA) The proponent should archaeologically survey the southern area of Long Island, which may contain the gallows site. **HLD Response** It should be noted that the southern area of Long Island is not part the development zone and will not be part of the leased area. It is understood that this southern section will be surveyed in 2006 by WA Maritime Museum (WAMM) through Government funding. HLD plans to prohibit access to the southern area of Long Island to both guests and resort-associated day visitors and is therefore of the view that it is not responsible to survey the southern area of Long Island. Restrictions on access will be achieved via the guest and day visitor induction programme, interpretive signs and the termination of the southern boardwalk at the helipad and jetty. Notwithstanding, the Department of Fisheries will remain responsible for the southern portion of the island.
Issue (Heritage Council of WA) Any excavation during the building of the proposed resort should be closely monitored by an experienced archaeologist. **HLD Response** During any construction work that involves major excavation, a qualified archaeologist will be on site on a watching brief.
Issue (Australia Nederlands agreement Concerning Old Dutch Shipwrecks (ANCODS)) Disturbance of *Batavia* wreck site or associated artefacts. **HLD Response** Dive and snorkel tours associated with the resort will be operated by a licensed operator under strict contract conditions with the resort, which will include a requirement for pre-dive heritage briefing. Dive operators and the public are required to comply with the Commonwealth *Historic Shipwrecks Act 1976* and the State *Maritime Archaeology Act 1973.*

Issues and HLD Response
Issue (Heritage Council of WA) An interpretation plan should be prepared encompassing the natural and cultural heritage values of Long Island. **HLD Response** A Long Island Resort Heritage Management Plan will be developed in consultation with the WA Maritime Museum (and also the Heritage Council if requested). All resort guests, day visitors and staff will undergo an induction. As part of the plan, interpretive signage will be erected and heritage displays incorporating material from the *Batavia* will be placed in the day visitor pavilion and guest reception area.
Aboriginal Heritage
Issue (Department of Indigenous Affairs, Heritage Council of WA) Potential occurrence of Aboriginal artefacts (e.g. middens) and visitation history on Long Island. **HLD Response** A search of the Register of Aboriginal Sites maintained by the Western Australian Department of Indigenous Affairs was undertaken and returned no registered sites. The National Native Title Register and Register of Native Title Claims was searched and there is currently no native title or native title claim active over the Abrolhos Islands in general or Long Island specifically. HLD has received formal advice that two of the three native title claimant groups have no objections with the proposal. A meeting is awaited with a third group and this will conclude the Aboriginal Heritage issue.
Birds
Issue (Kevin Coate) General impact of the proposed development on the bird population and specifically the impact of the erection of poles and aerials as Long Island is in a flyway for birds. **HLD Response** An Avifauna Management Plan has been developed to reduce potential impacts of the development upon avifauna. Small numbers of Wedge-tailed Shearwaters and Sooty Terns transit through Goss Passage, generally avoiding land enroute to/from foraging grounds. HLD will be adopting a light management strategy, reducing light overspill into the surrounding environment, and thereby reducing collision risks with avifauna.
Issue (Indre Asmussen) Impact of building a helipad in close vicinity to a white-breasted sea eagles' nest. **HLD Response** The nest is located 130 metres from the proposed helipad and is shielded completely from the proposed deck and access boardwalk by a storm ridge of coral shingle. HLD acknowledges that the single breeding pair of white-breasted sea eagles are likely to be disturbed to some degree, however it is also possible that the birds will acclimatise to predictable activities. However the current proposed helipad position is considered to be the best compromise when considering safety, marine and avifauna issues. Section 3.6.11 describes the helipad site consideration and construction.
Issue (Indre Asmussen, CALM Department of Fisheries) Impacts of proposed helicopter use on birds (e.g. potential for bird strike). **HLD Response** The helicopter will follow a fixed route and the landing and take off flight path will be from the north west of the helipad. It is understood that predictable flight paths can assist birds to adjust to helicopter arrivals and departures. The helicopter will approach and leave Long Island over water, which is one of the reasons why HLD plans to construct the helipad over water. It is proposed that the impact on birds will be minimised through not flying over any islands, which will help to reduce potential bird strike and disturbance due to noise. The helicopter will not fly between dusk and

Issues and HLD Response
dawn except in cases of emergency.
Issue (Indre Asmussen) Impact of proposed development on ospreys and white-breasted sea eagles on islands in the Wallabi Group. **HLD Response** Potential impacts on birds and mitigation measures are covered in the Avifauna Management Plan. It is acknowledged that the single pair of white-breasted sea eagles on Long Island is likely to be impacted by the development. It is also noted that ospreys may nest on Long Island and, at the time of the seabird study (refer to Appendix 10), a recently attended nest and four disused nest sites were discovered. The presence of white-breasted sea eagles on West Wallabi Island was one reason why HLD has decided to abandon the proposed guest activities and day trips to that island. No guest activities and day trips will occur to East Wallabi Island, except to collect guests from the airstrip and to visit Turtle Bay for day trips, which will be approached by boat only. Flights will not occur over land.
Issue (Conservation Council, Kevin Coate) Disturbance of Roseate terns during early nesting phase on Long Island and Short Island. **HLD Response** HLD proposes to use interpretive signage and education in relation to different bird species' nesting behaviour for both resort guests and day visitors.
Issue (Conservation Council, Kevin Coate) Internal/external lighting of resort and its impact on birds (e.g. storm petrels) at night. **HLD Response** Potential impacts on birds and mitigation measures are covered in the Avifauna Management Plan. HLD proposes to use sodium vapour lights, which give off red wavelengths and have been tested in Hawaii with favourable results. Lighting is to be downcast, and can be shielded, directed and focused, and will be fitted with lower wattage globes. Staff will be trained to reduce lighting as appropriate during critical breeding times (e.g. for shearwater and storm-petrel fledgling periods). Tinting glass on building windows and installing lights in tubes will aid in reducing the impacts of internal lights. Lights will be reduced in the evening following the dinner period.
Issue [Birds Australia (WA)] Impacts by guests from the resort on bird nesting areas while visiting areas of interest on other islands (e.g. Wiebbe Hayes Forts on West Wallabi Island). **HLD Response** Potential impacts on birds and mitigation measures are covered in the Avifauna Management Plan. The presence of white-breasted sea eagles on West Wallabi Island was one reason why HLD has decided to abandon the proposed guest activities and day trips to that island. Visits by resort guests and day visitors to other islands will be subject to seasonal closures where appropriate.
Issue (Conservation Council) Steps needed to minimise birds habituating under infrastructure (e.g. boardwalks). **HLD Response** HLD will investigate the use of barriers to prohibit bird habituation under guest accommodation buildings. However, it is planned that the raised boardwalks will facilitate cross island movement of fauna and it will not be possible (or necessary) to prevent birds nesting under the boardwalks.
Issue (Conservation Council) Seasonal closures or gates are needed to control guest movement thereby minimising disturbance to birds. **HLD Response** Potential impacts on birds and mitigation measures are covered in the Avifauna Management Plan.

Issues and HLD Response
Gates will be used when appropriate sections of boardwalk may need to be closed off at night or at certain times during critical bird breeding times. Resort guests and day visitors will be expected to keep to the boardwalks at all times.
Sea Lions
Issue (Conservation Council, Indre Asmussen) Long Island could be a possible birthing area for sea lions. **HLD Response** All published literature and anecdotal evidence received to date indicates that the Wallabi Group including Long Island is not a birthing area for sea lions, but contains a haul out area in the northern portion of Long Island.
Issue (Conservation Council, Indre Asmussen) Sea lions haul out on Long Island therefore guests will need to be educated in relation to sea lions and their potentially aggressive nature. **HLD Response** All resort guests, day visitors, staff and construction workers will undergo an induction, which will include a code of conduct for persons accessing the Australian sea lion haul out site. One section of boardwalk will be raised to a height of approximately 2 metres to avoid possible contact with sea lions near the northern extremity of the development area. This area will have handrails for guest and staff safety. Interpretive signage will also be present in this area.
Flora and Fauna
Issue (CALM, WA Museum) Need for a quarantine plan to minimise the introduction of non-endemic flora and fauna. **HLD Response** The introduction of non-endemic flora and fauna will be minimised by implementing a Weed Management Plan and a Vermin/Pest Management Plan. All resort guests, day visitors, staff and construction workers will be briefed on the management protocols. These Plans will include quarantine procedures.
Issue (Royal Western Australian Historical Society) Concern that bird, reptilian and rare and endangered plant species will be adversely affected by the proposed resort. **HLD Response** Section 7.4.2.3 outlines the bird species present on Long Island, potential impacts and management and monitoring measures, which are addressed in the Avifauna Management Plan. Only one species of terrestrial fauna is found on Long Island, the skink *Menetia greyii.* This skink is also found on North Island and composite islands in the Easter and Southern Groups. The skink is also found on the mainland. The CALM Priority 4 flora species *Lepidium puberulum* has been found on Long Island and prior to construction a thorough search of this area shall be conducted and the location of all individuals found will be recorded with a GPS. The location of *L. puberulum* individuals will be marked such that they are visible to the construction crew and can be avoided where possible. The construction workforce will be briefed on the significance of this species and how to identify the plant.
Tidal Pond 504
Issue (University of WA) Impact of proposal to improve amenity (e.g. odour) of tidal pond 504 by flushing with sea water. **HLD Response** The need to introduce additional seawater is anticipated to occur up to three to four days per month and will most likely occur during the less windy months of April to August. The proposal to slowly

Issues and HLD Response
introduce additional seawater to reduce odour on occasional days would be unlikely to disrupt the sediments and therefore the molluscs living within would be unaffected. The seawater to be introduced to the pond will flow slowly into the pond in such a way as to not disturb the sediment of the pond. See Section 7.4.4 for further details.
Terrestrial Environment Management
Issue (Conservation Council, Indre Asmussen) Lack of terrestrial environment management of the Abrolhos Islands. **HLD Response** HLD will pass this concern on to the Department of Fisheries as the regulatory authority for the Abrolhos. This issue is not considered a matter for this PER.
Public Access to Long Island
Issue (Recfishwest) Clarification on anchoring around Long Island. **HLD Response** HLD would be permitted to restrict public access on any private moorings only. In the interests of education, signage provided in particular areas would be of benefit to both resort guests and day trippers. It is understood that the Department of Fisheries will install a small number of public moorings to prevent need for day trippers to drop anchor.
Issue (WA Maritime Museum) Control of resort guests, day visitors and public to the southern part of Long Island. **HLD Response** HLD will be vigilant in educating and restricting resort guests and day visitors' movements to the southern area of Long Island. All resort-associated day visitors to Long Island will be required to undertake an induction to Long Island. While HLD recognises that currently the public may access all of Long Island in an unrestricted manner, interpretive signage will be erected for both the public and resort guests regarding the potential heritage value of the southern area of Long Island. Notwithstanding, the Department of Fisheries will remain responsible for the southern portion of the island as this is outside the leased area.
Issue (Recfishwest, Conservation Council) Potential loss of free public access to Long Island. **HLD Response** Currently, the public may access all of Long Island in an unrestricted manner. The approval of this resort would only prevent access by the public to the development zone beyond the day visitor pavilion. However, HLD considers it undesirable for the public to access and utilise all of Long Island in an unrestricted manner as this may lead to trampling vegetation, disturbing nesting birds and other environmental degradation. To this end, interpretive signage will be installed on the jetty and in the day visitor pavilion regarding the appropriate code of conduct for visiting Long Island.
Issue (Tourism Co-ordinates, Tourism WA) Management and facilities for day trippers. **HLD Response** Day visitors associated with the proposed resort will not be permitted to enter the main resort area unless by prior arrangement. However, day visitors may use add-on services such as food and beverage facilities and recreational activities. These visitors will be welcomed into the day visitor pavilion, which will include a kiosk, toilet facilities and interpretive material showcasing the natural and historical values of the island. Section 3.7 lists the potential activities available for both resort guests and day visitors.

Issues and HLD Response
Impacts of Guest Activities
Issue (CALM) Need for management of guest activities. **HLD Response** All activities carried out by resort guests will be implemented in accordance with a Visitor Activity Management Plan. Immediately upon arrival at Long Island all guests and day visitors shall be required to go through a short induction. This will focus on the major environmental and heritage issues relating to Long Island and surrounding marine areas to ensure no damage is done to the island. For resort guests a full induction to the Abrolhos is planned to include a code of conduct for visitors, information about the protection of the environment from human activity, an educational programme about the heritage sites and their history and how to enjoy the islands while assisting in their protection.
Issue (Conservation Council) Impact of resort guests day tripping to other islands. Responsibility for management and monitoring. **HLD Response** A code of conduct and restrictions on approach distances for breeding birds and the presence of Australian sea lions on other islands will be implemented by the resort. Seasonal closures will be in place where required and impacts on birds on Long Island and other islands to be visited will be monitored as part of ongoing monitoring commitments as outlined in the Avifauna Management Plan. Measures will be implemented to reduce the risk of guests spreading weeds to other islands or to Long Island. All visits to other islands will be managed through the Visitor Activity Management Plan and escorted by resort staff or contractors and these tour leaders will be responsible for ensuring guests on their tours adhere to these measures.
Boat Moorings
Issue (Recfishwest) Responsibility for boat mooring design, maintenance and allocation. **HLD Response** The moorings installed by HLD would be constructed to the design currently used on all Department of Fisheries public moorings. This is a proven method of least disturbance to the seabed floor using pins instead of anchors. Boat moorings may be installed by HLD to the west of Long Island in order to provide safe anchorage for resort boats to Long Island and to avoid coral damage by anchor drops. These would be private moorings only for approved vessels' use and maintenance will be carried out by the resort. Any other moorings to be installed in this area are at the discretion of the Department of Fisheries who would be responsible for maintenance and allocation. Only moorings that HLD will own and operate will be for their exclusive use.
Issue (Conservation Council, Recfishwest, Tourism Coordinates) Additional impacts may be caused through lack of public moorings and day-tripper boats. **HLD Response** HLD understands that the Department of Fisheries will install additional moorings and be responsible for the location, and maintenance of any public moorings in the vicinity of Long Island to avoid the need to drop anchor. It is noted that such impacts may already exist with current unmanaged visitor levels and, while the impacts caused by day trippers anchoring and visiting Long Island outside the proposed development area is out of HLD's control, it will try to educate through interpretive signage for day trippers that arrive on shore.

Issues and HLD Response
Use of Existing Rock Lobster Fishing Accommodation on Neighbouring Islands during Construction
Issue (Tourism WA) Availability of accommodation during rock lobster fishing season, between mid March and the end of June. **HLD Response** The construction crew will comprise an estimated 35 workers at the Islands and 65 in Geraldton. An agreement has been reached with the local rock lobster fishers that during the off-season construction workers may be accommodated in the fisher's huts on nearby islands and ferried by boat to the island daily. If construction takes place during the lobster season workers will be accommodated in the (newly completed) staff quarters on the island.
Sewage
Issue (CALM) Risk management in case of sewerage treatment system failure. **HLD Response** The vacuum pump station will comprise two pumps that run on an alternating cycle (one pump is functioning while the other is on standby), which provides a significant contingency against pump failure. In the unlikely event of both pumps failing then collection pits will act as buffer tanks for a minimum of one day (at maximum wastewater outputs). In addition, the central collection and treatment tank has been designed to hold seven day's capacity of wastewater output.
Issue (CALM) Treatment and disposal of black water. **HLD Response** The wastewater management system to be implemented for the resort involves the combination of wastewater (both black and grey water) and then collection of this for processing in one centralised treatment unit. This will then yield a treated effluent, which will be released into Goss Passage for dispersal. Section 3.6.1.4 covers wastewater treatment in detail.
Natural Disaster Contingencies
Issue (CALM) Consideration to be given to evacuation procedures in the event of tidal surges, tsunamis and cyclones. **HLD Response** Emergency evacuation will be via helicopter and/or aeroplane, utilising the airstrip on East Wallabi Island. It is intended that non-critical evacuations will be transported via boat to the airstrip, while critical evacuations will be via helicopter direct from the island. The helipad will have the capacity to receive Medivac helicopters and as such will provide a useful emergency facility for the surrounding area. Evacuation procedures will be further addressed by the resort operator's emergency procedures which are not considered a matter for this PER.
Low Impact and Release Fishing
Issue (Recfishwest) A small section of Long Island should be available for 'Low Impact' fishing, with an emphasis on 'release' fishing. **HLD Response** In keeping with the ethos of the resort, HLD believes that no shore fishing should take place by resort guests or resort-associated day visitors and the activity will be prohibited. Notwithstanding HLD recognises that the Department of Fisheries is the regulatory body for fishing at the Abrolhos

Issues and HLD Response
and shore based fishing on Long Island outside of the ROA is not currently restricted by Fisheries legislation.
Extension of the Beacon Island Reef Observation Area (ROA)
Issue (Recfishwest) Proposal to extend the Beacon Island ROA to the waters around Long Island is excessive. **HLD Response** Research shows ROAs are effective in protecting marine life and larger predatory species are known to increase in number under such protection. ROAs maintain the pristine environment, which will benefit resort guests and day visitors taking part in snorkelling and diving activities. The Department of Fisheries plans to review the boundaries of the all of the current ROAs at the Abrolhos and HLD plans to lobby the Department to extend the Beacon Island ROA to encompass the waters around Long Island to legally prohibit fishing activities.

7. ENVIRONMENTAL IMPACTS AND MANAGEMENT

7.1 IDENTIFICATION OF ENVIRONMENTAL IMPACTS

An "environmental impact" is defined as a modification in the status of the environment by a proposed action. Environmental impacts may affect the natural or social components of the environment and may be positive (beneficial) or negative (adverse). They may occur either as a primary result (direct) or as a secondary result (indirect) of the action, and may be temporary/short duration (short term) or permanent/long lasting (long term). Impacts may vary in magnitude from no change or only a slight discernable change, to a significant change in the status of the environment.

The environmental factors and impacts associated with the Long Island resort development were identified by HLD in consultation with EPA, DoE, CALM, Western Australian Museum and Department of Fisheries and through discussions with relevant stakeholders.

The environmental assets of greatest value that could potentially be impacted are:

- Seabirds and seabird breeding areas.
- Marine environment, including tidal ponds.
- Cultural heritage.

Other factors identified include:

- Carrying capacity.
- Terrestrial flora and vegetation.
- Terrestrial fauna (non-bird), including Australian Sea Lion (*Neophoca cinerea*).
- Landforms and soils.
- Conservation areas.
- Other islands (tourism impacts).
- Pollution:
  - Air quality.
  - Water quality.
- Visual amenity.
- Recreation.
- Rock lobster fishers.
- Wastewater disposal.

Other issues raised by stakeholders include:

- Site selection.
- Conflict of interest with Department of Fisheries (in relation to site selection).
- Evacuation procedures in the event of tidal surges, tsunamis and cyclones.

- Low impact and release fishing.
- Extension of the Beacon Island Reef Observation Area (ROA).

7.2 MANAGEMENT, MONITORING AND MITIGATION

In order to manage the potential impacts of the proposal on the environment a number of management plans will be developed and implemented. The plans will cover all aspects of the proposal to include:

- Construction management (including induction).
- Avifauna management and monitoring.
- Marine management and monitoring (including benthic habitat monitoring, water quality monitoring and diver/snorkeller management).
- Resort environmental management and monitoring.
- Staff induction.
- Visitor activity management, including visitor induction (day-trippers and overnight guests).
- Heritage management.
- Decommissioning and rehabilitation.
- Weed management.
- Vermin/pest management.
- Dangerous and Hazardous substances management.

The Construction Management Plan addresses management and mitigation measures for all environmental factors relevant to the construction stage of the project. The remaining management plans will address the environmental factors associated with the operational and decommissioning (where relevant) stages of the project as described in Section 7 of this PER.

7.3 CARRYING CAPACITY

7.3.1 Environmental Objective

To ensure the sustainable ecological and recreational carrying capacity of the local and regional environment is not exceeded by the proposed development.

7.3.2 Definition

In ecological terms, the carrying capacity of an environment is the size of population that can be supported by that environment for an indefinite amount of time without harm occurring to that environment. In terms of tourism and recreation, carrying capacity describes the limit of use or exploitation an environment can withstand. Beyond this limit the impact of tourism

activities is unacceptable. In this way, carrying capacity determines the maximum number of people that can use a destination without causing unacceptable harm to the environment.

7.3.3 Visitors to the Abrolhos Islands

From an extrapolation (16% per annum) of 2003/2004 (5,324 visitors) visitor records (Section 5.2.1 – Table 5.1), it is estimated that during the 2005/2006 period up to 4,500 tourists and 2,500 fishers and friends/relatives of fishers may visit the Abrolhos Islands by air charter. Approximately two-thirds of the tourist visits (about 3,000 tourists) are estimated to occur during the rock lobster fishing season of 15 March to 30 June each year.

Based on records of a local air charter tour operator, approximately 40% of air charter visitors may be overseas tourists, while most of the other visitors would be fishers, friends/relatives of fishers and Australian tourists. Overseas tourists could possibly be up to 10% (450 tourists) of the total projected annual tourist visitation to the islands.

In a normal stabilised year of operation (the first of which is projected to be year 4 of operation), it is envisaged that an average occupancy rate of 53% will be achieved. This reflects a projected range of 40% occupancy received in identified low months, 55% occupancy in shoulder periods and 80% occupancy in peak periods. This equates to 5,801 rooms sold per year, with 2 persons per room, totalling 11,602 guest nights per year. The average stay per guest is anticipated to be 2.2 nights, meaning that an average of 5,275 guests are expected at the resort per year (Jones Coulter Young, 2005). Ten staff will be accommodated at the resort on a year-round basis, with these staff being rotated off the island for breaks.

There is no formalised land-based tourist facility in the Wallabi Group or the Abrolhos Islands and it is projected (Section 2.2) that the Long Island tourism development will attract up to 5,275 guests in a typical stabilised operating year (Jones Coulter Young, 2005). Of this number, a projected (approximately) 2,000 guests will visit the resort during the rock lobster fishing season, based on guest seasonality coinciding with all the “premium” months and half of the “shoulder” month of March as shown in Table 7.1.

It is projected that the long-term market breakdown for Long Island resort would be 35% Western Australians, 15% other Australians and 50% international visitors. They will mainly be new visitors to the Abrolhos Islands and will be in addition to the existing visitation. It is expected that some of the existing visitors to the Abrolhos Islands may not utilise the overnight accommodation, but may use add-on services offered by the resort.

A breakdown of the annual visitation to the Wallabi Island Group is given in Table 7.2.

Table 7.1: Long Island Resort Guest Seasonality

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Island variables												
Temperature												
Wind speed												
School holidays												
Guest seasonality	**LOW**		**SHD**	**PREMIUM**		**SHOULDER**				**LOW**		
Market types												
Diving												
Fishing												
Windsurfing												
General leisure												
Corporate												
Family												
Nature/heritage												
Educational groups												
Local A1 fishermen and families												

Temperature	Mean maximum air temperatures >26 degrees	Mean max air temperatures 23-26 degrees	Mean max air temp <23 degrees
Wind speed	Consistent very strong winds	Strong winds in afternoon	Mild winds

Source: Jones Coulter Young (2005), pg. 7

Table 7.2: Projected Annual Visitation to Wallabi Island Group

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Fisher camps (land based)													
Rock lobster season													
Friends/relatives (air charters to East Wallabi and to a much lesser extent to Rat and North Islands)*			2,500										2,500
Long Island Resort													
Long Island guest seasonality	**LOW**		**SHD**	**PREMIUM**			**SHOULDER**			**LOW**			
Overnight guests[#]	338	305	465	656	677	451	465	465	450	338	327	338	5,275
Boat/air visitation (mainly non-land based)^	200		3,000				1,000			300			4,500
Total	843		7,749				2,380			1,303			12,275

*From Section 5.2.1, Table 5.1, line 1.
[#] Source: Jones Coulter Young (2005), based on a stabilised year of operation.
^ From Section 5.2.1, Table 5.1, lines 2, 3 and 4 based on conservative extrapolation of 16%.

7.3.3.1 Potential Impacts

The Long Island resort will provide a land-based tourist presence within the Wallabi Group that previously did not exist. The presence of the Long Island guests will potentially increase the number of sea-based users within the Wallabi Group by up to 75% during the rock lobster fishing season and 200% out of season. This is an overall annual increase of about 115%.

