

ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Redevelopment of
Lily Beach resort (Huvahendhoo), South Ari Atoll, Maldives



Proposed by

Lily Hotels Pvt. Ltd

Signature:

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For Water Solutions Pvt. Ltd., Maldives



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4 Non Technical summary

This report discusses the findings of an environmental impact study undertaken by Water Solutions Pvt. Ltd. upon request from Lily Hotels.

The Project

This project involves redevelopment of Lily Beach Resort located on Huvahendhoo island in South Ari Atoll, Maldives. Huvahendhoo is an oval-shaped sand cay lying on its own reef system close to the eastern rim of the Atoll. The island is roughly 2 km from inside the eastern rim of the atoll. The eastern end of the island is prone to long-period swells from the Indian Ocean. Towards east of Huvahendhoo, lies Huvahendhoo Kanduu or the channel. Huvahendhoo is directly exposed to the channel as there are no reefs or islands in between this channel and the island. The island is formed on a single reef and is elongated and narrow in formation. The proposed redevelopment will consist of two main components namely, construction and development of new additional facilities and refurbishment and enhancement of existing facilities. Additional new facilities will include development of 36 standards water villas with a jetty, development of 4 sunset water villas, a new over water spa, GM villa, reception, coffee shop and pool bar, Ala Carte Restaurant and Dive School. In addition, existing facilities will be refurbished to upgrade and meet the additional demands and blend with the new concept. This includes extension of the existing restaurant, refurbishment of semi water villas and standard rooms and construction of new staff accommodation.

Environmental Impacts

Environmental impacts of the proposed redevelopment works have been examined through a number of processes. The report has identified that the impacts of the redevelopment process will mainly be felt on the coastal and marine environment. Impacts on the marine environment will be felt through sedimentation and siltation caused by the construction activities on the lagoon and the coral reef, during this period. Impacts on the coastal environment will be felt as a result of developing new structures on the coastal zone such as the Ala Carte restaurant. Impacts are expected to be felt through changes in water quality, changes to the shore line and sediment movement. Baseline data has therefore been collected in order to monitor the changes to the marine and coastal environment which will be identified in periodical monitoring reports.

Alternatives and mitigation

Several alternatives were considered for the proposed project, including developing water villas without a jetty to reduce the number of columns on water. The Ala Carte Restaurant which is developed as a semi water restaurant has also been considered to be developed as a solid structure. Alternative technologies such as pile drilling to construct the supporting columns for over water structures were also considered. These alternatives, though it was considered, has been avoided as they are more undesirable in terms of environmental impacts

and costs. Several mitigation measures have been identified including silt curtains and sand traps to control sediment dispersal during construction period. In addition, limiting construction period to the minimum time possible time and proper supervision and monitoring has also been identified as mitigation measures. These measures are proposed in order to mitigate the impacts on the coral reef and generally the marine environment.

Finally, the report provides a conclusion which outlines the alternatives, the mitigation measures and the environmental monitoring that will be undertaken in Lily Beach Resort.

5 Introduction

This Environmental Impact Assessment report (EIA) has been prepared to full fill the requirements of the Environmental Protection and Preservation Act, law no. 4/93 for the proposed redevelopment of the Lily Beach resort on the island of Huvahendhoo in South Ari Atoll, Maldives. The project proponent is Lily Hotels. At present, Lily Beach resort has 85 rooms. After the redevelopment, the number of rooms will increase to 125 with a bed capacity of 250. The total cost of the project is estimated to be US\$ 15 to 20 million. The proponent has allocated one percent of the total project cost for environmental management.

This report will identify the potential impacts (both positive and negative) of the proposed redevelopment. The report will look at the project description in detail, existing environmental conditions, justifications given by the proponent for undertaking the proposed project components and alternatives. Alternatives to proposed components or activities in terms of location, design and environmental considerations would be suggested. A mitigation plan and monitoring programme before, during and after the works would also be suggested. This would ensure that the proposed activities are undertaken with caution and appropriate care so as to protect and preserve the natural environment of the island. Figure 1 shows an aerial view of Huvahendhoo (Lily Beach Resort).

Figure 1: Aerial view of Lily Beach (Huvahendhoo), South Ari Atoll.



The major findings of this report are based on qualitative and quantitative assessments undertaken during site visit in March and April 2007. However, due to unavailability of long term site-specific data, the impact assessment methodology has been restricted to field data collected, consultations, experience and professional judgment. This EIA has been produced in accordance with the EIA Regulations 2007, issued by the Ministry of Environment, Energy and Water on preparing Environmental Impact Assessment studies.

5.1 Aims and Objectives of the EIA

This report addresses the environmental concerns of the proposed redevelopment of Lily Beach Resort. It helps to achieve the following objectives.

- Allow better project planning
- Assist in mitigating impacts caused due to the redevelopment without undertaking EIA
- Promote informed and environmentally sound decision making
- To demonstrate the commitment by the proponent on the importance of environmental protection and preservation.

This EIA is intended to address the potential damage or impacts caused due to the redevelopment and prevent or minimize potentially adverse environmental impacts and enhance the overall quality of the project. The EIA process allows environmental issues to be addressed in a timely and cost-effective way during project design, preparation and implementation. This report can also help reduce overall project costs, assist in completing projects on schedule, and help design the project in a manner acceptable to all stakeholders. Since the project takes place in an ecologically sensitive environment, this EIA will help stakeholders to make environmentally sound decisions and ensure less damage to the environment and minimize future costs of mitigation.

From the perspective of the Proponent, the main objective of the EIA is to fulfil the obligations of the proponent to undertake an EIA under Clause 5 of the Environmental Protection and Preservation Act of the Maldives and requirements of the Tourism Regulations. In addition, it is also the objective of the proponent to undertake the redevelopment with minimum damage to the environment. In doing so, the EIA establishes qualitative and quantitative values upon the existing environment with the perspective that the future generations will be benefited. Furthermore, the EIA will emphasize the need for the present generation to be responsible for their actions and to minimize the burden they place on the environment.

5.2 Methodologies

Common and internationally recognized methods not entailing excessive costs have been used in this environmental evaluation and assessment. These are briefly discussed below.

EIA methodologies developed over the years which include screening, scoping and preliminary assessments have been employed. More specifically, the recently enforced EIA regulations 2007 has been followed beginning with the application to undertake an EIA. Due to time constraints, impact assessment has also been based on what is sometimes referred to as “ad hoc” methods which rely on expert opinion. In fact, most EIA methodologies, qualitative or quantitative, rely on expert judgment, based on the experience gained by EIA consultants over the past years.

This EIA is based mainly on data collected during a fact finding/field investigation missions in March and April 2007 by a team consisting of a coastal engineer, environmental engineer, marine biologist, environmental management specialist and a GIS consultant. The data collection methods are described in detail under the sections, Coastal Environment, Marine environment and Terrestrial environment.

Conditions of the existing environment were analyzed using appropriate scientific methods. Coastal surveys, terrestrial surveys, beach profiles and reef surveys were undertaken. In addition, detailed bathymetry and island's existing shore line and vegetation lines were mapped with high accuracy GPS. Additionally, impact predictions have been based on experience gained by the consultants from similar projects. In brief, three environmental components were studied in detail, namely coastal marine and terrestrial environment.

5.3 EIA Implementation

This EIA has been prepared by a local environmental consulting firm, Water Solutions. Water Solutions have been chosen by Lily Hotels as the environmental consultants for this project. Water Solutions engaged a multidisciplinary team of consultants to carry out this assessment and undertake long term monitoring. The team members included local expertise in environmental impact assessment, coastal engineering, marine biology, mapping and GIS and environmental engineering. The team members were:

- Abdul Aleem, BSc, MPH – Mapping and GIS
- Ahmed Zahid, BSc. – Environment management and Ecotourism Consultant
- Hussen Naeem, BSc. – Marine Biologist

5.4 Terms of Reference

The terms of reference for this EIA have been attached as an annex. This EIA has been prepared based on this terms of reference.

6 Project Description

6.1 Project Proponent

This project is proposed by Lily Hotels, to redevelop the island of Huvahendhoo (Lily beach resort). Huvahendhoo is located in South Ari Atoll and has been operational as a resort since 1994. However, the proponent wishes to redevelop the island with enhanced additional facilities in order to increase the standard of the resort and to market for new clients. The island has been leased to Lily Hotels by the Ministry of Tourism and Civil Aviation.

6.2 Background of the Proponent

Lily Hotel Private Limited was incorporated in the Republic of Maldives on 19 May 1993 as a limited liability company with the objective of building and operating tourist resorts and undertaking other tourism related services. In 1993 the company entered into an agreement with the Maldivian Government to develop and operate a tourist resort on the island of Huvahendhoo in Alifu Dhaalu atoll. The US\$6 million Lily Beach resort was opened in November 1994, within one year of awarding the island. Lily Hotel Private Limited is part of the Lily group of companies, which has a major share in the country's trade and shipping industries. Excellent service and commitment to consumer satisfaction has made the group a respectable and trusted name in the country's economy. The Lily group of companies comprise of Lily Enterprises Private Limited, Lily Shipping and Trading Private Limited, Lily International Private Limited and Lily Hotel Private Limited. The combined turnover of all the Lily business entities exceeds US\$40 million. In 2003, Lily Hotel became an 18% shareholder in Promus Private Limited, the sub-lease owner and operator of Soneva Gili Resort and Spa. Lily Hotel's acquisition of shares in Promus is part of a strategic initiative to gain a stake in the newly developing luxury resort business. Soneva Gili is a luxury resort catering to very up market travelers. It was awarded the "Best Beach Resort" award by the Tatler Magazine in 2003. Lily Hotels is also engaged in the operation and management of Island Hideaway resort opened in 2006 with 45 rooms at Dhonakulhi in Haa Alif atoll.

6.3 Project Location and Study Area

The project takes place in the island of Huvahendhoo or Lily Beach resort which is operated by Lily Hotels (see Figure 2).

Lily Beach Resort is a 4 star hotel, consisting of 69 standard bungalows, 16 semi water bungalows and one deluxe suite. The resort is a fine example of the cohabitation of modern amenities and services and the environment. Protection of the environment and providing a "green" experience is one of the driving principles of Lily Beach management. At Lily Beach, the environment has been left at its most pristine form while developing the most modern conveniences for the discerning traveler.

Lily Beach Resort was one of the first to be developed as an all inclusive resort in the country, and has contributed to the popularization of the concept in the country. It is also one of the country's best performing resorts, maintaining a consistently high occupancy rate. The resort was awarded the prestigious "High Occupancy Award" from the President of the Maldives for achieving the highest occupancy in the category of resorts with 100 to 199 beds in 1999 and 2000. In 2001 the resort was awarded the "Excellence of Service" award by the Tropical Places Award (UK).

6.4 Geography

Lily Beach resort (Huvahendhoo) is an oval-shaped sand cay lying on its own reef system close to the eastern rim of the Atoll located at about latitude of 3° 39' N and longitude of 72° 57' E. The island is roughly 2 km from inside the eastern rim of the atoll. The island is slightly inside, in the lee of the two reef systems known as Hithifalhu on the northeast and Athulivaru Falhu on the southeast facing the channel between these two reef systems (see Figure 3). The reef system of Huvahendhoo, which is oriented in a northeast-southwest direction, elongated in shape with the oval-shaped island in the middle in a slightly north-south orientation than the reef system. The eastern end of the island is prone to long-period swells from the Indian Ocean. Towards east of Huvahendhoo, lies Huvahendhoo Kandu or the channel. Huvahendhoo is directly exposed to the channel as there are no reefs or islands in between this channel and the island. The island is formed on a single reef and is elongated and narrow in formation. The island is oriented towards south-west to north-east direction along its length. The reef on the western side is considerably larger than that on the eastern side. Similarly, the reef edge from the southern side is considerably closer than that on the northern side .

Figure 2: Location of Lily Beach (Huvahendhoo) in South Ari Atoll

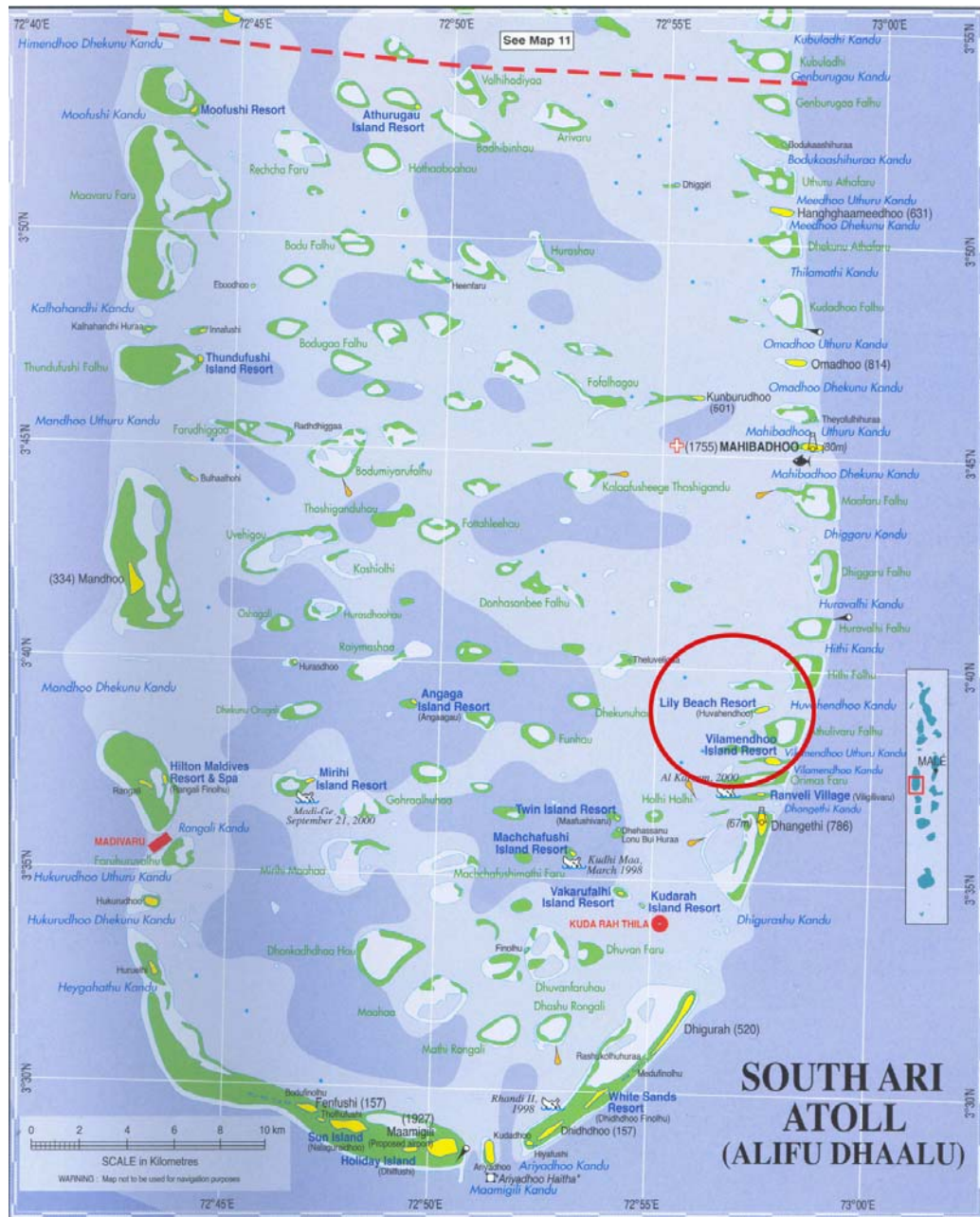
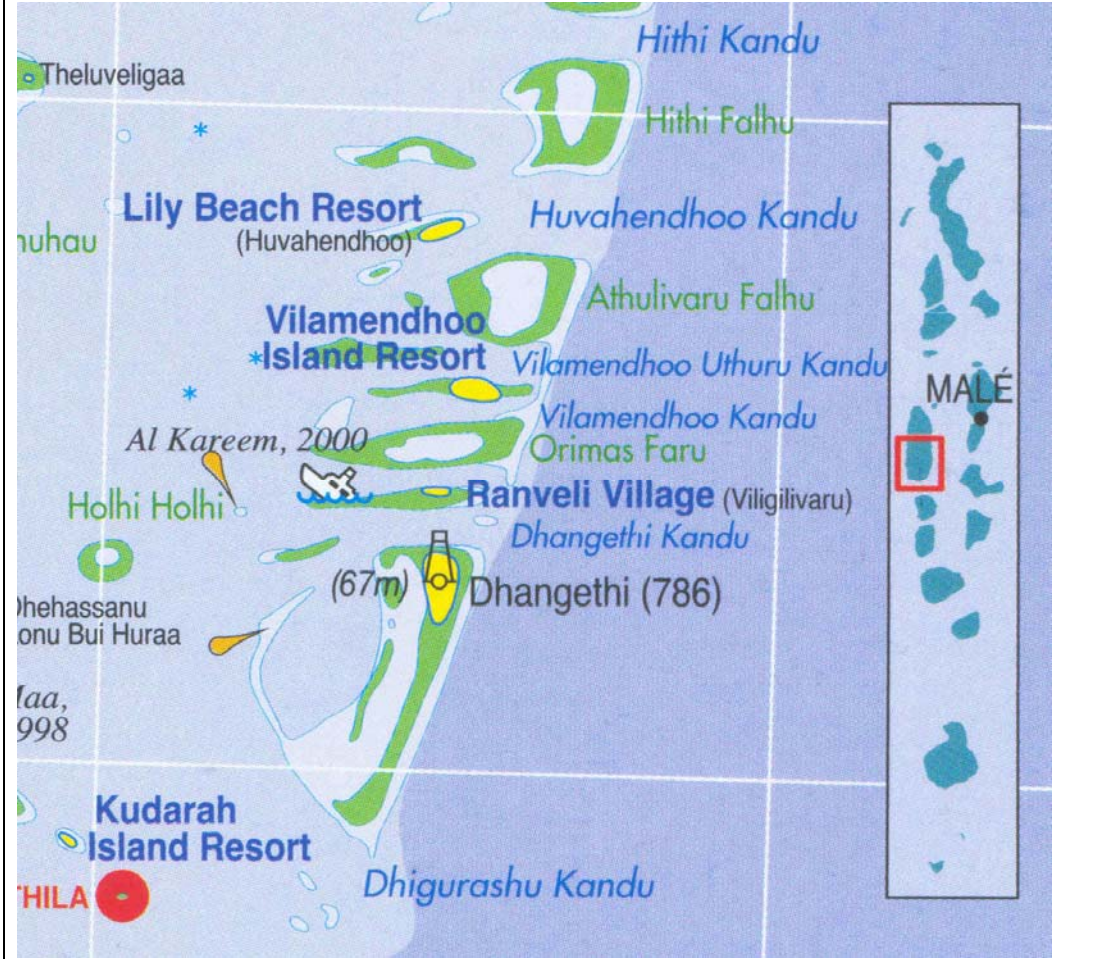


Figure 3: Location of Huvahendhoo island showing the near by islands and reefs.



The closest island to Huvahendhoo is Vilamendhoo Island resort, which is roughly 1.8km south of Huvahendhoo. The closest inhabited island is Dhangethi located approximately 5 km south. There are numerous reef patches surrounding Huvahendhoo and her reef system is sheltered by these surrounding reef systems. Despite the protection afforded by these reef systems, the island has high-rise breakwaters around its entire perimeter except the western half of the northern side. The main reason for these breakwaters being constructed in the past was to minimize erosion on areas in which the reef is closest to the beach. These breakwaters are located on the northeastern and southwestern sides with the reefline at about 20m from the shoreline. As this island system is close to the atoll rim and on the mouth of a relatively wide channel (Huvahendhoo Kanduru) it is very exposed to strong currents. The coral reef system of Huvahendhoo is elongated in east-west directions indicating strong influence of monsoonal current regimes surrounding the system. The strong currents and dynamic nature of the sands around the island may be the main reason why protection was required for the beaches.

Huvahendhoo has a very beautiful and easily accessible house reef, which is in good condition in terms of diversity and percentage of live coral cover. The coral reef of the island has over 35% live coral cover consisting of diverse range coral genera. Therefore, the management is very concerned about protecting the coral reef during the implementation of the proposed redevelopments.