Potential impacts include:

- Promotes tourism in the area, provides a focal point for visitors and provides economic benefits to the wider community.
- Enables education of visitors and the wider community on the values of the Abrolhos environment.
- Increased visitation to Long Island and other islands through an increased number of people participating in tourism activities may lead to environmental degradation.
- Increase in recreational fishing pressure may lead to a reduction in fish populations.
- Increase in the number of boats visiting the island may lead to loss of amenity and increased chance of a sullage spill or an introduced marine pest.

7.3.3.2 Management and Mitigation Measures

The resort operator is extremely conscious of the need to ensure tourists to the Long Island resort have an enjoyable and rewarding experience during their stay. They do not wish to impair the very experience people have come to the region to enjoy. The resort operator will have in place management plans to assist guests in appreciating the natural beauty of the area without degradation or overpopulation of the Abrolhos Islands.

Management measures include:

- All guests to Long Island will be required to undergo an Induction Programme.
- Implement monitoring and the Visitor Activity Management Plan.
- Integrate management of the resort with the wider management of the Abrolhos by Department of Fisheries and AIMAC.
- Only licensed charter fishing operators will be used.
- There will be no fishing permitted on Long Island.
- Charter fishing activities will be conducted on a ‘catch-and-release’ basis with the exception of 1 fish per person for personal consumption.
- Implement procedures for dealing with boats landing on the island with or without permission.
- Implement procedures to manage the number of boats going to Long Island (e.g. moorings, etc).
- Implement a Resort Environmental Management and Monitoring Plan during the operation of the resort.

7.3.3.3 Predicted Environmental Outcome

It is anticipated that the proposed management measures taking into consideration carrying

capacity, as well as the management measures proposed for the environmental factors of biodiversity, pollution management and amenity will help to ensure that environmental impacts are minimised and managed appropriately.

7.4 BIODIVERSITY

7.4.1 Terrestrial Flora and Vegetation

7.4.1.1 Environmental Objectives

- To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.
- Protect declared rare and priority flora, consistent with the provisions of the *Wildlife Conservation Act 1950* and the *EPBC Act 1999.*
- Protect other flora species of conservation significance.

7.4.1.2 Standards and Legislation

The following legislation is applicable to this proposal in relation to terrestrial flora and vegetation:

- *EPBC Act 1999* (Cth).
- *Environmental Protection Act 1986* (WA).
- *Wildlife Conservation Act 1950* (WA).
- *Conservation and Land Management Act 1984* (WA).

7.4.1.3 Potential Issues

Activities associated with the construction and operation of the resort have the potential to cause:

- Temporary or permanent loss of native vegetation that may result in the loss of potential flora species.
- Increased wind erosion due to clearing of vegetation during construction.
- Degradation of seabird nesting habitat through removal of vegetation.
- Trampling of vegetation during construction and by guests during operation.
- Weed introduction by construction workers, guests or day visitors.

7.4.1.4 Impact Assessment

The total footprint of the development upon Long Island, above the average high tide mark, will be approximately 0.89 hectares, or about 7.5 percent. Of this, the main development zone consists of approximately 0.5 hectares of buildings and 0.14 hectares of boardwalk. The remaining 0.35 hectares consists of 0.11 hectares for the northern boardwalk and 0.14 hectares for the southern boardwalk. Plate 14 shows the shrubland typical of the proposed development zone.

Table 7.3 outlines the area of expected terrestrial clearing by vegetation community type.

Table 7.3: Expected Area of Terrestrial Vegetation Clearing By Vegetation Community

Vegetation Community	Disturbance	Area Disturbed (m^2)	Area Disturbed (ha)	Total Community Area (m^2)	Total Community Area (ha)	Percent Disturbed
Beach	Northern and Central Boardwalk	44.37	0.00			3.87%
	Subtotal	**44.37**	**0.00**	**1147.87**	**0.11**	**3.87%**
Coral Rubble	Northern and Central Boardwalk	678.63	0.07			2.08%
	Southern Boardwalk	382.91	0.03			1.18%
	Subtotal	**1061.54**	**0.11**	**32552.11**	**3.26**	**3.26%**
a2,mZi cCi	Northern and Central Boardwalk	45.83	0.00			0.86%
	Southern Boardwalk	25.65	0.00			0.48%
	Subtotal	**71.47**	**0.01**	**5321.83**	**0.53**	**1.34%**
eZi s2Ci	Northern and Central Boardwalk	20.43	0.00			1.82%
	Subtotal	**20.43**	**0.00**	**1123.75**	**0.11**	**1.82%**
m,nSr a2Zc	Northern and Central Boardwalk	278.19	0.03			1.54%
	Subtotal	**278.19**	**0.03**	**18015.09**	**1.80**	**1.54%**
m,nZp sGi, uFi	Buildings	945.48	0.09			14.59%
	Northern and Central Boardwalk	39.20	0.00			0.60%
	Southern Boardwalk	343.08	0.03			5.29%
	Subtotal	**1327.76**	**0.13**	**6480.13**	**0.65**	**20.49%**
m,oZi sGr	Northern and Central Boardwalk	93.34	0.01			3.11%
	Subtotal	**93.34**	**0.01**	**3001.37**	**0.30**	**3.11%**
mSp a2Zc xGr s2Fi	Buildings	4103.99	0.41			19.90%
	Northern and Central Boardwalk	1304.47	0.13			6.33%
	Southern Boardwalk	181.40	0.02			0.88%
	Subtotal	**5589.86**	**0.56**	**20621.81**	**2.06**	**27.11%**
oZr sGr	Southern Boardwalk	324.56	0.03			13.03%

Vegetation Community	Disturbance	Area Disturbed (m^2)	Area Disturbed (ha)	Total Community Area (m^2)	Total Community Area (ha)	Percent Disturbed
	Subtotal	**324.56**	**0.03**	**2490.92**	**0.25**	**13.03%**
s3Ci	Northern and Central Boardwalk	2.96	0.00			1.08%
	Subtotal	**2.96**	**0.00**	**274.58**	**0.03**	**1.08%**
tZi s3Ci	Southern Boardwalk	97.24	0.01			5.47%
	Subtotal	**97.24**	**0.01**	**1778.57**	**0.18**	**5.47%**
Grand Total		**8928.49**	**0.89**	**120379.75**	**12.04**	**7.42%**

The main development zone is mostly covered by the mSp a2Zc xGr s2Fi vegetation community (Sparse scrub of *Myoporum insulare* over an *Atriplex* species heath with a mixed species sparse grassland and *Senecio lautus* [sic] herbfield). This vegetation community covers approximately 17 percent of the island. The development footprint covers approximately 27.11 percent (2.06 hectares) of this vegetation community.

Harvey *et al.* (2001) identified five vegetation communities of conservation significance that occurred on the Abrolhos Islands. Of these, the *Atriplex cinera* dwarf shrubland occurs on Long Island. This vegetation community is significant as it provides habitat for burrowing seabirds where the sand beneath these shrublands is sufficiently deep.

Atriplex species dwarf shrubland covers approximately 5.7 hectares (47.5 percent) of Long Island. The development footprint covers approximately 0.64 hectares, or 10 percent, of the *Atriplex* species dwarf shrubland vegetation associations on the island. The remainder of the development is located over coral rubble surfaces devoid of vegetation.

Impacts on *Atriplex cinera* dwarf shrubland resulting from the construction and operation of the resort may include:

- Clearing of vegetation for foundations and access ways. This is estimated to be ten percent of the total footprint or 0.18 hectares of *Atriplex* dwarf shrubland (about three percent of total).
- Shading of the remaining *Atriplex* dwarf shrubland both underneath and around buildings and boardwalks. This is estimated to be approximately 0.42 hectares.

During the October 2005 site visit, the Priority 4 species *Lepidium puberulum* was located on the western side of the development close to the exclusion zone for Tidal Pond 504. This species may be disturbed through direct clearing or trampling during construction.

A total of 14 weed species are widespread across Long Island and within the proposed tourism development area.

The long-term impact on vegetation and flora for construction and operation of the resort is expected to be:

- The permanent disturbance of 0.18 hectares associated with suspended foundation supports and service compound foundations and slabs.
- The temporary loss of 0.42 hectares, due to shading from suspended infrastructure, is expected to re-establish on decommissioning and removal of infrastructure.

7.4.1.5 Management and Mitigation Measures

HLD will minimise the impact on vegetation through the following measures:

- The resort buildings and boardwalks will be raised on piled supports approximately 500 millimetres above the ground. The supports will be constructed of alternative compact steel piling system or concrete using minimal sized footings. This will reduce the total area of clearing required. Where vegetation within the footprint of the development is higher than the projected floor height, this vegetation shall be pruned to an appropriate height instead of being removed where possible.
- Impacts to flora and vegetation will be minimised by implementation by the contractor of construction activities in accordance with the Construction Management Plan.
- Construction staff will be given environmental specific inductions.
- In order to minimise the amount of vegetation trampled during construction and decommissioning all access ways shall follow the alignment of the boardwalk where possible or be aligned on temporary access over resistant coral rubble surfaces that are devoid of native vegetation.
- Trampling of vegetation will be monitored by resort staff as part of the Resort Environmental Management and Monitoring Plan.
- An avifauna expert will be on site during the start of construction to advise on methods to minimise impacts on vegetation important for bird habitats.
- During operation, the boardwalks will formalise access around the island. No guests or visitors shall be allowed to walk on other parts of the island away from the boardwalks. There is one exception to this. A 'beach trail' will be established from the end of the northern boardwalk enabling guests to return to the resort along the beach on the eastern side of Long Island, ultimately connecting up with the boardwalk again at a point approximately 400 metres walk along the beach. This walk will be well marked with interpretive signage detailing the environmental and cultural aspects along the route. This signage will also highlight the importance of following the trail and the impacts that occur when people stray from the trail.
- Prior to construction a thorough search for the CALM Priority 4 flora species *Lepidium puberulum* will be conducted within the proposed areas of impact and the location of all individuals found will be recorded with a GPS. The location of *L. puberulum* individuals will be marked such that they are visible to the construction crew and can be avoided where possible. The construction workforce will be briefed on the significance of this species and how to identify it.
- Weed invasion will be controlled through procedures contained in a Weed Management Plan (Appendix 16). Procedures and measures include:
    - Roles and responsibilities of resort staff and contractors.
    - Procedures to be followed and monitoring and reporting requirements.
    - Emphasis on education of guests, visitors, staff and contractors on the importance of weed management and ensuring weeds are not introduced to or spread around the Abrolhos Islands.
    - Upon arrival guests/staff will be requested to stand on a large mat that has been doused with antiseptic solution. This will be on the jetty and could be adjacent to interpretive signage. Guests will be requested to inspect their socks and shoes for weed material such as seeds. They will also be requested to brush off the soles of their shoes. These two mechanisms are one of the main ways in which weeds are spread.

- A quarantine area on the mainland where goods will be loaded. This area will be kept clear of weeds and routinely checked by trained staff.
- Plant hygiene and ensuring all equipment and vehicles are clean prior to entering or leaving Long Island.
- Education of all staff, contractors, guests and visitors in ensuring their person and equipment is free of vegetative matter prior to entering or leaving the island.
- Areas within the services compound which require clearing will be clearly defined on plans and on the ground, and clearing activities will be supervised.

7.4.1.6 Predicted Outcome

Some loss of vegetation is inevitable as clearing will be required during construction of the resort. However, by raising the buildings and boardwalk off the ground and using minimal footings the amount of vegetation cleared will be kept to a minimum. It is not expected that construction, operation and decommissioning of the resort will impact upon the conservation status of either individual species or the vegetation of Long Island.

Taking into account the management and mitigation measures outlined above, the environmental objective for terrestrial flora and vegetation will be achieved.

7.4.2 Terrestrial Fauna

7.4.2.1 Environmental Objective

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

7.4.2.2 Standards and Legislation

- *EPBC Act 1999* Migratory Species List (inclusive of the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA) and Bonn Convention).
- *EPBC Act 1999* Listed Marine Species.
- Wildlife Conservation (Specially Protected Fauna) Notice 2006.
- CALM Threatened and Priority Fauna Database.

7.4.2.3 Bird Species

Birds of Conservation Significance

Within the Abrolhos Islands as a whole, eight species of birds are protected under the Western Australian Wildlife Conservation (Specially Protected Fauna) Notice 2006 (*Wildlife Conservation Act 1950*) and are Declared Threatened Fauna. A further three species are known as CALM Priority 4 Species. One of these species, the Brush Bronzewing, is known to occur at Long Island although has not been recorded breeding on the island (see section 4.6.1.6).

Many bird species of the Abrolhos have also been given protection under the *EPBC Act 1999*. Of the birds occurring in the Abrolhos as a whole, 10 species have been declared

Threatened Species (see section 4.6.1.6). None of these species have been observed on Long Island.

A total of 32 species occurring within the Abrolhos are protected as Migratory Species under the *EPBC Act 1999* (see section 4.6.1.6). Of these species, 11 have been observed on Long Island, with five of those species known to breed on the island (see Table 4.6).

Potential Impacts

A survey of avifauna was carried out in September and December 2005 to assess, in part, the numbers of migratory waders utilising areas of Long Island (Surman 2006a). A total of three migratory wader species were observed (Grey-tailed Tattler, Ruddy Turnstone, Red-necked Stint) as well as the resident the Red-capped Plover. Previous reports indicate that a further four species visit Long Island intermittently: Greenshank, Bar-tailed Godwit, Grey Plover and Sanderling (Coate 2005, Storr *et al.* 1986).

During the surveys, three areas of importance to waders were identified: Tidal Ponds 506, 507, and coral ridge areas adjacent to Tidal Pond 507. These areas are utilised by waders as foraging areas and coral ridge areas as shelter during high tides and from the prevailing southerly winds.

The intertidal reef flats located along the eastern shore of Long Island also provide important foraging opportunities for migratory waders. Similarly, the intertidal reef that joins Long Island to Short Island provides foraging habitat and roosting habitat for a number of birds, principally terns and some migratory waders.

The potential impacts of the development on migratory birds and their habitats include:

- Direct disturbance to habitat within the lease area that is required for the construction of accommodation, access boardwalks and landing facilities.
- Increased disruption to roosting or feeding behaviour of *EPBC* listed Migratory Species from increased human traffic and associated operations.
- Potential injury, disorientation or death to *EPBC* listed Migratory Species from collision with development infrastructure due to inappropriate lighting.
- Alteration to foraging habitat.

Table 7.4 demonstrates the expected areas of various habitats to be cleared.

Table 7.4: Expected Area of Habitat Clearing

Habitat	Disturbance	Area of Disturbance (ha)	Area of Habitat (ha)	Percent Disturbed
Coral Ridges				
	Buildings	0.16		3.72%
	Boardwalk - North	0.05		1.16%
	Boardwalk - Central	0.02		0.47%
	Boardwalk - South	0.08		1.86%
Subtotal		**0.31**	**4.30**	**7.21%**
Low Sand Dunes				
	Buildings	0.23		15.75%
	Boardwalk - North	0.03		2.05%
	Boardwalk - Central	0.00		0.00%
	Boardwalk - South	0.02		1.37%
Subtotal		**0.28**	**1.46**	**19.18%**
Vegetation				
	Buildings	0.15		3.30%
	Boardwalk - North	0.03		0.66%
	Boardwalk - Central	0.08		1.76%
	Boardwalk - South	0.04		0.88%
Subtotal		**0.30**	**4.55**	**6.59%**
Total		**0.89**	**10.31**	**8.63%**

Impacts to threatened species are believed to be minimal. During the September/October and December 2005 avifauna surveys, no readily identifiable impacts to these species were noted. However, fishing practices associated with deep water fishing charters may attract shearwaters, petrels or albatrosses, which may become entangled in fishing lines whilst attempting to procure fish baits.

The potential impacts of the development on Threatened or Priority Bird Species include:

- Attraction to vessels associated with the construction or operation phase of the development.
- Potential injury, disorientation or death to birds from collision with development infrastructure due to inappropriate lighting.
- Inadvertent injury associated with deep water fishing activities.

Other potential impacts to all birds include:

- Disturbance caused by guest activities.
- Impacts associated with helicopter arrivals/departures.
- The potential for certain species to become nuisance species through guests feeding birds or through the presence of alternative water/food sources. This particularly relates to Silver Gulls.
- Impacts from inappropriate solid waste disposal.

- Impacts from oil spills or other dangerous substances spills.
- Impacts from collapse or damage to burrows.
- Impacts associated with vermin or pest species.

Table 7.5 provides an estimate of the direct impacts of the resort on *EPBC* listed threatened and migratory bird species of Long Island.

Table 7.5: Estimated Direct Impacts of Resort on Threatened and Migratory Bird Species of Long Island

Migratory/ Threatened Bird Species	Nesting Habitat Type on Long Island*	Estimated No. Pairs on Long Island#	Percent Habitat Disturbed^	Est. No. Pairs Directly Displaced	Notes
Bridled Tern (*EPBC* Listed Migratory)	Vegetation	250	6.59 %	16	Based on the nesting sites being evenly distributed within the identified nesting colonies (see Figure 16). Some or all of these birds may relocate to the undisturbed southern portion of Long Island or other islands nearby.
Caspian Tern (*EPBC* Listed Migratory)	Coral Ridges	1	7.21 %	0	The alignment of the boardwalk avoids this nest site so the pair will not be directly displaced.
Wedge-tailed Shearwater (*EPBC* Listed Migratory)	Low Sand Dunes	Breeding not observed in 2005 surveys.	19.18 %	Unknown	Numbers of breeding pairs will be determined during the tri-annual surveys. Long Is. noted to be the least important nesting colony for this species in the Houtman Abrolhos (Table 4.5)
White-breasted Sea-Eagle (*EPBC* Listed Migratory)	Nesting outside development area	1	0	0	The nest site for this pair is on the southern portion of the island beyond the direct impact of resort development. The pair may habituate to humans or relocate to another island.
Eastern Reef Egret (*EPBC* Listed Migratory)	Nest site adjacent to western shore	1	0	0	Nest site in a section of collapsed limestone cliff face. Boardwalk and resort will not directly affect this area.
Bar-tailed Godwit (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island
Greenshank (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island
Grey-tailed Tattler (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island
Ruddy Turnstone (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island

Migratory/ Threatened Bird Species	Nesting Habitat Type on Long Island*	Estimated No. Pairs on Long Island#	Percent Habitat Disturbed^	Est. No. Pairs Directly Displaced	Notes
Sanderling (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island
Red Necked Stint (*EPBC* Listed Migratory)	N/A	0	0	0	Nesting not known from Long Island
Brush Bronzewing (Abrolhos Pop.) (WA *Wildlife Conservation Act* Wildlife Conservation (Specially Protected Fauna) Notice 2006 "Priority 4 Species")	N/A	0	0	0	Nesting not known from Long Island

* Habitat Types as described in Section 4.6.1.4.
# Based on the data supplied in Table 4.5
^ Figures from data supplied in Table 7.4

Management and Monitoring

The management and mitigation strategies to be adopted to minimise impacts to all bird species are outlined in the Avifauna Management Plan (Surman 2006b) (Appendix 4). In addition to the strategy outlined in the Avifauna Management Plan the proponent will undertake the following strategies to minimise disturbance to both habitat and species of birds:

- Wherever practicable, disturbance to landforms will be minimised
- Wherever practicable, removal of, or disturbance to vegetation will be minimised
- Construction activities will be coordinated to reduce impact on the breeding cycle of resident birds, particularly burrow-nesting species.
- Construction activities through the sandy nesting areas will be monitored by suitably qualified personnel.
- All movement on the island will be kept to designated pathways to reduce disturbance to areas away from the development.
- All personnel associated with operations on Long Island will be inducted into the key points of the Avifauna Management Plan.
- All disturbances to landforms during construction will be overseen by suitably qualified personnel to ensure compliance with the management strategies set out in the Avifauna Management Plan.
- Tri-annual surveys of established monitoring sites on Long Island and control islands will be undertaken to monitor changes in avifauna distribution, population sizes or reproductive success.
- The proponent will manage lighting of vessels, resort buildings and accommodation units during construction and operations of the development to reduce attractive powers of lighting (see section 7.6.3.5 and the Avifauna Management Plan – Appendix 4).
- No fish offal, bait or other fishing waste will be disposed of at sea, or in the vicinity of seabirds.

- Contractors operating fishing vessels will be inducted in methods to avoid capture of seabirds with baited hooks.
- Flight paths of helicopters/planes will be fixed and will be over water rather than flying over islands. Aircraft will not come within 1000 metres (laterally) of islands (other than Long Island or East Wallabi Island when landing). These measures reflect recommendations of the Great Barrier Reef Marine Park Authority.
- Helicopters will have a fixed flight path around the northern limits of Long Island and approach from the north-west, which is downwind of the prevailing winds, thereby minimising noise levels at the island.
- Flights will be during the day and not during the night, to avoid disturbance to burrow-nesting birds.
- Float planes must land at least 300 metres from Long Island and slowly taxi to the jetty.
- Speeds of jet skis and motorised boats will be governed by low speed, low noise. A five knot limit will be imposed on all resort vessels including jet skis within 200 metres of islands.
- Jet skis will be subject to "no go" areas sensitive to birds and sea lions and seasonal closures. Islands that are "closed" should not be approached closer than 200 metres. Details of these areas are provided in the Avifauna Management Plan (Appendix 4) and the Visitor Activity Management Plan.
- All visits to other islands will be guided and numbers will be strictly limited, with numbers depending on the sensitivity of the environment. Wildlife viewing tours are likely to be restricted to 6-12 guests. During visits to other islands, any traversing of islands will be done strictly on existing tracks. Where no tracks exist, guests will remain on beach areas around the perimeter to prevent the collapse of bird burrows and to maintain the lowest possible profile to assist in minimising bird disturbance.
- The potential for Silver Gulls or other species to develop into nuisance species (affecting their health and the natural species balance on the island) will be minimised through a staff/visitor induction programme explaining the problems with feeding fauna and interpretive signage at key points in the resort.
- All food scraps and solid wastes will be removed from the island and kept secure prior to this time. Silver Gull populations will be monitored as part of the Avifauna Management Plan. Waste management is addressed in sections 7.6.4, 7.6.5 and 7.6.6.
- Oil spills and dangerous substances will be managed as outlined in Section 7.6.8.4.
- The collapse of burrows is a risk in the construction phase, and this is addressed in the Construction Management Plan (see Appendix 3). The collapse of burrows is also a risk during operation of the resort if guests or staff stray off the boardwalk and wander over the island. This risk is managed in the Visitor Activity Management Plan.
- The potential impacts of vermin or pest species on birds is addressed in section 7.4.2.4 and in the Vermin/Pest Management Plan (Appendix 17).

7.4.2.4 Other Terrestrial Fauna

Native Species

Terrestrial (non-bird) fauna of the region includes the Tammar Wallaby, the Southern Bush Rat and 23 species of reptiles. The Tammar Wallaby is a Priority 5 listed species. The

Tammar Wallaby is known to occur on East and West Wallabi Islands as well as North Island, where it was introduced from the Wallabi Islands (Abbott and Burbidge, 1995). The Southern Bush Rat occurs on East and West Wallabi Islands.

The Abrolhos Dwarf Bearded Dragon and the Houtman Abrolhos spiny-tailed skink are listed as CALM Priority 4 species. The Abrolhos Dwarf Bearded Dragon is endemic to the Abrolhos and the spiny-tailed skink is found on Pigeon Island, Tattler Island and East and West Wallabi Islands within the Wallabi group as well as islands in the Southern Group and Easter Group. The Carpet Python is listed under Schedule 4 (otherwise specially protected fauna) of the *Wildlife Conservation Act 1950* (WA). The Carpet Python has been recorded from West Wallabi Island and there is evidence that it also occurs, or has historically occurred, on North Island and East Wallabi Island.

Only one species of terrestrial fauna is found on Long Island, the skink *Menetia greyii.* This skink is also found on North Island and composite islands in the Easter and Southern Groups. The skink is also found on the mainland. *M. greyii* is known to live under slabs of coral rubble or in vegetation litter.

Potential Issues

During construction, the clearing of vegetation on Long Island for the resort is likely to disturb some habitat of the skink *M. greyii*. Other construction related impacts include noise and dust disturbance.

There is potential for some habitat areas on Long Island to be affected by fire and weed species.

During construction, operation or decommissioning of the resort, there is potential for habitat to be trampled.

There is potential to disturb the habitat of species of conservation significance through visits to other islands such as West Wallabi, East Wallabi and North Island. However, none of these islands will be visited by the resort guests, with the exception of East Wallabi. Guests will be collected from the East Wallabi airstrip and visits will also be made to Turtle Bay, which will be approached from the water. Resort guests will not be sightseeing on the island or walking over the island.

Some other islands may be visited that may host unrecorded populations of fauna of conservation significance. There is potential for damage to habitat to result from these visits.

Impact Assessment

The species *M. greyii* is not of particular conservation significance and is common throughout the composite islands of the Abrolhos and on the mainland. The total area of disturbance as a result of resort construction will be about 0.18 hectares. Part of the skink's habitat is under coral slabs and the disturbance to coral slabs during the construction process is likely to be minor. The other habitat for the skink was in vegetation litter, indicating that it does not rely on live vegetation cover as habitat. Impacts associated with dust and noise during construction are likely to be minor. As the resort will be raised on footings rather than laid on the ground, the ground disturbance and therefore dust generation will be minimal. Noise impacts will be minimised through management strategies. The skink is highly mobile and therefore it is likely that any individuals residing in the area of disturbance will naturally move away from the areas of increased human activity and relocate to adjacent areas.

The impacts on terrestrial fauna on other islands including species of conservation significance are predicted to be negligible. The most important islands from a conservation view point (West Wallabi and East Wallabi) will not be visited by resort guests except as listed above.

Management and Mitigation Measures
HLD will minimise the impacts on terrestrial fauna by implementing the following:

- The project layout has been designed to minimise the clearing of vegetation. The resort area and boardwalks will be raised on footings 500 millimetres above the ground level and this will minimise vegetation cleared and also facilitate fauna movements around the island.
- Construction impacts such as dust generation and noise will be minimised through the implementation of the Construction Management Plan (CMP).
- Habitat trampling will be minimised. All construction workers, staff, resort guests and day trippers will be inducted in the importance of remaining on the boardwalks at all times. Signage will be installed to reinforce this message.
- During construction and decommissioning fixed pathways will be used that will, where possible, follow the alignment of the boardwalk.
- The potential disturbance to listed species or other fauna on other islands is not considered a likely occurrence. East and West Wallabi Islands will not be visited other than to use the airstrip or to use Turtle Bay which will be approached from the water only.
- Guests may visit other islands in close proximity to Long Island. However, these islands will only be visited as part of an escorted tour and only during appropriate times with consideration being given to bird nesting and the presence of sea lions. Any traversing of islands will be done strictly on existing tracks.
- Management of impacts related to fire and weed introduction are addressed in Section 7.8 and the Weed Management Plan, respectively.

Predicted Environmental Outcome
Taking into account the management and mitigation measures outlined above, it is considered that the environmental objective for fauna will be achieved.

Introduced Pest/Vermin Species
Potential Issues
There are several records of introduced fauna species occurring in the Abrolhos. The Department of Fisheries (2003) reports that cats and rats have contributed to the local extinction of wedge-tailed shearwaters, sooty terns and common noddy on Rat Island. House mice and rabbits have been recorded on several islands in the Abrolhos. Long Island is currently free of introduced terrestrial fauna.

Impact Assessment
There is potential for the resort development to lead to the introduction of pest or vermin species to Long Island. This could occur during the construction, operation or decommissioning phase.

With boat arrivals from the mainland anticipated to occur on most days (especially during the peak tourist season), there is potential for pest species to arrive on boats. Pests may also be

transported in cargo, whether transported by air or sea. As rats have been known to swim over short distances, boats moored adjacent to Long Island may also be a potential source of vermin.

Should vermin such as rats and mice become established on Long Island, a severe impact on the birds and also the skinks would be likely to result. As reported by the Department of Fisheries (2003), introduced species can contribute to local extinctions.

Management and Mitigation Measures

Management and mitigation measures will be implemented to reduce the risk of vermin related impacts on Long Island, the details of which are provided in the Vermin/Pest Management Plan (Appendix 17). The plan includes:

- In the first instance, the need to prevent vermin/pests from reaching the island. Since many of the supplies will be coming to the island via the Broadwater Resort in Geraldton, supplies to be stored at this facility and will be quarantined. All goods will be examined for the evidence of vermin/pests. This will be done through the setting of flour trays and baited traps to detect the activity of rodents. Spraying for insect pests will be conducted in the Broadwater quarantine facility. Staff will conduct visual inspections, looking for droppings or nesting materials.
- The storage rooms at the Broadwater Geraldton facility will be treated by pest eradication professionals periodically. This may also apply to the areas where food will be partially prepared for sending to the island.
- As excess packaging will be removed prior to shipping stores to the island, staff will also take this opportunity to examine the packages for evidence of vermin.
- Boats used in transport, supply of gas/fuel or in recreational tour activities may also be a source of vermin/pests. All boat owners/skippers will be required to periodically complete thorough checks of their vessels and supply a written guarantee that their vessel is free of vermin/pests. This will include the need for vessel owners to conduct periodic trapping, baiting and spraying and visual inspections for signs of vermin on a regular basis.
- All construction personnel working on Long Island will be required to undergo a full Site Induction Programme including the importance of vermin prevention (particularly rats and mice), hygiene and recording vermin sightings. Construction personnel will be required to check all materials, vehicles, machinery, tools and boats used during the construction phase for vermin presence and complete the relevant checklist prior to leaving Geraldton.
- If vermin are sighted during construction phase, identify target fauna as vermin and follow procedure for immediate removal as outlined in the Management Plan. The cause of vermin occurrence will be investigated and corrective actions to prevent reoccurrence will be implemented.
- A vermin inspection of the whole facility will be conducted post construction, prior to the full operation of the resort. The removal of any vermin identified should take place in line with the Management Plan.
- There is a chance that vermin may still reach the island, for example, from day-tripper boats that are moored close the island. On-island vigilance will be required to make sure vermin are detected early and eradicated. Kitchen staff will conduct regular visual inspections of the kitchen and maintenance staff will regularly inspect grease trap and sewage treatment areas for vermin. Flour trays will be deployed in the kitchen and dry stores area. These will be checked twice each day for signs such as footprints or droppings that could be evidence of vermin/pest presence. A series of baited traps will

also be set in these areas as a precaution. No baits or traps will be placed in areas where they could be inadvertently eaten by native fauna.

- Should vermin/pests be sighted, staff will follow the procedures in the Vermin/Pest Management Plan for internal reporting and eradication.
- Another potential attraction for vermin could be garbage in guest rooms. Guests will be requested to tie tops of garbage bags once food has been put inside bags. All wastes will be removed daily from guests and staff quarters.

Predicted Environmental Outcome
Given the management and mitigation procedures outlined above and to be further documented in the Vermin/Pest Management Plan, it is considered that the environmental objective for this factor will be met.

7.4.3 Marine Environment

7.4.3.1 Benthic Habitats

Environmental Objective
To maintain the integrity, ecological functions and environmental values of the seabed and coast.

The EPA's Guidance Statement No. 29 addresses the protection of Benthic Primary Producers (BPP) such as seagrasses, seaweeds, turf algae and corals. It covers both BPP and BPP Habitats (BPPH), that is, the BPPs and the substrate that can or does support them.

The EPA recommends the delineation of a management unit of 50 square kilometres in which issues such as ecosystem integrity, cumulative impact and biodiversity are addressed (EPA, 2004), although the EPA does consider larger units, such as Cockburn Sound (approximately 100 square kilometres) based on ecological principles. A proposed management unit of 50 square kilometres (five by 10 kilometres), centring on Long Island, is given in Figure 18. The location of the management unit was chosen to include the nearby islands (Beacon, Pigeon etc) around which historic impacts may have occurred, and to place Long Island towards the centre of the area.

Within this management unit the following calculations are required:

1. All loss/damage to BPPH caused by human activities since European habitation of Western Australia;
2. Current area of BPPH; and
3. Loss/damage of BPPH likely to result from proposed works.

The BPPH guidance statement defines six categories of marine ecosystem protection and the cumulative loss thresholds for each. The area surrounding Long Island consists of both Category A (Department of Fisheries (DOF) Reef Observation Area to the north and east of Long Island) and Category C (Fish Habitat Protection Area covering the majority of the Wallabi Group) BPPH classes. The cumulative loss thresholds (% of original BPPH within management unit) for these areas are 0% and 2% respectively (EPA, 2004). As the vast majority of the proposed 50 square kilometres management unit is classed as Category C, and any future direct habitat losses resulting from the proposed development will occur within areas that come under this category, the cumulative loss of habitat will be assessed against the two percent threshold (i.e. cumulative loss of up to two percent of the historic BPPH is seen as meeting EPA objectives).

Current Extent of BPPH within Management Unit

The current coverage of BPPH within the management unit can be calculated from the habitat coverage data obtained from the work undertaken by Hatcher *et al.,* 1998 and Webster *et al*., 2002 (Table 7.6).

Table 7.6: Marine Habitat Coverage within Proposed BPPH Management Unit

Geomorphological Units	Sensitivity Class	Area (ha)
Isolated Patch Reefs	High	326.1
Drowned Doline Field	High	711.0
Complex Karst Platform	High	1131.7
Sheltered Reef Slope	High	498.4
Sub-total		2667.2
Exposed Reef Slope	Moderate	270.4
Submerged Platform	Moderate	472.9
Back Reef	Moderate	59.8
Sub-total		803.1
Emergent Platform	Low	253.1
Static Sediment Deposit	Low	318.9
Storm Rubble Field	Low	148.7
Sub-total		720.7
Unclassified		809.1
TOTAL		**5000.0**

(Data from Webster *et al*., 2002)

Historic Losses of BPPH

Human Habitation Impacts

The benthic habitats surrounding Long Island are relatively undisturbed but those surrounding islands on which fisher's dwellings can be found (West Wallabi, Pigeon, Little Pigeon, Alcatraz and Beacon Islands) are likely to have been affected by nutrient and waste inputs and some physical damage from boating activities. However, emergent platform, which has been classified as exhibiting a low sensitivity to physical disturbance, surrounds most of the coastline of these islands, with the exception of Beacon Island (Webster *et al*., 2002). It is likely that this habitat type (low relief limestone platforms with dense turfs of fleshy and calcareous algae and encrusting invertebrates dominant in areas protected from desiccation) also exhibits the lowest sensitivity to nutrient inputs. Therefore it is likely that only minimal degradation of benthic habitats has occurred adjacent to these islands. Beacon Island, surrounded by sensitive complex karst platform, is likely to have experienced greater impacts due to anthropogenic activities.

As no pre-impact habitat data is available for these areas, the extent of historic habitat impacts has to be estimated. It seems appropriate, given little information on the extent of impacts, to assume that any habitat within 20 m of the developed shoreline will have been severely modified by turbidity, sedimentation or scour impacts from berthing vessels and nutrient inputs from associated untreated waste disposal. As the south and west coasts of Beacon Island are fringed by shallow reef and are therefore not accessible by sea and are undeveloped, these areas will not be included in the calculation of historic habitat impacts.

Lobster Fishing Impacts

Wider damage across the Wallabi Group is likely to have been caused by the operation of lobster fishers. However, it has been estimated that only a relatively small proportion of the total potting effort occurs in water depths less than 20 metres (25% within Wallabi Group (Webster *et al*., 2002) and therefore only a small proportion of sensitive habitats are subject to potential damage (Webster *et al*., 2002, Hatcher *et al*., 1988, Wright *et al*., 1988), and that within the Wallabi Group only 0.31% of highly sensitive habitats (and 0.39% of moderately sensitive habitats) are impacted by lobster pots annually (Webster *et al*., 2002). For the purposes of estimating cumulative impacts, it will be assumed that some of the corals within highly sensitive habitats may take up to 10 years to recover, corals within moderately sensitive habitats are likely to recover within five years and corals within low sensitivity habitats will recover within one year. Therefore the worst-case cumulative impacts on highly sensitive habitats, for example, have been calculated by multiplying annual damage estimates by 10.

The Department of Fisheries undertook groundtruthing of geomorphological units previously mapped by Hatcher *et al*. (1988) and collected information on the intensity of rock lobster fishing effort in the islands using aerial surveys, interviews and existing catch and fishing effort data (Webster *et al*., 2002). From this information the distribution of fishing effort between each habitat type was estimated. The percentage surface area of low, moderate and high sensitivity communities impacted by rock lobster pots within each island group was then estimated. This data can be used to estimate possible historic BPPH losses within the proposed Long Island management unit, but comprises estimates of possible impacts over each island group and is not suitable for the detailed calculation of historic BPPH losses due to rock lobster fishing.

Tourism Impacts

In the Wallabi Group 17 scuba diving sites were identified (Webster *et al*., 2002) with the number of anchoring events annually estimated at 135. Boats were found to selectively anchor within sediment areas when visiting sensitive habitats (Webster *et al*., 2002) but it is likely that some damage is caused by anchoring and diver activity. As the number of anchor drops annually (135) is much less than the number of lobster pot drops (273,000), for which impacts were estimated (Webster *et al*., 2002), historic habitat losses from tourism impacts within each habitat class have been estimated as being up to 10% of those resulting from commercial fishing operations.

Estimated Impacts on BPPH

Given the above information, it seems likely that only a very small area of BPPH within the proposed management unit has been severely impacted by historic activities, with an estimation of the proportion of habitat classes (classed by their sensitivity to physical disturbance; Webster *et al*., 2002) impacted (not lost) given below (Table 7.7).

Table 7.7: Estimated Historic Impacts on BPPH within Marine Management Unit

Cause of Impacts	Approximate Area of Impacts (ha)	Approximate Proportion of Habitat Sensitivity Class Impacted (%)		
		High*	Moderate**	Low***
Human habitation	10.76	0.05	0.10	0.59
Commercial fishing[#]	1099.93	3.10	1.95	0.36
Tourism	109.99	0.31	0.20	0.04
TOTAL	1220.68	3.46	2.25	0.99

Notes:

** High sensitivity habitats calculated by multiplying annual damage estimates by 10 (estimated ≤10 years to recover)*

*** Moderate sensitivity habitats calculated by multiplying annual damage estimates by 5 (estimated ≤5 years to recover)*

**** Low sensitivity habitats calculated estimated to take ≤1 year to recover*

[#] Figures obtained from estimates of the proportion of Wallabi Group habitats impacted together with the estimated longevity of impacts.

Data from Webster et al., 2002. Figures for high and moderately sensitive habitats are likely to represent 'worst-case' impacts, with more rapid recovery of habitats likely.

7.4.3.2 Potential Issues

Direct Loss/Damage of BPPH Expected from Proposed Pipeline Construction and Operation

The desalination and wastewater effluents will be discharged into Goss Passage, on the east side of Long Island, as the currents in this deep channel will be relatively strong (predominantly northwards) which will cause the effluent to be rapidly diluted. The close proximity of live corals to the shoreline at the proposed outlet site, together with the near-shore basin formed by shallow reef structures approximately 13 metres from the shoreline, means that discharge of the desalination effluent to the swash zone, considered initially, is not an appropriate strategy. It is likely to be less damaging to benthic communities to dispose of both effluents to 10 metres below sea level (BSL).

Discharge to 10 metres BSL is proposed to ensure that the TWW effluent is rapidly diluted and that there is no risk of the ANZECC/ARMCANZ (2000) guidelines for primary contact recreation being exceeded away from the area of initial dilution, and that the end of the outlet pipes are not visible from the ocean surface or the island.

The wastewater outlet pipe is anticipated to be approximately 0.05 metres in diameter and will cross approximately 70 metres of benthic habitat before reaching the required depth. The desalination wastewater outlet pipe is anticipated to be approximately 0.10 metres in diameter and will run alongside the wastewater outlet pipe. Details regarding the pipeline placement and anchoring are yet to be finalised, but it is likely that the inshore section of the outlet pipes will be placed within a one metre wide excavated trench, to be back-filled by rubble or concrete, so that it is less visible from the island as it runs across the shallow bedrock. The offshore portion of the outlet pipes, to the east of the shallow reef area, could be laid directly onto the seabed and held in place by rubble/concrete or steel pins. This methodology would likely result in the direct loss of up to a total of 70 square metres of benthic habitat including construction phase impacts.

The likely disturbance to each habitat type caused by construction/placement of the outlet pipes is presented in Table 7.8. The trenching/surface laying of the pipes would cause the disturbance of up to 0.005 hectares of live corals (44 square metres of shallow *Acropora* spp. reef with approximately 100% coral cover and 11 square metres of bedrock/coral rubble with approximately ≤ 40% coral cover) and have a total footprint of 0.007 hectares. The losses of each benthic habitat type which would result from the proposed method of outlet pipes construction represent the overall loss of less than 0.01% of habitats mapped during this study (Table 7.8) and cause disturbance well below the two percent (of the 50 square kilometres BPPH management unit) cumulative loss threshold set out in the guidance statement (EPA 2004).

Furthermore, within areas around Long Island, the loss of corals from physical damage during construction will be temporary and natural growth of existing colonies and recruitment from new settlement should fill gaps within a few years. The coral habitat (defined here as substrate suitable for coral growth) will not disappear.

Most of the areas to be affected by construction impacts will be those where branching or tabulate *Acropora* are prevalent. These corals are relatively fragile and more easily impacted by turbidity than the submassive corals such as the Faviids. Typical *Acropora* habitat at the Abrolhos Islands sees *Acropora* colonies which have grown until they abut (or nearly so) each other. In these areas, *Acropora* commonly grows at 8-15 cm/yr (MSA 1998) until it contacts another coral, at which stage it stops growing. Loss of some *Acropora* will see the resulting empty space filled quickly by restarted growth. Where distances between corals are too large for growth to span (generally 1-2m) recruitment should occur.

Salvage of large coral colonies prior to the installation of the discharge pipe with subsequent re-attachment over the pipe could reduce the period for complete re-colonisation of the area from several years to around 1 year. However, the expense is unlikely to be warranted and in this area of active coral growth, recovery is best left to natural processes as recommended in a recent review of coral offset programs (Jokiel 2005).

Table 7.8: Predicted Direct Benthic Habitat Losses within BPPH Management Unit Resulting from Outlet Pipes Placement (Trench/Surface Laying Method)

Habitat Type	Habitat Sensitivity	Habitat Class	Approximate Area of Impacts (ha)	Proportion of Habitat Sensitivity Class within Management Unit Impacted (%)
Sand and coral rubble	Low	Mobile sediment sheets	0.0011	0.0002
Intertidal reef	Low	Emergent limestone platform	0.0004	0.0001
Bedrock/coral rubble with *Acropora* spp.	Moderate	Emergent limestone platform	0.0011	0.0001
Shallow *Acropora* spp. reef	High	Drowned doline fields	0.0044	0.0002

Indirect Loss/Damage of BPPH Expected from Proposed Pipeline Construction
Significant indirect impacts from turbidity or suspended sediment are not expected during construction of the pipeline as the shallow portion to be excavated contains relatively few

corals, and trenching will be of short duration. Over the offshore dense coral area the pipeline will simply be laid in place and anchored. Activities that generate high turbidity will not occur over the predicted coral spawning periods (expected to be 4-5 days in March or April).

Impacts from Discharge of Treated Wastewater and Desalination Water

The near-field dispersion characteristics of the desalination and wastewater discharges were modelled using the 'Visual Plumes' (VPLUMES) model (Frick *et al*. 2001). The VPLUMES programme is an initial dilution model accepted for use by the United States Environmental Protection Agency (http://www.epa.gov/). The initial dilution phase occurs from point of discharge to a point of maximum rise or fall (e.g. reaching the surface of the water body).

The UM3 initial dilution model, which is part of the Visual Plumes (VPLUMES) suite of dilution models (Frick *et al.* 2001), was applied to the proposed wastewater and desalination discharges from Long Island for a range of ambient conditions.

The UM3 numerical model, its predecessor PLUMES and other similar models (e.g. CORMIX), are designed to model the near-field behaviour of plumes—that is, the behaviour in the region where the plume first enters the surrounding waters and then (in the case of positively buoyant plumes) rises and mixes with the surrounding waters. These models capture simple features concerning the surrounding environment such as depth at point of discharge, net current and wind speed. However, because the models do not take into account broader scale bathymetry and hydrodynamics, these models generally do not accurately predict the far-field behaviour—that is, the behaviour after the plume has reached the surface or is fully mixed in the water column. Three-dimensional baroclinic or barotropic hydrodynamic models are required to better estimate far-field behaviour, but are not considered necessary for modelling low volume and rapidly dissipating discharges where the relevant management criteria are met in the near-field.

The parameters used within the model set-up are given in Table 7.9. It can be seen that the flows of both the desalination discharge and treated wastewater are very small. The treated wastewater discharge pipe will require a diameter of ~ 2.5 cm (i.e. not much larger than a garden hose) while the desalination water discharge pipe will have a diameter of 10 cm with 25 mm ports. The treated wastewater has been modelled as coming from an open-ended pipe as it is considered unlikely that ports would be engineered for such small flows.

The desalination discharge has been modelled as being discharged through a tee fitted to a 1 metre high "riser". The design requires an elbow at the seabed, rising vertically for 1 metre and ending in a tee fitting. The tee would be 0.3 metres long and the desalination discharge would exit from the two 25 mm diameter ports discharging vertically at the ends of the tee. It is envisaged that the elbow will be set in a concrete block pinned to the seabed, with no other support.

Table 7.9: Marine Model Set-up Parameters

Parameter	Input value
Treated wastewater effluent	
Outlet pipe diameter	0.05 m
Outlet depth	10 m (MSL)
Discharge rate	17 kL/day ($2.0x10^{-4}$ m^3/s)
Discharge salinity	~2 psu
Ambient salinity	35 psu
Discharge temperature	22°C
Ambient temperature	20°C
Current direction	Longshore
Current speed	Modelled for 0.1 knot (calm)
Discharge nutrient concentrations*	Total Nitrogen (TN) 30 mg/L Total Phosphorus (TP) 12 mg/L
Desalination effluent	
Outlet pipe diameter	0.10 m
Outlet depth	10 m (MSL) with a 1-metre riser (at 9 m depth)
Discharge rate	140 kL/day ($1.6x10^{-3}$ m^3/s)
Discharge salinity	~45 psu
Ambient salinity	35 psu
Discharge salinity	22°C
Ambient temperature	20°C
Current direction	Longshore
Current speed	Modelled for 0.1 knot (calm)
Discharge nutrient concentrations	n/a

*Notes: * Based on the manufacturer's estimated upper limits*

No data on current velocities through Goss Passage are available. However, it is well documented that wind shear at the water surface produces surface currents. Wind driven surface currents have speeds of about 2% of the wind speed (http://www.dlwc.nsw.gov.au/care/water/estuaries/factsheets/physical/movement.html#wind). Summer winds at the Abrolhos are most commonly from the south-east and south-west with speeds in excess of 20 kilometres per hour (>5.5 m/s) occurring 76 percent of the time and exceeding 32 kilometres per hour (>8.8 m/s) 44 percent of the time. Therefore it is likely that surface currents of over 0.2 knots (0.11 m/s) will occur throughout the Abrolhos during much of the summer season. As Goss Passage is a deep channel separating the shallow region surrounding East and West Wallabi Islands, Pigeon Island and Long Island from Beacon Island it is likely that currents will be 'funnelled' through, reaching speeds in excess of 0.2 knots over much of the summer. Winds tend to be weaker in the winter months (Webster *et al*. 2002). In addition to the wind-driven currents the Leeuwin Current and its eddies reach speeds in excess of about 1 knot, although speeds of 2 knots (1 m/s) are common (http://www.marine.csiro.au/LeafletsFolder/44leuwin/44.html). Therefore it is likely that currents in excess of 0.1 knots (and up to 3 knots) will occur within Goss Passage through the

year, and therefore modelling of the near-field dispersion of the wastewater and desalination effluent has been carried out using a current speed 0.1 knot. This will be the worst case as higher current speeds result in increased mixing and dispersion.

Wastewater Discharge

On discharge at 10 m below sea level, the treated wastewater effluent, which is more buoyant than seawater, will rise towards the surface, mixing with the ambient seawater as it does so. Under low current speeds (0.1 knot) the model predicts that the plume will fully mix with ambient seawater and first reach the water surface within ~20 m of the discharge point (see the ambient plume boundary[1] in Figure 19). As the discharge flows are so small, under higher current speeds, the effect of the plume buoyancy is quickly overcome by the larger mixing forces associated with the ambient current and turbulence at the seabed. The plume will be drawn away from the discharge point and rapidly mixed with ambient seawater near the seabed.

Modelling suggests that the treated wastewater effluent will achieve an average initial dilution of 1:10,000 within 20 m (Figure 20). Beyond this distance, the plume can be considered to be fully mixed with the water column. The extremely rapid dilution is due to the combination of very low flows and the buoyancy of the treated wastewater.