In March and April 2007, when the island was surveyed to develop the concept plans for the redevelopment, the perimeter of the island measured 1501.68 meters along the low tide line and the total area of the island accounts to be 68152.69 square meters. The vegetated area of the island measures 42862.57 square meters along its perimeter. The island is relatively narrow and the width at the widest point measures 102.03 meters. The beaches on the island are found on the northern, eastern and south-western sides. The average height of the island is 1.5 -1.7 metres above mean sea level. There are several break waters constructed around the island covering at least one third of the perimeter of the reef.

6.5 Need and Justification

6.5.1 Need to Redevelop and Upgrade the Resort

Tourism in the Maldives is rapidly expanding with tourist arrivals increasing at about 60% between 1990 and 1995 and about 50% from 1995 to 2000. Following the control of SARS outbreaks and following the aftermath of the terrorist attacks in the United States, the world travel and tourism industry started to show a rapid increase. The tourist arrivals in the Maldives also increased quite rapidly in November 2003 with over bookings diverted to similar destinations such as Seychelles (Haveeru, 7 December 2003). However, the tsunami of December 2004 has left the industry crippled requiring additional infrastructure and investments. Therefore, there is a need to create added capacity to cater for the growing tourism industry in the Maldives.

The growth in the tourism industry of the Maldives has various economic benefits as prescribed in the Second Tourism Master Plan. These include:

- Foreign exchange earnings – over 70% of all foreign exchange earnings is from tourism
- Income generation
- Employment
- Development of entrepreneurial activities
- Improved public facilities

In addition to its contribution to the overall development of the country and growth of the tourism sector, the proposed project will help improve the overall quality of the resort environment. The island has been operational since 1994 and ever since then, no major renovation has been undertaken in the resort. As a result, several facilities such as semi water villas and guest rooms require renovation and upgrading in order to maintain a minimum standard. This project is vital for the improvement of services offered by the resort and enhancing the image of the resort and customer satisfaction through improved facilities and environmental enhancement. Therefore, the proposed redevelopment would improve the overall aesthetics and image of the resort and increase its marketability to the high-end tourist

market. This will enhance the profitability of the business and improve the resort's overall economic performance. Additional rooms would also mean that it would increase government revenue from bed tax and other indirect benefits would be accrued, such as more employment opportunities and growth of other fringe businesses in the region. Furthermore, the current design of the island does not allow additional facilities and expansion to occur without undertaking development on the lagoon. This is because, the island has very limited land area and all the services that are required at present will not be accommodated along with guest facilities, if they were all to be accommodated on the island. Therefore, developing new facilities on lagoon will not only increase the variety of services provided to the clients, but will allow utilizing more space in the island. For example, the existing spa area will be utilized to expand the existing gym, by developing a new spa on the northern side lagoon. Furthermore, the proposed redevelopment will also increase job opportunities through creation of new employment opportunities with the expansion. In short, the project aims to achieve the following objectives:

- Enhance the overall quality of the resort by providing additional services and facilities such as water villas and spa.
- Increase the economic value of the western lagoon by providing aesthetically appropriate water villas to guests.
- Provide more space in the island environment for staff facilities and other service areas.

6.6 Project duration

The project is expected to take eight (8) months starting 1st May 2008.

6.7 Development Objectives and Targets

The tourism product of the Maldives is almost entirely based on the natural beauty of the islands. Therefore, protection of the islands natural environment is crucial to maintain the environment quality of the resort and also guarantee the clientele. The basic design concept of the redevelopment is to create a setting as to reflect and blend with the inspirational natural setting of the island without breaking the island's natural integrity. The water villas and the spa proposed on the west and north side respectively has been proposed to be added on the lagoon in a harmonising manner with the natural setting. The sensitive coral reef environment of the island has been considered and the lagoon will not be dredged or excavated in any way to erect these structures in order to ensure that minimal damage occurs to the environment.

6.8 Description of project components

This project involves redevelopment of Lily Beach Resort located on Huvahendhoo island in South Ari Atoll, Maldives. See the attached site plan with the proposed new developments in appendix. The island has been in operation since November 1994. Several modifications have been brought to the island infrastructure throughout the past, however, the new redevelopment will have several new components. The proposed redevelopment will consist of two main components namely, construction and development of new additional facilities and refurbishment and enhancement of existing facilities. At present, Lily beach resort has 16 semi water villas and 69 standard rooms.

6.8.1 Proposed new infrastructure

The following infrastructure will be constructed in the resort as new developments. Refer to new site plan attached as appendix.

Construction of a new over water spa

The current spa will be used as part of the gym. The current location of spa is not suitable as it is situated among noisy public areas such as tennis courts and gym. Proximity to these facilities conflicts with the main objectives of a spa, which is to create a peaceful and isolated environment where guests will be undisturbed while they get their treatment. Furthermore, the landscaping and the design of the spa cannot be improved without expanding considerably, which is not an option as land is limited. Therefore a brand new spa will be developed on the north side lagoon, well isolated from the public and other facilities.

Development of 36 standard water villas on the western lagoon with an access jetty

These standard villas will be developed on the lagoon to cater for elite clients. These villas will provide easy access to the beautiful coral gardens from both sides. Water villas will be developed on concrete pad and piles, to allow current and water flow underneath in order to cause minimum disruption to the current regime in this region. A cross sectional view of a standard water villa is attached as appendix.

Development of 4 sunset water villas at the end of the water villas jetty

These villas are targeted to exclusive clients and guests, where facilities and floor space will be considerably more than standard villas. Similarly, these villas will also be developed on concrete pads and piles to minimize the impact on local hydrodynamics. A cross sectional view of a sunset villa is attached as appendix.

GM villa, reception, coffeeshop and pool bar on the northern half of western end

These infrastructures will be developed on land. Currently, there is no separate accommodation for GM and therefore, this was considered as an important aspect with the new development concept.

Ala Carte Restaurant and Dive School on the southern half of the western end

The dive school is currently located roughly at the center of the island, opposite the arrival jetty. However, this location is not suitable for a dive school as several frequent diving trips in a single day creates excessive use of the arrival jetty. With this proposed relocation, the dive school will be developed almost at the base of the existing service jetty. This will allow unobstructed movement of divers in and out of the island without having to use the arrival jetty. It will also allow diving activities to be confined to a separate area where normal guest activities will not be interfered.

The Ala Carte Restaurant will develop as a semi water restaurant on the western side, in close proximity to the water villas. The main objective is to cater for guests in water villas as the distance of water villas to the main restaurant is considerably far. The cross section view of the Ala Carte restaurant is attached in the appendix.

6.8.2 Refurbishment new infrastructure

The following infrastructures will be extended or renovated as part of the redevelopment. Refer to existing site map attached as appendix.

1. Construction of new staff accommodation block and recreation centre (2 storey staff building) by demolishing some of the existing staff accommodation. Staff block nos 12 (3 units) and 35 will be demolished (refer to existing site map). A total of 475 cubic meters of debris is estimated to be generated as a result of the demolition.
2. Upgrading of existing semi water villas and standard rooms
3. Extension of the existing restaurant
4. Construction of a new public area (pool bar kitchen and toilet block)
5. Laundry/Housekeeping
6. Extension of the existing pool deck

The proposed new structures and modifications to existing structures are indicated in the site plans attached as an annex.

6.9 Brief description of proposed new facilities and enhancements

6.9.1 Jetties

The main arrival jetty and the service jetty of the resort is on the south side (see site plan attached as annex) of the island which will be protected from the harsh weather conditions of the northeast monsoon, during the peak tourist season. These existing jetties will be upgraded. Upgrading will be done by replacing the damaged supporting columns / piles and refurbishing the decking.

6.9.2 Public Areas

Public facilities will be developed within the island and on the lagoon and beach. Areas such as the swimming pool deck will be expanded and upgraded. The wooden deck has been damaged and so a new deck will be developed. A new spa will be developed on the north side lagoon. A reception and pool bar will also be constructed on the north-west side beach.

6.9.3 Guest Villas

Existing land villas including semi water bungalows will be upgraded. Additional guest villas will be developed on the western side lagoon. Upgrading will not involve any demolition and will include, interior decoration such as replacing the ceilings and widows; painting etc.

6.9.4 Water Supply

Additional reverse osmosis desalination plant (RO plants) will be installed to cater for additional water demands. During construction, the existing desalination plants will be used to generate water for construction purpose. The capacity of the existing RO plats is 200 tons per day. Capacity of water production will be 150 tonns per day during construction stage and during the operation of the resort; it would be increased to 300 tonns per day.

6.9.5 Wastewater Management

Currently, the islands wastewater is disposed via septic tanks. With the new upgrading, existing septic tanks will be sealed and a new wastewater treatment plant will be installed. A sequence batch processing type (SBR) treatment plant will be installed. The final treated effluent will be used as gardening and flushing. An emergency sea outfall will be constructed, which will be located adjacent to the existing service jetty (see existing site plan attached as annex).The output quality of the treated wastewater will be as follows. BOD-25 mg/L; COD-90 mg/L; TSS-1 mg/L. The capacity of the treatment plant is 150 tons per day.

6.9.6 Power Generation and fuel management

During the construction stage of the redevelopment, electricity at 440 volt, 3-phase, 50 Hz will be generated for the proposed redevelopment via 4 generators. The 440-volt supply is distributed throughout the island.

During the operation of the resort, electricity at 440 volt, 3-phase, 50 Hz will be generated for the proposed redevelopment via two 1000kVA, one 800 KVA and one 600 KVA prime fuel oil generation sets.

6.10 Project Activities

The proposed project involves the redevelopment of Huvahendhoo island into a 125 room (250 bed) tourist resort with enhanced and additional facilities. The guest rooms or villas will be developed in 4 distinctive concepts namely:

1. executive sunset villas,
2. standard water villas,
3. semi water villas and
4. standard rooms.

New additional facilities will be developed such as water villas (Executive sunset villas and standard villas), over water spa, reception/pool bar, Dive school and Ala Carte restaurant. In addition, existing infrastructure will be upgraded. The resort redevelopment will take place within the proposed period of eight months and will involve the following activities.

6.10.1 Land based activities

The following land based activities will take place in the island.

Activity 1: Demolition of the existing staff accommodation. The demolition is expected to generate 475 cubic meters of waste. The demolished debris will be used as filling for foundations as the new staff accommodation blocks will be constructed with raised floor level. Hence, the debris will be utilized within the island. Any excess debris will be transferred to Thilafushi.

Activity 2: Construction of new 2 storey staff quarters. See attached site plan. Very limited number of trees will be removed or cleared for this component, as existing staff block will be demolished. Details of this are described under Terrestrial section.

Activity 3: Construction of Ala Carte Restaurant on the western side of the island. Very limited trees will be removed to construct the building. Young and sparsely distributed plants are present in this region. Hence, some trees will be required to be removed, but nothing significant.

Activity 4: Construction of GM Villa, Dive school, reception/coffee shop and pool bar western side of the island. Funa (*Calophyllum inophyllum*), Dhiggaa (*Hibiscus tiliaceus*) and Dhakan'dhaa (*Premna obtusifolia*) are present in this region. Hence, some trees will be required to be removed, but nothing significant. No coconut trees will be removed.

6.10.2 Lagoon based activities

The following lagoon based activities will take place on the island.

Activity 1: Construction of the spa and access jetty on the north side lagoon.

Activity 2: Construction of the water villas and access jetty on the west side lagoon.

6.11 Construction Schedule and methodology

Construction will begin in May 2008. As soon as the EIA is approved and a decision note is issued, the project activities will initiate including finalizing contractors and other issues. Mobilization of the workforce will begin from then onwards (transporting materials and arranging other logistics). Materials such as cement, gravel, timber and other materials will be transported to the island in batches. They will not be stored on the beach. They will be stored in empty areas of the island and protected from rain. The redevelopment project is expected to be not more than 8 months for construction. The project is expected to begin in May 2008. A detailed construction schedule is attached as an annex.

6.11.1 Construction strategy

The resort will be redeveloped in the planned time period to reduce cost and also reduce the environmental damage. Both land based and water based construction activities will be done in parallel. Construction and refurbishment of land based existing facilities will be undertaken by one group, supervised by the contractor. At the same time, construction of concrete piles and footings for the overwater structures will be undertaken on land before moving them on to the water. Construction of over water structures will then be undertaken. This will reduce the amount of construction activities on water, thereby reducing the environmental impacts.

6.11.2 Supporting Columns

All over water and semi water structures will be constructed on piled columns. This consists of reinforced concrete columns placed on reinforced concrete pads.

6.11.3 Work methods for over water structures

Construction of over water structures will be on concrete piled columns. Initially, Foundation casts, will be made on land and then positioned in the lagoon. These will then be anchored to the lagoon bed. Following this, column cast, decking, and installation of prefabricated building structures will be fixed. Afterwards, plumbing, electrical and fire networking lines will be laid. While anchoring the foundation pads and columns, mitigation measures identified will be enforced to minimize sedimentation and siltation.

6.11.4 Works methods for land based activities

Standard construction methods will be used. It is intended to use typical concrete foundations and columns in the construction of staff accommodation buildings and other structures on land. This methodology involves the use of reinforced concrete to create a foundation joint by horizontally running beams. Together, the beams and the concrete base create a solid foundation on which columns and the building structure will be supported. The walls will be constructed using cement blocks. For the semi water structure, namely the Ala Carte restaurant, concrete piling will be used. This method will ensure that least disruption is caused on the shore processes such as sediment movement.

6.12 Project Inputs and Outputs

6.12.1 Project Inputs

The types of resources that will go into the redevelopment of the resort and from where and how these will be obtained are given in Table 1 and Table 2.

Table 1: Matrix of major inputs during construction period

INPUT RESOURCE(S)	SOURCE/TYPE	HOW TO OBTAIN RESOURCES
Construction workers (800+)	Maldivians and foreigners	Open bidding by advertising in local papers/other sources
Water supply (construction period)	Existing Desalination plant	150 m ³ /day desalination plant
Electricity/Energy (construction period)	Existing Diesel generators	440 kVA, generator
Construction machinery	Excavators, barges, general construction tools, lorries, cranes, loader	Local suppliers
Telecommunications	Hotel Phone Systems, Fax Machines, E-mail and internet facilities	Already this services is available in the island
Transport (sea)	Sea transport by dhoni and speed boats. Materials to be transported in carrier vessels or large barges.	
Food and Beverage	Mainly imported sources except a few locally available.	local purchase
Fuel, Kerosene and LPG	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

Table 2: Matrix of major inputs during operational phase

INPUT RESOURCE(S)	SOURCE/TYPE	HOW TO OBTAIN RESOURCES
Operational Staff (300)	Maldivians and foreigners	Utilize current staffs and also obtain additional staffing through advertising in local newspaper, media.
Electricity / Energy (during operation)	Light diesel (low sulphur content)	440 kVA, generator
Water supply (during operation)	Desalinated water	300 m ³ /day desalination plant
Diving and sports gear	Air Compressor Nitrox Enabled Air Compressor Nitrox Membrane System High Pressured Airbank (for Nitrox Membrane System)	Import
Electrical appliances/machinery	Energy efficient machinery and lighting; ozone-friendly refrigerators*	Local suppliers
Telecommunications	Hotel Phone Systems, Fax Machines, E-mail and internet facilities	Local telecom company to provide telecom service. Already this service is available. Only expansion is required.
Transport (air and sea)	International air travel, domestic air and sea transport	
Food and Beverage	Mainly imported sources except a few locally available. Preference will be given to locally produced food items	Import/local purchase
Laundry chemicals	Detergent, All Purpose Cleaners, Glass Cleaners, Bathroom Cleaners, Destainer Bleach, Oxygen Bleach, Softener, Alkali Neutraliser, Detergent, DetergentPlus, Starch, Stain Spots Remover, etc. NOTE: All Chemicals are Bio-degradable compounds	Local resort suppliers
Paper Products	Tissue Roll, Tissue Boxes, Hand Tissues, Guest In-room Paper	Import/purchase locally

	Amenities/ Brochures Office Use Paper Products	
Insecticides, pesticides, etc.	Imported pesticides	Import/local suppliers
Fire fighting equipment	Fire Pumps, Fire Protection System, Smoke Detectors, Carbon Dioxide and Foam Fire Extinguishers, etc.	Import/local suppliers
Fuel, Kerosene and LPG	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

*Note: Deep freezers, chillers, air conditions and other similar utilities will be ozone friendly and will abide to the Montreal Protocol.

6.12.2 Project Outputs

The type of outputs (products and waste streams) and what is expected to happen to the outputs are given in Table 3.

Table 3: Matrix of major outputs of environmental significance during construction stage

PRODUCTS AND WASTE MATERIALS	ANTICIPATED QUANTITIES	METHOD OF DISPOSAL
Sewage and wastewater Grey water/laundry wastewater	Estimated to be at 250 litres/person/day	Treat the wastewater using the existing septic tanks.
Construction and general waste from construction activities	475 cubic meters of debris. Additional 220 kg per day	Debris from the staff block demolition will be used for foundation fillings for the new accommodation block. Rest of the waste will be stockpiled in the island and regularly sent to landfill in Thilafushi
Waste oil and grease	100-300 litres per month	Stockpiled and sent to landfill in Thilafushi.
Hazardous waste	Approximately 400 litres of diesel and oils per month	Barrelled and stored until disposal. Final disposal to landfill in Thilafushi
Noise	Only localised to the island environment	-
Air pollution	Limited quantities of dust in only designated areas	Mainly arising as a result of dust emission from the construction work such as cement mixing, moving machinery and other processes. Only localised

Table 4: Matrix of major outputs of environmental significance during operational stage.

PRODUCTS AND WASTE MATERIALS	ANTICIPATED QUANTITIES	METHOD OF DISPOSAL
Potable water bottles (1.5 liter mineral water bottles).	25,500 Plastic bottles per month	Plastic Bottles – recycled and disposed off to Thilafushi regularly
	1416 Glass bottles per month	Glass – crushed and regularly sent to landfill in Thilafushi
Sewage and wastewater Grey water/laundry wastewater	Estimated to be at 250 litres/person/day	Treat the wastewater using the new wastewater treatment plant and reuse in gardening and toilet flushing.
General/domestic waste	1083 bags per month	Incinerated and also sent to Landfill in Thilafushi. Deep sea disposal will also be considered.
Food and kitchen waste	1388 Garbage Bags per month of 30 days. 800 KG per day	Bio-degradable: composted on site and excess disposed to open sea with minimum 50 miles from any land-natural waste. Some quantities will also be incinerated.
Waste oil and grease	708 litres per month	Incineration, disposal to waste management centre in Thilafushi. They may also be made available for local fisherman free.

Scrap metal/cans/plastics	347 kg per day	Crushed and compacted by mechanical compactors and eventually transported to the waste management center in Thilafushi .
Paper and cardboard	46 boxes per day	Recycled, Send to waste management center in Thilafushi and also some incineration will be undertaken.
Hazardous waste	555 litres of diesel and oils per month	Barrelled and sent to waste management centre in Thilafushi
Garden wastes	Estimated to be in moderate quantities	Mulched and used as fertilizer. Excess will be incinerated.

The above estimates are based on five years of monitoring data collected in five resorts by CDE Private Ltd.

7 Policy, Legal and Administrative Framework

7.1 Overview

The project conforms to the requirements of the Environmental Protection and Preservation Act of the Maldives, Law no. 4/93. The EIA has been undertaken in accordance with the EIA Regulation 2007 of the Maldives by registered consultants. Furthermore, it adheres to the principles underlined in the regulations, action plans, programmes and policies of the following Government Ministries.

- Ministry of Environment, Energy and Water
- Ministry of Tourism and Civil Aviation
- Ministry of Agriculture and Marine Resources

These are discussed in detail in the following sections.

7.2 Applicable Policies, Laws and Regulations

7.2.1 *Environmental Protection and Preservation Act*

The Articles of the Environmental Protection and Preservation Act (Law No. 4/93) addresses the following aspects of environmental management:

- Guidelines and advice on environmental protection shall be provided by the concerned government authorities.
- Formulating policies, rules and regulations for protection and conservation of the environment in areas that do not already have a designated government authority already carrying out such functions shall be carried out by MEEW.
- Identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation.
- An EIA shall be submitted to MEEW before implementing any developing project that may have a potential impact on the environment.
- Projects that have any undesirable impact on the environment can be terminated without compensation.
- Disposal of waste, oil, poisonous substances and other harmful substances within the territory of the Maldives is prohibited. Waste shall be disposed only in the areas designated for the purpose by the government.
- Hazardous / Toxic or Nuclear Wastes shall not be disposed anywhere within the territory of the country. Permission should be obtained for any trans-boundary movement of such wastes through the territory of Maldives.
- The Penalty for Breaking the Law and Damaging the Environment are specified.
- The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment.
-
- The proposed redevelopment project will fully abide to the Environmental Preservation and Protection Act. Disposal of oil, chemicals and other hazardous materials will be

strictly controlled and managed. Such materials will not be disposed in to the local or the regional environment, but will be transported to designated waste disposal site, such as Thilafushi.