Primary productivity in WA's marine waters is strongly limited by the availability of nitrogen (e.g. Lord & Hillman 1995, Lourey *et al* 2006) and as such, it will be the availability of surplus nitrogen that may cause impacts through increased primary productivity in the vicinity of the discharge. The nitrogen concentration within the wastewater discharge will be 30 mg/L, which will primarily be in the form of nitrate+nitrite (NO_2+NO_3). Based on measurements of background concentrations of NO_2+NO_3 reported by Marine Science Associates & Environmental Contracting Services offshore from Rat Island in 1998 (26 values), a dilution of approximately 1:3,500 of the treated wastewater discharge with background seawater containing NO_2+NO_3 at a concentration of 14.5 ug/L will be required to reduce the NO_2+NO_3 concentrations to the 80th percentile of background values (Table 7.10)[2]. Modelling for calm conditions has suggested that the dilution required to achieve the 80th percentile of background dissolved inorganic nitrogen concentrations should be attained well within 20 m of the discharge point (Figure 20), and monitoring will aim to confirm this. Chlorination of the treated wastewater such that there will not be any measurable bacterial count in the effluent stream, coupled with the high level of initial dilution means that there is no risk of any exceedence of human health criteria.

Table 7.10: Dilutions required for wastewater NO_2+NO_3 levels to reach background (80th percentile) concentrations

Concentration of NO_2+NO_3 in seawater[#] (ug/L)	Concentration of NO_2+NO_3 in wastewater[##] (ug/L)	Dilution required to reach 80th percentile
Median: 14.5 80th percentile: 23.0	30,000	~1:1,600

[#] *based on values reported by Marine Science Associates & Environmental Contracting Services (1998)*

[1] The ambient plume boundary corresponds to the area at which concentrations in the plume are estimated to be equal to the ambient conditions.

[2] The survey of dissolved inorganic nitrogen concentrations in seawater at Long Island by Oceanica in 2005 recorded 6 values, which were in the range reported by Marine Science Associates & Environmental Contracting Services (1998).

[##]*treatment plant manufacturer's upper estimates.*

The effects of sustained nutrient inputs to coral communities can influence a variety of ecological aspects including (Dr. Jim Stoddart, pers comm., MScience, November 2005):

a) Eutrophication in poorly-flushed areas;

b) Decrease in reproductive output;

c) Lowered settlement rates;

d) Increased growth in corals leading to fragile colonies; and

e) Increased mortality in some species.

However, such impacts occur only following sustained addition of nutrients into poorly-flushed waters so are unlikely to occur due to the proposed discharge (low discharge rate, well-flushed waters and highly buoyant discharge) (Dr. Jim Stoddart, pers comm., MScience, November 2005). It is likely that any impacts on the surrounding coral habitats due to elevated nutrient concentrations, if they occur at all, will be limited to an increased risk of lower reproductive output, altered growth patterns and perhaps increased mortality of some species within a radius of approximately 30 metres (long-shore or towards the surface) of the end of the outlet. Effects of the discharge on the other habitats in this area may be visible as a slight increase in the growth of macroalgae on bare rock substrate. It is extremely unlikely that any impacts from the construction or operation of the outlet will occur within the Reef Observation Area.

Desalination Water Discharge

The desalination effluent will be ~30% more saline than the ambient seawater (i.e. salinity of 45.5) and will therefore tend to stay near the seabed following discharge. For this reason a 1-metre riser will be attached to the end of the desalination outlet pipe and fitted with a 25 mm tee to enhance initial mixing. Once discharged, the saline water will mix with the ambient seawater reaching the range of background salinity after approximately 1:66-fold dilution within 3.3 metres of the outlet at the approximate depth of 9 metres (Figure 21 and 22). By the time the plume reaches the seabed (10m depth) the average initial dilution will be 1:94 (4.2 metres from the outlet). The background salinity and range for the region was based on information provided by Lourey *et al*. 2006, where a median salinity of 35.6 was used as the mid-point of a range of 0.3 (i.e. a 1:66 dilution of a plume of salinity 45.5 results in a salinity of 35.75). The high level of dilution is a result of the relatively small flows (1.6 L/s) from the outlet.

Although corals are resistant to high salinities in some regions of the world (e.g. the Arabian Gulf), mortality of Abrolhos corals, which do not have a history of exposure to elevated salinities, is likely following prolonged exposure. However, such impacts are likely to be limited to the area immediately surrounding the discharge point (≤ 5m to the north, south and east, with no impacts anticipated up-slope to the west). As such, negligible coral losses are expected to result due to the discharge of saline desalination waters.

Proposed Mixing Zone for Management

It is proposed that a mixing zone with a radius of 30 m is prescribed (refer Figure 23) for the outlet. The proponent will commit to managing the discharge so that all relevant physical, nutrient and primary contact human health criteria are met at the edge of this mixing zone (refer Marine Monitoring and Management Plan in Appendix 6). The radius of 30 m is relatively small and provides an additional degree of conservatism with regard to the model results which predicted that all parameters would achieve background levels within 20 m of the point of discharge.

Direct Loss/Damage of BPPH Expected from Proposed Jetty Construction and Operation

An L-shaped jetty is will be constructed off the western side of Long Island, reaching approximately 35 metres offshore with the 30 metres long north-south berthing face extending over the reef slope into a water depth of greater than five metres (mean sea level). It is proposed that the east-west section of the jetty be approximately six metres wide, and secured by rows of 0.45 metre diameter steel piles, and the north-south section approximately eight metres wide and secured by rows of 0.45 metre diameter steel piles. Direct impacts on the benthic habitats in the area will therefore arise from the placement of piles into the seabed, with the offshore piles from the north-south section of the jetty possibly being placed into the reef wall at an angle (not vertical) (table 7.11).

Table 7.11: Predicted Direct Benthic Habitat Losses within BPPH Marine Management Unit Resulting from Jetty Pile Placement

Habitat Type	Habitat Sensitivity	Habitat Class	Approximate Area of Impacts (ha)*	Proportion of Habitat Sensitivity Class within Management Unit Impacted (%)
Sand and coral rubble	Low	Mobile sediment sheets	0.0018	0.0002
Coral rubble & sand with live sub-massive corals & brown macroalgae	Low	Complex karst platform	0.0010	0.0001
Branching *Acropora* spp. 'stands'	High	Drowned doline fields	0.0047	0.0002

** Estimate based on three rows of piles along E/W section and four rows of piles along N/S section, piles being 3 m apart along length, 1 m^2 of habitat loss per pile (for example 18 m wide strip of sand and coral rubble habitat with three piles every three metres = 0.0018 ha of habitat loss).*

Indirect Loss/Damage of BPPH Expected from Proposed Jetty Construction and Operation

Indirect losses may result during the construction of the jetty and during the operation of the jetty (for example from scour due to propeller wash). To minimise turbidity and suspended solids production during the construction of the jetty, the screw pile technique will be used, which is the best method for the least disturbance of surrounding area and generation of turbidity. No spoil is created during installation as no pre-excavation is required before installing the piles. It is also the quickest technique, using medium to high resolution rotations of 0.45 metre wide screw piles. This technique is relatively quiet and vibration free. Substrate is made up of coarse coralline sand (over a limestone platform) that is not expected to carry significant distances or be suspended for a significant length of time.

Indirect impacts due to the operation/use of the jetty are likely to be limited to shading of the habitats directly beneath the jetty (approximately 450 square metres) and turbidity/suspended solids/scour effects adjacent to the offshore side of the jetty associated with the mooring and manoeuvring of vessels (approximately 250 square metres if impacts limited to a 50 metres long, five metres wide area along the offshore side of the jetty).

As significant events in sediment mobilisation and transport are relatively brief, they are difficult to detect (and thus manage) through practical monitoring programs. Thus monitoring of water quality during construction is not planned.

Direct Loss/Damage of BPPH Expected from Proposed Helipad Construction and Operation

The helipad will be situated within an area of sand and coral rubble, with no live corals or macroalgae (surveyed in October 2005), to minimise the environmental impacts of this structure. The helipad will float on the water surface and be secured in place by four large anchors or four piles. The anchors/piles will cause the total loss of approximately four square metres of habitat.

It is proposed to construct a floating walkway from the helipad to the shore, and this will cross approximately 25 metres of unvegetated sand and coral rubble habitat plus a short distance (approximately five metres) of the habitat 'coral rubble and sand with live sub-massive corals and brown macroalgae'. Direct damage to the latter habitat is likely to be limited to approximately three square metres* due to the placement of support anchors/piles (placed to avoid the few obvious *Acropora* sp. corals in this area) (*assumes one anchor/pile every three metres, two rows of piles, one square metre of habitat loss per pile).

Indirect Loss/Damage of BPPH Expected from Proposed Helipad Construction and Operation

Indirect impacts from the helipad (measuring approximately eight x eight metres) and associated walkway will be limited to the shading of approximately 15 square metres of vegetated habitat (coral rubble and sand with live sub-massive corals and brown macroalgae) by the three metre-wide walkway and the shading of approximately 140 square metres of unvegetated sand and coral rubble habitat by the helipad and walkway (64 square metres under helipad and 75 square metres under the walkway).

Direct Loss/Damage of BPPH Expected from Proposed Snorkelling Platforms Construction and Operation

It is proposed that two short snorkelling platforms be constructed to give the resort visitors easy access to shallow (less than or equal to one metre) water. It is proposed that two such structures be built, extending up to five metres from the shoreline, and overlying sand and coral rubble habitat within the proposed snorkelling area. The placement of piles into the seabed will lead to the loss of up to five square metres of habitat.

Indirect Loss/Damage of BPPH Expected from Proposed Snorkelling Platform Construction and Operation

The snorkelling platforms are likely to be built from steel/wooden piles with grating used for the deck, thereby reducing the amount of shading caused by the structures. Minimal shading of predominantly high energy, unvegetated habitat is likely to occur.

Direct Loss/Damage of BPPH Expected from Increased Tourist Activities

The area surrounding Long Island is currently used for recreational purposes by an unknown number of visitors each year (2,871 tourists and visitors were known to visit the Abrolhos islands in 2004, but it is not known what proportion of these visited Long Island (Emily Stoddart, pers comm., UWA, October 2005). Increased use of the surrounding area by diving or fishing charter vessels, or by commercial fishers, could potentially cause additional impacts within the proposed BPPH management unit. Those vessels associated with the resort will need to adhere to the speed limits adopted by the resort and any prescriptions included in the Visitor Activity Management Plan.

No resort associated vessels will be allowed to anchor outside of designated mooring areas, which will be located within sand areas. Impacts from diving trips organised from the resort will be minimal as no vessels will be anchored outside designated mooring areas (over sand). Although inexperienced divers are known to cause some physical damage while diving over reef habitats (Rouphael and Inglis 1995), the damage caused to corals is usually minimal, with parts of corals but no whole colonies potentially damaged (Harriott *et al*. 1997) (see Marine Management and Monitoring Plan – Appendix 6).

A snorkelling/swimming area has been defined in an area where sand and coral rubble habitat provides access to deep (greater than one metre) water, to avoid the trampling of sensitive habitats. Areas identified to support dense live corals within 0.5 metres (MSL) of the water surface will be closed to snorkellers to provide protection from fin and arm impacts (Figure 24). Therefore no habitat losses are expected.

For vessels not associated with the resort, additional moorings will be supplied to prevent the need to drop anchor and damage benthic habitat. Visitors not associated with the resort will be educated through appropriately installed signage and communication with resort staff where necessary. Should any behaviour be observed that would result in environmental degradation, the Department of Fisheries will be notified as the controlling authority for the Abrolhos Islands.

Indirect Loss/Damage of BPPH Expected from Increased Tourist Activities
No indirect impacts, resulting from increased tourist activities managed by the resort, are expected within the area surrounding Long Island.

7.4.3.3 Impact Assessment - Cumulative Impacts within BPPH Management Unit

Estimates of the percentage of habitats historically impacted by rock lobster fishing, human habitation and tourism within the Wallabi Group suggest that up to a total of 6.8% of habitats within the proposed management unit could have been impacted. However, the estimates of rock lobster fishing impacts provided by the Department of Fisheries (Webster *et al*., 2002) have been calculated over each island group as a whole and are unlikely to be accurate when applied at a smaller scale. However, it is likely that some historic impacts have occurred within the management unit as a result of rock lobster fishing and associated activities. Losses of benthic habitats due to the proposal are expected to be minimal, with a maximum of 0.49 hectares of the 62 hectares of habitats surrounding Long Island mapped during this study potentially impacted (Table 7.12). The proportion of each habitat type surrounding Long Island potentially impacted by the proposal is generally small (less than one percent).

When considered in terms of the EPA's suggested 50 square kilometres management unit, no additional habitat impacts greater than 0.07% of the habitat class within the BPPH management unit are expected to result from the proposed resort, despite using worst case scenarios [for example one square metre of habitat loss per jetty pile when each pile has a footprint of 0.16 square metres and assumption of total shading by jetty deck when significant light will reach habitats under the margins of the jetty (and the jetty piles will represent additional hard substrate suitable for coral settlement and growth)]. Despite the historic impacts (some damage from rock lobster pots and loss/modification of habitats surrounding some islands inhabited by commercial fishers), it is expected that the cumulative loss of benthic habitats will be less than two percent [the cumulative loss threshold for Category C under the BPPH guidance statement (EPA 2004)] following the development of the resort (Table 7.13). No losses of BPP or BPPH are anticipated within the Reef Observation Area.

Table 7.12: Estimated Losses of BPPH within Mapped Area (62 ha)

Losses	Habitat Type (2005 mapping)	Area of Impacts (ha)	Proportion of Mapped Habitat Type* Predicted to be Lost (%)
Direct Losses			
Outlet pipe	Intertidal reef	0.0004	0.070
	Sand & rubble	0.0011	0.014
	Bedrock/coral rubble	0.0011	0.031
	Shallow *Acropora* sp. reef	0.0044	0.050
Jetty	Sand & rubble	0.0018	0.016
	Coral rubble & sand with corals	0.0010	0.014
	Branching *Acropora* spp. stands	0.0047	0.050
Helipad & boardwalk	Sand & rubble	0.0021	0.027
	Coral rubble & sand with corals	0.0003	0.006
Snorkelling platforms	Sand & rubble	0.0005	0.007
Tourism	Bedrock/coral rubble with *Acropora* spp.	0.0000	0.000
	Coral rubble & sand with corals/algae	0.0000	0.000
	Branching *Acropora* spp. 'stands'	0.0000	0.000
Indirect Losses			
Outlet pipes	Shallow *Acropora* sp. reef	0.2827	4.478
Jetty	Sand & rubble	0.0108	0.141
	Coral rubble & sand with corals	0.006	0.115
	Branching *Acropora* spp. stands	0.0532	0.763
Helipad & boardwalk	Sand & rubble	0.0140	0.183
	Coral rubble & sand with corals	0.0015	0.029
Snorkelling platforms	Sand & rubble	0.0000	0.000
TOTAL		0.3937	N/A

Notes: *From 2005 mapping of Long island habitats (62 ha).

Table 7.13: Estimated Losses of BPPH within the Proposed 50 km^2 Management Unit

Losses	Habitat Class[#]	Habitat Class Losses within Management Unit (%)
Direct Losses		
Outlet pipes	Emergent limestone platform	0.00
	Mobile sediment sheets	N/A
	Emergent limestone platform	0.00
	Drowned doline fields	0.00
Jetty	Mobile sediment sheets	N/A
	Complex karst platform	0.00
	Drowned doline fields	0.00
Helipad & boardwalk	Low sensitivity	0.00
	Complex karst platform	0.00
Snorkelling platforms	Low sensitivity	0.00
Tourism	Complex karst platform	0.00
	Complex karst platform	0.00
	Drowned doline fields	0.00
Indirect Losses		
Outlet pipes[@]	Drowned doline fields	0.04
Jetty	Low sensitivity	0.00
	Complex karst platform	0.00
	Drowned doline fields	0.01
Helipad & boardwalk	Low sensitivity	0.00
	Complex karst platform	0.00
Snorkelling platforms	Mobile sediment sheets	N/A

Losses	Habitat Class[#]	Habitat Class Losses within Management Unit (%)
CUMULATIVE LOSSES	High sensitivity	0.05
	Moderate sensitivity	0.00
	Low sensitivity	0.00
	TOTAL	0.05

Notes:

[#]Habitat classes from Webster et al. (2002).

[NA]Mobile sediment sheets not recorded within management unit area by Webster et al. (2002).

[@]Based on possible impacts within a 50 m radius (long-shore or towards the surface) of the outlet.

Management and Mitigation Measures

The proposal would result in a higher level of protection for habitats surrounding Long Island due to the following:

- Proposed eventual expansion of the Reef Observation Area to encompass all of Long Island.
- Increased provision of moorings (by Department of Fisheries), leading to less anchoring-dropping adjacent to Long Island.
- Enforcement of 'no-fishing' zone within 300 metres of the shoreline of Long Island.
- Increased awareness of environmental impacts within resort guests and day visitors through visitor induction, interpretive material and participation in activities.

Therefore the slight impacts expected due to the construction and operation of the jetty, helipad and outlet are likely to be outweighed, in the long-term, by improved management of the marine environment surrounding Long Island.

Table 7.14: Predicted Marine Impacts and Mitigating Factors

Issue	Process	Impact	Mitigating Factors
Direct loss of BPPH	Modification of habitats if outlet pipe laid on the surface and trench dug through reef features.	Modification of 0.007 ha of seabed, including 0.005 ha of dense shallow *Acropora* spp. reef (0.05% of this habitat type mapped surrounding Long Is).	Outlet path will be selected to minimise impacts. Back-filling of trench and rubble/concrete anchoring of pipe would counter the loss of hard substrate and new surfaces likely to be rapidly colonised.
Direct loss of BPPH	Modification of habitats beneath and adjacent to jetty.	Direct habitat loss due to pile footprint. Shading and minor turbidity impacts beneath and adjacent to jetty.	Use of piles to secure jetty will result in minimal (0.0057 ha) habitat loss and minimal turbidity during construction. Piles will act as new substrate for invertebrate colonisation. Habitats beneath the jetty will be shaded as a metal grill or mesh is not suitable for the decking surface. Annual monitoring of site during operation to ensure corals are not damaged more than 10m from jetty due to vessel operations. If corals are damaged beyond this zone, examine mitigation methods.
Direct loss of BPPH	Physical damage due to tourist activities – boat anchors, damage by snorkellers/divers.	Physical damage of shallow water sensitive coral habitats surrounding Long Island.	Designation and enforcement of 'no-go zones' around Long Island where shallow coral habitats are located. Diver/snorkeller management plan including thorough induction for all

Issue	Process	Impact	Mitigating Factors
			participants.
Change in coral/macroalgal community	Increased nutrient input into nearshore waters.	Potential for decreased reproductive output, altered growth patterns and increased mortality within some coral species. Potential increase in abundance of 'nuisance' green algae. Possible increase in cover of macroalgae on adjacent bare rock surfaces.	Low volume of TWW to be discharged. Discharge of highly buoyant treated wastewater effluent to highly dispersive environment. Potential impacts on coral limited to within 50 m of outlet. Annual monitoring of site. If growth depressed vs references by >25%: Mortality rate (including partial mortality) >25% higher vs references site, this triggers the need to mitigate by reducing nutrient inputs further.
Change in coral/macroalgal community	Discharge of saline desalination waters.	Increased mortality within corals immediately adjacent to discharge point.	Rapid dilution of saline discharge to background salinity (≤ 5m).
Change in habitat distribution	Shading (jetty and helipad/boardwalk) and turbidity/suspended sediment/scour (jetty use) effects.	Loss of coral habitat caused by shading, turbidity/suspended solids or scour effects around jetty.	Helipad and boardwalk predominantly over unvegetated habitat. Activities that generate high turbidity will not occur over the predicted coral spawning periods. Offshore edge of jetty over deep (> 5 m) water to reduce scour effects.

Predicted Environmental Outcome

It is expected that the cumulative loss of benthic habitats will be less than two percent of the cumulative loss threshold for Category C under the BPPH guidance statement (EPA 2004) following the development of the resort. Therefore it is considered that the environmental objectives for this factor have been met.

7.4.3.4 Vertebrate Marine Fauna

The vertebrate marine fauna of the Abrolhos are diverse. Australian Sea Lions are found at the northern limit of their range. Sea Lions are known to use the islands of the Wallabi Group as haul-out areas but not for breeding.

Other marine mammal species known to occur around the Abrolhos are the Humpback Whale, Bryde's Whale, Minke Whale, Bottlenose Dolphin and Striped Dolphin.

In addition to those listed above, the EPBC Protected Matters database lists a number of other marine mammals that may occur or whose habitat may occur in the area (Appendix 9). These are namely the Southern Right Whale, Blue Whale, Dugong, Dusky Dolphin and Killer

Whale. Anecdotal evidence indicates that the Australian Fur Seal and Common Dolphin are also visitors to the Abrolhos Islands (Dr. C Surman, pers. comm.).

The marine Green Turtle and Loggerhead Turtle are reported to be found in low numbers at the Abrolhos although there are no records of turtles breeding in the area. The Leatherback Turtle is also recorded on the EPBC Protected Matters database as potentially occurring in the area. Two sea snakes are recorded by the EPBC Protected Matters database as species that may occur or whose habitat may occur in the area.

The fish fauna species composition at the Abrolhos comprises 389 species, with 66 percent of these being tropical species, 19 percent of species being warm temperate species and 13 percent being subtropical species. Another two percent of species were of uncertain origin.

Searches of the CALM Threatened Fauna database and the EPBC Protected Matters Database identified 15 fish species of conservation significance. This list comprised three shark species and twelve species from the seahorse and pipefish family (Sygnathidae). The full results of these searches can be found in Appendix 9.

Potential Issues

Increased presence of humans at Long Island and visiting other islands nearby may disturb any Australian Sea Lions attempting to use the islands as a haul-out area. As Sea Lions may haul out at any point on an island, the potential for resort guests to come into close contact with Sea Lions exists at any point around the island. One point in particular is known to be a favourite haul-out site. This site is located north of the main development on the west side of the island (near tidal pond 503).

In addition to disturbance of Sea Lions, there is potential for humans to be injured through interaction with Sea Lions.

Disturbance of the benthos around Long Island through construction of the jetty, helipad and wastewater outflow pipe may generate minor short-term turbidity and damage habitat for fish.

Wastewater discharge or accidental fuel spill from the jetty or boats could lead to pollution of marine waters, affecting vertebrate marine fauna.

If unregulated, recreational fishing around Long Island could result in a decrease in local populations of fish.

Impact Assessment

There is potential for Sea Lions to be disturbed by guests walking along the boardwalk near the haul-out area, although it is anticipated that the Sea Lions, if disturbed, will move off to other suitable haul-out areas nearby.

The visitation to other islands by resort guests will be closely controlled and rules relating to Sea Lions will apply. Islands that are used for breeding by Sea Lions are not found in the Wallabi Group and will not be visited by resort guests. Therefore breeding Sea Lions will not be impacted.

During construction of the jetty, helipad and wastewater outlet pipe, the benthos will be disturbed and this may affect fish habitat. This has the potential to alter water quality over

short periods. The primary effect will be the suspension of sediments by disturbance of the bottom. Periods of elevated turbidity during construction are likely to be too brief to affect benthic communities through the reduction of light. Mobilisation of sediments with subsequent settlement onto adjacent benthos may cause physical impacts in the short or longer term by smothering organisms or impeding future settlement of larvae. Impacts on benthic habitats are addressed in Section 7.4.3.1 and the Marine Management and Monitoring Plan (Appendix 6).

Discharge of the treated wastewater to 10 metres below sea level will ensure that the total wastewater effluent is rapidly diluted and that there is no risk of the ANZECC/ARMCANZ (2000) guidelines for primary contact recreation being exceeded. See Section 7.6.5 for further details of treated wastewater quality.

Small quantities of fuel (petrol) for the quad bike, resort jet boat, glass-bottom boat and jet skis will be stored at the island. Diesel for primary power generation will be stored within self-bunded storage tanks.

The risk of fuel spills from boats is addressed in Section 7.6.6.

The likely effect of recreational fishing on local populations of fish that would be targeted is unknown, although it should be noted that certain areas of Long Island are part of the Beacon Island Reef Observation Area and fishing (other than rock lobster fishing) within this area is not permitted. Should guests wish to participate in deep-sea fishing, tours will be offered from the resort using sustainable techniques. These tour operators will be appropriately licensed and will be required to comply with the normal regulations as set out by the Department of Fisheries.

Management and Mitigation Measures
HLD will minimise the impacts on vertebrate marine fauna by implementing the following:

- In the area that is known to be a sea lion haul-out area on Long Island, the boardwalk will be raised to a height of two metres. This will prevent the physical interaction of humans and sea lions and prevent potential physical injury to both. By raising the boardwalk in this area, sea lions will be able to pass under the walkway and access the interior of the island, particularly the tidal pond 503.
- Resort guests and staff will receive information about Sea Lions as part of their respective inductions. This will include information to on Sea Lions being dangerous animals and information to minimise stress to Sea Lions. Interpretive signage will be installed on the boardwalk to further inform people about Sea Lions.
- Impacts to Sea Lions on other islands will be minimised through the Visitor Activity Management Plan (VAMP). The VAMP includes a section that states that no resort-associated tours will land on the beach of islands where Sea Lions are resting at that time. This measure will also ensure visitor safety. Resort guests will not be visiting other islands other than on escorted tours.
- Construction of the jetty will be done almost exclusively from a floating barge to prevent the need for heavy equipment to be resting on the benthos. This will minimise sediment mobilisation.

- During construction of the helipad, as much as possible of the helipad will be assembled prior to installation on the water. For construction that must occur on the water, a floating barge system will be used to minimise damage to the benthos and generation of sediment. Since the helipad will be floating and held in place with 4 large anchors, the sediment generation is expected to be minimal.
- Construction of the wastewater pipeline will have a direct impact on benthic habitat (see Section 7.4.3.2). However, the generation of sediment from this process is not expected to be great due to construction being largely through reef rather than over sand. Where possible, a floating barge will be used for construction.
- Discharge of treated wastewater is unlikely to have a significant impact on vertebrate marine fauna. The discharge water will be released to a depth of 10 metres to ensure adequate mixing. In addition, the water will be treated to a sufficient level to meet ANZECC/ARMCANZ (2000) guidelines for primary contact recreation. It is expected that some fish fauna currently living around the outlet pipe may relocate to other areas.
- The risk of a fuel spill that could damage marine habitat or directly affect vertebrate marine fauna is considered minimal. All fuels would be stored in a bunded area within the services compound.
- Diesel for primary power generation will be stored in a self-bunded area fully augmented with spill kits. Additionally standard ducting used for pumping fuel from diesel supply vessels into the shore based storage tanks (which already have spill/leak prevention redundancies built in as standard) would be double sheathed as an additional spillage risk mitigation measure.
- The risk of a fuel spill from boats visiting the island is addressed in Section 7.6.6.
- No recreational fishing of any kind will be permitted from the shore of the Island. This will ensure that the resort does not negatively impact the fish fauna of Long Island and this will also enhance snorkelling and diving experiences for guests. Preventing fishing from the island shore is in keeping with the nature-based, low impact theme of the resort.
- Numbers on deep-sea fishing trips will be limited. Fishing will be on a catch-and-release basis, although guests will be permitted to retain one fish per person to be prepared for their evening meal. The resort will not store fish for guests.

Predicted Environmental Outcome
Taking into account the management and mitigation measures outlined above, it is considered that the environmental objective for fauna will be achieved.

7.4.4 Tidal Pond Biodiversity

7.4.4.1 Potential Issues

The tidal pond that occurs within the development zone (known as "Pond 504" as per paper by Black and Johnson, 1997) will, at times, impact on the amenity of the resort. During extreme neap tides, the pond fails to drain thoroughly as it does during other higher tides. This causes the algae to begin to decompose leading to a foul smell (Study team, pers. observation, 2005). The problem is compounded on days of low wind (B. Humfrey, pers. observation). As the resort's restaurant and other facilities will be situated immediately adjacent to the pond, this is an undesirable outcome.

It is proposed to introduce additional seawater to pond 504 during days when environmental conditions (neap tide and low wind) may lead to the generation of an undesirable smell. It is intended that the additional seawater would imitate a naturally occurring higher tide event.

The need to introduce additional seawater is anticipated to occur up to three to four days per month at the most and will be most likely to occur during the less windy months of April - August.

The potential issue is the risk of this additional water negatively impacting on the unusual mollusc fauna of the tidal pond.

A further risk to the tidal pond is that of people walking on the pond edge leading to erosion of the banks.

It should be noted that there are approximately 50 tidal ponds occurring in the Abrolhos Islands and tidal pond 504 is not known to contain any unique species or ecosystems that distinguish it as more important than the other ponds in the Abrolhos.

7.4.4.2 Impact Assessment

The environmental values of the ponds on Long Island were discussed with the leading researchers in the field. Opinions were sought from Drs Robert Black, Mike Johnson and Jane Prince (all of University of Western Australia) and Dr Fred Wells (Department of Fisheries). It was the opinion of the researchers that the mollusc species whose presence in the tidal ponds of the Abrolhos represents a "range extension" for the species are the most unusual of the known species present and therefore perhaps the species of the most interest. For these species, the sediment layer in the pond is considered to be of importance, particularly the fact that it does not dry out at low tide as occurs in some other ponds. The proposal to slowly introduce additional seawater on occasional days would be unlikely to disrupt the sediments and therefore the molluscs living within would be unaffected (M. Johnson, R. Black, pers. comm., November 2005).

Other mollusc species that live around the edge of the pond require a tidal rise and fall of pond waters to survive. It was noted that these species are more widespread than those living in the sediments. These species would also have the ability to move up and down the pond banks in response to the tidal (or artificially enhanced) rise and fall of water and would therefore be unlikely to be affected (J. Prince, pers. comm., November 2005).

Tidal pond 504, although close to the resort, is within an "exclusion zone" as set out by the Department of Fisheries. Therefore, resort guests and staff will not be permitted to access the pond and this will prevent trampling of the pond banks. Staff and visitor inductions and interpretive signage will raise awareness of the importance of protecting to the tidal ponds on the island.

7.4.4.3 Management and Mitigation Measures

The impact on the tidal pond biodiversity will be mitigated by the following measures:

- Seawater will only be introduced on days where a foul smell is likely to result from exposed decaying algae and low wind conditions;
- Seawater will only be introduced to the minimum height required to cover the decaying algae and mitigate the smell. Introduced seawater will never exceed to natural high tide level; and
- The seawater to be introduced to the pond will flow slowly into the pond in such a way as to not disturb the sediment of the pond.

7.4.4.4 Predicted Environmental Outcome

The predicted environmental impact on the mollusc species in the tidal ponds is expected to be minimal. In fact the additional seawater slowly introduced on occasional neap tides is likely to provide a less stressful environment than the lower (natural) tide (M. Johnson, pers.comm., November 2005).

7.5 CONSERVATION AREAS

7.5.1 Environmental Objectives

To maintain the environmental value of areas identified as having significant environmental attributes.

7.5.2 Relevant Standards and Legislation

The *Land Administration Act 1997* allows for the creation of the A-Class Reserve, which is vested in the Minister for Fisheries. The State *Fish Resources Management Act 1994* provides for the management of fish resources in the state and the regulation of the Abrolhos Islands Reserve. It also allows for the establishment and management of Fish Habitat Protection Areas and Reef Observation Areas.

The *Australian Heritage Council Act 2003* provides the mechanism for the listing of places on the Register of the National Estate.

An area of the Wallabi Group of the Abrolhos has been included in the National Heritage List (NHL) under the *EPBC Act 1999*, which was amended in 2005. The *EPBC Act 1999* protects the environment with regard to matters of National Environmental Significance. The proposed tourist resort on Long Island is subject to approval under the Act.

7.5.3 Terrestrial Conservation Areas

7.5.3.1 Potential Issues

The whole of the Abrolhos Islands are an A Class Reserve including the islands themselves. The Reserve is set aside for the purposes of conservation of flora and fauna, tourism and purposes associated with the fishing industry. Therefore the establishment of a nature-based resort is in keeping with the intention of the Reserve.

The Register of the National Estate (RNE) is compiled and maintained by the Australian Heritage Council and consists of more than 13,000 places of natural, historic and indigenous significance. Two sites on the RNE relate to terrestrial areas at the Abrolhos. The Houtman Abrolhos Islands Reserve is significant for its processes, richness and diversity, its significance for future research, its aesthetic values and its social values. The Ruins of Huts on West Wallabi Island is significant for its cultural (historic) processes. As West Wallabi Island will not be visited by resort guests there will not be any impacts on this conservation area.

The inclusion of the site on the NHL means that the values as identified by the Australian Heritage Council would be protected, and it is these values, and not necessarily the entire place itself, that will be protected through listing. This means that the listing does not necessarily preclude the development of the resort, provided the resort would not significantly impact on the listed values of the place.

7.5.3.2 Impact Assessment

Impacts on the terrestrial values of the Houtman Abrolhos Islands Reserve have been partly addressed by the Department of Fisheries (2003) in the Land Conservation Values of the Houtman Abrolhos Islands. This document states that Long Island has high conservation significance on account of its historic role in the *Batavia* story. Long Island was recorded to have a medium conservation significance with respect to seabirds as it is not as important as other islands in the region.

With respect to heritage, the heritage surveys conducted to date by WAMM indicate that there are unlikely to be any artefacts related to the *Batavia* story that remain in the development zone of the island.

Impacts on the National Heritage Listed values are addressed in Section 8.1.3.3.

The seabirds of the island are significant and potential impacts on the birds have been addressed in Section 7.4.2.3.

7.5.3.3 Management and Mitigation Measures

The impact on the terrestrial conservation areas will be mitigated by the following measures:

- Implementation of a Long Island Resort Heritage Management Plan to be developed in conjunction with WAMM and the Department of Fisheries to ensure consistency with the Heritage Management Plan to be developed by the Government for the National Heritage Listed place.
- Interpretive signage will be installed around the resort and boardwalk as appropriate following consultation on the content with WAMM.
- Inductions (including construction workers, staff, guests and day visitors) will include information on the heritage values of the island and procedures to be followed in the event of a chance find.
- Archaeologists will be on site for a watching brief during any major excavation undertaken during construction.

- The Visitor Activity Management Plan (Appendix 5) outlines the procedures for managing visitor activities in such a way that minimises potential impacts on terrestrial conservation areas.
- The birds of the island will be protected through the measures outlined in Section 7.4.2.3 and the Avifauna Management Plan (Appendix 4).
- Impacts to vegetation and other fauna will be managed as per Sections 7.4.1 and 7.4.2, respectively.

7.5.3.4 Predicted Environmental Outcome

Given the low-impact nature of the proposed resort and the management procedures outlined above, it is considered that the environmental objectives of this factor will be met.

7.5.4 Marine Conservation Areas

7.5.4.1 Potential Issues

The marine areas of the Abrolhos are protected under a number of different mechanisms.

- The waters of the Abrolhos Islands are a Class A Reserve (A20253) vested in the Western Australian Minister for Fisheries. The Reserve is set aside for the purposes of conservation of flora and fauna, tourism and purposes associated with the fishing industry.
- The Abrolhos Islands are also a Fish Habitat Protection Area (FHPA). There are three purposes to the Abrolhos Islands FHPA relating to:
  - The conservation and protection of fish and the aquatic ecosystem;
  - Aquaculture; and
  - The management of fish and activities relating to the appreciation or observation of fish.
- There are four Reef Observation Areas (ROAs) in the Abrolhos Islands. All species of fish including molluscs, algae, coral and finfish are totally protected in the ROAs, with the exception of western rock lobster which may be taken by recreational and commercial fishers using pots during the season (Fisheries WA, 1998a). The ROA at Beacon Island includes some of the coral areas to the north of Long Island (Figure 11).
- The Register of the National Estate (RNE) contains the Houtman Abrolhos Islands Reserve as well as several other listings. All seven historic shipwrecks that are located in the Abrolhos are listed sites on the RNE including the *Batavia*. The Houtman Abrolhos Marine Area is significant for its natural and cultural rarity, its research potential, its representational value, its aesthetic value and its social value.
- Listing on the National Heritage List. A section of the Wallabi Group of islands has recently been included on the National Heritage List by the Australian Heritage Council due to its association with the historic shipwreck *Batavia*.

7.5.4.2 Impact Assessment

There is potential for the natural heritage values of the marine conservation areas to be impacted through the release of sewage into the water, or during construction of the jetty, helipad or outflow pipe. Natural values may also be damaged through a fuel spill or through unregulated tourist activities such as diving.

The cultural heritage of the marine conservation areas could potentially be impacted through unregulated diving including the theft of artefacts (if found) or damage to the remains of the wreck of the *Batavia*. Damage could potentially occur from unsuitable anchoring near historic sites. It is an offence for vessel masters/ skippers and tourism operators to damage a historic site or its site environment by directly anchoring on it. Diving activities in the area are currently unregulated.

7.5.4.3 Management and Mitigation Measures

The impact on the marine conservation areas will be mitigated by the following measures:

- Wastewater will be treated to meet ANZECC water quality guidelines prior to release at a depth of 10 m into Goss Passage. Modelling has shown that this is likely to mitigate the impact on the surrounding environment to an acceptable level.
- During construction, a floating barge will utilised to minimise the impact on the marine environment.
- Monitoring of marine environments will be conducted on a regular basis as described in the Marine Management and Monitoring Plan (Appendix 6) to assess whether impacts are occurring. Trigger levels will be set and if reached, mitigation will occur.
- Sewage generated on board resort-associated vessels shall be disposed of in accordance with the State Government's *Strategy for Management of Sewage Discharge from Vessels into the Marine Environment*, with no disposal of sewage in areas of the Fish Habitat Protection Area that lack satisfactory dilution factors (see Section 7.6.6).
- Diving on historic wrecks will be strictly controlled by dive operators. These operators will be licensed to operate in the area. All divers will be given an environmental briefing including ways in which to prevent damage to historic sites and corals. Divers will be informed that the *Batavia* and other historic wrecks are protected by legislation. Divers will be informed of the requirements of and penalties associated with breaching the Commonwealth *Historic Shipwrecks Act 1976* and the State *Maritime Archaeology Act 1973*.
- The cultural heritage values of the marine area will be protected by the Heritage Management Plan. All dive or tour operators associated with the resort will be required to abide by this plan and the Long Island Dive and Snorkel Site Management Plan within the Marine Management and Monitoring Plan (Appendix 6).
- Dive boats will utilise fixed moorings where possible. Where moorings are not installed, dive operators will use either a "live" boat to drop divers off and collect them, or vessels will be anchored a safe distance away from the site over an area of sandy bottom. Masters and skippers will follow these procedures to ensure anchoring causes no damage to historic sites.

7.5.4.4 Predicted Environmental Outcome

Given the management procedures outlined above, it is considered that the environmental objectives for marine conservation areas will be met.

7.6 POLLUTION MANAGEMENT

7.6.1 Air Emissions

7.6.1.1 Environmental Objective

To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

7.6.1.2 Relevant Standards and Legislation

- Prevention of Air Quality Impacts from Land Development Sites (EPA, 2000), Final Guidance Statement No. 18.
- *Environmental Protection Act 1986*.
- World Health Organisation Guidelines for Air Quality 2000.

7.6.1.3 Potential Issues

Gaseous emissions will result from burning of fuels for the diesel powered generators and engine exhausts of construction equipment and resort vehicles. This includes carbon monoxide, carbon dioxide and nitrous oxide.

Minimal dust may be generated from clearing and construction activities where these activities occur over sandy areas.

It is envisaged that there will be minimal dust and other emissions generated by the proposed development. Potential impacts upon the air quality of the area include:

- Dust generated from clearing and construction activities over sandy areas.
- Emissions from generators used during construction.
- Emissions from generators used to supply power during operation.

7.6.1.4 Impact Assessment

There is very little infrastructure located within the Abrolhos. Existing infrastructure mainly consists of huts used by rock lobster fishers during the rock lobster season and the airstrip on East Wallabi Island. As a result, the air quality of the Abrolhos is expected to be pristine.

Vegetation clearing will be minimal and no greenhouse gas issues are anticipated.

Disturbance of sandy areas or pulverising of coral rubble may provide a source of dust. The degree of dust generated during construction activities is expected to be minor and localised with minimal disturbance to the ground.

7.6.1.5 Management and Mitigation Measures

The following management and mitigation measures will be implemented to minimise and control air emissions:

- Disturbance of vegetation will be kept to a minimum.
- Access will be via boardwalks at all times, other than when initial construction requires temporary access and in these times access will follow the future boardwalk route.
- Sandy areas will be avoided other than when constructing foundations.
- Construction activities and dust suppression measures will be implemented in accordance with the Construction Management Plan.
- Dust suppression measures will be instituted using water sprays, as necessary.
- Site personnel will visually monitor dust levels during construction.
- Vehicles and power generating equipment will be regularly maintained and serviced to manufacturer's specifications to ensure efficient running of equipment and optimum fuel consumption, thereby minimising exhaust emissions.
- Emissions from generators will be minimised using best practice techniques.
- The helipad has been located over water to preclude any dust generation during operation.
- Photo-voltaic (solar) energy will be used as much as possible to augment primary power supply.

7.6.1.6 Predicted Environmental Outcome

Given the management and mitigation measure above, it is considered that the environmental objective for this factor will be met.

7.6.2 Noise

7.6.2.1 Environmental Objective

- To protect the amenity of the community from noise impacts associated with development or land use by ensuring that statutory requirements and acceptable standards are met.
- To avoid unacceptable adverse impacts on the natural environment, including native fauna.

7.6.2.2 Relevant Standards and Legislation

- *Environmental Protection (Noise) Regulations 1997* (WA).

7.6.2.3 Potential Issues

Noise generated as a result of the resort will be primarily due to:

- Power generation from generator sets.
- Resort guests and staff during day-to-day activities (including music).
- Overflying or nearby planes and helicopters.
- Water craft mooring at the jetty and jet skis and other recreational activities using motorised craft.
- Pedestrian and vehicular trafficking of the boardwalks.

7.6.2.4 Impact Assessment

The resort is located on the central and western side of the island and prevailing winds from the south-east and south-west will mostly diffuse sound to the north-west and north-east, away from the remainder of the island.

The resort facilities and boardwalks north and south of the development area are surrounded and, in some cases within the sandy areas, located over sensitive bird breeding areas. Noise generated from the operation and activities associated with the resort may result in fauna avoiding the area and, with respect to birds, disrupt breeding and reduce habitation in the vicinity of noise generating areas, with potential dislocation of some species and reduction in bird population on the island.

Noise has the potential to impact on bird species on Long Island and other islands in the vicinity of nearshore water-based activities.

The nearest human residence is on Beacon Island, one kilometre east of Long Island. The presence of the resort is not expected to be an issue to residents, as the main facilities face westwards and noise will not be excessive.

7.6.2.5 Management and Mitigation Measures

Noise emissions generated by the construction and operation of the resort and recreational activities are expected to be manageable and localised to the immediate areas of the facilities and not create a nuisance beyond the boundaries and infrastructure of the resort. HLD will implement the following noise management measures:

- Flight paths of helicopters/planes will be fixed and will be over water rather than flying over islands. Aircraft will not come within 1000 metres (laterally) of islands (other than Long Island or East Wallabi Island when landing). These measures reflect recommendations of the Great Barrier Reef Marine Park Authority.
- Helicopters will have a fixed flight path around the northern limits of Long Island and approach from the north-west, which is downwind of the prevailing winds, thereby minimising noise levels at the island.
- Flights will be during the day and not during the night, to avoid disturbance to burrow-nesting birds.
- Float planes must land at least 300 metres from Long Island and slowly taxi to the jetty.

- Speeds of jet skis and motorised boats will be governed by low speed, low noise. A five knot limit will be imposed on all resort vessels including jet skis within 200 metres of islands.
- Jet skis will be subject to "no go" areas sensitive to birds and sea lions and seasonal closures. Islands that are "closed" should not be approached closer than 200 metres. Details of these areas are provided in the Avifauna Management Plan (Appendix 4) and the Visitor Activity Management Plan (Appendix 5).
- No amplifiers or loud music will be allowed.
- Noise management will be included in guest and staff inductions.
- Signage will include noise warnings.
- Bird and sea lion behaviour will be observed to determine if noise is impacting on their presence.
- Vehicles and generators will be fitted with noise reducing mufflers and will be regularly maintained.
- Generators will be based in sound proof containers with acoustic insulation to reduce noise levels.

7.6.2.6 Predicted Environmental Outcome

Impacts to local fishing community and residents on Beacon Island are expected to be none or minimal.

The design, operation and management of the resort will minimise the potential impact on fauna such that noise is not expected to have any permanent or adverse impact on fauna.

7.6.3 Lighting

7.6.3.1 Environmental Objective

To avoid or manage potential impacts from light spill and comply with acceptable standards.

7.6.3.2 Relevant Standards and Legislation

Australian Standard AS 4282-1997 *Control of the Obtrusive Effects of Outdoor Lighting* outlines a range of management measures that can be used to assist in reducing the amount of diffusion and spill lighting throughout the resort.

7.6.3.3 Potential Issues

- Light overspill to the surrounding environment can adversely affect a range of fauna, including insects, mammals and birds.
- Light spillage may attract birds and over water may attract marine fauna to the nearshore.
- Changed light levels may attract or deter animals in the area.

- Changed light levels can disorientate fauna.
- Additional lighting at night can lead to bird collisions with objects.

7.6.3.4 Impact Assessment

Light will be generated by the resort from internal and external lighting in accommodation/ rooms, function/dining facilities, swimming pool area and along the boardwalks. Birds will especially be sensitive to lighting and the design of the resort lighting takes into account the potential to disrupt, disorientate and cause potential injury to bird life.

7.6.3.5 Management and Mitigation Measures

HLD will implement the following light management measures:

- Lighting is to be downcast, and can be shielded, directed and focused, and will be fitted with lower wattage globes. Staff will be trained to reduce lighting as appropriate during critical breeding times (e.g. for shearwater and storm-petrel fledgling periods, see Figure 5, Surman (2006 a, b).
- Tinting glass on building windows and installing lights in tubes will aid in reducing the impacts of internal lights.
- A lighting plan will be adopted to minimise avoidable light spill from guest rooms and the resort's common facilities, with lighting in the main restaurant and bar being progressively dimmed throughout the night. Lighting after the dinner period will be greatly reduced.
- Yellow (sodium vapour) light will be used wherever practical to minimise impacts on birds. These lights give off red wavelengths and have been tested in Hawaii with favourable results. Lighting will be directed vertically where possible and focussed toward resort buildings and featured areas, to minimise ambient light levels outside the main resort compound.
- Details of the lighting measures adopted to minimise impacts on birds are found in the Avifauna Management Plan (Appendix 4).

7.6.3.6 Predicted Environmental Outcome

The potential impacts of light overspill from the resort can be managed with appropriate lighting management strategy in design of resort and operation to minimise any adverse or permanent impacts to birds and other fauna of Long Island.

7.6.4 Solid Waste Disposal

7.6.4.1 Environmental Objectives

To ensure that waste products do not adversely effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory requirements and acceptable standards.

7.6.4.2 Relevant Standards and Legislation

The following legislation is applicable to this proposal in relation to solid waste disposal:

- *Health Act 1911* (WA).
- *Environmental Protection (Sea Dumping) Act 1981* (Cth).

In addition, the Department of Fisheries has developed a Draft Waste Management Strategy for the Abrolhos Islands (2005) (the Strategy). This document describes the current practices for disposal of solid, liquid and hydrocarbon wastes, briefly indicates the impacts of these practices and provides solutions and strategies for implementing better environmental practice in relation to waste disposal and management. The recommendations of the Strategy for solid waste disposal that relate to this proposal are:

- Review potential acceptable options to establish the most functional and cost effective management practices to remove waste material from the Islands.
- Sea dumping and incineration of waste, as waste disposal options, to be phased out.
- Review potential funding options to facilitate a "whole of archipelago" domestic waste collection programme.
- A solid waste disposal tender to collect all domestic garbage be called for the 2006 season.
- Ongoing review of waste management best practices should be undertaken.
- A comprehensive education programme should be developed, in conjunction with the DoE and other government agencies, to provide fishers with the best options to safely recycle or dispose of their wastes.
- The Department of Fisheries to develop a "Visitor Charter" to include waste management and environmental guidelines. These guidelines will require all wastes to be disposed of appropriately. Island visitors such as charter boats and other boat visitors to operate under the Charter.
- New enterprises, such as aquaculture and tourist facilities/operations should only be approved with appropriate waste management systems incorporated into their project plan.
- Investigate the potential to establish large volume 'in-vessel' composting systems to handle all compostable waste on larger Islands (Department of Fisheries, 2005).