7.3 Second National Environment Action Plan (1999)

The aim of NEAP II is to protect and preserve the environment of the Maldives and to sustainably manage its resources for the collective benefit and enjoyment of present and future generations.

Main strategies of the NEAP II are:

- Continuous assessment of the state of the environment in the Maldives, including impacts of human activities on land, atmosphere, freshwater, lagoons, reefs and the ocean; and the effects of these activities on human well-being
- Development and implementation of management methods suitable for the natural and social environment of the Maldives, and maintain or enhance environmental quality and protect human health, while at the same time using resources on a sustainable basis
- Consultation and collaboration with all relevant sectors of society to ensure stakeholder participation in the decision making process
- Preparation and implementation of comprehensive national environmental legislation in order to provide for responsible and effective management of the environment
- Adhering to international and regional environmental conventions and agreements and implementation of commitments embodied in such conventions.

NEAP II specifies priority actions in the following areas.

- Climate change and sea level rise; coastal zone management;
- biological diversity conservation; integrated reef resources management;
- integrated water resources management;
- management of solid waste and sewerage;
- Pollution control and management of hazardous waste;
- sustainable tourism development;
- land resources management and sustainable agriculture
- human settlement and urbanisation.

NEAP II contains environmental policies and guidelines that should be adhered to in the implementation of the proposed project activities.

The redevelopment of Lily Beach will also be in accordance with the main strategies of the NEAP II. The proponent has committed one percent of the total project value for the environmental component including development of EIA and monitoring. The monitoring programme proposed in this report outlines the environmental management strategy and plan. This EIA has also been prepared in consultation with all the key stakeholders. Therefore, these measures address the key strategies outlined in the NEAP II.

7.3.1 National Biodiversity Strategy and Action Plan

The goals of the National Biodiversity Strategy and Action Plan are:

- Conserve biological diversity and sustainably utilize biological resources.
- Build capacity for biodiversity conservation through a strong governance framework, and improved knowledge and understanding.
- Foster community participation, ownership and support for biodiversity conservation.

In implementing the proposed project activities due care has to be given to ensure that the national biodiversity strategies are adhered to. The proponent has committed fully on conservation and protection of the environment while undertaking this proposed project. More specifically, the coral reef and generally the marine environment have been assessed in detail in order to assess baseline values. Quantitative and qualitative surveys were undertaken to assess the biological diversity of the coral reef, especially in close proximity to the proposed development area. Hence, development of the water villas will take in to account the conservation of biological diversity. Practical mitigation measures and solutions have been identified to conserve and protect the biodiversity.

7.3.2 Protected Areas and Sensitive Areas

Under Article 4 of the Environment Protection and Preservation Act, the Ministry of Environment is vested with the responsibility of identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation. At present there are no rules and regulations made available to the public on designation and protection of habitats and heritage areas.

The redevelopment is proposed in the island of Huvahendhoo. There are no protected sites or resources such as protected birds and trees in the island environment.

7.3.3 Waste management policy

The Ministry of Environment, Energy and Water has developed the framework for a national waste management policy. The key elements of the policy include:

- Ensure safe disposal of solid waste and encourage recycling and reduction in waste generated.
- Develop guidelines on waste management and disposal and advocate to enforce these guidelines through inter-sectoral collaboration.
- Ensure safe disposal of chemical, industrial and hazardous waste.

The key objective of the waste management policy would be the formulation and implementation of guidelines and means for solid waste management to maintain a healthy environment.

Waste management for the proposed project has been considered during the construction and operational stage. Since the island is being redeveloped, measures are already in place to manage the waste during operational period, such as incineration and regular transfer of waste to Thilafushi. There is already an established waste management mechanism in the island.

Similarly, during the redevelopment process, waste management strategies have been developed, details of which are outlined in the report. Therefore, this project will also confirm to this policy.

7.3.4 Regulation on sand and aggregate mining

This regulation addresses sand mining from uninhabited islands that have been leased; sand mining from the coastal zone of other uninhabited islands; and aggregate mining from uninhabited islands that have been leased and from the coastal zone of other uninhabited islands.

Neither sand nor aggregate will be mined for this project. This regulation would not have any implication on the proposed project.

7.3.5 Ban on coral mining

Coral mining from the house reef and the atoll rim has been banned through a directive from the President's Office dated 26th September 1990. According to these policies,

coral mining is not to be carried out on island house reefs;

coral mining cannot be carried out on atoll rim reefs and common bait fishing reefs;

coral or sand mining is only allowed from designated sites, and approval from the concerned Atoll Office is required prior to the commencement of any mining operation.

requests for coral or sand mining from residents of inhabited islands are required to be submitted to the Atoll Office through their respective island office

the island office is required to estimate the quantity of corals required for the applied construction work and hence this ensures that permission is granted to mine just the required amount;

Every island is required to keep a log book of the amount of corals mined.

sand mining is not allowed on the beaches of inhabited islands, islands leased for industrial developments and tourist resorts and within the lagoons adjoining these islands.

Coral and sand would not be mined in any stage of the project.

7.3.6 Tourism Act (Law no. 2/99)

This Act provides for the determination of zones and islands for the development of tourism in the Maldives:

- the leasing of islands for development as tourist resorts,
- the leasing of land for development as tourist hotels and tourist guesthouses,
- the leasing of places for development as marinas,
- the management of all such facilities; and

- the operation of tourist vessels, diving centers and travel agencies, and
- the regulation of persons providing such services.

7.3.7 Ministry of Tourism Regulations and Circulars

The Tourism Regulations in the Maldives ensure that carrying capacity of the island and atoll ecosystems are well within limits and the negative effects of the development are minimal. The Ministry also issues circulars on several occasions and when necessary to discourage activities such as sand and coral mining, developing on the coastal environment and waste disposal which may cause harm or damage to the natural environment, which is the main tourism product.

Tourism regulations strictly discourage modifications to the natural movement of sand around the islands. Therefore, Tourism Regulations require that special permission from the Ministry of Tourism and Civil Aviation be sought before commencing any coastal modification works on any tourist resort. It is also stated that hard engineering solutions are not encouraged and construction of solid jetties and groynes be controlled and shall only be undertaken after conducting an Environment Impact Assessment study. Similarly, design of boat piers, jetties and other such structures are required to be in such a way that these shall not obstruct current and sediment circulation patterns of the island.

The Ministry also issues circulars on several occasions and when necessary to discourage activities such as sand and coral mining, developing on the coastal environment and waste disposal which may cause harm or damage to the natural environment, which is the main tourism product.

All over water structures proposed to be developed in Lily Beach will conform to this regulation. The conceptual plan and drawings have been approved by the Tourism Ministry. Details of the cross section and engineering drawings have been attached as an appendix.

7.4 Framework for Environmental Assessment

The enforcement of EIA regulation in the country began with the formulation of the Environmental Protection and Preservation Act (Law 4/93) in April 1993 in order to protect, preserve and safeguard the fragile environment of the country. The Environmental Act gives very high prominence towards safeguarding the environment with regard to all the development activities and is currently being implemented by the Environment Research Center of the Ministry of Environment, Energy and Water. The Ministry has been formed recently and its mandate includes:

- organizing, developing and managing systems for environmental monitoring, including periodically evaluating the actual state of the environment, and forecasting environmental changes;
- evaluating environmental impact assessment reports of new projects and monitoring reports for existing facilities;
- issuing and revoking certificates based on compliance with environmental standards;

According to article 5 (a) of the Act, an Environmental Impact Assessment shall be submitted to the Ministry of Environment, Energy and Water according to guidelines formulated by the Ministry before implementing any activity that may have an adverse impact on the environment. The Ministry shall determine projects that need such assessment. This umbrella law gives the Ministry the right to terminate projects that have undesirable impacts or claim compensation for damages caused by activities that are detrimental to the environment.

This project fully complies with this law as all necessary permits have been undertaken and this report is submitted in order to obtain the necessary EIA Decision Note.

7.4.1 Environmental Impact Assessment Regulation 2007

The Ministry of Environment, Energy and Water has issued new EIA regulation on May 2007, which guides the process of undertaking the Environmental Impact Assessment in the Republic of Maldives – This guideline also provides a comprehensive outline of the EIA process, including the roles and responsibilities of the consultants and the proponents. This regulation outlines every step of the IEE/EIA process beginning from application to undertake an EIA, details on the contents, minimum requirements for consultants undertaking the EIA, format of the EIA/IEE report and many more .

The guidance provided in this Regulation was followed in the preparation of this EIA report. The EIA has also been prepared by registered consultants.

7.4.2 Post EIA Monitoring, Auditing and Evaluation

The environmental monitoring programme given in EIA reports is an important aspect of the EIA process. The monitoring programme outlines the objectives of the monitoring; the specific information to be collected; the data collection program, and managing the monitoring program. Managing the monitoring programme requires assigning institutional responsibility, reporting requirements, enforcement capability, and ensuring that adequate resources are provided in terms of funds, skilled staff, etc.

The monitoring programme outlined in this report will comply with the EIA Regulations 2007.

7.5 Relevant International conventions, treaties and protocols

7.5.1 The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances That Deplete the Ozone Layer is a landmark international agreement designed to protect the stratospheric ozone layer. The treaty was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere; chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform--are to be phased out by 2000 (2005 for methyl chloroform). Scientific theory and evidence suggest that,

once emitted to the atmosphere, these compounds could significantly deplete the stratospheric ozone layer that shields the planet from damaging UV-B radiation.

Redevelopment of Lily Beach resort will not involve use and consumption of any substances banned in this convention. Even during the operational stage of the resort, compounds or substance that contain ozone depletion will not be imported.

8 Existing Environment

This section covers the general existing environmental conditions of Huvahendhoo, especially those areas which may be impacted by the proposed works. The section also covers methodologies used to collect data on the existing environment. A detailed review of specific existing environmental conditions on Huvahendhoo Island, such as terrestrial, coastal and marine environment have been considered in separate chapters of the report.

The key environmental and economic components of the project under consideration are:

Vital Environmental, Social and Economic Components

- Coral reef areas around the proposed water villas
- Marine biodiversity and live bait species populations
- Accretion/ Erosion patterns around the island
- Land/seascape aesthetic value
- Terrestrial Flora and Fauna (not considered in detail)
- Marine water quality

The existing environment of the island has been studied by the consultants during a field visit undertaken in March 2007. A photographic summary of the existing environmental conditions is provided in Figure 4.

8.1 General Methodologies

Conditions of the existing environment of the study area were analyzed by using appropriate scientific methods. The environmental components of the study area were divided into marine, terrestrial and coastal resources. Although Terrestrial component was not considered as important for this redevelopment, baseline environmental conditions were appraised. The marine environment of the island covered the coral patches, the lagoon and the house reef of Huvahendhoo, especially around the area of the proposed new development. The coastal environment covered the beaches, the breakwaters and coastal processes including longshore sediment transport, nearshore currents, tides and wave climate. The terrestrial environment covered an assessment of the vegetation of the island.

The environmental conditions were assessed by dividing the tasks among three groups – marine, coastal and terrestrial. The different methods used in assessing and reporting the conditions of the existing environment of the island are outlined in the following subsections.

8.1.1 Mapping and Location identification

The entire island, including reef line, shore line, vegetation line, coral patches, breakwaters and groynes were mapped as a starting point for the assessment. Mapping was undertaken using hand held differential GPS. The location of data collection sites were also marked using handheld GPS. Each of the teams possessed a GPS to identify their locations. These were later integrated into one map. Beach profile locations have also been marked by permanent markers or bench marks on site.

8.1.2 Marine Water Quality

One of the main environmental components that would be affected by implementing the project would be marine water quality, especially on the western side and northern side lagoon. Water quality was assessed during the field trip in April 2007 using a handheld water quality logger and also testing at National Health Laboratory. Water quality was assessed at selected locations within the impact zone. The locations, frequency and parameters to be monitored are given in the Monitoring Programme outlined in the relevant sections of the EIA.

8.1.3 Coastal processes

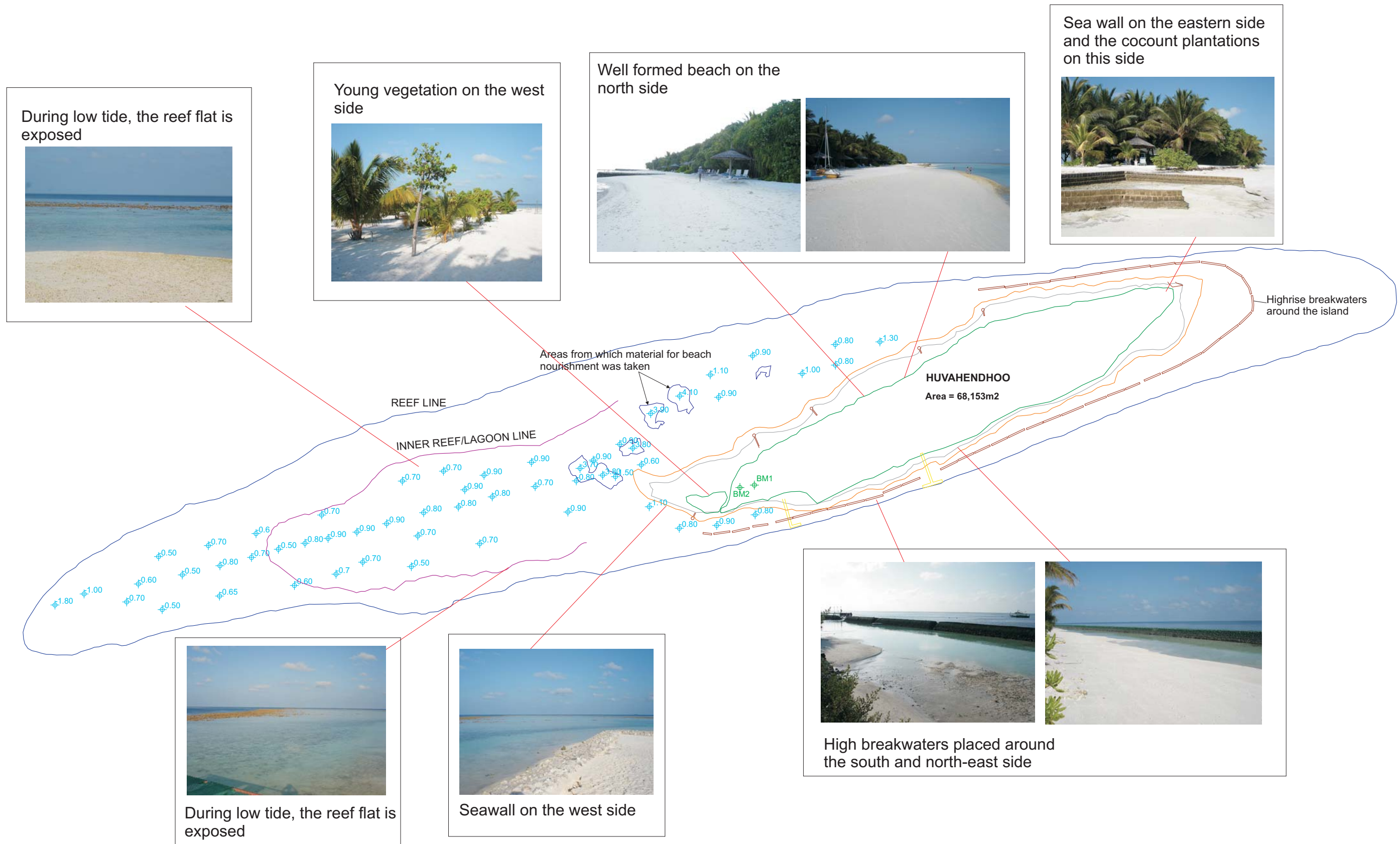
Several beach profiles were taken from designated locations around Huvahendhoo by means of standard levelling techniques. These benchmarks would be used for long term monitoring. The measurement of beach profiles involves standard practice of surveying with a staff and a dumpy level. Measurements were taken along the beach profile line at different intervals when there occurs a distinctive morphological feature such as beach ridge, high water mark, an erosion scarp, dip, rise, or other significant break in the beach slope up to a minimum distance of 30m from the Benchmark.

In addition long term monitoring of the coastal processes such as currents, wind and tides will be undertaken at regular intervals in order to formulate an appropriate coastal zone management plan.

8.1.4 Marine Environment

Marine environmental surveys were conducted to collect data on key environmental components (i.e. the coral reef system) that will be impacted due to the redevelopment. Purpose of the surveys were to define and establish marine environmental baseline conditions for impact evaluation during and after the proposed work of redevelopment of the resort. Surveys were based on standard marine environmental surveys so that they can be repeatedly carried out to monitor and record changes and assess possible impacts on the marine environment from the proposed work activities as well as operation of the resort. These surveys should be continually repeated to assess the short-term and long-term impacts on the marine environment. Surveys include quantitative and qualitative surveys. These methodologies are discussed in detailed under the Marine Environment.

Figure 4: Photographic summary of the major environmental and coastal conditions at Huvahendhoo island resort.



9 Existing Terrestrial Environment

9.1 Chapter Brief

This chapter will look at the terrestrial zone of the island environment which is the area inside the vegetation. As outlined in the Terms of reference, this report will only focus on describing the baseline terrestrial environmental conditions. Therefore, this chapter will cover the following:

- Baseline terrestrial environmental conditions of the island.
- The different proposed components of the project that will impact upon the terrestrial environment with their specific impacts and mitigation measures.

The baseline terrestrial environment of Huvahendhoo was studied in detail by selecting random transects at different regions of the island. These transects were selected to summarize the existing terrestrial condition of the island and to map the areas where significant trees are located. Terrestrial environment survey was strictly focused on selected areas of the islands vegetation and identifying their abundance and occurrence in the island. Transects were selected for vegetation line and the inner vegetation. The western side of the island has a newly vegetated area where trees are in the process of becoming mature. At present, this area contains young vegetation which has been manually planted by the management. A detail vegetation map of this area was also undertaken.