Solid wastes generated by the resort will include both 'wet' and dry wastes. Wet wastes include food scraps, greases and fats while dry wastes include paper, cardboard, (food) oil filters and plastics. Wastes will also be generated during the construction and decommissioning phases of the resort and will mainly consist of building waste. Solid wastes will also be generated onboard boats during the various tourist activities and these impacts will be discussed in detail in Section 7.6.6.

The recommended disposal options for some examples of solid waste that may be generated by the Long Island Tourism proposal are shown in Table 7.15.

Table 7.15: Recommended Solid Waste Disposal Options for the Abrolhos Islands

Waste Classification	Compost (on Mainland)	Recycle on Mainland	Safe Disposal on Mainland
Domestic waste	Food scraps	Cardboard packaging, paper, glass containers, plastic containers (inc. soft drink bottles), aluminium and steel cans, cooking oils/fats (where appropriate)	Nappies, cooking oils/fats
Chemicals			Poisons, pesticides, cleaning agents, corrosives, detergents, paint and thinners
Boating		Bait boxes, paint and thinners, tools	Paint and thinners, tools, rope and floats, holding crates, buckets
Construction and demolition waste		Timber panels, timber framework, steel sheeting, steel framework	Timber panels, timber framework, asbestos sheeting, tiles, electric cable

Source: Department of Fisheries, 2005

7.6.4.3 Potential Impacts

Impacts associated with solid waste disposal relate mostly to poor containment and attraction of animals, both native and vermin species. The impacts related to solid waste disposal are:

- Attraction of native fauna species to the resort area due to presence of alternative food sources and nesting materials. These species may become a nuisance and/or the balance of fauna species may be disrupted.
- Attraction and/or increase in prevalence of vermin due to the presence of alternative food sources and nesting materials.
- Pollution and a decrease in visual amenity due to inadequate storage, containment or removal of wastes.
- Animal deaths through eating or entanglement in wastes.

7.6.4.4 Management and Mitigation Measures

The Long Island Tourist Resort aims to minimise waste generation in all areas of construction, operation and decommissioning. In order to achieve this some materials will be prepared on the mainland prior to being shipped to Long Island. Such measures will include:

- The buildings are to be assembled offsite and transported to the island by sea and positioned on foundations designed for minimal disturbance. Materials will be pre-cut and/or pre-fabricated in Geraldton to reduce the need for extra materials, minimise packaging and avoid wastage. All materials will be portaged from the boat to the work area.

- As much as is possible, resort food will be pre-prepared at Broadwater's Geraldton operation thus limiting the quantity of wet waste and food scraps stored at any one time on Long Island.
- Where possible, arrangements will be made with suppliers such that products are delivered to Long Island with minimal packaging. Where this is not possible some packaging materials may be removed at Geraldton.

In order to ensure effective waste management during operation of the resort a Solid Waste Management Plan (SWMP) will be developed as part of the Operational Environmental Management Plan. Waste management during the construction phase will be covered by the CMP while waste management during decommissioning and rehabilitation will be covered by the Decommissioning and Rehabilitation Plan (DRP). Important elements of waste management on Long Island will include:

- Educating construction workers, staff, guests and day visitors of the impacts that poor solid waste management can have on the environment of and surrounding Long Island including the fauna such as Silver Gulls. This information will be included in all inductions.
- Large mobile garbage bins (MGBs) shall be used to store general wastes prior to removal from the Island. These bins shall be raised on wheels 200 millimetres off the ground and shall have attached lids thus enabling containment of the wastes. Solid wastes shall be transported from Long Island to the mainland within these MGBs.
- Separate MGB shall be provided for recyclable materials. These bins shall be similar in style to the general waste bins and shall be transported in the same way.
- A waste compactor shall be installed in the services compound. All waste shall be compacted at the time of storage in the waste storage area of the services compound.
- A baler unit shall be installed in the services compound for baling of cardboard and similar wastes. This will ensure that the risk of such wastes being blown about the island is minimised.
- During routine equipment and plant servicing activities the onus will be on the contractor to remove from Long Island all waste generated and dispose of these products in the appropriate manner on the mainland.
- Waste oils, fats and greases originating from the kitchen shall be contained within specific disposal bins and taken to the mainland for disposal or recycling.
- Regular inspections shall be undertaken by resort management of the entire resort and waste storage/generation areas to ensure waste is adequately contained.

7.6.4.5 Predicted Outcome

The management measures outlined above and set out in the SWMP, CMP and DRP shall ensure that solid waste management does not compromise the environmental values of Long Island and that the environmental objective for this issue is achieved.

7.6.5 Wastewater Disposal

7.6.5.1 Environmental Objectives

To ensure that waste products do not adversely effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory requirements and acceptable standards and to ensure:

- Ecosystem integrity equivalent to at least a high level of protection.
- Maintenance of seafood for human consumption.
- Maintenance of aquaculture.
- Maintenance of primary and secondary contact recreation.

7.6.5.2 Relevant Standards and Legislation

The disposal of wastewater and construction and operation of sewerage systems is regulated under the *Health Act 1911* (WA) and the *Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974* (WA).

The State Water Quality Management Strategy No. 6 and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 outline the requirements for water monitoring programmes and provide trigger values for mitigation.

7.6.5.3 Potential Impacts

One of the major attractions of the Abrolhos is the clear water that surrounds the islands. Potential impacts from the disposal of wastewater are:

- Pollution of the waters surrounding the wastewater discharge point leading to a reduction of benthic marine species abundance, cover and diversity.
- Pollution of the waters surrounding the discharge point leading to decreased amenity and human health risks.
- Organic matter within wastewater has the potential to act as a food source and attract fish and other marine animals to the discharge area.
- Contamination of fish stocks and other seafood such that it is unfit for human consumption.
- System failure leading to overflow of containment facilities, pollution of the area surrounding containment facilities and risks to human health.
- Discharge of swimming pool water during maintenance or filter backwash periods has the potential to adversely impact on marine environment.
- Potential impact of hydrocarbon spill on water quality.
- Potential impact of turbidity generation during construction.

7.6.5.4 Management and Mitigation Measures

The wastewater system for black and grey water disposal shall be designed to ensure the concentration of suspended solids is minimal and that maximum potential concentrations of Total Nitrogen (TN) and Total Phosphorous (TP) do not exceed 30 milligrams per litre and 12 milligrams per litre respectively (based on treatment system's specifications from manufacturer). The effluent from the resort will be disposed of into Goss Passage at a depth of ten metres.

The dispersion characteristics of the discharge have been modelled by Oceanica Consulting under the parameters set out in Table 7.16.

Table 7.16: Parameters Used to Model Dispersion Characteristics of Wastewater Discharge

Parameter	Input value
Outlet pipe diameter	0.05 m
Outlet depth	10 m (MSL)
Discharge rate	17 kL/day ($2.0x10^{-4}$ m^3/s)
Discharge salinity	~2 psu
Ambient salinity	35 psu
Discharge temperature	22°C
Ambient temperature	20°C
Current direction	Longshore
Current speed	Modelled for 0.1 knot (calm)
Discharge nutrient concentrations	Total Nitrogen (TN) 30 mg/L Total Phosphorus (TP) 12 mg/L

Modelling shows that the treated wastewater effluent will achieve an initial dilution of 1:10,000 within approximately 20 metres of the discharge point (see Section 7.4.3.2 and Figure 19 and 20).

Monitoring of the waters around Long Island will be undertaken to ensure there is no significant impact on the marine environment. These management and monitoring measures are outlined in the Marine Management and Monitoring Plan (Appendix 6). It should be noted that if the default trigger values for nutrients are exceeded during the annual monitoring, results obtained from sites located at the edge of the mixing zone (30 m from the discharge point) will be compared to those obtained from the sites 100 m to the north and south of the proposed wastewater discharge site, and from the reference site, to determine whether the elevated levels are likely to be due to the wastewater discharge.

The vacuum pump station will comprise two pumps that run on an alternating cycle (one pump is functioning while the other is on standby), which provides a significant contingency against pump failure. In the unlikely event of both pumps failing then collection pits will act as buffer tanks for a minimum of one day (at maximum wastewater outputs). In addition, the central collection and treatment tank has been designed to hold seven day's capacity of wastewater output.

The desalination effluent will be ~30% more saline than the ambient seawater and will therefore sink following discharge. As it sinks it will mix with the ambient seawater, reaching the range of background salinity after approximately 1:66-fold dilution within 3.3 metres of the outlet at the approximate depth of 9 metres (Figure 21 and 22).

The swimming pool will not be emptied into the ocean. Should the swimming pool water need to be discharged it is envisaged that this will be done during a closed period at the resort and therefore the water will be pumped through the wastewater treatment plant.

A buffer tank will be installed to receive the water discharged during routine backwashing of the filters. This backwash water can then be held within the tank until chlorine levels have dropped to an acceptable level to allow the water to be slowly introduced into the wastewater treatment unit (via the sewer system). This buffer tank will also allow backwashed swimming pool water to reach ambient temperature before treatment and subsequent discharge.

The potential impact of hydrocarbon spill on water quality has been addressed in Section 7.6.8.

The potential impact of turbidity generation during construction is addressed in section 7.4.3.1.

7.6.5.5 Predicted Environmental Outcome

It is predicted that impact on the environment will be limited to an increased risk of lower reproductive output, altered growth patterns and potentially increased mortality of more sensitive coral species within a 50 metre radius of the end of the outlet. Due to the predicted low concentrations of suspended solids and efficient dispersal by the current of the Goss Passage, wastewater is not expected to represent an alternative food source for marine animals and thus will not result in attraction of animals to the area.

The design parameters of the wastewater disposal system and the measures outlined in the Marine Management and Monitoring Plan (Appendix 6) will ensure that the environmental objective for wastewater disposal is achieved. It is anticipated that microbiological counts will meet the Australian and New Zealand Guidelines for Fresh and Marine Water Quality ANZECC/ARMCANZ (2000) guidelines for primary contact recreation at the edge of the mixing zone. However, during the collection of baseline water quality data from the water surrounding Long Island in October 2005, several of the default trigger values for nutrients were exceeded. Therefore nutrient concentrations exceeding the guideline values may occur within the proposed mixing zone. Due to a lack of information on the spatial and temporal variation of background nutrient concentrations, and on the expected concentrations of nutrients within the wastewater, it is not possible to accurately predict the expected levels of nutrients and other contaminants within and adjacent to the mixing zone.

7.6.6 Waste Products from Boats

7.6.6.1 Environmental Objective

To ensure that waste products from boats do not adversely effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory

requirements and acceptable standards and to ensure the maintenance of seafood for human consumption and the maintenance of aquaculture.

7.6.6.2 Relevant Standards and Legislation

Relevant State and Federal legislation is based on the *International Convention for the Prevention of Pollution from Ships 1973* as modified by the Protocol of 1978. This Convention is also known as MARPOL 73/78 and covers both accidental and operational oil pollution, pollution by chemicals, goods in packaged form, sewerage, garbage and air pollution. To date, Western Australian Legislation only covers pollution resulting from oils and noxious substances as outlined in the *Pollution of Waters by Oil and Noxious Substances Act 1987*. The Australian Government legislation is the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This legislation covers pollution by oils, noxious substances, packaged goods, sewerage, and garbage. In summary, the laws that relate to recreational boating are:

- No dumping of oil anywhere at sea.
- No dumping of any plastic anywhere at sea. Plastics include synthetic ropes, plastic garbage bags, and synthetic fishing lines and nets.
- No dumping of floating rubbish within 25 nautical miles of the nearest land.
- No dumping of garbage including food wastes, paper products, rags, glass or metals within 12 miles of the nearest land. Garbage ground to less than 25 millimetres can be discharged more than three miles from nearest land.
- No dumping of human waste within three nautical miles of the nearest land, or within any port limits.

In October 2004 a State government working party implemented the *Strategy for Management of Sewage Discharge from Vessels into the Marine Environment*. This strategy sets out three discharge zones and prohibited activities as follows:

Zone 1: No discharge zone.

The discharge of sewage from vessels, whether it is treated or untreated, is prohibited in Zone 1. The no discharge zone includes:

- Marinas, yacht clubs, boat harbours and ports/maritime export facilities.
- Most inland waters.
- Marine nature reserves and sanctuary zones within marine parks.
- Designated areas of marine parks, marine management areas or fish habitat protection areas, where the dilution/dissipation factor is not deemed to be satisfactory.
- Within 500 metres of any aquaculture operation.
- Within 100 metres of any recognised swimming area.
- Other designated areas of high environmental value.

Zone 2: No discharge except for vessels with approved treatment systems.

Sewage treated to an approved standard can be discharged in Zone 2. The treated sewage discharge zone includes areas such as:

- Parts of estuaries, marine parks and fish habitat protection areas, where the dilution factor is deemed to be satisfactory.
- Waters more than 20 metres from a stationary vessel or person in the water.

Zone 3: Open zone.

Untreated sewage may be discharged from vessels within Zone 3. Zone 3 comprises all State Waters except:

- Those waters which are within Zone 1 or Zone 2.
- Waters within 500 metres of land.
- Waters within 100 metres of a stationary vessel or person in the water (Department for Planning and Infrastructure, 2004).

The definition of Zone 3 waters clearly contradicts the Australian Government *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This Act clearly states that if there is no law in the State where the dumping takes place that covers sewage discharge into the sea the Australian Government Act shall apply. Therefore, until such State legislation is enacted no untreated sewage may be discharged from a vessel within three nautical miles of any land.

7.6.6.3 Potential Impacts

Boats and boating activities will be an important component of the proposed tourist resort. Boats will be utilised to transport staff, guests and day visitors to and from the island, transport supplies to the island, remove wastes from the island and provide access to activities such as diving, fishing and sightseeing.

Waste products from boats can cover a wide variety of materials depending upon the activities undertaken. Waste generated during boating activities related to the Long Island tourist resort may include:

- Fishing line and tackle.
- Damaged equipment (e.g. snorkels).
- Hydrocarbons (e.g. fuel and oils).
- Sewage.
- Bilge water.
- Food containers and wrappings.
- Food scraps.

These wastes may escape into the environment through accident (e.g. oil spill, wind blown rubbish) or during normal operation (eg emptying of bilge water). Without proper management of the wastes generated during boating activities the following impacts have the potential to occur:

- Decrease in visual amenity due to inadequate storage or containment of wastes.
- Decrease in visitor enjoyment of the Abrolhos Islands.
- Animal deaths (including bird migratory species) through eating or entanglement in wastes.

- Loss of marine biodiversity due to pollution of waters leading to decreased abundance, cover or diversity of species.
- Introduction of marine pests or weeds through emptying of bilge water.

7.6.6.4 Management and Mitigation Measures

No solid wastes shall be permitted to be dumped into the ocean from boats associated with the Long Island tourist resort. This will apply to all supply, transport and recreational boats. All contracted tour or supply operators shall be required to confine all solid wastes on their vessels and arrange for these to be disposed of or recycled on the mainland. Solid wastes generated by boats operated by the resort shall be contained onboard until the vessel returns to the island. Upon return to the island, all solid wastes shall be dealt with according to the management strategies outlined in Section 7.6.4 – Solid Waste Disposal and the Solid Waste Management Plan.

No vessels shall be permitted to purge bilge water within the surrounds of Long Island. Where possible, all vessels shall be required to empty bilge water in the open ocean.

Sewage generated on board shall be disposed of in accordance with the State Government's *Strategy for Management of Sewage Discharge from Vessels into the Marine Environment*, with no disposal of sewage in areas of the Fish Habitat Protection Area that lack satisfactory dilution factors.

In the event of a hydrocarbon (eg fuel or oil) spill from a boat the measures outlined in Section 7.6.8 – Dangerous and Hazardous Substances and the Dangerous and Hazardous Substances Management Plan shall apply. These measures shall include the provision of spill kits to be located on the jetty and in the services compound and the training of staff and contract personnel in spill response.

As an additional measure, all contracted operators shall be required to abide by strict environmental performance standards as part of their contracts.

7.6.6.5 Predicted Environmental Outcome

The implementation of the management and mitigation measures outlined above and in Section 7.6.4, Section 7.6.8, the Solid Waste Management Plan and the Dangerous and Hazardous Substances Management Plan will ensure that the environmental objective in relation to waste products from boats is achieved.

7.6.7 Groundwater and Tidal Pond Water Quality

7.6.7.1 Environmental Objective

- To maintain the quality of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected.
- To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

7.6.7.2 Relevant Standards and Legislation

Standards

- ANZECC, ARMCANZ: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000.
- NEPC: Contaminated Sites Management Series - Assessment Levels for Soil, Sediment and Water, November 2003.
- WRC, DME and DEP: Water Quality Protection Guidelines No 1-11, Mining and Mineral Processing, 2000.

Legislation

- *Environmental Protection Act 1986*.
- *Water and Rivers Commission Act 1995*.

7.6.7.3 Potential Issues

Other than some isolated, minor perched brackish water lenses in the underlying coral limestone formation, there is no separate groundwater aquifer beneath Long Island. The water underlying Long Island occurs as a surface expression in the tidal ponds and is saline. The water is not suitable as a source of drinking water.

The lack of tidal variation in Pond 504 at certain times of the year results in a build-up of algae, which is unsightly and has potentially offensive odours and may detract from the amenity of the resort. It is proposed to flush the water system by introducing seawater during these low tidal range periods.

Other potential issues include:

- Potential pollution or damage through human interference of the perched water lenses and tidal ponds.
- Water quality changes may impact the ecology or amenity of the tidal ponds.

7.6.7.4 Impact Assessment

The introduction of seawater will create artificial tidal variations in Pond 504 that will not be outside of the existing tidal pond range. The seawater that will be introduced is very slightly less saline than the water in the pond and will temporarily change water quality in the pond during these periods. As seawater naturally enters the pond system during high tides and at other times rainwater enters the pond through surface runoff and incident rain, it is not expected that the intermittent introduction of seawater will adversely affect water quality.

The design, operation and activities of the resort are not expected to impact on the perched water lenses contained in the underlying coral limestones of the island. Any incidental rainfall and resulting stormwater runoff from the resort structures that percolates into the underlying coral substrate will be uncontaminated and a continued source of replenishment to any underlying perched water lenses.

Bunding and containment measures provided for wastewater, hydrocarbons and other potentially polluting liquids will prevent pollution of any underlying perched water lenses in the event of spillages or leaks from piping and storage tanks.

7.6.7.5 Management and Mitigation Measures

HLD will implement measures to reduce and minimise any potential adverse impacts associated with the operation of the resort and the artificial flooding of Pond 504 by:

- Implementing an Induction Programme for all staff and visitors.
- Implementing a Marine Monitoring Plan and Management Plan, including a section on tidal ponds.
- Installing and regularly maintaining storage and containment infrastructure for wastewater, hydrocarbons and potentially polluting materials.

7.6.7.6 Environmental Outcome

The quantity and quality of water underlying the island and contained in tidal ponds will not be adversely changed by the resort and the ecosystem function provided by the tidal pond will be able to be maintained. Induction of staff and visitors and implementation of a monitoring programme will help to ensure this outcome.

7.6.8 Dangerous and Hazardous Substances

7.6.8.1 Environmental Objective

To ensure that the storage and handling of dangerous and hazardous substances does not effect the environment or the health, welfare and amenity of people and nearby land users by meeting statutory requirements and acceptable standards.

7.6.8.2 Relevant Standards and Legislation

Dangerous and hazardous substances include hydrocarbons such as fuels, oils and solvents and chemicals such as detergents and other cleaning products. The transport, storage and handling of dangerous goods, as related to the Long Island tourist resort proposal, are controlled by the following legislation and regulations:

- *Explosives and Dangerous Goods Act 1961* (WA).
- *Explosives and Dangerous Goods (Dangerous Goods Handling and Storage) Regulations 1992* (WA).
- *Dangerous Goods (Transport) Act 1998* (WA).
- *Dangerous Goods (Transport) (General) Regulations 1999* (WA).
- *Dangerous Goods (Transport) (Dangerous Goods In Ports) Regulations 2001* (WA).

Dangerous good are defined as combustible liquids and those listed in the Australian Code for the Transport of Dangerous Goods by Road and Rail, except infectious substances and radioactive material.

Australian Standard 1940 – 2004 (The storage and handling of flammable and combustible liquids) sets out the requirements for the storage and handling of dangerous goods such as fuel, solvents and oils.

7.6.8.3 Potential Impacts

There are a number of impacts that can result from the storage and handling of dangerous and hazardous substances. These impacts are:

- Pollution of the marine environment through improper disposal of chemicals into the sewerage system.
- Pollution of the marine environment through fuel spills during refilling of bulk supply containers and refuelling of vessels.
- Pollution of the marine environment through accidental spillage as a result of damage to marine vehicles (eg collision with reef).
- Pollution of the terrestrial environment through fuel spills during refuelling of vehicles.
- Pollution of the terrestrial environment through chemical spills as a result of refilling containers from bulk stores.
- Potential for gas leaks from LPG storage tanks resulting in risk of ignition, fire and explosion.

7.6.8.4 Management and Mitigation Measures

The Long Island Oil Spill Environmental Management Plan (see Appendix 7) has been designed to identify the likelihood and potential consequences of a fuel spill associated with the resort. This document also proposes management strategies to minimise the risks and reports the sensitivity of the environment in the highest risk area near the jetty.

In order to ensure safe and proper handling and storage of hydrocarbon and dangerous substances a Dangerous and Hazardous Substances Management Plan (DHSMP) will be developed prior to operation of the resort. Key elements of the DHSMP are:

- All dangerous waste and/or chemicals shall not be disposed of via the sewerage system to prevent their eventual release to the marine environment and shall be returned to the mainland for safe disposal.
- Dangerous goods will be stored within the services compound. Storage is likely to be within a 3m long x 2.4m wide x 2.4m high aluminium or steel sea container.
- A small amount (up to 500L) of unleaded petrol will be stored at the island for the use of small vessels based at the resort such as the jet skis, the resort jet boat and the glass-bottom boat. Storage is likely to be in 200L drums. Supply boats and passenger transport boats will not be refuelled at the island nor will recreational boats visiting Long Island. Helicopters will also not be refuelled at the island to minimise risk of a hydrocarbon spill.
- Up to 2500L of diesel will be stored within self-bunded storage tanks fully augmented with spill kits. Additionally standard ducting used for pumping fuel from diesel supply vessels into the shore based storage tanks (which already have spill/leak prevention

redundancies built in as standard) would be double sheathed as an additional spillage risk mitigation measure.

- Refuelling of land vehicles shall be undertaken only in designated refuelling locations. Where possible these shall be located on hardstand to limit the risk of soil contamination from fuel spillage.
- Refilling of chemicals from bulk containers will be conducted only in the bunded services area compound to prevent a possible spill leading to marine or terrestrial contamination.
- The services compound (refuelling area) shall be equipped with a hydrocarbon spill kit.
- A spill kit shall be maintained on the jetty as this is a high risk area in terms of spillage.
- All staff shall be trained in spill and emergency response procedures.
- Emergency stop valves shall be fitted to the LPG tanks.
- Records of all deliveries and usages of chemicals and fuels to be kept.
- Material safety data sheets to be kept in an easily accessible location for all substances used around the resort.
- All chemicals and hydrocarbons shall be stored in accordance with AS1940-2004.

In addition, all contractors will be required to carry spill kits onboard their vessels and will be trained in spill response in order to deal with accidental spillages when away from the island. The responsibility for the transport of dangerous and hazardous substances to Long Island shall remain with the transporters. Enforceable performance standards shall be a key component of all contracts.

7.6.8.5 Predicted Environmental Outcome

Implementation of the DHSMP and the management measures outlined above shall ensure that the environmental objective for this issue is met.

7.7 LANDFORMS AND SOILS

7.7.1 Environmental Objective

To maintain the integrity, ecological functions and environmental values of soil and landform.

7.7.2 Potential Issues

Long Island is a low-lying relatively flat island generally about two metres above sea level. The majority of the island is composed of corals, coral gravel and plate-like cobbles, with sandy beaches and low dunes present in some areas. Plate 15 shows a group of birds (Crested Terns) over the coral gravel of Long Island. Plate 16 provides the north western view from southern development limit showing a substrate type of coral rubble/plate-like cobble and low dunes in the background.