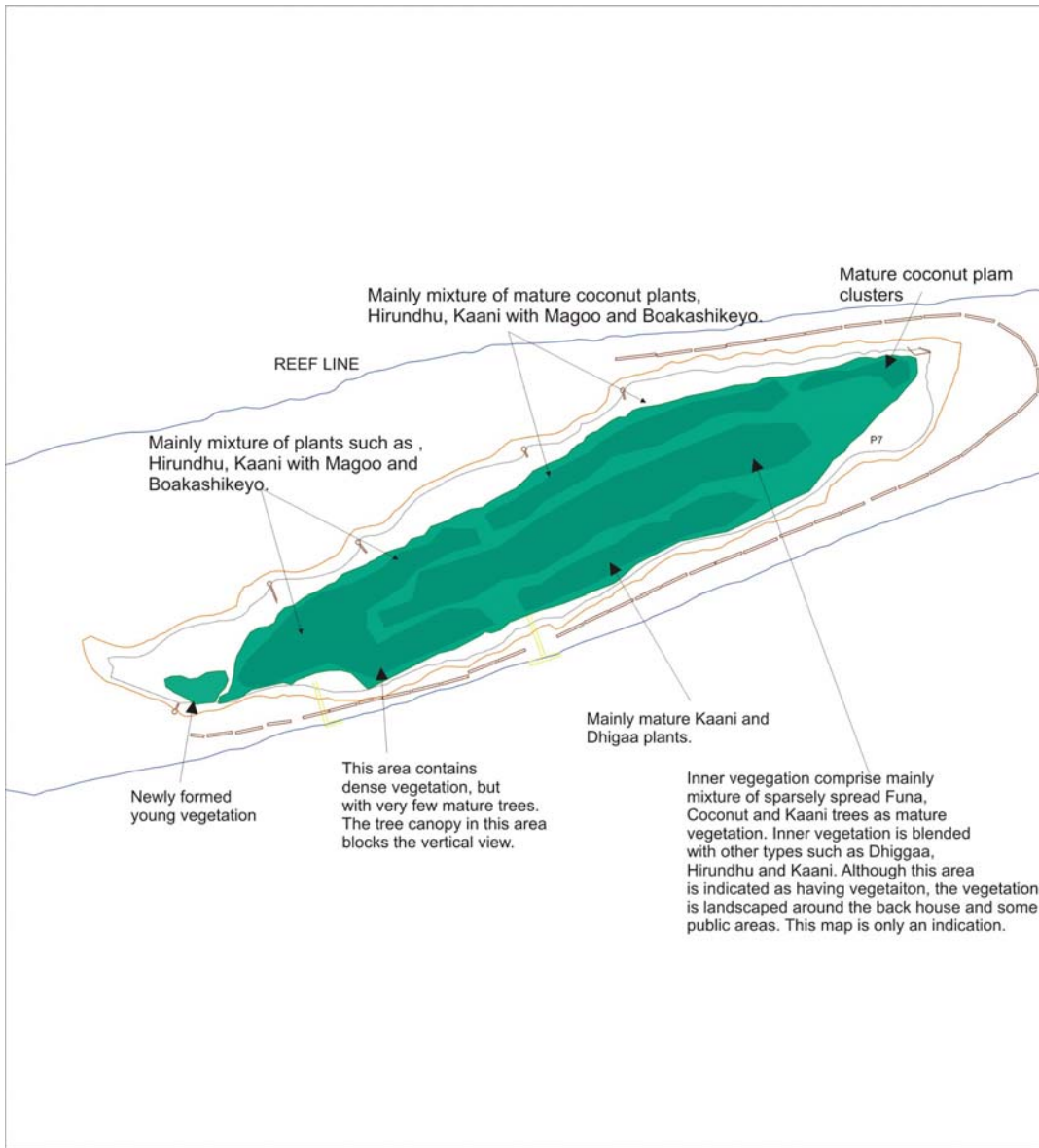
9.2 Data collection methodology and existing baseline conditions of the terrestrial environment

9.2.1 Floral Landscape

The landscape of Huvahendhoo is very mature but cannot be considered diverse. There are limited varieties of plant species than what is observed in other large uninhabited islands with greater diversity. There are also no terrestrial landscapes of significance nor any threatened species of plants.

There are considerable amount of mature trees on the inside including those found along the vegetation line, especially on the southern side towards the east of the arrival jetty. As a result, the percentage of large mature trees in the island is quite high. The main type of mature trees in the island is *Cocos nucifera*, (coconut palms), *Thespesia populnea* (Hirundhu), *Hibiscus tiliaceus* (Dhiggaa) and Kaani (*Cordia subcordata*). A summary vegetation map is provided in Figure 5.

Figure 5: Terrestrial vegetation map



9.3 Result of the vegetation survey

9.3.1 Inner vegetation

The vegetation along this section vegetation line was found to contain 11 species of trees. They are illustrated in Table 5.

NAME	COUNT	PERCENTAGE	CANOPY HEIGHT
Boakashikeyo (<i>Pandanus tectorus</i>)	3.00	4.55	3.67
Coconut Palm (<i>Cocos nucifera</i>)	40.00	60.61	7.09
Dhakan'dhaa (<i>Premna obtusifolia</i>)	2.00	3.03	6.00
Dhiggaa (<i>Hibiscus tiliaceus</i>)	8.00	12.12	7.75
Dhunburi (<i>Ochrosia borbonica</i>)	1.00	1.52	2.50
Feyru (<i>Psidium guajava</i>)	2.00	3.03	5.25
Funa (<i>Calophyllum inophyllum</i>)	1.00	1.52	9.00
Hirundhu (<i>Thespesia populnea</i>)	5.00	7.58	5.00
Kaneeru (<i>Nerium oleander</i>)	1.00	1.52	3.00
Magoo (<i>Scaevola taccada</i>)	3.00	4.55	6.00
Muranga (<i>Moringa oleifera</i>)	2.00	3.03	5.00

Table 5: Percentage of species and their average canopy height recorded from transect A

The dominant species observed in this region was Coconut Palm (*Cocos nucifera*). The highest average canopy height was recorded for Funa (*Calophyllum inophyllum*). The average canopy height of this zone varied between 3 to 9meters.

9.3.2 Vegetation Line

The vegetation along this section vegetation line was found to contain 9 species of trees. The dominant species observed in this region Uni (*Guettarda speciosa*) (see Table 6).

NAME	COUNT	PERCENTAGE	CANOPY HEIGHT
Boakashikeyo (<i>Pandanus tectorus</i>)	6.00	5.66	6.70
Boashi (<i>Tournefortia argentea</i>)	3.00	2.83	5.00
Coconut Palm (<i>Cocos nucifera</i>)	25.00	23.58	6.75
Dhiggaa (<i>Hibiscus tiliaceus</i>)	27.00	25.47	7.98
Hirundhu (<i>Thespesia populnea</i>)	9.00	8.49	5.28
Kuredhi (<i>Pemphis acidula</i>)	3.00	2.83	3.17
Kaani (<i>Cordia subcordata</i>)	4.00	3.77	8.00
Magoo (<i>Scaevola taccada</i>)	19.00	17.92	3.61
Uni (<i>Guettarda speciosa</i>)	35.00	33.02	5.50

Table 6: Percentage of species and their average canopy height recorded along transect B

The highest canopy was recorded for Kaani (*Cordia subcordata*), which was observed to be varying between young and mature and recording over 8 meters. The average canopy height of this zone varied between 3 to 8 meters.

9.3.3 Newly formed young vegetation on the western side.

The vegetation along this section vegetation line was found to contain 6 species of trees. The dominant species observed in this region was Coconut Palm (*Cocos nucifera*) (see Table 7).

NAME	COUNT	PERCENTAGE	CANOPY HEIGHT
Boakashikeyo (<i>Pandanus tectorus</i>)	1.00	2.27	2.20
Coconut Palm (<i>Cocos nucifera</i>)	19.00	43.18	1.91
Dhiggaa (<i>Hibiscus tiliaceus</i>)	6.00	13.64	3.00
Dhakan'dhaa (<i>Premna obtusifolia</i>)	4.00	9.09	2.18
Kuredhi (<i>Pemphis acidula</i>)	3.00	6.82	2.67
Magoo (<i>Scaevola taccada</i>)	11.00	25.00	0.65

Table 7: Percentage of species and their average canopy height recorded along the newly formed vegetated area

The highest canopy was recorded for Dhiggaa (*Hibiscus tiliaceus*) which was observed to be approximately 3 meters. The average canopy height of this zone varied between 0.5 to 3 meters. The summary of the vegetation survey conducted in this zone and the average canopy height is illustrated in Figure 6. The Ala Carte Restaurant will be located in this area.

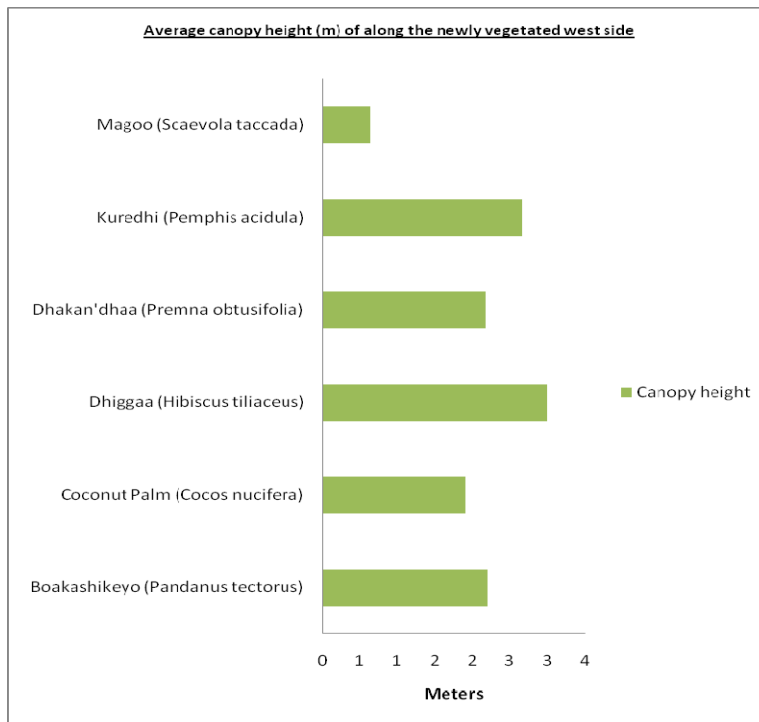


Figure 6: Illustration and average canopy height of plant species observed along the newly formed vegetated area

9.4 Groundwater quality

Groundwater assessment was conducted to assess the ambient conditions of groundwater in Lily beach. Methodology used to assess groundwater was to obtain a water sample from a groundwater well. The resort does not use groundwater for any purpose, hence no attempt was made to mark the location of the sampling well. Samples were not taken from the well directly, but using a pump connected to the well. Groundwater of the island was tested for selected parameters outlined below.

Table 8: results of the groundwater quality of Lily Beach resort.

Parameter tested	Ground water sample
E-Conductivity	3200 us/cm
TDS	1590 mg/l
Nitrates	3 mg/L
Phosphates	0.23 mg/L
pH	8.03

9.5 Environmental Impacts and Mitigation measures

9.5.1 Impact Identification

Huvahendhoo is currently a fully operational resort. Although some modification has been made to the islands vegetation, the island is still in its natural form. The proposed redevelopment is not expected to bring an any significant negative impact on the islands existing vegetation. Very few structures have been proposed to be developed in the island as additional structures. The structures that will be developed as additional facilities will also not require any major vegetation clearing.

9.5.2 Assessing Impacts

Environmental impacts of the proposed redevelopment work have been examined through a number of processes. These include consultations with the stakeholders, field surveys, observations and assessment, and field experience gained from similar development projects implemented throughout the country. Potential positive and negative impacts on the environment have been considered.

The impacts of the proposed redevelopment on the terrestrial environment have been looked into and is considered to be only short term during the construction period.

The impacts are categorized into short-term and long-term. Most of the short-term impacts are related to constructional phase, while the long-term impacts are associated with the operational phase.

Possible negative impacts on the environment have been considered in worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in both constructional and operational phases.

This EIA identifies and quantifies the significance of adverse impacts on the environment from the proposed project. Impacts on the environment were identified and described according to their location/attribute, extent (magnitude) and characteristics (such as short-term or long term, direct or indirect, reversible or irreversible) and assessed in terms of their significance according to the following categories:

Negligible – the impact is too small to be of any significance;

Minor adverse – the impact is undesirable but accepted;

Moderate adverse – the impact give rise to some concern but is likely to be tolerable in short-term (e.g. construction phase) or will require a value judgement as to its acceptability;

Major adverse – the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project.

9.5.3 Uncertainties in impact prediction

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. There is also limited data and information regarding the particular site under consideration, which makes it difficult to predict impacts. However, the level of uncertainty, in the case of Lily Beach is expected to be very low due to the limited activities in the terrestrial environment and experience of resort redevelopment in similar settings in the Maldives. Nevertheless, it is important to consider that there will be uncertainties and to undertake voluntary monitoring of natural processes as described in the monitoring programme given in this report.

Figure 7: Terrestrial impact zones and comparison of the vegetation map with the proposed site plan

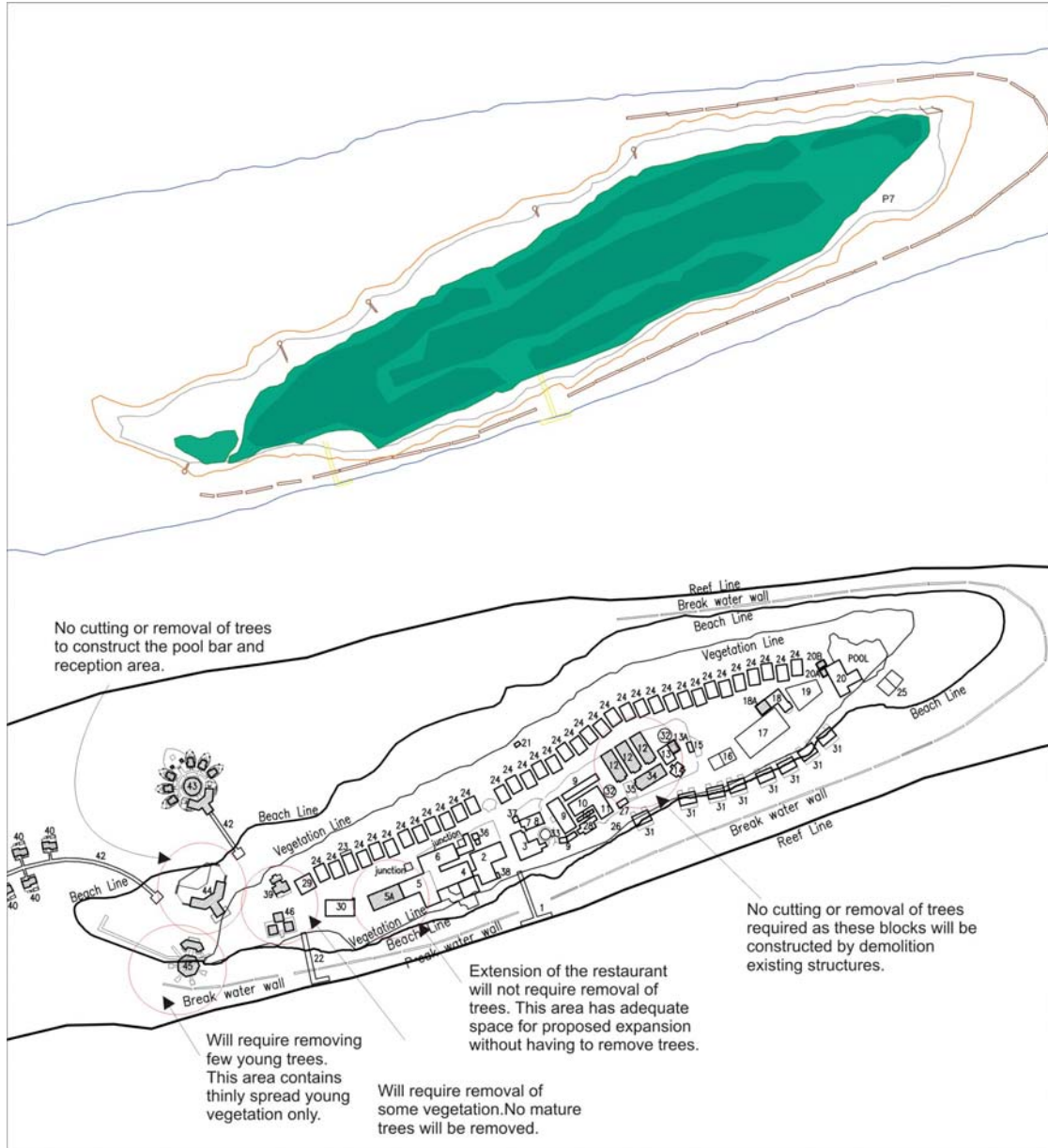





Table 9: Matrix of major terrestrial environmental impacts during construction and operation stage.

Environmental Aspect	Potential Impacts	Mitigation Measures	Magnitude of impacts	Cost of mitigation
Construction stage				
Groundwater and surface water	<p>Excavation for foundations may lead to exposure of groundwater and increase the chance of contamination of the groundwater.</p> <p>Only very limited excavation will be undertaken to construct the staff accommodation block, GM Villa and dive school. Pool bar, reception and Ala Carte restaurant will be constructed on the coast, and will therefore not affect the water lens.</p>	<p>Good construction practices will be followed such as not leaving open ditches and excavating only to the required depth.</p> <p>Limiting time period between excavation and foundation laying.</p>	Minor Adverse	<p>Mitigations measures will be Included in the contract document.</p> <p>Cost therefore included in the project.</p>
Noise	<p>The noise level is expected to increase during site preparation and construction only around construction stage with the use of machinery and earth moving equipment. Construction noise</p>	<p>Although not expected to create a significant negative impact on human settlement, noise will impact the construction workers. Therefore construction workers will be provided with proper personal protection equipments</p>	Minor adverse	<p>Measures will be included in the contract document.</p> <p>Cost therefore included in the project.</p>

Environmental Aspect	Potential Impacts	Mitigation Measures	Magnitude of impacts	Cost of mitigation
Construction stage				
	<p>impacts are not expected to be a nuisance to human settlements as Huvahendhoo is isolated.</p> <p>Noise impacts are therefore going to be localized to Huvahendhoo Island only.</p>	<p>(PPE) such as ear muffs. Site supervisors will also be required to ensure that workers wear these PPE.</p> <p>Construction machinery and vehicles will be serviced at regular intervals in order to keep noise to a minimum.</p>		
Vegetation clearing	<p>No vegetation clearing is required, for construction of the reception and pool bar. Very few young trees will be required to be removed for the construction of the Ala Carte restaurant. Staff blocks will be constructed by demolishing existing staff blocks.</p> <p>Construction of Dive school and GM Villa will require removal of some trees.</p> <p>Extension of the restaurant will not require vegetation removal or cutting of any trees.</p>	<p>Limiting vegetation removal only to young trees.</p> <p>Limiting vegetation clearing to only the amount required.</p> <p>When foliage or branches are required to be trimmed, it will only be done to the minimum level required.</p>	Negligible	No cost incurred.

Environmental Aspect	Potential Impacts	Mitigation Measures	Magnitude of impacts	Cost of mitigation
Construction stage				
Air pollution	Dust from construction activities including demolition of the staff block and other processes such mixing of cement and movement of vehicles.	Regularly watering the ground, trees and plants around construction areas to control dust and also prevent dust from spreading to other areas.	Minor Adverse	Measures will be included in the contract document. Cost therefore included in the project.

9.6 Photographic summary of terrestrial flora

	
<p>Inner vegetation showing a combination of young and mature trees sparsely spread.</p>	
	
<p>Young vegetation growing on the western side thundi</p>	
	
<p>Mature coconut trees on the eastern tip of the island</p>	<p>Mixture of young and mature trees along the vegetation line</p>

10 Coastal Environment

10.1 Chapter Brief

This chapter will look at the coastal zone of the island environment which is the area between the vegetation line and the reef flat. Therefore, this chapter will cover the following:

- General meteorological conditions in the Maldives.
- Existing environmental conditions of the coastal environment of Huvahendhoo (Lily Beach), especially at the location of the existing and proposed coastal structures.
- The different proposed components of the project that will impact upon the coastal environment with their specific impacts and mitigation measures.
- Alternatives to the proposed project components, their impacts and mitigation measures.
- Monitoring programme for the coastal zone of Huvahendhoo island.

10.2 Existing Coastal Environment

10.2.1 *Island Formation Geological and Setting*

Huvahendhoo is an oval-shaped sand cay lying on its own reef system close to the eastern rim of the Atoll located at about latitude of 3° 39' N and longitude of 72° 57' E. The island is slightly inside, in the lee of the two reef systems known as Hithifalhu on the northeast and Athulivaru Falhu on the southeast facing the channel between these two reef systems. The reef system of Huvahendhoo, which is oriented in a northeast-southwest direction, elongated in shape with the oval-shaped island in the middle in a slightly north-south orientation than the reef system. The eastern end of the island is prone to long-period swells from the Indian Ocean. The strong current in the channel together with the influence of swells within the channel probably creates the dynamic conditions observed in the northeast to east side of the island. On the western side, Huvahendhoo faces the atoll lagoon and is protected by being in the lee of several reefs on its west. The reef on this side is quite close to the beach and has a immediately slanting reef edge.

The closest island to Huvahendhoo is Vilamendhoo, which is also a resort island and lies slightly southeast of Lily Beach. The closest inhabited island is Dhangethi which is about 5 kilometers south of Huvahendhoo. There are numerous reef patches surrounding Huvahendhoo and her reef system is sheltered by these surrounding reef systems. Despite the protection afforded by these reef systems, the island has high-rise breakwaters around its entire perimeter except the western half of the northern side. The main reason for these breakwaters being constructed in the past was to minimize erosion on areas in which the reef is closest to the beach. These are the northeastern and southwestern sides with the reefline at about 20m from the shoreline. However, it is not certain that these breakwaters provide adequate protection to the beaches but are more of an eyesore to tourists.