The soils and landforms of the island and the surrounding seabed may be impacted upon in a variety of ways. The potential impacts occurring from the proposed development on the soil and landforms of the island and nearby seabed include:

- Over-exploitation of the sandy beaches.
- Potential to increase erosion of the island.
- Construction activities have the potential to compact the soil and damage the soil structure.
- Compaction of the soil by visitors walking over the island.
- Potential for damage to the seabed during the installation of the jetty, helipad, boat moorings and swimming/diving platforms.
- Tidal ponds (and immediate vicinity of Tidal Pond 504).
- Heritage areas (elevated areas potentially associated with *Batavia* mutineer hangings).

Long Island has been formed from the surrounding reef and is therefore subject to many coastal processes. These include the processes of wind and wave erosion and deposition of sediments. Potential impacts from the resort could be:

- The resort's land based infrastructure interrupts the natural movement of sediment leading to unnatural levels of terrestrial erosion or deposition, affecting fauna and flora.
- The resort's marine based infrastructure interrupts the natural movement of water currents and therefore leads to unnatural levels of coastal erosion or deposition, affecting fauna and flora.

7.7.3 Impact Assessment

The resort will be contained within the designated development zone above the 2.0 metres AHD contour, which excludes an area around Tidal Pond 504. With the exception of the services compound area, all structures will be raised on piled supports. Disturbance and compaction of sands and coral rubble surfaces will be minimised and alteration of landform minor, thereby retaining the ecological function and heritage value of the island.

All access over the island, following construction, will be via raised boardwalks. Temporary overland access during construction will be along the boardwalk route or over non-sandy, non-vegetated resistant coral formation and rubble.

The construction and operation will not permanently alter the physical environment or lead to erosion or degradation of the soils, tidal pond or landform.

Access onto the island will be via a jetty and helipad with an interconnecting, raised boardwalk that will avoid all interaction with the seashore. In the vicinity of the helipad and jetty, the western shoreline comprises shingle that is mobile, which then rises to a resistant, consolidated coral limestone formation.

A sandy section of beach along the north-eastern corner of Long Island will be used as part of the northern boardwalk trail. Only guests will be allowed to walk on the shoreline. The sand covers a planar coral limestone surface and the processes that create and maintain the supply

of sand onshore to support this natural beach process will remain. Two beach gazebos will be constructed at the northern end of the island, and these will be adjoined by swimming platforms. However, the raised nature of the gazebos and the very short nature of the swimming platforms together with their construction on short pylons will ensure these structures will not impede sand movement.

7.7.4 Management and Mitigation Measures

As noted above, Long Island has largely been formed under the influence of marine processes. However, the entire resort has been designed to facilitate coastal processes whilst minimising damage on flora and fauna. Specifically, the following measures have been adopted:

- The jetty will be constructed using open piling.
- The helipad will be moored through a system of anchors.
- The main resort area and the entire boardwalk will be raised off the ground by approximately 500 millimetres.
- The treated wastewater outlet pipes will be buried across the inshore reef, and it is expected that corals will grow over this pipeline.

Hence, these elements will not interrupt sediment transport and are therefore unlikely to impact upon the natural coastal processes.

Other management measures include:

- Implement the Construction Management Plan.
- Implement an Induction Programme for construction personnel.
- All services will be run suspended underneath the boardwalk.
- The amount of land disturbed will be minimised.
- Implement an Environmental Monitoring and Management Plan.
- Beach access will be restricted to designated areas and appropriate signage will be installed.

7.7.5 Predicted Environmental Outcome

Implementation of the infrastructure elements outlined above shall ensure that the environmental objective for this issue is met. The ecological and heritage values of the landform and soils of Long Island will be retained by appropriate design and operation of the resort and management measures to be implemented by the resort.

7.8 FIRE MANAGEMENT

7.8.1 Environmental Objective

To ensure adequate fire management is undertaken such that the risk to the environment from the proposed development is minimised.

7.8.2 Relevant Standards and Legislation

The *Bush Fires Act 1954* (WA) sets out the responsibilities of the landowner or occupier in relation to control and the extinguishing of fires on land for which they are responsible.

7.8.3 Potential Impacts

The outbreak of fire on the island could have the following environmental impacts:

- Destruction of vegetation.
- Loss of the CALM Priority 4 species *Lepidium puberulum*.
- Destruction and/or abandonment of seabird nests and burrows.
- Death or injury to fauna unable to escape the fire.

7.8.4 Management and Mitigation Measures

All buildings have been designed such that there are no fire compartments that exceed 500 square metres. This allows the facility to meet Building Code of Australia (BCA) (2005) requirements such that fire servicing for the facility can be achieved using fire extinguishers strategically positioned around the facility and appropriate to the nature of the fire that may be generated.

A documented procedure for evacuation will be installed in all rooms. Training and fire drills will be conducted regularly with the assistance of a professional company that offers emergency procedures training.

As part of the induction process all guests and day visitors shall be briefed on the procedures to follow if a fire breaks out such as:

- Evacuation of buildings and marshalling areas.
- How to raise the alarm if they are the first to notice a fire on the island.
- The location of fire-fighting equipment.

High risk activities, such as welding, shall be undertaken during the cooler periods of the day whenever possible.

7.8.5 Predicted Environmental Outcome

By ensuring all staff and contracted employees are trained in fire management, providing adequate fire-fighting equipment and ensuring all guests and day visitors are aware of the procedures to be followed in the even of a fire the environmental objective for this issue shall be achieved.

7.9 REHABILITATION AND DECOMMISSIONING

7.9.1 Environmental Objective

To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

7.9.2 Relevant Standards and Legislation

The EPA released Draft Guideline No. 6 *Rehabilitation of Terrestrial Ecosystems* for public comment in January 2006. The guidance statement "promotes the use of completion criteria and definitions for the rehabilitation of natural ecosystems which (i) allow success to be measured within realistic timeframes, (ii) are sufficiently precise to allow outcomes to be affectively audited, but are also flexible when required, (iii) are based on sound scientific principles and (iv) acknowledge the consequences of permanent changes to landforms soils and hydrology" (Environmental Protection Authority, 2006). Furthermore, the guidance statement:

- Provides a common framework and the general standards for setting rehabilitation objectives for environmental impact assessment in Western Australia.
- Describes the quality and quantity of information required to determine the environmental impacts of expected permanent changes to ecosystems.
- Proposes uniform standards for the analysis, interpretation and reporting of outcomes for auditing purposes.
- Outlines the requirements of completion criteria for both abiotic factors, including visual amenity and heritage, soils, safety and sustainability, and biological factors, including vegetation resilience, habitat, plant and animal diversity and weed management (Environmental Protection Authority, 2006).

7.9.3 Potential Issues

The initial lease for the Long Island tourist resort will be for a period of 21 years. Extensions to the lease will then be negotiated. If the lease is not renewed the facility shall be decommissioned.

7.9.4 Potential Impacts

Potential impacts related to decommissioning and rehabilitation of the resort area are:

- Trampling of vegetation during removal of infrastructure.
- Clearing of vegetation around buildings in order to safely remove infrastructure.
- Damage to the marine habitat during removal of the jetty, helipad and other marine based infrastructure.
- Inadequate rehabilitation leading to poor reinstatement and recovery of terrestrial vegetation and marine habitat.
- Weed introduction during decommissioning activities.

- Weed introduction during rehabilitation as a result of using non-local seed or seed that is not certified 'weed free'.
- Disturbance of nesting seabirds leading to abandonment of nests.
- Destruction of seabird burrows that have been established beneath the boardwalks.
- Reduction in visual amenity due to wastes being left on the island.

7.9.5 Management and Mitigation Measures

To ensure that adequate resources are available and that appropriate measures are taken to ensure decommissioning occurs in an appropriate manner a full decommission and rehabilitation plan (DRP) will be developed. The DRP will be reviewed every ten years to ensure that it reflects current opinion, techniques and technology. The DRP will be developed in accordance with EPA Draft Guidance Statement No. 6 *Rehabilitation of Terrestrial Ecosystems*.

Upon closure, all infrastructure will be removed except were negotiations with appropriate authorities determine that facilities should remain, i.e. it may be determined that the jetty remain to provide access to the island. Construction of infrastructure on pylons will minimise the disturbance to the site and therefore the level of reinstatement required. In addition, in order to minimise the amount of vegetation trampled during decommissioning all access ways shall follow the alignment of the boardwalk where possible.

Where the re-establishment of plants is required species endemic to Long Island will be used. Seed or vegetative matter used in reinstatement shall be sourced from locally occurring populations. Seed shall be sourced from suppliers that can certify their product as being 'weed free'. Weed control will also be used to maximise the likely survival of any plantings undertaken. Monitoring of the rehabilitated areas shall be undertaken to ensure self-sustaining vegetation is established.

To minimise the impact on nesting seabirds all decommissioning activities will be undertaken in consultation with a suitably qualified avifauna specialist. Before the boardwalk is removed the locations of seabird burrows around and under the boardwalk shall be recorded. Particular note shall be made of any burrows that are in use. All efforts shall be made to prevent the destruction of burrows. Access paths shall be aligned to avoid disturbance of burrows or nests. This issue is further dealt with as part of the DRP.

Where marine based infrastructure is removed, monitoring of the benthic habitat shall be continued to ensure recovery of the area. Where assisted reinstatement is required, marine experts will be consulted as to the most appropriate techniques and materials to use.

All decommissioning and rehabilitation wastes shall be removed from Long Island and taken to the mainland for appropriate disposal. Consultation with WAMM and other stakeholders may recommend that interpretive signage relevant to the history of Long Island remain to ensure the amenity and values of Long Island are recognised and maintained.

7.9.6 Predicted Environmental Outcome

The measures outlined in the DRP together with regular review of the management plan will ensure that the environmental objective for this issue is achieved and that the impacts identified above are minimised.

8. SOCIAL ISSUES AND MANAGEMENT

8.1 HERITAGE

8.1.1 Environmental Objective

To ensure that changes to the biophysical environment do not adversely effect historical and cultural associations and comply with relevant heritage legislation.

8.1.2 Aboriginal Heritage

8.1.2.1 Relevant Standards and Legislation

The *Aboriginal Heritage Act 1972* (WA) provides for the protection of sites and artefacts used by and/or of significance to the original inhabitants of Australia. The Act also provides for the recording of the location of these sites and artefacts.

Aboriginal heritage issues are also considered by the EPA, who has developed a Draft Guidance Statement for the Assessment of Aboriginal Heritage with the objective of ensuring that the changes to the biological and physical environment resulting from a proposed development do not adversely affect matters of heritage significance to Aboriginal people. The proponent is required to provide sufficient information to the EPA to consider if Aboriginal heritage is a relevant environmental factor in relation to the proposal. If it is determined to be a relevant factor, sufficient information must be provided such that the EPA can report to the Minister on the implementation of the proposal in relation to impacts on attributes of heritage significance to Aboriginal people. It is suggested in the Guidance Statement that the following actions be taken:

- Consultation with the Aboriginal Affairs Department and desktop review of site records in accordance with the *Aboriginal Heritage Act 1972*.
- Undertake an Aboriginal heritage survey including consultation with appropriate Aboriginal people and/or an archaeological survey.
- Informing the relevant Aboriginal people of the proposal, including potential impacts.
- Consultation with relevant Aboriginal people to highlight their concerns regarding the proposal.
- Demonstrating that these concerns have been adequately considered in impact management strategies.

8.1.2.2 Potential Impacts

Following consultation with the (WA) Department of Aboriginal Affairs, consultation was conducted with the Yamatji Land and Sea Council. Consultation with the Yamatji Land and Sea Council on 7 February 2006 indicated that the Abrolhos Islands were not part of the Yamatji Native Title Claim and that Yamatji would have no concerns of a cultural nature with the proposed development.

Legal representatives from Yamatji Marlpa Land and Sea Council advised that formal advice would need to be sought from four coastal native title claimants in the Geraldton region (Hutt River WC00/1, Naaguja WC97/73, Amangu WC04/2 and Nanda) at the next round of official meetings. Two of these meetings (Amangu and Naaguja) have already taken place and were attended by the proponent. These meetings were held on 8th June and 23rd June 2006 respectively. The claimants responded that they had no concerns with the proposal. A meeting date has not yet been set for the Nanda meeting. The proponent has been advised by the Yamatji Marlpa Land and Sea Council that it will not be necessary to meet specifically with Hutt River claimants as these individuals are all represented within the other groups and would therefore be consulted within the other three meetings. The issue of Aboriginal Heritage will be concluded after the meeting with the Nanda group, which will also be attended by the proponent.

8.1.2.3 Management and Mitigation Measures

Any Aboriginal Heritage issues relating to the project will be addressed following the advice obtained after the final formal meeting with the Nanda native title claimants.

8.1.2.4 Predicted Outcome

The environmental objectives for this factor will be met.

8.1.3 European Heritage

8.1.3.1 Relevant Standards and Legislation

The following legislation is applicable to this proposal:

- *Australian Heritage Council Act 2003* (Cth).
- *Commonwealth Historic Shipwrecks Act 1976* (Cth).
- *Protection of Movable Cultural Heritage Act 1986* (Cth).
- *Environmental Protection and Biodiversity Conservation Act 1999* (Cth).
- *Heritage Act 1990* (WA).
- *Maritime Archaeology Act 1973* (WA).
- *Museum Act 1969* (WA).

Within the *EPBC Act 1999*, Section 324Y relates to National Heritage management principles. Part 2(a) includes obligations for a constitutional corporation to implement or give effect to the National Heritage management principles.

This factor shall be assessed in line with the environmental objective.

8.1.3.2 Potential Issues

Long Island has a high heritage value both nationally and internationally through its association with the *Batavia* wreck and mutiny.

The Wallabi Group also possesses sites of cultural and heritage value associated with the *Batavia* and other shipwrecks (e.g. the *Hadda*), the fishing industry, guano mining and military use during World War II.

On 6 April 2006, an area of the Wallabi Group (including Long Island) was gazetted for inclusion on the National Heritage List under the *Batavia* Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos (Figure 10). The proposed tourism development will now be a "Controlled Action" on the grounds of National Heritage and as such requires approval under Section 4 of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) in relation to the provisions of sections 15B and 15C of the *EPBC Act*.

8.1.3.3 Potential Impacts

Though several archaeological surveys have been conducted on Long Island, the exact locations of the occupation, slaughter and gallows sites have not been determined. These sites could be damaged during the construction of the resort and through uncontrolled access of guests and visitors around Long Island during the operational phase of the resort. Where heritage sites are found these sites may be damaged though uncontrolled access and artefacts may be lost or damaged through souveniring or vandalising by visitors. The presence of the resort complex on Long Island may also result in the impression that those heritage sites on Long Island are only able to be visited by paying guests and are no longer freely accessible to the general public.

A potential positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia* that took place in the Wallabi Group in 1629.

The Long Island resort will inevitably result in increased visitation to some areas and sites. These sites include shipwrecks and sites of heritage value on other islands (e.g. Beacon Island). Without careful management these sites may be damaged. Increased visitation may also result in a reduced quality of the experience for those who currently visit these sites.

Table 8.1 below presents the Heritage Values of the site as gazetted on 6 April 2006 and listed on the National Heritage List. The table also summarises the potential impacts of the proposed development on each of these values.

Table 8.1: Potential Impact of Tourism Proposal on National Heritage Values

National Heritage Significance Criterion*	National Heritage Values*	Potential Impact of Long Island Tourism Development on Heritage Values
a. the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of	The *Batavia* and its associated sites hold an important place in the discovery and delineation of the Western Australian coastline. The wreck of the *Batavia*, and other Dutch ships like her, convinced the VOC (Dutch East India Company) of the necessity of more accurate charts of the coastline and resulted in the commissioning of Vlamingh's 1696 voyage.	A potential positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia*. The resort activities would include controlled visitation of historical sites (guided tours) as opposed to

National Heritage Significance Criterion*	National Heritage Values*	Potential Impact of Long Island Tourism Development on Heritage Values
Australia's natural or cultural history	Wrecked on 4 June 1629, it is the oldest of the known VOC wrecks on the WA coast and has a unique place in Australian shipwrecks. The sites consists of the wreck itself on Morning Reef, the survivors camps and gravesites on Beacon Island, and the enclosures on West Wallabi Island. Because of its relatively undisturbed nature the archaeological investigation of the wreck itself has revealed a range of objects of considerable value to the artifact specialist and historian investigating material in use by the Dutch in the first half of the 17th Century. The reconstruction of the hull has taught us much about 17th Century shipbuilding techniques. The remains of the cargo carried by the vessel have provided economic and social evidence of the operation of the Dutch port at *Batavia* in the early 17th Century. The two ruined 'huts' on West Wallabi Island are the oldest structure built by Europeans in Australia. As a result of their being marooned on the mainland, Wouter Loos and Jan Pelgrom de Bye are regarded as the first known European residents of the Australian continent. The human skeletal material recovered from Beacon Island has proved to be of considerable research significance. As the date and circumstances of most of the deaths on the island are known, the osteological evidence collected from the island has proved important as reference data for comparative osteological studies for other 17th and 18th Century Dutch burials. No other Australian shipwreck has the same associations with mutiny and murder such as the *Batavia* and this has fired public imagination.	ad hoc uncontrolled visitation as currently occurs. The Resort may result in increased visitation to the *Batavia* wreck and sites of heritage value on other islands (e.g. Beacon Island). There is potential for these sites to be damaged. Increased visitation may also result in a reduced quality of the experience for other visitors. Damage could potentially occur from unsuitable anchoring of resort-associated boats near the *Batavia* wreck. There is no potential to impact on the huts at West Wallabi Island as the resort will not offer visits to West Wallabi Island.
c. the place has outstanding heritage value to the nation because of the place's potential	The number of archaeological discoveries made at Wallabi Islands sites indicate that they may still have potential to yield further information. The Western Australian Maritime Museum believe that there is still undiscovered skeletal material on Beacon	Heritage sites, particularly in areas not yet surveyed, could be damaged during the construction of the resort and through uncontrolled access of guests and visitors around the

National Heritage Significance Criterion*	National Heritage Values*	Potential Impact of Long Island Tourism Development on Heritage Values
to yield information that will contribute to an understanding of Australia's natural or cultural history	Island as well as on West Wallabi Island. Continued investigation of the sites may have capacity to contribute further detail on 17th century Dutch lifestyle, diseases, and the hardships of the journey and the mutiny.	island during the operational phase of the resort. Artefacts may be lost or damaged through souveniring or vandalising. There is potential for heritage values to be diminished through inappropriate decommissioning of the resort.
d. the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: i. *a class of Australia's natural or cultural places; or* *ii. a class of Australia's natural or cultural environments*	The *Batavia* provides one of the best Australian examples of the characteristics of a shipwreck site, including: • The wreck occurred after a long and arduous voyage where considerable hardship had already been experienced by the passengers and crew. • The vessel was wrecked at night on a coral reef that provided little by way of shelter and sustenance to the survivors. • The wreck contained what was for its time vast wealth in the form of silver coins and jewels of great value. • The survivors only hope of assistance was from an isolated Dutch outpost 900 nautical miles away, and to fetch this assistance required a superb feat of seamanship in open boats under considerable hardship. The wreck of the *Batavia* is unique in the annals of Australian shipwrecks because of the consequential events of the Cornelisz-led mutiny and murders after the departure of Pelsaert to fetch assistance.	A potential positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia*. The presence of the resort complex on Long Island may result in the impression that those heritage sites on Long Island are only able to be visited by paying guests and are no longer freely accessible to the general public. There is potential for unaccompanied or unauthorised day visitors to land on the island and wander unsupervised.
g. the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community	The *Batavia* wreck sites have social and cultural significance to members of the wider Australian community due to their role in defining the archetypal Australian shipwreck story. The places on which the events unfolded during and after the wreck of the ship, are associated with a nationally important story which graphically illustrates the dangers inherent in sea travel to Australia. The hardships inherent in this travel have become part of Australia's cultural traditions, expressed through books like Hugh Edwards' *Island of Angry Ghosts* and Henrietta Drake-Brockman's *Voyage to*	A likely positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia*.

National Heritage Significance Criterion*	National Heritage Values*	Potential Impact of Long Island Tourism Development on Heritage Values
or cultural group for social, cultural or spiritual reasons	*Disaster* and music, such as Richard Mill's opera '*Batavia*'.	

** As documented on the National Heritage List.*

8.1.3.4 Management and Mitigation Measures

A Long Island Resort Heritage Management Plan (HMP) will be developed in consultation with WAMM and the Department of Fisheries to ensure consistency with the Heritage Management Plan to be developed by the Government for the National Heritage Listed place. This plan will cover the operational and decommissioning phases of the resort. The Construction Management Plan (see Appendix 3) covers potential heritage issues during the construction phase. The Heritage Management Plan will also deal with heritage issues both on Long Island and on other islands and sites. The following sections outline the management and mitigations measures that shall be adopted for each aspect of the resort.

Construction

A Construction Environmental Management Plan (CMP) has been developed in consultation with the construction contractor and taking into account the recommendations of WAMM and DEH in relation to heritage issues.

During construction of the resort a qualified archaeologist shall be employed during periods of major excavation to undertake a watching brief as recommended by Anderson *et al.* (2005). The archaeologist shall ensure that any relics disturbed by construction are recorded and recovered following correct protocols and procedures. The archaeologist shall also provide information and liaison between the construction contractor, WAMM and other government agencies in relation to heritage issues. Additionally, all construction personnel will be required to undergo an induction specific to the environment and issues associated with Long Island and the Abrolhos Islands. This induction will include heritage issues and procedures to be followed if a potential artefact is uncovered. It will also cover responsibilities for any workers that may visit heritage sites outside of work hours.

Resort Operation

During the operational phase of the resort there is potential for impacts upon heritage sites and artefacts both on Long Island and those at other islands or locations. The majority of these impacts will result from guest visitation and access. The HMP seeks to put in place procedures to minimise these impacts. Aspects of the HMP and impact minimisation can also be found in the Visitor Activity Management Plan (VAMP). These plans will focus on

formalising access to sites of heritage value, providing interpretation and education as to the value of these sites and methods for monitoring and mitigating impacts on heritage sites.

Long Island was the location for occupation by one of the groups of survivors from the *Batavia* wreck, their subsequent murder and the trial and execution of the mutineers. The exact locations of these sites have never been discovered, though there is potential for them to be in the unsurveyed southern portion of the island. As such, the best way to protect these sites is to restrict the movements of people over the island, particularly the southern portion, and provide education and interpretation on the historical values of Long Island. This shall be achieved by installing boardwalks north and south of the resort, prohibiting random wandering over the island and educating guests, visitors and staff in the history and value of Long Island through inductions and interpretive signage. Visitors will be encouraged to visit the Geraldton Museum prior to arriving on the island to gain a background to the heritage of the area. An on-island induction will follow, once visitors arrive on the island. Visitors and guests shall be encouraged to use the northern boardwalk and walk-trail if they wish to explore the island as there is a low likelihood that historical sites are present in this area.

A heritage display will be established in the day visitors pavilion and the resort reception area. This will include artefacts on loan from the WAMM that relate to the *Batavia*. Interpretive signage will accompany these artefacts.

There exists a potential for unaccompanied or unauthorised day visitors to land on the island and wander unsupervised. This shall be discouraged and independent day visitors shall be controlled as far as practicable under the tourism licence. Interpretive signage will be available in the day visitors pavilion to educate day visitors.

All staff shall undergo a full induction to the Island as a condition of appointment. This shall include all heritage issues both on Long Island and the surrounding Abrolhos Islands.

Decommissioning

A Decommissioning and Rehabilitation Plan (DRP) will be developed and regularly reviewed to ensure best practice methods and technologies are implemented taking into account the recommendations of WAMM and DEH in relation to heritage issues.

As decommissioning will remove all buildings and infrastructure from the site it is expected that the disturbance footprint will be similar to that disturbed during construction. As no new areas will be disturbed it is likely that no heritage issues will be encountered that were not addressed during construction. All decommissioning personnel will be required to undergo an induction specific to the environment and issues associated with Long Island and the Abrolhos Islands. This induction will include heritage issues and procedures to be followed if a potential artefact is uncovered.

With respect to the National Heritage Listing, the potential impacts of the proposed resort on the listed heritage values (see Table 8.1 above) are summarised below in Table 8.2, along with the proposed management and mitigation measures to address each of these potential impacts.