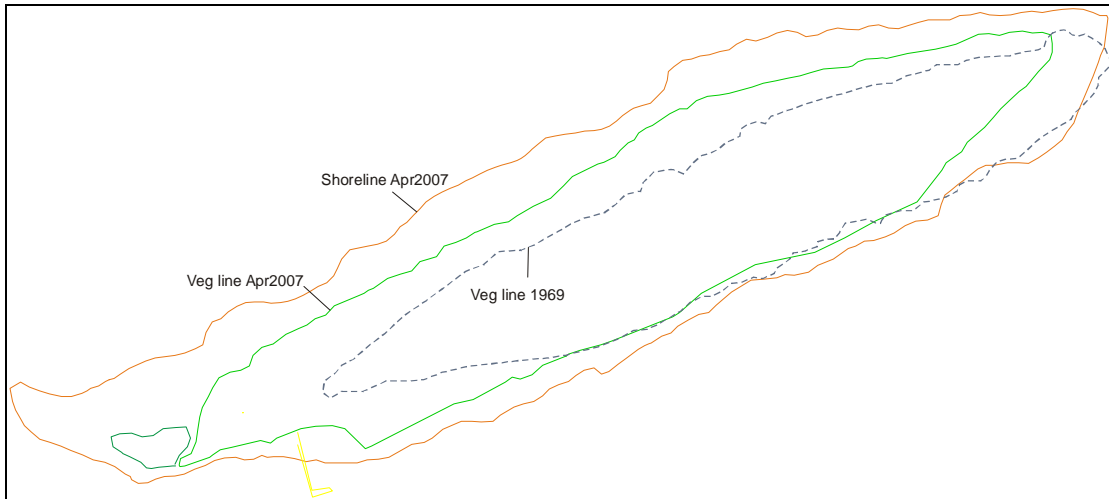


Figure 8: Comparison of Huvahendhoo vegetation line in 1969 and 2007.

According to the geological formation, vegetation and soil characteristics of the island, the island can be said to have been created from a nodal point in the northeast corner of the reef system. This is more apparent from the natural island setting seen in the aerial photo of 1969 (see Figure 9). The east or northeast end of the island also has the shortest distance from the reefline. The southwest end of the island also has narrow reef extent. These two sides (northeast and southwest) are about 20m from the reef line while the eastern and western ends are about 200 and 700m from the reef line respectively. The lagoon extent, or the clear lagoon area is also greatest on the western side, where the proposed water villas will be developed.

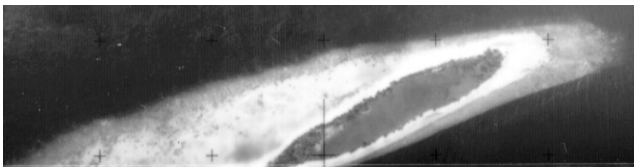


Figure 9: Aerial photo taken in 1969 (Royal Air Force)

Aerial views of the island prior to the placement of breakwaters and groynes were not available except for the aerial photo of 1969. Therefore, the following assessment of the erosion-accretion patterns around the island was based on the 1969 aerial photo and recent survey. The aerial photo of 1969 does not clearly show the shoreline at that time. Therefore, comparisons cannot be made in terms of changes to the shoreline. At present, there is a set of shore-parallel, nearshore breakwaters affecting the longshore sediment transport patterns as some breakwaters are shore-connected at average tide and even at high tide thereby stopping longshore sediment transport completely. This is evident from some past aerial photos (shown below) which were kindly shared by the Lily Beach Management. These aerial views do not show a horizontal plane, therefore, comparisons could not be made.



Figure 10: Aerial view of Lily Beach after the breakwaters were constructed.

The island is expected to have a sand spit or thundi on the western side during the northeast monsoon, which would erode and move towards the eastern side during the southwest monsoon. However, this movement is also restricted. The island does have sandspits on these areas, most of which is nourished sand. The western end has stabilized and growth of bushes can be seen. Beach nourishment is a continuous process in many resort islands of the Maldives. As such, the marks of this process can be observed, from aerial photos and the bathymetry survey, as a few dredged or deepened areas within the northern and northwestern lagoon (see Figure 11).



Figure 11: Aerial photo indicating the areas from which beach fill material was taken

10.2.2 Climatic Setting

The Maldives, in general, has a warm and humid tropical climate with average temperatures ranging between 25°C to 30°C (MHAHE, 2001) and relative humidity ranging from 73 per cent to 85 per cent. The country receives an annual average rainfall of 1,948.4mm. There is considerable variation of climate between northern and southern atolls. Table 10 provides a summary of key meteorological findings for Maldives. General studies on climatic conditions of Maldives were taken into account during study as local level time-series data are limited for longer periods at the nearest meteorological station.

Table 10: Key meteorological information

Parameter	Data
Average Rainfall	9.1mm/day in May, November 1.1mm/day in February
Maximum Rainfall	184.5 mm/day in October 1994
Average air temperature	30.0 C in November 1973 31.7 C in April
Extreme Air Temperature	34.1 C in April 1973 17.2 C in April 1978
Average wind speed	3.7 m/s in March 5.7 m/s in January, June
Maximum wind speed	W 31.9 m/s in November 1978
Average air pressure	1012 mb in December 1010 mb in April

10.2.2.1 Monsoons

Monsoons of Indian Ocean govern the climatology of the Maldives. Monsoon wind reversal plays a significant role in weather patterns. Two monsoon seasons are observed: the Northeast (*Iruvai*) and the Southwest (*Hulhangu*) monsoon. Monsoons can be best characterized by wind and rainfall patterns. The southwest monsoon is the rainy season which lasts from May to September and the northeast monsoon is the dry season that occurs from December to February. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November.

10.2.2.2 Rainfall

Annual average rainfall in Maldives is about 1900mm. There is a marked variation in rainfall across Maldives with an increasing trend towards south. The annual average rainfall in north is 1977mm and for south is 2470mm.

The southwest monsoon is known as the wet season with monthly average rainfall ranging from 125-250mm. The northeast monsoon is known as the dry season with average monthly rainfall of 50-75mm.

Rainfall records indicate an average annual rainfall of 2500mm. The intensity of rainfall is a concern in the Maldives since intensity is high with low frequency. However, excessive rainfall is not a concern for Huvahendhoo since the island does not cup towards the middle but rather diverts the runoff towards the shore on all sides especially the western side where the island has a low elevation.

10.2.2.3 Temperature

Daily temperatures of Maldives vary little throughout the year with a mean annual temperature of 28°C. The annual mean maximum temperature recorded for Male' during the period 1967-1995 was 30.4°C and the annual mean minimum temperature for the same period was 25.7°C. The

highest recorded temperature for Male' was 34.1°C on 16th and 28th of April 1973. The hottest month recorded was April 1975 with a maximum monthly average temperature of 32.7°C, the next highest being 32.6°C in April 1998. The lowest minimum average temperature of 23.7°C was recorded in July 1992.

10.2.2.4 Wind

Wind has been shown to be an important indirect process affecting formation development and seasonal dynamics of the islands in the Maldives. Winds often help to regenerate waves that have been weakened by travelling across the reef and they also cause locally generated waves in lagoons. Therefore winds are important here, as being the dominant influence on the sediment transportation process (waves and currents). With the reversal of winds in the Maldives, NE monsoon period from December to March and a SW monsoon from April to November, over the year, the accompanying wave and current processes respond accordingly too. These aspects have ramification on the seasonal sediment movement pattern on the islands and also the delivery/removal of sediments from the reef platform/island.

The two monsoon seasons have a dominant influence on winds experienced across Maldives. These monsoons are relatively mild due to the country's location close to the equator and strong winds and gales are infrequent. However, storms and line squalls can occur, usually in the period May to July; gusts of up to 60 knots have been recorded at Male' during such storms.

Wind was uniform in speed and direction over the past twenty-plus monsoon seasons in the Maldives (Naseer, 2003). Wind speed is usually higher in central region of Maldives during both monsoons, with a maximum wind speed recorded at 18 m.s-1 for the period 1975 to 2001. Maximum wind speed recorded in the south was 17.5 m.s-1 during the period 1978 to 2001. Mean wind speed was highest during the months January and June in the central region, while wind speed was in general lower and more uniform throughout the year in the southern region. Wind analysis indicated that the monsoon was considerably weaker in the south (Naseer, 2003). During the peak months of the SW monsoon, southern regions have a weak wind blowing from the south and south-eastern sectors.

Table 11 summarises the wind conditions in Huvahendhoo throughout the year. Medium term meteorological data from Malé International Airport weather station was used in this analysis.

Table 11: Summary of general wind conditions in Huvahendhoo

Season	Month	Wind
NE - Monsoon	December	Predominantly from NW-NE. Stronger winds from W
	January	
	February	
Transition Period 1	March	From all directions. Mainly W. Stronger winds from W
	April	
SW - Monsoon	May	Mainly from W. Stronger winds from W
	June	
	July	
	August	
	September	
Transition Period 2	October	Mainly from W. Stronger winds from W
	November	

Table 12: Scatter diagram for Huvahendhoo. Wind speed versus wind direction (%). All Year (1999)- (adapted from DHI, 1999)

Wind speed (m/s)	Wind Direction								
	NE	E	SE	S	SW	W	NW	N	
1	0.94	0.95	0.96	1.19	1.02	0.97	0.82	0.78	
2	2.02	1.95	2.13	1.91	1.81	1.92	1.57	1.46	
3	2.30	2.79	2.98	2.74	2.74	2.99	2.31	2.12	
4	2.04	2.26	2.75	2.91	2.86	2.90	2.15	1.91	
5	1.45	1.97	2.30	2.21	2.98	2.49	1.51	1.27	
6	0.54	0.99	1.42	0.94	1.79	2.36	1.02	0.80	
7	0.10	0.32	0.74	0.28	0.91	2.04	0.43	1.10	
8	0.05	0.06	0.26	0.11	0.52	1.39	0.19	0.04	
9	0.01	0.01	0.16	0.01	0.19	0.94	0.10	0	
10	0	0	0.05	0	0.04	0.75	0.04	0	
11	0	0	0	0	0	0.46	0.01	0	
12	0	0	0	0	0	0.07	0.01	0	
13	0	0	0	0	0	0.02	0	0	

The arrival and service jetties as well as public areas are concentrated on the southern side of the island while most of the guest villas face the northern side. The eastern thundi area, which is prone to severe weather including the effects of wind-generated waves and oceanic swells from the channel, has the swimming pool and bar. The reef extent on this end is small.

The western end of the island is generally protected from wind and wind-generated waves during the northeast monsoon and even during the southwest monsoon, because the island is in the lee of several other reefs.

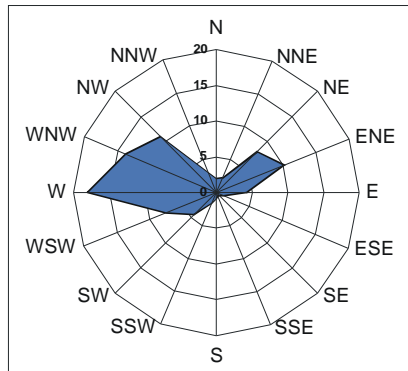


Figure 12: General wind rose diagram for the Maldives (source MEEW 2005).

10.2.2.5 Waves

Wave energy is important for sediment movements and settlement, and it is also a crucial factor controlling coral growth and reef development. Waves have been attributed to the diversity and

the abundance of coral and algal species. These aspects have implications for the type and perhaps the supply of sediment s into the island.

Studies by Lanka Hydraulics (1988a & 1998b) on Malé reef indicated that two major types of waves on Maldives coasts: wave generated by local monsoon wind and swells generated by distance storms. The local monsoon predominantly generates wind waves which are typically strongest during April-July in the south-west monsoon period. During this season, swells generated north of the equator with heights of 2-3 m with periods of 18-20 seconds have been reported in the region. Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves.

Distant cyclones and low pressure systems originating from the intense South Indian Ocean storms are reported to generate long distance swells that occasionally cause flooding in Maldives (Goda, 1988). The swell waves that reached Malé and Hulhule in 1987, thought to have originated from a low pressure system of west coast of Australia, had significant wave heights in the order of 3 metres.

In addition, Maldives has recently been subject to earthquake generated tsunami reaching heights of 4.0m on land (UNEP, 2005). Historical wave data from Indian Ocean countries show that tsunamis have occurred in more than one occasion, most notable been the 1883 tsunami resulting from the volcanic explosion of Karakatoa (Choi *et al*, 2003). Huvahendhoo was not affected by the recent tsunami of 26 December 2004.

Huvahendhoo is exposed to waves generated by swells combined with short-wind-generated waves traveling through the channel facing the eastern side. The channel helps to minimize the impact of waves on the eastern and northern shores. Waves breaking on the southern and southwestern side, on the other hand, may be considered to be stronger because of the narrow reef extent on this side. However, the overall effect of waves on the shores of Huvahendhoo may be considered small given that the island has slight variation in its eastern and western ridges.

Waves breaking on the south and western side may be less strong because it faces the atoll lagoon, therefore it has less influence in island building. Possibly more fresh input of sediment takes place during the NE monsoon and the shaping and medium term dynamic movement of the island takes place during the SW monsoon. There is more rubble on the eastern end of the island indicating the influence of the northeast monsoon on island building. The overall result of wave influence on the morphodynamics of the island during the NE monsoon might be rapid deposition of sediment and shaping of the island taking place during the SW monsoon.

General wave conditions in Huvahendhoo is summarised in Table 13. (adapted from DHI, 1999).

Table 13: Summary of wave condition in Huvahendhoo

Season	Total	Long Period	Short Period
NE - Monsoon	Predominantly from E-S. High Waves from W	From S-SW	Mainly E-NE. High waves from E
Transition Period 1	Mainly from SE-E	From S-SW	Mainly from NE-SE
SW - Monsoon	From SE-SW. Mainly from S. Medium waves also from W	From S-SW	Mainly from SE-S. High waves from E
Transition Period 2	As SW monsoon	From S-SW	From SE-W. Higher waves from E

This aspect of climate will therefore have an effect on the design of any coastal infrastructure and water sports activities planned for the resort under the proposed redevelopment.

10.2.2.6 Tides

Tides affect wave conditions, wave-generated and other reef-top currents. Tide levels are believed to be significant in controlling amount of wave energy reaching an island, as no wave energy crosses the edge of the reef at low tide under normal conditions. In the Maldives where the tidal range is small (1m), tides may have significantly important influence on the formation, development, and sediment movement process around the island. Tides also may play an important role in lagoon flushing, water circulation within the reef and water residence time within an enclosed reef highly depends on tidal fluctuations.

10.2.2.7 Currents

Studies on current flow within a reef flat in Male' Atoll suggests that wave over wash and tides generate currents across the reef platforms, which are also capable of transporting sediments (Binnie Black & Veatch, 2000). However, available information suggests that tidal currents are not strong due to small tidal range.

Generally, current flow through the Maldives is driven by the dominating two-monsoon season winds. Westwardly flowing currents are dominated from January to March and eastwardly from May to November. The change in currents flow pattern occurs in April and December. In April the westward currents flow are weak and eastward currents flow will slowly take place. Similarly in December eastward currents flows are weak and westward currents will take over slowly.

Studies on current flow process within a coral atoll have shown that waves and tides generate currents across the reef platforms, which are capable of transporting sediments on them. Currents, like waves are also modified by reef morphology. Under low-input wave conditions (0.5m heights) strong lagoonward surge currents (>60cm/sec) are created by waves breaking at the crest. Studies on current flow across reef platforms have shown that long-period oscillations in water level cause transportation of fine-grained sediments out of the reef-lagoon system, while strong, short duration surge currents (<5sec.) transport coarse sediments from the breaker zone to seaward margin of the backreef lagoon. Always sediment accumulates at the lee of high-speed current

zones. Generally zones of high current speed (jets or rips, 50-80cm/sec) are systematically located around islands.

Data on current speed and direction around Huvahendhoo was measured on the day of the field visit. These are given in Figure 13. However, spot data taken on a single day would not yield sufficient data to understand coastal dynamics. Therefore, long term monitoring of data will be recommended in the monitoring programme proposed for the resort. Figure 13 provides a view of longshore currents around Huvahendhoo on the day of the field visit in April 2007. During the current measurements, the wind was from a southwest-westerly direction.

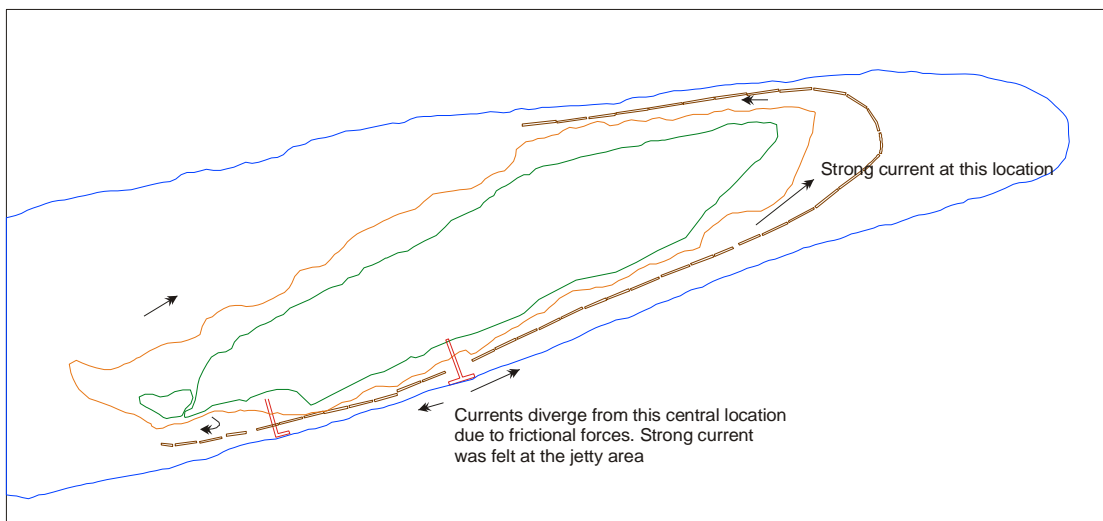


Figure 13: Longshore currents around Huvahendhoo, April 2007

Aspects relating to currents have a direct impact on the project, especially in the design of future coastal protection measures. Therefore, longterm monitoring of currents is important.

10.2.3 Features of the Coastal Environment

The coastal environment was considered as a main component that would be affected by the proposed redevelopment of Lily Beach Resort on Huvahendhoo island. The existing coastal dynamics were studied briefly during field visits. These include site specific data on the coastal environment including currents and sediment movement patterns. Beach erosion and accretion patterns around the island were studied using aerial photographs taken in 1969 and recent surveys.

The coastline was mapped using a differential GPS. This allowed measurement of the total area of existing beach. The implications of these baseline data are very important for future quantitative measurements as this will aid in the calculation of the beach loss or erosion or accretion. A general bathymetric and currents survey was also undertaken in specific locations.

The coastal environment of Huvahendhoo comprised of mainly white sandy beaches, beach rock, beach rubble and shallow lagoon or *falhu*. The reef patches within the lagoon areas are not

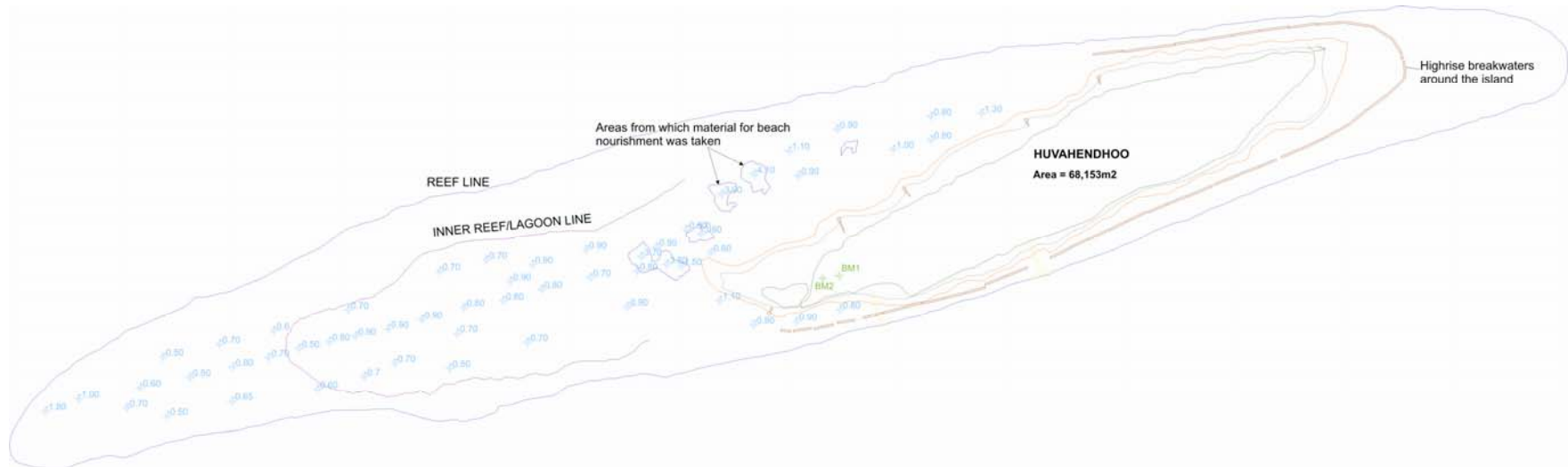
covered in this chapter as it will be covered in the Marine Environment section. Types of coastal vegetation will also be given in the Terrestrial Environment section.

Figure 4 represents the different features of the Huvahendhoo including coastal environment of and a description of these different features is given in the following sections.

10.2.4 Lagoon

A proper lagoon exists on the north and western side of Huvahendhoo. The south side also has a lagoon but is very narrow due to the small reef extent on this side. The lagoon around the island is quite shallow except for a few deepened patches on the northwest and western side. These patches have been deepened to pump sand to the beach, which undergoes a constant and dynamic erosion-accretion process. The bathymetry of the lagoon on the northwest and western sides is shown in Figure 14. The lagoon consists of medium-fine sandy floor, and scattered patches of coral colonies especially at the western side. Lots of fines can be seen on the northwest and western side lagoon and foreshore areas due to fines emanating from the sand pumping. The water quality is in a pristine state with minute levels of phosphates and nitrates. There is no sign of faecal contamination of the lagoon surrounding Lily Beach.

Figure 14: Bathymetry of the lagoon on north-west and western side



10.2.5 Beach

There is no distinctive variation in beach composition around the island. However, the beach extent can be seen to vary in the aerial photograph of 2002. The beach material is mainly composed of loose skeletal carbonate sediments, mainly fragments of green calcareous algae *Halimeda* sp., encrusting and branching red algae, molluscs, foraminiferans, echinoderms and bryozoans. Approximately 5-7m of white sandy beach exists around the island. The widest beaches are at the northwest side with a sandspit (thundi) on the western end. The northern side of the island has grown from its natural state (seen in aerial photo of 1969). A comparison of vegetation lines of Huvahendhoo, shown in Figure 15 indicates that the island has undergone erosion on the eastern end and accretion along with beach nourishment on the western and northwest. The southern side had remained the same. The main cause of this appears to be regular sand pumping as well as placing of sand to enhance beaches.

Figure 15: A comparison of vegetation lines of Huvahendhoo

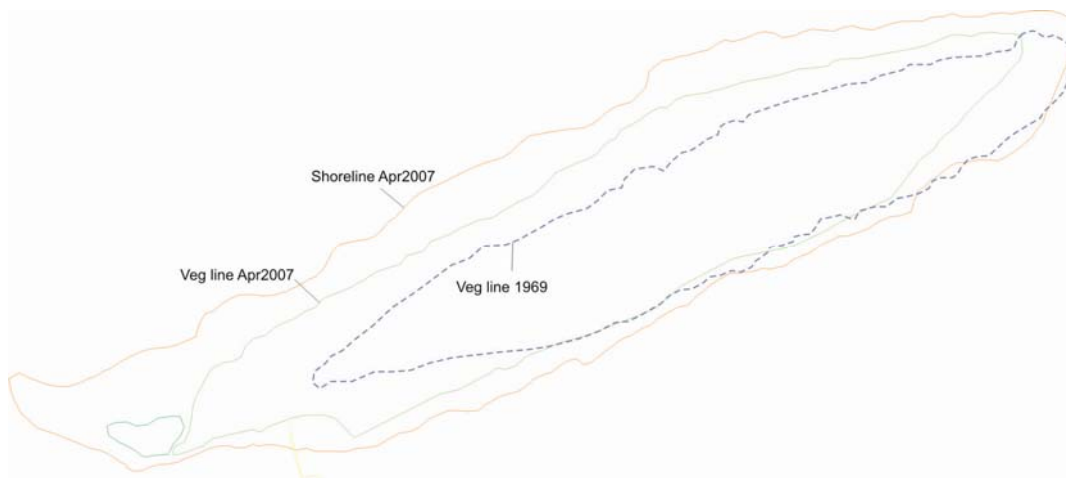
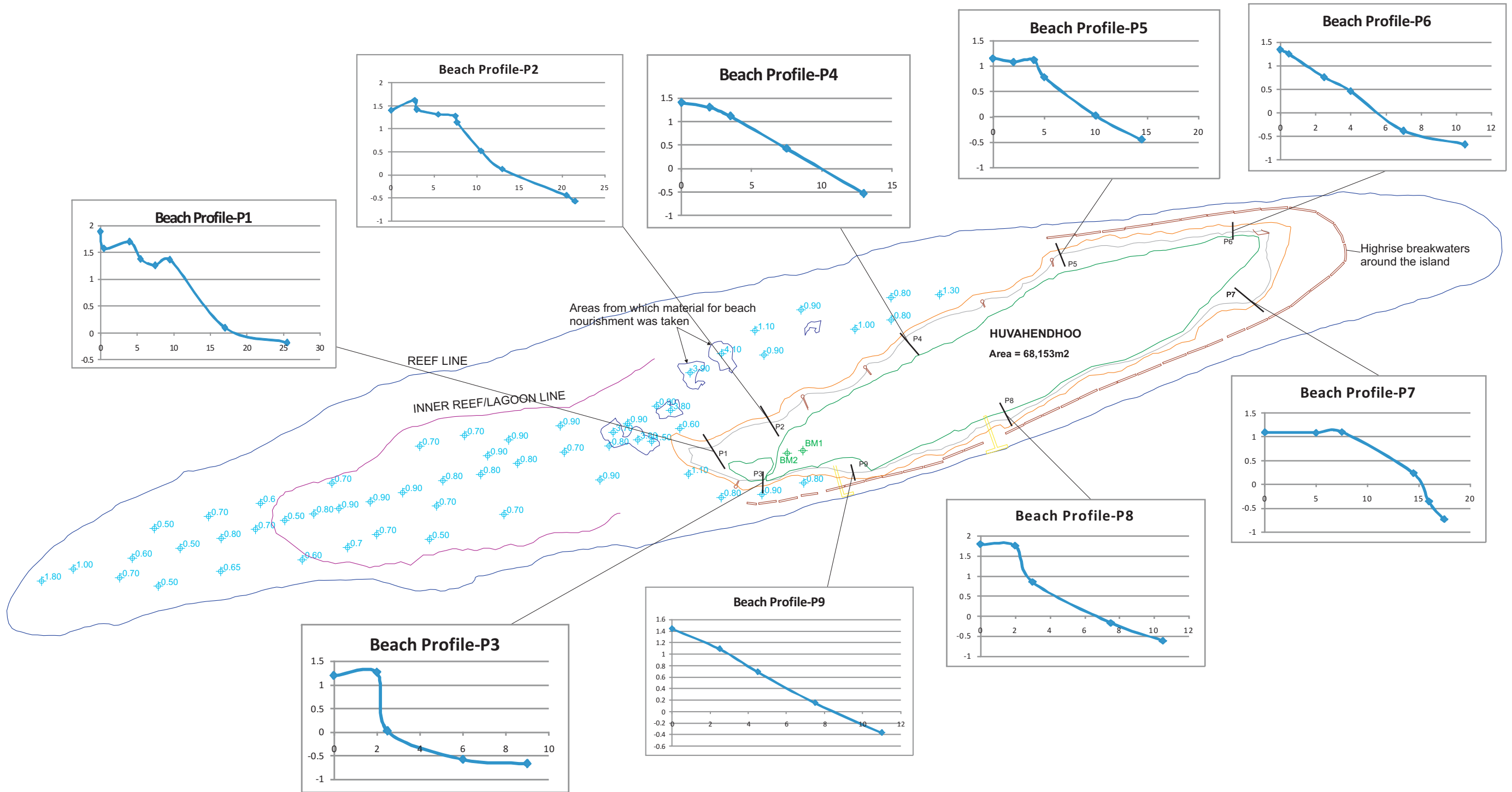


Figure 16 -: Beach profiles taken at designated locations around Huvahendhoo



10.3 Environmental Impacts

The consequences of developing coastal infrastructure in highly dynamic coastal areas are well documented. Inevitably coastal infrastructure alters natural sediment transport patterns to a certain degree triggering accretion and erosion patterns, often with considerable environmental and socio-economic consequences. The problem is certainly felt strongly in the Maldives where sandy beaches are an important asset for the tourism industry. This section will look at the impacts of the proposed redevelopment on the coastal environment. Furthermore, measures to mitigate impacts would be suggested so that overall environmental improvements can be made to the environment of Huvahendhoo during the implementation of the proposed redevelopment.

10.3.1 Coastal Works

During the initial stages of the redevelopment of Lily Beach Resort (Huvahendhoo) or during the construction phase will be the major direct short-term impacts and some secondary long-term impacts on the coastal environment. Potential negative impacts on the reef system and beach environment from the proposed work are limited to a relatively small number of activities which include:

- Construction of spa and water villas
- Construction of piled jetties for the proposed spa and water villas.
- The construction of proposed Ala-Carte restaurant's over-water deck
- The construction of the Reception/Coffeeshop/Pool/Bar complex.

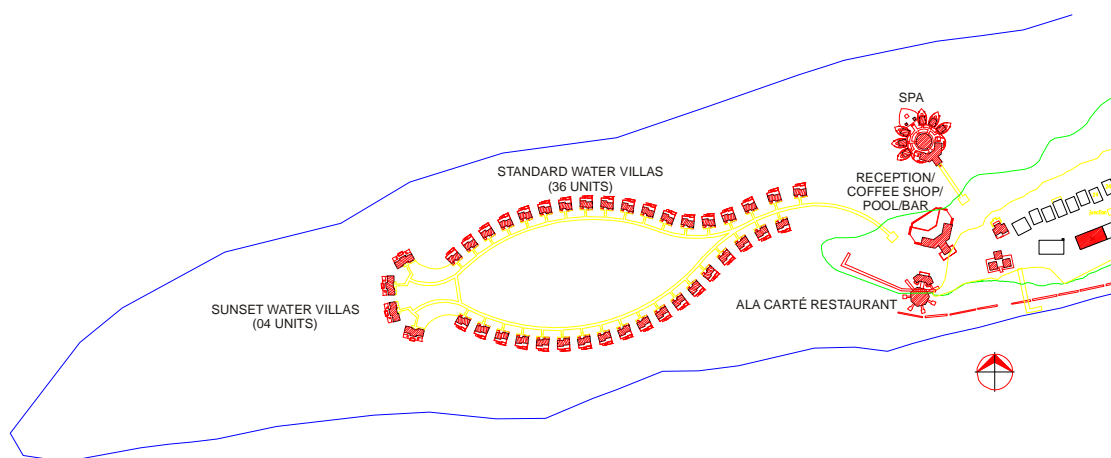


Figure 17: Proposed structures and activities in the coastal environment

10.3.1.1 Construction of Proposed Spa and Water Villas

The spa will be located on the northwestern side lagoon and the water villas on the western end lagoon. The impact of construction of the spa and water villas on the coastal environment would be similar where the main impact would be the effect of the columns on the longshore sediment transport. Since the structures are shore connected, there will be some degree of disruption of natural sediment transport patterns at the base of the jetties. This impact would be greater in the proposed area due to the dynamic nature of the area. However, since longshore processes and the natural dynamic equilibrium have been affected, the proposed structures are not expected to

affect longshore transport. The impact will be minimal. There may be some sand accretion at the base of the jetty as the shore connects with the first few beams, which would act as nearshore breakwaters forming a salient which would result in a tombolo at the lee of the beam structure.

Overall, the construction of proposed spa and water villas would cause some degree of sedimentation (discussed in the Marine Environment section) and potential changes to the long shore transport and littoral regime of the island, as discussed above. This is considered a minor adverse impact if mitigation measures were taken. The impact of sedimentation would be considered negligible if pre-cast columns were used rather than in-situ construction.

10.3.1.2 Construction of Proposed Ala Carté Restaurant

The construction of proposed Ala-Carte restaurant's over-water deck standing on piles would also cause some degree of sedimentation (discussed in Marine Environment section) and potential changes to the longshore transport and littoral regime of the island. The impact of the restaurant structure on longshore transport will be greater than that of the spa and water villas. In this case, the structure is on the shoreline whereas in the case of the spa and water villas, the structures are quite a distance away from the shoreline. Therefore, this activity may be considered to have a moderate adverse impact on the sediment distribution around the western coastline due to the number of columns that will be erected.

10.3.1.3 Construction of Proposed Reception/Coffeeshop/Pool/Bar

The construction of the Reception/Coffeeshop/Pool/Bar complex takes place on the western side at the foreshore between the vegetation line and low tide line. Therefore, this structure is expected to have some degree of influence on the longshore sediment transport patterns. This structure will have the greatest impact on the shore processes and it may be necessary to consider beach nourishment up to the low tide line or end of the structure in such a way that erosion on the down drift side will be minimized. Further studies of the longshore currents may be necessary to suggest such beach nourishment, which is not within the scope of this EIA. Therefore, if beach nourishment was found necessary, separate approval has to be sought. This is also considered to be moderate adverse.

Table 14: Summary of impacts of coastal works and proposed structures on the coastal environment

Impact characteristic	Major work activities that may negatively impact coastal environment during construction and operation			
	Water Villa Suites	Spa	Reception, Coffee Shop, Pool and Bar	Ala Carté Restaurant
Nature of impact	Cumulative	Cumulative	Cumulative	Cumulative
Magnitude of impact	Minor negative	Minor negative	Moderate negative	Moderate negative
Extent of Impact and environmental attribute impacted	Primary impact of fine sediment on shallow lagoon and longshore sediment transport. Bottom biota affected. Water quality reduced (short term) due to fines in the water column	Primary impact of fine sediment on shallow lagoon and longshore sediment transport. Bottom biota affected. Water quality reduced (short term) due to fines in the water column	Primary impact of fine sediment on shallow lagoon and longshore sediment transport. Bottom biota affected. Downdrift erosion may become apparent and would have to be managed.	Primary impact of fine sediment on shallow lagoon and longshore sediment transport. Bottom biota affected. Water quality reduced (medium term) due to fines in the water column.
Duration of impact	Short term	Short term	Short to medium term	Short to medium term
Reversibility	Reversible	Reversible	Reversible	Reversible
Impact significance	Low	Low	Moderate	Moderate

Note: The above assessments are specific to the coastal environment not including the coral patches and house reef of Huvahendhoo

10.4 Mitigation Measures

10.4.1 Construction of Proposed Spa and Water Villas

Mitigation Measures	Cost of mitigation
<p>The following mitigation measures will help minimize the impacts.</p> <ol style="list-style-type: none"> 1. The Spa and water villas will be built on columns. STRICTLY no solid structures 2. Ensure appropriate supervision and monitoring during works 3. Use precast columns and footings 4. Carry out the work in low tide hours during calm weather 5. Complete the work in as short a time period as possible 6. Use manual methods as much as possible 7. Create awareness and brief the workforce on how to minimize impacts 	<ol style="list-style-type: none"> 1. Included in the project design phase. 2. Cost included in the monitoring plan 3. Included in the project design phase 4. Included in the project design phase and contract document 5. Included in the contract document 6. Included in the contract document 7. Included in the contract document

10.4.2 Construction of Proposed Ala Carté Restaurant

Mitigation Measures	Cost of mitigation
<p>The following mitigation measures will help minimize the impacts.</p> <ol style="list-style-type: none"> 1. The Ala Carté Restaurant will be built on columns. STRICTLY no solid structures 2. Ensure appropriate supervision and monitoring during works 3. Use precast columns and footings 4. Carry out the work in low tide hours during calm weather 5. Complete the work in as short a time period as possible 6. Use manual methods as much as possible 7. Create awareness and brief the workforce on how to minimize impacts 8. If necessary, place silt screens between the breakwater barricades to prevent any sediment flow onto closeby housereef 	<ol style="list-style-type: none"> 1. Included in the project design phase. 2. Cost included in the monitoring plan 3. Included in the project design phase 4. Included in the project design phase and contract document 5. Included in the project design phase and contract document 6. Included in the contract document. This method may not be cost effective and will be avoided. 7. Included in the contract document and also environment consultants will be required to undertake this prior to construction. Cost included as part of the monitoring programme.

10.4.3 Construction of Proposed Reception/Coffeeshop/Pool/Bar Complex

Mitigation Measures	Cost of mitigation
<p>The following mitigation measures will help minimize the impacts.</p> <ol style="list-style-type: none"> 1. It is recommended to use piled structure instead of a solid structure 2. Ensure appropriate supervision and monitoring during works 3. Carry out the work during low tide 4. Create awareness and brief the workforce on how to minimize impacts 	<ol style="list-style-type: none"> 1. Included in the project design phase. 2. Cost included in the monitoring plan 3. Included in the project design phase and contract document 4. Included in the contract document and also environment consultants will be required to undertake this prior to construction. Cost included as part of the monitoring programme.

10.5 Coastal Zone Monitoring Programme

10.5.1 Introduction

Monitoring is an essential tool to identify potential negative environmental impacts and take measures to mitigate those impacts before severe environmental damage occurs. Hence, monitoring forms an integral and important part of the Environmental Impact Assessment process. If relevant environmental, social and economic parameters are adequately monitored important lessons can be learnt at relatively little cost with the advantage of having solid bases on which to identify guidelines for future developments.

The proposed monitoring programme will yield beneficial results if it was undertaken for a longer period. For decisions involving the coastal zone, it is important to understand shore process for at least a year. Therefore, the proposed monitoring programme is recommended for at least two years from the onset of the proposed redevelopment project.

10.5.2 Tentative Monitoring Programme

The monitoring programme outlined for the proposed project is tentative in that monitoring and evaluation should be for continual improvement and so the monitoring programme shall be improved too. The proposed monitoring programme will include two monthly monitoring to cover the three stages of the project implementation, namely:

Stage 1: Immediately before starting civil works

Stage 2: During civil works (every two months)

Stage 3: At the end of construction phase (every three months)

10.6 Cost of monitoring

The proponent has committed fully for the monitoring programme outlined in this report (Commitment letter from the proponent is attached as an annex). The cost indicated below is for monitoring the project during the construction stage and operational stage. Monitoring will be undertaken by subcontracting the work to Water Solutions Pvt. Ltd. This amount indicated is the total cost of monitoring during the construction and operational phase. Monitoring will include, Marine and Coastal environmental monitoring plans identified in the report. Summary monitoring reports will be provided every two months and final report will be provided at the end of the construction stage and will adhere to Schedule M of the EIA Regulations, 2007. The proponent has allocated one percent of the total project cost for the environmental management including monitoring during the construction stage and after the project.

Table 15: Cost of monitoring programme

DESCRIPTION	TOTAL (US\$)
Transport to Lily Beach (Huvahendhoo) via sea plan. (total of 3 consultants @ \$ 250 per person)	750.00
Accommodation	To be provided by the proponent.
Food	To be provided by the proponent.
Consultants fee (monthly fee) including report writing during the construction period and operational period.	12,00.00
Monitoring of both coastal and marine components.	
Monthly Total (One thousand nine hundred and fifty US Dollars only)	19,50.00

Table 16: Detailed monitoring plan (coastal component).