Table 8.2: Management and Mitigation Measures for Potential Impacts on Heritage Values

Potential Impact of Long Island Tourism Development on Heritage Values**	Management and Mitigation Measures	Timeframe
A potential positive impact of the resort is that of increased awareness and understanding of the important historical events associated with the *Batavia*. The resort would involve controlled visitation of historical sites (guided tours) as opposed to ad voc uncontrolled visitation.	Prior to construction of the resort, all construction personnel will undergo an induction on the heritage values of Long Island. A Long Island Heritage Management Plan (HMP) will be developed and put in place procedures to minimise impacts on the heritage values that may result from resort-associated activities. One of the roles of this document will be to provide interpretation and education on these heritage values. Visitors and staff will be educated in the history of Long Island through inductions and interpretive signage. Visitors will be encouraged to visit the Geraldton Museum prior to arriving on the island to gain a background to the heritage of the area. An on-island induction will follow, once visitors arrive on the island. A heritage display will be established in the day visitors pavilion and the resort reception area. This will include artefacts on loan from the WA Maritime Museum that relate to the *Batavia*. Interpretive signage will accompany these artefacts. It is anticipated that guests will be offered guided heritage tours and lectures incorporating visits to Beacon Island. Interpretive signage will be placed on the boardwalks as appropriate to further educate guests. Numbers of guests on guided tours will be strictly limited. All staff shall undergo a full induction to the Island as a condition of appointment. This shall include all heritage issues both on Long Island and the surrounding Abrolhos Islands.	Prior to construction for construction workers Prior to operation, interpretive materials and signage will be developed in conjunction with appropriate authorities.
A potential impact of the Resort is increased visitation to the *Batavia* wreck and sites of heritage value on other islands (e.g. Beacon Island).	A Visitor Activity Management Plan has been developed to manage all visitor activities such as tours and visits to other islands. All diving activities on the *Batavia* will be	Visitor Activity Management Plan submitted for assessment with PER.

Potential Impact of Long Island Tourism Development on Heritage Values**	Management and Mitigation Measures	Timeframe
There is potential for these sites to be damaged. Increased visitation may also result in a reduced quality of the experience for other visitors. Damage could potentially occur from unsuitable anchoring of resort-associated boats near the *Batavia* wreck. There is no potential to impact on the huts at West Wallabi Island as the resort will not offer visits to West Wallabi Island.	conducted by licensed operators and these operators will have a system of communication between themselves to prevent over-crowding of the popular dive site. Visits to other islands will be conducted on an escorted tour basis only, with tour operators using their discretion on the numbers of visitors. Vessel masters/ skippers will not anchor close to or on the *Batavia* directly as it is an offence to damage historic sites. The resort will not conduct tours to West Wallabi Island due to the difficulty of accessing the island and the sensitivity of the natural values of the site.	
Heritage sites, particularly in areas not yet surveyed, could be damaged during the construction of the resort and through uncontrolled access of guests and visitors around the island during the operational phase of the resort. Artefacts may be lost or damaged through souveniring or vandalising. There is potential for heritage values to be diminished through inappropriate decommissioning of the resort.	A Construction Management Plan (CMP) will be implemented and include a heritage induction for all construction personnel. This covers procedures for a chance find of an artefact. During construction a qualified archaeologist shall be employed to undertake a watching brief during major excavation. The Long Island Resort Heritage Management Plan (HMP), interpretive signage and educational activities will minimise impacts during operation. Long Island was the location for occupation by one of the groups of survivors from the *Batavia* wreck, their subsequent murder and the trial and execution of the mutineers. The exact locations of these sites have never been discovered, although two-thirds of the island (including the development site) have been surveyed. There is still potential for these sites to be in the unsurveyed southern portion of the island, the section that will not be used by the proposed resort. The best way to protect these potential sites is to restrict the movements of people over the island, particularly the southern portion, and provide education and interpretation on the historical values of Long Island. This shall be achieved by installing boardwalks north and south of the resort, prohibiting random wandering over the island and	Prior to construction for construction personnel. During construction. Long Island HMP and other interpretive material to be developed prior to operation of the resort.

Potential Impact of Long Island Tourism Development on Heritage Values**	Management and Mitigation Measures	Timeframe
	educating guests, visitors and staff in the history and value of Long Island through inductions and interpretive signage. Visitors and guests shall be encouraged to use the northern boardwalk and walk-trail if they wish to explore the island as there is a low likelihood that historical sites are present in this area. It is understood that WAMM is currently seeking Government funding to conduct an archaeological survey of the southern portion of Long Island. This would mean that no unsurveyed areas would remain on Long Island. A Decommissioning and Rehabilitation Plan (DRP) will be developed and regularly reviewed to ensure best practice methods and technologies are implemented taking into account the recommendations of WA Maritime Museum and DEH in relation to heritage issues. All decommissioning personnel will be required to undergo an induction specific to the environment and issues associated with Long Island and the Abrolhos Islands. This induction will include heritage issues and procedures to be followed if a potential artefact is uncovered.	Decommissioning and Rehabilitation Plan to be developed prior to operation.
The presence of the resort complex on Long Island may result in the impression that those heritage sites on Long Island are only able to be visited by paying guests and are no longer freely accessible to the general public. There is potential for unaccompanied or unauthorised day visitors to land on the island and wander unsupervised.	Signage on the jetty will explain the HLD lease area and the facilities available for day visitors. The day visitor pavilion will contain interpretive material and artefacts on loan from WAMM. Day visitors and resort guests will undergo an induction immediately upon arrival at the Resort. Independent day visitors shall be controlled as far as practicable under the tourism licence and directed to the day visitors pavilion.	Signage and interpretive material to be developed prior to operation.

*** From Table 8.1*

8.1.3.5 Predicted Outcome

Implementation of the CMP, HMP, DRP and VAMP and induction of all contractors, staff, guests and visitors and other management procedures outlined above shall ensure that the heritage values of Long Island and the Abrolhos Islands are not compromised.

8.2 LANDSCAPE VALUES AND VISUAL AMENITY

8.2.1 Environmental Objective

To ensure that visual amenity is considered and measures are adopted to reduce adverse visual impacts on the surrounding environment as low as reasonably practicable.

8.2.2 Potential Issues

Long Island, in keeping with most of the islands of the Abrolhos, is low-lying (View 4) with elevations typically varying between two and 3.5 metres AHD and a small central portion rises just over four metres AHD. The island is predominantly overlain with bleached greyish-white coral rubble and sparsely vegetated with coastal scrub between 200 and 700 millimetres high.

The islands with fisher camps have multicoloured shacks and transportables (View 5) with occasional two storey structures and numerous jetties radiating from the islands. Antennas are prominent on the skyline on these camps.

The resort will comprise single storey structures with low angle monopitch roofs, with the exception of the function area, which will have low-profile dual pitched roofing. The roofing will be a grey colour and the exterior of the buildings will be painted predominantly grey and brown, in keeping with the existing environment of the island (View 1). One antenna is anticipated for the resort.

The structures will be raised up to 0.5 metres above ground level with the upper elevation of structures ranging between 7.5 and 10 metres AHD.

The boardwalks on the island will be raised 0.5 metres above the natural ground surface and will, in most cases, be below the skyline of the island outside of the resort development area.

8.2.3 Impact Assessment

The main viewshed will be from the east, where the deep water of Goss Passage will allow boats to pass between 100 and 900 metres from the island (Views 2 and 3). The resort, when viewed from deep water to the north and south, will be distant and will not be clearly visible due to the elongated north-south alignment of the northern and southern portions of the island with the intervening land in the foreground.

The resort will be visible from the west, but access by boat is constrained by the shallow water and reef.

The visual impact when viewed by boat from the water will be limited to mainly Goss Passage to the east and to a limited extent from the west. The water-based views will be mainly confined to fishers working in the area and charter boats visiting the islands. The resort's low profile will be visible on the skyline and will have a minor impact on the view from Beacon Island (one kilometre east).

The resort will be visible from the air to planes and helicopters visiting the islands for sightseeing and those flying to and from Geraldton and landing on East Wallabi Island.

The resort, when viewed from the air, will blend into the surrounding patchwork of dark coloured vegetation from a distance.

8.2.4 Predicted Outcome

The resort will have a low profile and colouring, which is in keeping with the natural landform and amenity of the existing islands.

Taking into consideration the potential impacts and the design measures proposed, the environmental objective for visual amenity will be achieved.

8.3 ABROLHOS ISLANDS ACCESS ISSUES

8.3.1 Environmental Objective

As no specific objective was found that relates to "access", it was considered most appropriate to discuss the objective that relates to recreation. The objective is: To ensure that existing and planned recreational uses of the environment are not compromised.

8.3.2 Relevant Standards and Legislation

As there are no regulatory standards this issue is to be assessed against the objective.

8.3.3 Commercial Fishing and Aquaculture

8.3.3.1 Potential Issues

The western rock lobster (WRL) fishery in WA is worth over AUD300 million annually. Catches in the Abrolhos account for over 20% of the State's commercial catch in the fishery. At the Abrolhos Islands the commercial WRL fishing season runs from 15 March to 30 June each year, during which time ~1.2 million pot lifts occur (Rossback *et al*., 2005).

Other fisheries in the area are the Wetline Fishery, with most fishing activity occurring in deeper water, and the Mid-west Trawl Fishery. Activity in the Trawl Fishery (largely targeting scallops) is sometimes known to occur within one nautical mile of the northern tip of Long Island.

The nearest aquaculture site (a licensed pearl farm) is at least three nautical miles away from Long Island.

8.3.3.2 Impact Assessment

Activities of resort guests could potentially impact on commercial fishers, particularly rock lobster fishers. This could result from guests conducting their own activities in small vessels and physically impeding the route of commercial fishers. Rock lobster fishers sometimes traverse the water very close to the southern tip of Long Island in higher tides (in jet boats). If guests were to swim or conduct water activities in this area, this could result in a safety hazard to commercial fishers and guests.

The potential for negative impact on aquaculture is considered very slight. The AMWING Pearl Producers' Association have identified a potential for future positive interaction between the tourism operation and their pearl farms, with tours of the farms possibly being offered to resort guests.

8.3.3.3 Management and Mitigation Measures

To ensure that no negative impact occurs on commercial fishing the following measures have been adopted:

- Resort guests will not be permitted to conduct independent boating activities. No dinghies will be available and jet-skis will only be used on fully escorted tours. All activities will be conducted in accordance with the Visitor Activity Management Plan.
- To prevent a possible safety hazard, swimming and snorkelling areas have been designated and guests will be required to swim only in these areas. These areas are well away from passages used by commercial fishers. Swimming platforms and gazebos will be provided in these locations to assist with access. In addition, there will be no access permitted to the southern part of the island at all, removing this potential hazard. This message will be conveyed during the guest and staff inductions.
- Guests will not be conducting any fishing from the island and will only be permitted to fish from licensed fishing tour operator's vessels.

8.3.3.4 Predicted Outcome

The management and mitigation measures described above ensure that the environmental objective for this factor will be met.

8.3.4 Tourism and Recreation

8.3.4.1 Potential Issues

Whilst formalised data on numbers of tourists at the Abrolhos Islands is not available, unpublished data gathered from various sources indicates that numbers of tourists are increasing every year. Visitation to the Abrolhos is not regulated or restricted in any way, and the public currently enjoys access to all of the islands at any time. Most of the islands do not contain interpretive signage to warn visitors of the potential to impact local fauna or

environmental values. Some islands do contain signage, such as West Wallabi Island, around the Wiebbe Hayes forts.

The islands are currently visited by a diverse mixture of people. Other than the commercial fishers and their friends and families, most people visit the Abrolhos for the following activities:

- Recreational fishing.
- Diving/snorkelling.
- Nature observation.
- Visiting islands and heritage sites.

Long Island is such an important site from a heritage perspective, it is important to ensure that the public is still able to access the islands. Long Island is also an important site for nature-based recreation for activities such as diving /snorkelling the Long Island Dive Trail or bird watching. The public must be able to continue to access these recreational activities.

8.3.4.2 Impact Assessment

There may be a perception that the development of the resort at Long Island will prevent access to the entire island, making it the domain of the wealthy tourist only. The potential impact is that people who would previously have visited Long Island would now stay away, missing out on a valuable recreational experience.

Another potential impact is that the Long Island tourism development will attract additional day-trippers to the island who would not have visited had the resort not existed there, with its facilities for day visitors. There is potential for these visitors to have a detrimental effect on the environment of Long Island or potentially the cultural heritage, should they happen to find an historic artefact.

There is potential for resort guests to cause increased visitation to dive sites and popular tourist sites and for this to impede access by other tourists to these sites. The additional visitors in the area may cause additional environmental impacts on other islands to be visited.

There is a potential positive impact of enhanced recreational opportunities and heritage interpretation leading to a much-improved appreciation of the island's heritage and natural values, which may help to protect both in the future.

8.3.4.3 Management and Mitigation Measures

The following management and mitigation measures are proposed to minimise any negative impacts relating to tourism access and recreation:

- Interpretive signage installed at the resort jetty will explain the HLD lease area and the facilities available to day-trippers. Resort advertising will also promote the availability and usage of the island by day-trippers.
- The signage on the jetty will request visitors to use the resort's boardwalks to minimise impact on the island and although not part of the HLD lease areas, the information will request day-trippers not to walk over the other areas of the island as this may lead to

disturbance of nesting birds and vegetation and potentially heritage sites. A heritage display will be established in the day visitor's pavilion. This will include artefacts from the *Batavia* that have been supplied by WAMM. Interpretive signage relating to the heritage of the island will also be installed in collaboration with WAMM. This signage will detail procedures for visitors finding a potential artefact.

- Currently there are no restrictions on the numbers of people diving the popular dive sites at the Abrolhos and it should be noted that visitors other than resort guests may also be diving on the sites to the north of the island around the Long Island Dive Trail. All resort diving activities will be conducted by licensed operators and it is expected that these operators will have a system of communication between themselves to prevent over-crowding of popular dive sites.
- Visits to other islands will be conducted on an escorted tour basis only, with tour operators using their discretion on the numbers of visitors accessing the site at one time.
- Visits to other islands will be controlled through the Visitor Activity Management Plan. No visits will be made to East or West Wallabi Islands other than to the airstrip or to areas such as Turtle Bay that will be approached from the water. Other points in the Visitor Activity Management Plan include limiting speeds of jet skis and motorised boats to five knots within 200 metres of islands. "No go" areas and seasonal closures will be implemented. During visits to other islands, any traversing of islands will be done strictly on existing tracks. Where no tracks exist, guests will remain on beach areas around the perimeter to prevent the collapse of bird burrows and to maintain the lowest possible profile to assist in minimising bird disturbance.
- The positive impact associated with increased information will be maximised. All guests will be strongly encourage to visit the Geraldton Museum before visiting Long Island, and this will enhance their knowledge of the history of the area. Upon arrival at Long Island, all guests will undergo an induction that will cover heritage and natural values and the ways to protect both of these. In addition, whilst on the island visitors will be able to participate in many activities that will enhance their recreational experience. This also applies to day-trippers, who will be able to access the interpretive material in the day visitors pavilion as well as diving, snorkelling, glass bottom boat tours and other activities by arrangement with the management.

8.3.4.4 Predicted Outcome

Given the mitigation and management measures outlined above, it is considered that the objective for this factor has been met.

8.3.5 Scientific Research

8.3.5.1 Potential Issues

Every year various fisheries and environmental research programmes are conducted at the Abrolhos. The Abrolhos Islands are of special interest to marine scientists due to the diversity of species and the presence of both tropical and temperate species.

8.3.5.2 Impact Assessment

Currently the only research station in the Abrolhos is the Department of Fisheries' Saville-Kent Centre at Rat Island in the Easter Group. The presence of the permanent facilities of the resort at Long Island may represent an enhanced opportunity for research in the Wallabi Group.

8.3.5.3 Management and Mitigation Measures

- Accommodation may be available to researchers during the off-peak season to conduct research programmes.
- Resort staff may be able to assist in ongoing research programmes such as those that require regular monitoring.

8.3.5.4 Predicted Outcome

It is considered that the potential increased access to research opportunities means that the objective for this factor will be met.

9. STUDY TEAM

Humfrey Land Developments (Barry Humfrey)
Humfrey Land Developments has been involved in property development, project management and joint venture partnerships for over 15 years. As the manager of Springdale Holdings Pty Ltd, Humfrey Land Developments holds land in trust for numerous property development syndicates and acts as project manager on developments for both private and public clients. Humfrey Land Developments currently has projects in Geraldton (being the first truly smart wired subdivision in Western Australia), Exmouth and Port Hedland.

In 1996 Humfrey Land Developments won the prestigious 'Country Urban Development or Subdivision' award for excellence from the Urban Development Institute of Australia. Humfrey Land Developments brings extensive experience in property development to this project and has exhibited vision and innovation in the Seacrest Estate, which is an $80 million joint venture with the Department of Housing and Works in Geraldton.

Managing Director, Barry Humfrey, was educated and lives in Geraldton. Barry has owned rock lobster fishing and wet line boats that fished the Abrolhos Islands and has a daughter and son-in-law involved in the rock lobster fishing industry at the Abrolhos Islands, giving a valuable insight into what is required environmentally to succeed with a tourist venture in this area.

Broadwater Hospitality (Scott Cogar)
Broadwater was founded in Western Australia in 1990 and operates seven landmark resort properties throughout regional and metropolitan WA, being one of this State's most capable and largest operators of regional resort properties.

Broadwater has extensive experience, infrastructure, resources, and a proven track record in (greenfield) development, management and operation of resort-style properties in regional locations. In addition, Broadwater's senior management team has extensive experience and expertise in the development and operation of island based and remotely sited resorts - particularly resorts located in ecologically sensitive (marine park) environments.

Broadwater operates seven resort-style (four to five star) properties in Western Australia, with an eighth property currently under development. Broadwater's senior management team (five senior executives) has over 100 years' cumulative experience in the tourism and hotel industries, having held executive management or general management responsibility for many world-renowned resorts in the Asia-Pacific region. In addition, Alan Boys (of Hotel & Leisure Advisory) is an independent consultant to Broadwater, being a highly regarded and well-known tourism consultant with three decades of experience in the consulting and accounting sectors of the tourism industry. Alan Boys will provide advice and assistance to Broadwater for this project.

RBA Consulting (Matt Bird)
RBA Consulting is a Perth based organisation specialising in the provision of a wide range of strategic planning services for the tourism, travel and leisure industries. The company has been consulting to the industry since 1986 and our client base includes a range of government agencies and private industry developers. The company has developed a high profile within the Australian tourism industry and is one of the most highly respected tourism service

organisations operating in Western Australia. Of particular note, our strategic planning clients have included the Department of Conservation and Land Management, the Western Australian Tourism Commission (now Tourism Western Australia), Perth Convention Bureau, Office of Aboriginal Economic Development, a number of Western Australian Regional Development Commissions, and Local Government Authorities and a number of major private industry operators.

Wood and Grieve Engineers (Mike Best and Andre D'Sanges)
Wood and Grieve Engineers are a large engineering consultancy originally established in Perth in 1961 and now operating throughout Australia. The organisation's services include civil, structural, electrical, mechanical, hydraulics and environmentally sustainable design services. The firm provides services to private industry and government clients for land development, property, infrastructure, resource, commercial, industrial and retail industries in Australasia. The organisation has almost 200 staff Australia wide, with 120 staff based in the Perth head office. Wood and Grieve Engineers are a quality endorsed organisation gaining accreditation to AS 3901 in August 1992 and ISO 9001 in June 1995. Wood and Grieve Engineers have the skills and experience to provide all the necessary engineering expertise to the Long Island project.

Jones Coulter Young (Paul Jones and Ian Hart)
Jones Coulter Young (JCY) is a Western Australian owned Architecture and Urban Design practice internationally renowned for design excellence through many award winning architectural and urban design projects. JCY concentrates on the local market and has a proven track record in producing innovative design solutions.

JCY's commitment to design excellence and the acknowledgement of JCY's high standards of design have been recognised by the community and professional bodies by the many awards received for energy conservation, architectural design, excellence in housing, master builders construction awards and planning awards.

JCY was further honoured in 2001 by inclusion into the quality publication 'New Directions in Australian Architecture' which featured the work of 14 of Australia's most progressive architects. JCY was the only Western Australian based company to be included in the book.

MBS Environmental (Lance Bosch and Carolyn Beasley)
Martinick Bosch Sell Pty Ltd, trading as MBS Environmental, is an Australian consulting company specialising in the fields of environmental science, environmental engineering, water resources and project management. The company (formerly Martinick McNulty Pty Ltd) was established in 1978 and is based in Perth, Western Australia. For over 25 years, MBS Environmental has provided environmental and management services to private, public and government organisations and agencies within the industrial, residential, transport, commercial and mining sectors. Services have been provided throughout Australia and countries located in Southern Africa, Eastern Europe and Asia.

MBS Environmental has extensive experience in both land and marine based developments, conducting environmental impact assessments, preparing environmental plans and monitoring the implementation of various management systems. MBS Environmental will oversee and manage all environmental aspects of the project through its highly qualified staff of environmental engineers and scientists and others on the consultant team. MBS

Environmental will work in close cooperation with marine environmental consultants Oceanica.

Halfmoon Biosciences (Dr Chris Surman)
Halfmoon Biosciences is a Western Australian based consultancy. Chris Surman is a professional ecologist with a strong maritime background, who grew up in Geraldton. He has worked extensively on seabirds throughout Australia, from Bass Straight to Christmas Island. Dr Surman has been involved with seabird surveys and monitoring at the Houtman Abrolhos since 1987 and has an extensive seabird database of the area. He has developed monitoring programs and oil spill contingency plans for oil and gas companies on the NW Shelf, has conducted Marine Mammal surveys on seismic vessels and advised the Department of Fisheries, Western Australia on management issues for the Houtman Abrolhos. His knowledge of the ecology of the Houtman Abrolhos has been gained from over 20 years of visits to the area, including 10 years living and working at the Pelsaert Group as a research scientist.

Oceanica (Mark Bailey and Spencer Shute)
Oceanica Consulting Pty Ltd (formerly DAL Science & Engineering Pty Ltd) is Western Australia's largest specialist marine consultancy. Oceanica has extensive experience in the management and implementation of environmental programmes for coastal and estuarine systems, and in the preparation of detailed documentation for regulatory approval, including interaction with all statutory authorities. Oceanica has also been actively involved in public consultation and community information programmes associated with many major projects in Western Australia. All of Oceanica's professional personnel have high-level academic qualifications and wide experience, and can provide a range of multi-disciplinary skills and services. The Oceanica team has built a reputation for quality environmental consulting with a high degree of integrity and reliability in the areas of project management, community consultation, environmental impact assessment, coastal processes and geomorphology, environmental engineering and modelling, habitat mapping, nutrient and contaminant issues, environmental surveys, technical reviews and policy relating to marine and coastal issues.

Crothers Construction (David Crothers)
Crothers Construction Pty Ltd has been a registered company since 1998, however the principals and founders of the company all have over 25 years experience in the industry. David Crothers has for the past 36 years been involved in estimating, quantity surveying, project management and administration, design and construction of projects, refurbishment, manufacturing and building services in the commercial, civil and industrial sectors. Crothers Constructions senior staff has gained a wealth of experience working throughout the Midwest, Gascoyne, North West, Kimberley and South-East Asian regions. Crothers Construction is a design and construction company covering commercial, civil and industrial construction, project management, commercial refurbishment and development projects. On this particular project, the role of Crothers Construction will be to assist with the design and documentation processes, provide construction management throughout the project construction period involving obtaining materials and labour, awarding of contracts, arranging transport to and from the islands, quality management and to deliver the project on time and on budget.

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PLATES

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APPENDIX 1

Environmental Scoping Document
Prepared by MBS Environmental, November 2005, 78pp.

See CD-Rom supplied

APPENDIX 2

Correspondence from EPA and DEH

APPENDIX 3

Construction Management Plan

APPENDIX 4

Avifauna Management Plan for the Long Island Tourism Development, Wallabi Group, Houtman Abrolhos, Western Australia.

Surman, C. A. (2006)

APPENDIX 5

Visitor Activity Management Plan

APPENDIX 6

Long Island Marine Management and Monitoring Plan

Oceanica Consulting Pty Ltd and MScience Pty Ltd (2006)

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Long Island Oil Spill Environmental Management Plan

Oceanica Consulting Pty Ltd. (2006)

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Surman 2006a

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How 2005

APPENDIX 13

Long Island Benthic Habitat Survey
Oceanica Consulting Pty Ltd, 2006

APPENDIX 14

Long Island Heritage Survey
Anderson *et al*. 2005

APPENDIX 15

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APPENDIX 17

Vermin/Pest Management Plan