Coastal environmental monitoring during construction stage								
			2008				2009	
Parameters	Method of undertaking monitoring	Responsible Person	April*	May	July	Sep	Nov	Jan
Dissolved Oxygen	Using on site water quality logger	Env Consultants	x	Construction begins	x	x	x	x
Turbidity	Using on site water quality logger	Env Consultants	x		x	x	x	x
Beach profiles shown in	Using auto levels and staff	Env Consultants	x		x	x	x	x
High and low tide lines	Using differential GPS	Env Consultants	x		x	x	x	x
Longshore current around the island	Using drogues	Env Consultants	x		x	x	x	x
Reporting					1st summary report	2nd summary report	3rd summary report	Final report

* Pre construction monitoring

Monitoring will be undertaken for the same parameters every three months after the completion of the project. Monitoring reports will be submitted every three months during operational stage

11 Marine Environment

11.1 Chapter Brief

This chapter will look at the marine environment of the island which is the area between. Therefore, this chapter will cover the following:

- General methodologies used to collect data
- Existing environmental conditions of the marine environment of Huvahendhoo (Lily Beach), especially around areas where development is proposed.
- The different proposed components of the project that will impact upon the marine environment with their specific impacts and mitigation measures.
- Alternatives to the proposed project components, their impacts and mitigation measures
- Monitoring programme for the coastal zone of Huvahendhoo island

11.2 Marine Environmental Surveys

Marine environmental surveys were conducted to collect data on key environmental components (i.e. the coral reef system and the lagoon system) for the purpose of assessing and establishing marine environmental baseline conditions. The surveys and assessment were the basis for impact evaluation during and after the proposed work of development of the tourist resort. Surveys were based on standard marine environmental surveys so that they can be repeatedly carried out to monitor and record changes and assess possible impacts on the marine environment from the proposed work activity as well as operation of the proposed facility. These surveys will be continually repeated to assess the short-term and long term impacts on the marine environment.

11.3 Methodology adopted

Quantitative and qualitative surveys were conducted to establish the baseline status of the coral reef system of Huvahendhoo (Lily Beach) island. Methodologies adopted for these surveys are internationally accepted and widely used to assess the status of coral reefs in the country as well. Photo-Quadrat reef survey and visual observation of the reef were conducted at the coral reef system. Qualitative and visual observation of the lagoon was surveys were used to assess the status of the lagoon in the proposed development area.

11.3.1 *Quantitative Survey*

Photo Quadrat coral reef survey method was used to collect quantitative data of coral reef benthic communities i.e. live corals and their types, other benthos, dead corals and other reef substrate.

A series of photographs were taken of the quadrat using an underwater camera, which was mounted on a specially designed frame. These photographs were combined to form a photo-composite of the quadrat. Photo-composite of the mapped area of the reef were analysed using computer software. It provided a detail record of individual corals, sandy or rubble area and other benthos to a mapped area. The photographs not only allowed speedy

collection of data in the field, but also provided a permanent record of the quadrat, which is useful for long-term monitoring of growth, mortality and recruitment

Photo Quadrate will be used to monitor change in the macro-benthos community through time. Through long-term monitoring the biological conditions, growth, mortality and recruitment of corals in a permanently marked (fixed) quadrat located at 3m depth on the reef slope will be assessed.

Following are the coral maps produced by the photo-quadratreef survey and assessment method at Site 1 and Site 2 as shown in Figure 18.

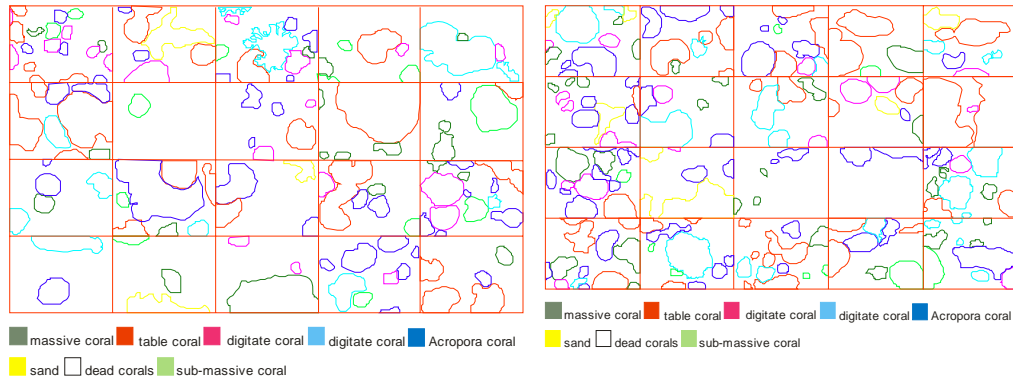


Figure 18: Coral maps produced by the photo-quadratreef survey

These maps can be compared to quantify amount of different categories of reef benthos over long-term to see coral growth and mortality.

11.3.1.1 Background

Many sub-tidal communities have been examined using photo-quadratreef method. The use of photographs to monitor recruitment, growth and mortality of individual coral colonies within quadrates, over several years and has been used in many other studies of coral reef communities. The technique is widely used to monitor the growth of corals. Monitoring of coral colonies over time using successive observation and photography can also be useful technique for detecting sediment smothering.

Advantages

- Sampling was nondestructive.
- Detail and careful observation, photography and mapping of such a fixed area will provide a good record of what takes place in the area.
- Can be a good source of information on estimates for growth rates, partial mortality, mortality and recruitment, if sufficiently replicated.
- Provide a permanent record of the site.

Disadvantages

- The method is slow
- The equipment is somewhat cumbersome, especially in strong currents.
- The photography requires a relatively flat area.
- The method only examines a relatively small area.

Equipment

- Small boat with outboard engine and safety equipment
- SCUBA equipment
- A quadrat, 1m x 1m
- Underwater camera
- A stable tetrapod stand to hold the camera a fixed distance from the substratum for vertical-plane photographs. The base of the frame was 1x1 m and the plate for attachment of the camera is 0.8 m high.

Site selection

- Representative sites of the reef were selected after assessment of broad area of the reef using visual observation survey. Permanent monitoring sites were set up on reasonably flat substrata in representative area of the reef with respect to live coral cover, dead coral, other benthos and habitat types. Surveyed sites were shown on figure 1. Quantitative surveys were conducted at Sites 1 and 2. Qualitative surveys were conducted at Sites 3, 4 and 5.

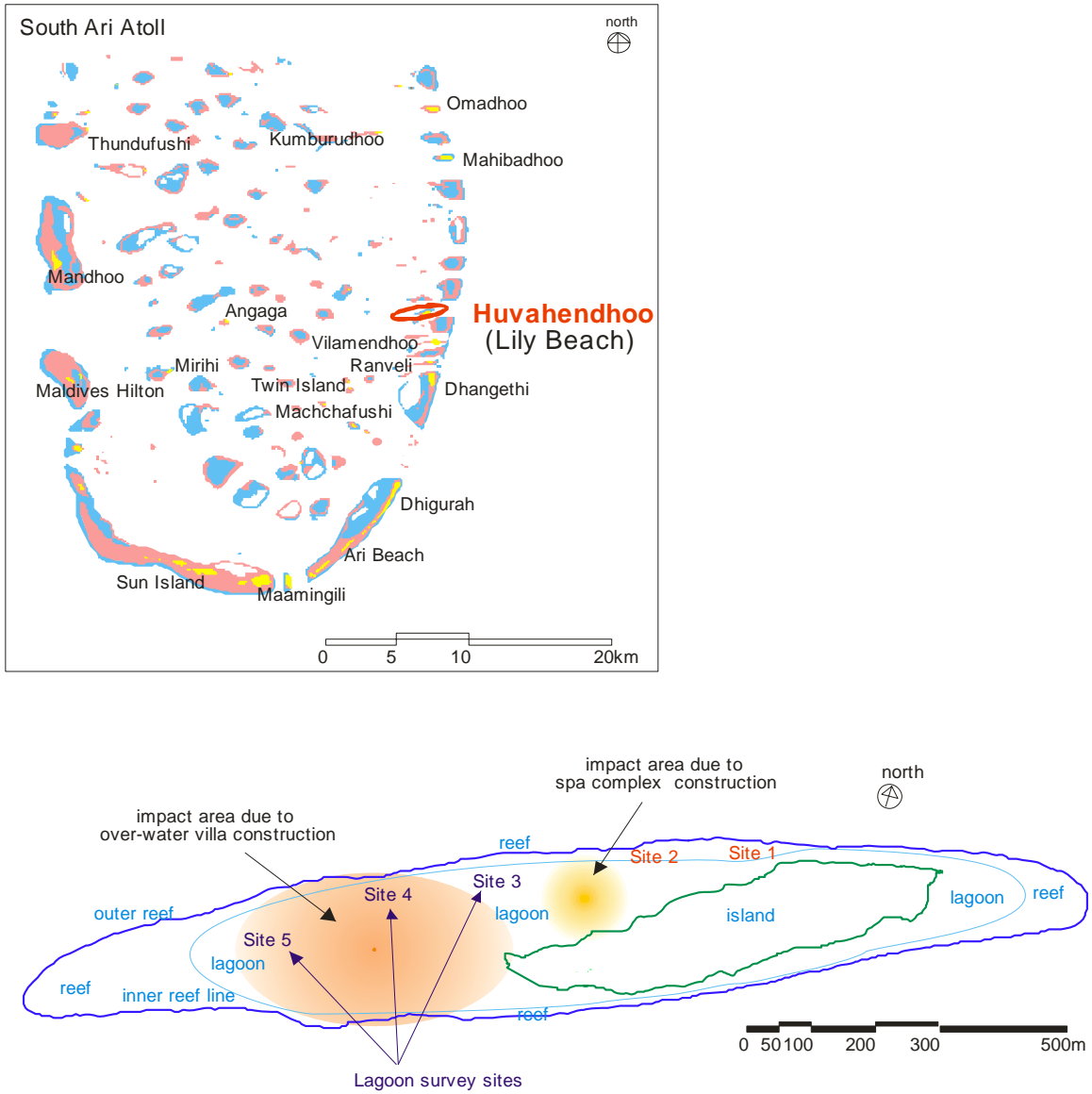


Figure 19 Map of Huvahendhoo showing survey sites and potential impact areas

11.4 Marine water quality

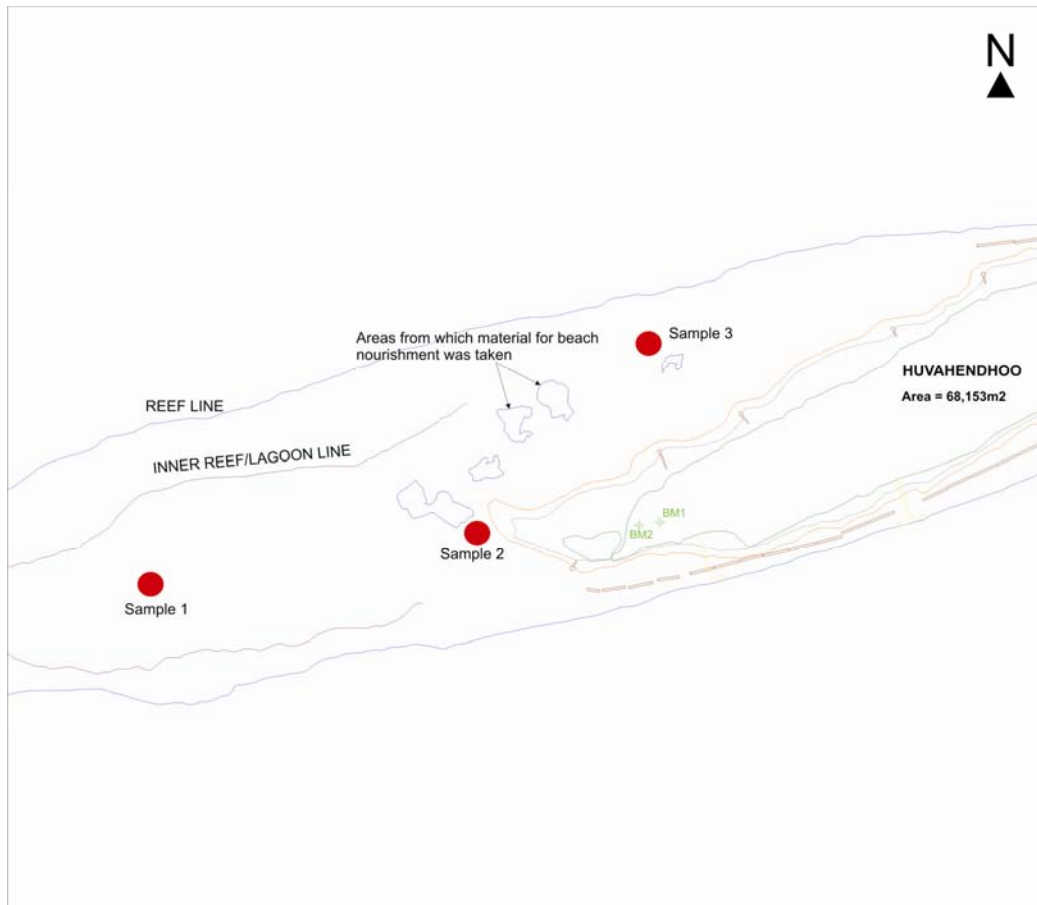
The primary objective of the marine water quality sampling was to determine the baseline conditions of the marine water in the island. Qualitative and quantitative assessments were made on sea water. As the proposed redevelopment activities are mainly associated with the northern and western side marine environment, this was considered to be a very significant aspect of the EIA process. three sampling stations were selected in the coastal waters. The sites were selected based on their location relative to proposed developments. The sea water is clean and clear. To confirm this, water quality tests were done both on site using water quality loggers and at the National Health laboratory. The results indicate no pollution from any human activities nor any other source. Nitrate levels were untraceable in all the three samples. Phosphate levels were also nil in the two samples. These readings indicate negligible nutrient loading. Furthermore, the turbidity levels were also very low.

Table 17: Results of the marine water quality tests undertaken in April 2007 at Huvahendhoo Island.

PARAMETERS	SAMPLING STATIONS		
	Sample 1	Sample 2	Sample 3
GPS Coordinates (UTM)	475239.0652 N	578548.7539 N	714725.0831 N
	4260788.4847 E	4738792.4318 E	4951960.9458 E
Salinity (ppt)	51	51	51
DO (mg/L)	0.2	0.1	0.1
Turbidity (NTU)	0	1	1

Table 17 illustrates the result of the marine water quality test. Figure 20 illustrates the marine water sampling locations.

Figure 20: Marine water quality sampling locations



11.4.1 Qualitative surveys

Qualitative surveys were conducted on the reef and lagoon system covering the large area of reef edge and slope areas, lagoon areas and sections of the reef-flat. The technique was based on visual observation by snorkeling. These surveys were used to assess the general status of the coral reef and the lagoon.

11.5 Description of marine environment

11.5.1 Abiotic environment

The marine environment of Huvahendhoo consisted of a relatively small individual coral reef system, a shallow lagoon system and the various habitats and processes within these systems which collectively function as a small island system.

Huvahendhoo island system is located close to eastern rim of the atoll as seen in figure1. Nine other coral reef systems which area larger than Huvahendhoo reef system exist within a radius of approximately 5km. The closest coral reef system are approximately 1km north and southeast of Huvahendhoo coral reef system.

As this island system is close the atoll rim and on the mouth of a relatively wide channel (Huvahendhoo Kanduu) it is very exposed to strong currents. The coral reef system of Huvahendhoo is elongated in east-west directions indicating strong influence of monsoonal current regimes surrounding the system.

11.5.2 Coral reef system

A maximum linear length and width of the system was estimated as 1,500m and 230m respectively. The outer and inner perimeter of the reef system was estimated to be approximately 3,200m and 2,460m respectively. The reef area of the system including the reef-flat and reef slope was estimated to be approximately 86,300m². The following figure shows proportions of the environmental attributes of the island system in terms of area.

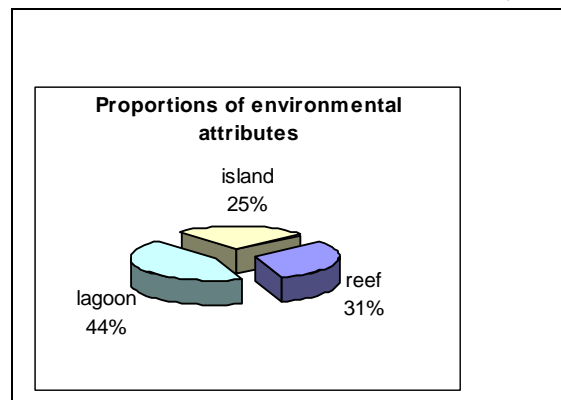


Figure 21: Proportion of environmental attributes of the island

The coral reef system of Huvahendhoo is very well developed with extensive coral and substrate cover all around the reef system.

The reef slope is very steep on northern and southern sides and both ends of the system has gentle reef slope. This indicates that there is a strong flow of westerly monsoon current during northeast monsoon and easterly monsoonal current during southwest monsoon.

Extensive reef-flat measuring a width of approximately 200m is found on the western end of the reef system and width of reef-flat on eastern end is approximately 100m. The reef-flat on either side area very narrow having approximately 20m in average. The total reef area including the reef-flat and shallow areas of the reef slope was estimated as 86,300m²

11.5.3 Lagoon system

A maximum linear length and width of the lagoon system was estimates as approximately 1,130m and 200m respectively. The lagoon area was estimated as approximately 115,000m².

Large lagoon area is found on western side of the island is significantly larger than on other areas. The lagoon on northern and southern side of the island is very narrow as the reef system is elongated east-west direction.

The bottom substrate of the lagoon consisted of mainly sand. Western part of the lagoon bottom consisted of individual coral colonies and unconsolidated rubbles which gets denser moving towards west.

11.6 Biotic marine environment

The biotic marine environment of the system can be categorized into two main components. They are the habitats within the coral reef system and the lagoon system. The two major habitats within the reef system include the reef slope and the reef-flats having distinct biotic marine environments. The major habitat within the lagoon is the lagoon bottom.

11.6.1 Coral reef system

The coral reef system of Huvahendhoo island is in good condition in terms of diversity and percentage live coral cover. The photo-quadrant reef survey and visual observations conducted showed that the coral reef of the island had over 35% live coral cover consisting of diverse range coral genera. See figure 2 for locations of coral reef surveys.

The following figure shows the benthic composition the reef in terms of percent cover of different categories of corals genera and other benthos given by the photo-quadrant reef survey at survey site 1. Standard error for the following estimates area $\pm 10\%$.

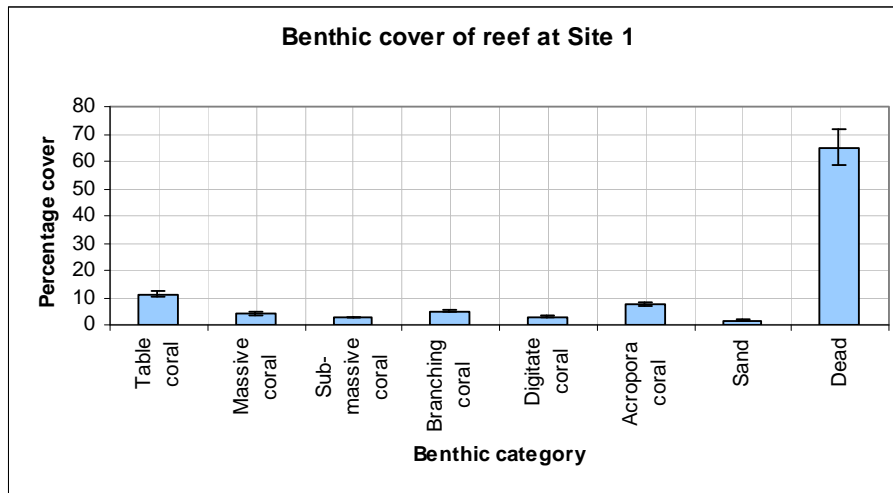


Figure 22 Benthic cover of the reef at Site 1

Massive type coral cover was recorded as 4%. These mainly included *Porites*, *Favites*, *Favia*, and *Platygyra* species.

Table corals was the most abundant corals type. An estimate 11% of this site consisted of *Acropora* table corals of colony sizes ranging from about 10 – 80cm in diameter. These colonies mostly belong to *Acropora latistella* species.

Other categories of corals recorded were 3% sub-massive corals, 5% *Acropora* branching corals, 3% *Acropora* digitate corals, and 7% *Acropora* non-branching corals.

Sandy areas of the reef consisted of approximately 2% and dead area of the reef was estimated as 65% of the reef area.

The photo-quadrant reef survey conducted at site 1 of the reef system showed that this reef section consisted of high percentage of live coral cover and species composition. Total amount of live coral cover of the reef at site 1 was estimated as 33%. The following figure shows the overall status of the reef at Site 1.

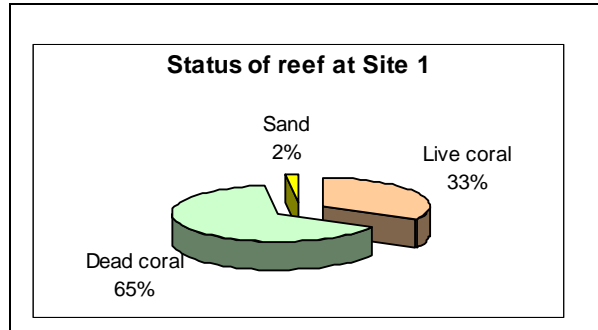
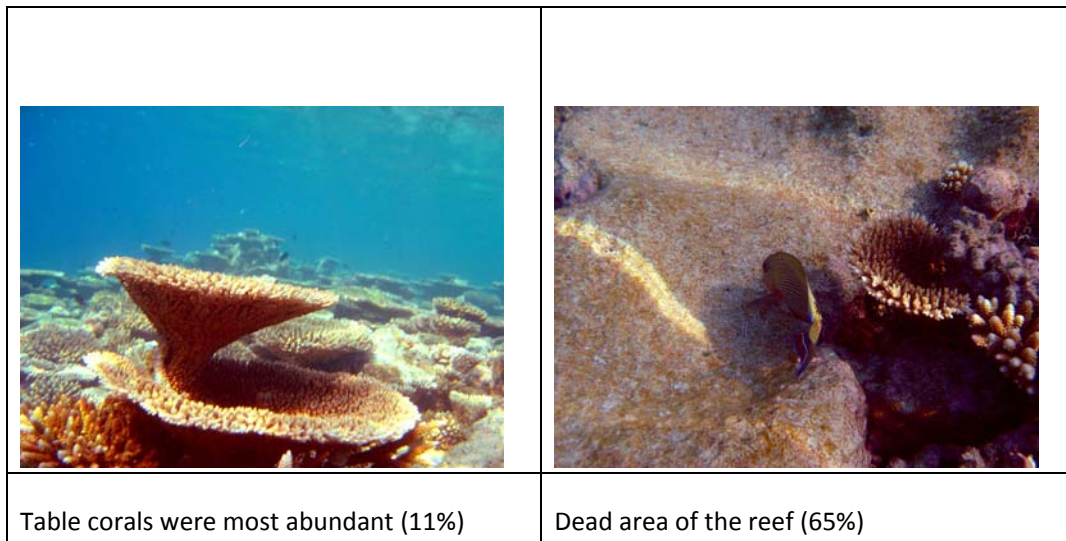


Figure 23: Status of the reef at Site 1

The site 1 of the reef had 33% live coral, 2% sand and 65% dead corals covered with algae. The photo-quadrant reef survey at Site 1 showed that the reef was in good condition with respect to live coral cover.



The following figure shows the benthic composition the reef in terms of percent cover of different categories of corals genera and other benthos given by the photo-quadrate reef survey at survey site 2.

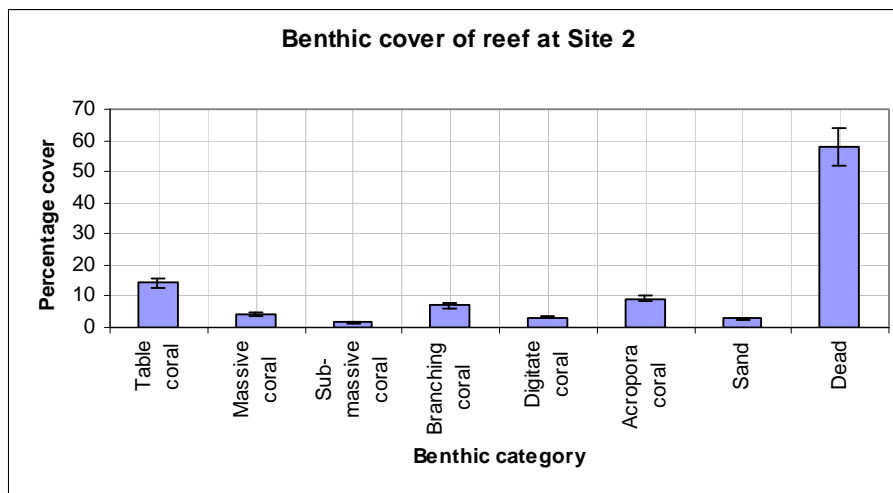


Figure 24: Benthic cover of the reef at Site 2

Table corals was the most abundant corals type. An estimate 14% of this site consisted of *Acropora* table corals of colony sizes ranging from about 10 – 100cm in diameter. These colonies mostly belong to *Acropora latistella* species as in site 1.

Massive type coral cover was recorded as 4%. These mainly included *Porites* and *Favites* species.

Other categories of corals recorded were 2% sub-massive corals, 7% *Acropora* branching corals, 3% *Acropora* digitate corals, and 9% *Acropora* non-branching corals.

Sandy areas of the reef consisted of approximately 3% and dead area of the reef was estimated as 58% of the reef area.

The photo-quadrant reef survey conducted at site 2 of the reef system showed that this reef section consisted of high percentage of live coral cover and species composition. Total amount of live coral cover of the reef at site 2 was estimated as 39%. The following figure shows the overall status of the reef at Site 2

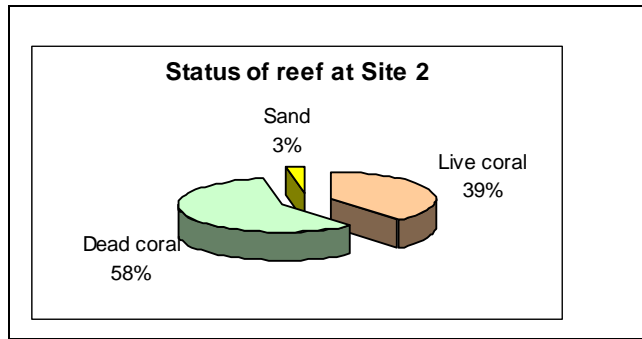
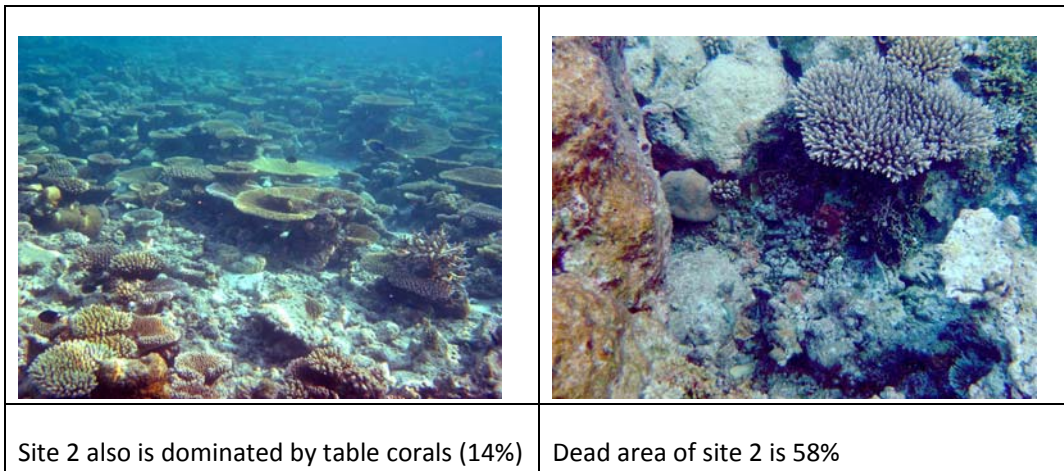


Figure 25: Status of the reef at Site 2

The site 2 of the reef had 39% live coral, 3% sand and 58% dead corals which are covered with algae. The photo-quadrant reef survey at Site 2 showed that the reef was in good condition with respect to live coral cover.



11.6.2 Lagoon system

The lagoon survey was concentrated on northwester side of the island where impact of over-water villa construction. The lagoon survey showed that lagoon bottom consisted of mainly coarse and fine sand in most areas and unconsolidated rubble in few areas especially in western and eastern sides of the island as in most islands having similar shape and orientation. Abundant number of individual live coral colonies especially closer to the reef-flat areas was recorded in the lagoon areas. These colonies mostly belong to fast growing *Acropora digitate* and *Porites massive* corals of colony sizes ranging 5- 60 cm.

Other epibenthos and in-fauna of the lagoon bottom was not assessed however, lagoon bottom infauna surveys and assessments conducted in similar environments showed that the lagoon bottom environment consisted of mainly burrowing polychaete worms, copepods, amphipods, bivalves and other crustaceans.

The pelagic life of the lagoon in this area consisted of only few species of fishes including trevallies, Family Carangidae, Goatfishes, Family Mullidae and Emperors, Family Lethrinidae. Abundance of fishes belonging to these families was also limited within the locality as these fishes are not territorial. Rare or endangered species were not observed in the locality. Biotic environment of the lagoon in the locality was found to have no special attribute/characteristic or environmentally sensitive area. See figure 2 for locations of the lagoon surveys.



Lagoon bottom consisted of mainly sand and unconsolidated rubble.



Lagoon close to the inner reef area consisted of few colonies of coral patches

11.7 Prediction of impacts on the marine environment

11.7.1 Impact prediction methods

Impacts on the marine environment from various activities of the proposed development have been predicted through analysis of the proposed project, discussions with the project proponent, field surveys, observations and assessment as well as based on field experience of similar other work in the country. Quantitative and qualitative data collected from filed work were analysed to predict the extent and significance of the impacts that may arise from the proposed project activities. The two components of the marine environment that will be impacted are identified as the lagoon and the coral reef system.

Quantitative assessment of potential direct and indirect impacts due to the proposed development were based on area calculation of the lagoon, coral reef and the lagoon area that will be covered by the over-water villas and the spa complex in the lagoon. Extent of spreading of fine sediment in the proposed construction activities is predicted based on the direction and speed of current in the locality. These predicts are also based on a number similar other developments.

Impacts from these activities will be due to disturbance to the lagoon bottom in construction activities and release of fine sediment to the lagoon water column. In addition to this some of the individual coral colonies of in the lagoon area will be removed to lay down the footings of the over-water structures. Indirect impacts will be felt to the pelagic organisms inhabiting the lagoon and coral reef areas close to the development locality. Indirect and long term impacts on the marine environment will be more accurately assessed by long term monitoring and assessment as part of this environmental assessment.

11.8 Impacts on the marine environment from the proposed redevelopment

Impacts on the marine environment arising from the proposed project are limited to two main activities of the project. These are activities involved in construction of over-water villas and over-water spa complex.

The following figure shows the direct and indirect impacts that would arise due to the proposed over-water villa construction.

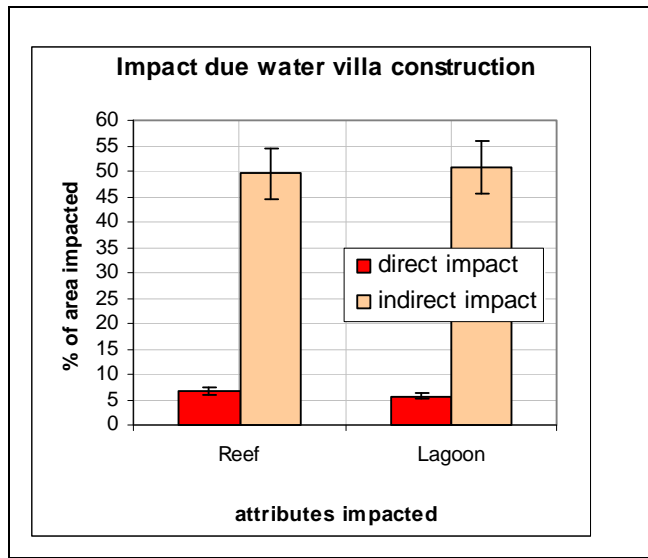


Figure 26: Direct and indirect impacts of over-water villas

The surveys and assessment showed that the proposed construction of over-water villas would impact the lagoon and the coral reef directly and indirectly. Direct impact on coral reef will be removal of some of the coral colonies in the development area. This impact will be felt on an estimated 7% of the coral reef system. Indirect impact on coral reef will be spreading of sediment plumes on the coral reef. This impact will be felt on an estimated 49% of the coral reef system.

Direct impact on lagoon will be disturbance to the lagoon bottom in laying the footings of the over-water structures. This impact will be felt on an estimated 6% of the lagoon. Indirect impact on the lagoon will be spreading of sediment plume in the lagoon water. This impact will be felt on and estimated 51% of the lagoon. Estimated error of these predictions are $\pm 10\%$.

The following figure depicts the direct and indirect impacts that would arise due to the proposed over-water villa construction.

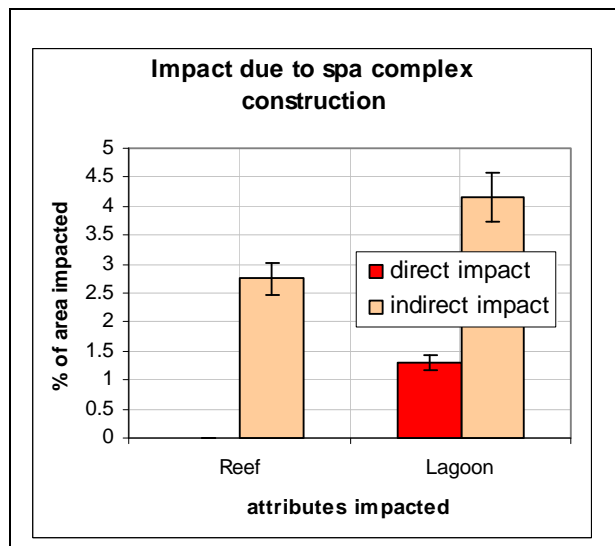


Figure 27: Direct and indirect impacts of spa complex

Construction of spa complex will directly and indirectly impact the lagoon and indirectly impact the coral reef. The indirect impact on coral reef will be felt to an estimated 3% of the coral reef system. This will be due to the spreading of fine sediment on the coral reef. Direct impact on lagoon will be felt on an estimated 1% of the lagoon due to the laying of the footings of the structure. Indirect impact on the lagoon will be felt on an estimated 4% of the lagoon. This impact will be due to the spreading of sediment plume in the lagoon water in construction activities.

11.9 Significance of the impacts

Impacts that will arise from activities of the proposed project were categorised into the following characteristics in the table and the significance of impacts was determined based on these characteristics and analysis of the impacts from this project and other analogous projects. These impacts correspond in the worst case scenario and after mitigation measures were taken. The following table shows the main impacts that will arise from the proposed project activities and their significance based on impact characteristics.

Impact characteristic	Project activities	
	Over-water villa construction	Over-water spa complex construction
Nature of impact	cumulative	cumulative
Magnitude of impact	Major adverse	Minor negative
Geographical range of impact & environmental attribute	<p>Direct impact on 7,000m² of lagoon</p> <p>Indirect impact on 60,000m² of lagoon.</p> <p>Direct impact on 6,000m² of coral reef</p> <p>Indirect impact on 43,000m² of coral reef</p>	<p>Direct impact on 1,500m² of lagoon</p> <p>Indirect impact on 5,000m² of lagoon.</p> <p>No direct impact on coral reef</p> <p>Indirect impact on 2,400m² of coral reef</p>
Duration of impact	Short-term on lagoon / Long-term on coral reef	Short-term on lagoon and coral reef
Reversible/Irreversible of impact	Reversible over long-term	Reversible over short-term
Impact significance	Significant	Significant

Table 18: Significance of impacts

Significant negative impacts from the proposed development will be on the attributes of lagoon bottom, water column and the coral reef system due to cumulative impacts of direct and indirect impacts on these attributed. Magnitude of impact is calculated in relation to the total area of the lagoon and the coral reef. Direct geographic range of impact felt will be the immediate proposed development area and indirect impacts will be felt on a larger area due spreading of fine sediment. Duration impact is predicted in terms of severity of impacts. Direct impacts last longer than indirect impacts. Reversibility is predicted based on natural recovery of the habitats impacted. The coral reef naturally takes longer to recover than the lagoon habitats. Significance of the impacts is predicted based on the nature, geographic range where impacts are felt, magnitude, duration and reversibility of the impacts.

11.10 Mitigation measures

Early planning is one of the most important steps in reducing and eliminating any adverse impact from the proposed project. Environmental concerns are considered concurrently with technical planning of the project and precautions will be applied from the outset of the

planning process through all phases of the project activities.

Minimum and most appropriate area for the development of the over-water structures was selected to minimise negative impacts through prior planning and consultations. Environmental surveys were conducted to identify these and means of impact mitigations.

Supervision and inspection of the project activities are imperative to minimise adverse impacts. Therefore, competent environmental consultants with experienced in same or similar work in the local environment will be consulted and allowed to inspect and monitor the work activities of the project life-cycle. Coordination and communication among the environmental consultants, contractors and the proponent is vital to minimise adverse impacts on the environment and enhance the positive impacts. Hence this process will be followed. Following are the specific mitigation measures that will be taken to mitigate predicted impacts on the marine environment arising from the project activities.

Sedimentation and siltation resulting from the proposed work activity will be minimised and contained within the area by using appropriate techniques such as use of silt curtains and other appropriate retention method to reduce spreading of sediment and silt plumes to the lagoon floor, lagoon water and the coral reef. Silt curtains will be used around areas where concrete footings will be anchored to erect the over water structures. Concrete footings and columns will be constructed on land before moving them to the lagoon.

In order to minimize the damage on the marine environment, all concrete footings and columns for over water structure will be constructed on land before moving and anchoring them in the lagoon.

Proposed development work will be carried out to coincide with low tide and westerly current so as to minimise effects of sediment on the reef. Proposed development work will be carried out in calm weather and sea condition.

Machinery, equipment and vessels used in the project activities will be maintained in good condition and operated in a manner that they do not pose a risk of the environmental degradation.

All work activities will be kept to the minimum period of time to reduce impacts on the environment.

Work will be inspected and supervised in whole lifecycle of the proposed project. Supervision of work will be carried out by a competent and independent party with experience of similar work and its possible impacts to the environment. Supervising party will not be in anyway related to the contracted party to ensure that mitigation measures were taken even at extra project costs. Supervising party will carry out compliance monitoring and reporting to ensure that the predicted impacts are not exceeded. If predicted impacts were exceeded, the work will be halted and impacts re-assessed and reported.

All the project activities will be completed within the shortest possible time to minimize negative impacts on the environment.

The monitoring programme specified in this report will be followed and reported in both work phase and operation phase.

11.11 Marine Environmental monitoring

The parameters that are most relevant for monitoring the impacts that may arise from the proposed project activities are included in the monitoring plan. These include turbidity and nutrient contents of lagoon water, sedimentation and live coral cover and coral recruitment. Monitoring will be carried out as part of the environmental impact assessment and mitigation of possible negative impacts from the proposed project of the resort redevelopment.

11.11.1 Aim of monitoring

The primary aim of the monitoring is to provide information that will aid impact management, and secondarily to achieve a better understanding of cause-effect relationship and to improve impact prediction and mitigation methods.

11.11.2 Objectives of monitoring

The following monitoring plan is used to measure impacts that occur during the proposed project activities and determine the accuracy of impacts that are predicted and the effectiveness of mitigation measures. The objectives of the monitoring plan are to measure:

the amount of sedimentation on the reef

water quality and visibility and

coral cover and recruitment

to ensure that these measurements are kept within the baseline limits and predicted impacts are accurate and mitigation measures taken are effective.

11.11.3 Monitoring time frame

Monitoring will begin soon before civil works are undertaken and will be done throughout the construction period once in every two months. Summary monitoring reports will be compiled every 2 months during the construction period and a final report will be prepared at the end. Monitoring will also follow every three months once the project is implemented.

11.12 Monitoring report

A detail monitoring report will be compiled after the completion of the civil works based on the data collected for monitoring the parameters included in the monitoring plan. This report will be submitted to the relevant Government agencies for compliance. The report will include details of the site, data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. In addition to this more frequent reporting of environmental monitoring will be communicated among the project proponent, the contractors and supervisors to ensure

possible negative impacts are mitigated appropriately. These reports will also be submitted to the relevant Government authorities when necessary.

11.13 Impact Monitoring Plan

MONITORING REQUIREMENTS	INDICATORS	TECHNIQUE	RESPONSIBLE PERSON	FREQUENCY
Marine water visibility	Visibility	Saatchi Disc & Tow line distance	Env Consultant	Every other day during work. Every 3 month thereafter
Coral cover	% live coral cover	Qualitative & Quantitative	Env Consultant	Every 2 months during construction stage. Once a year thereafter
Coral recruitment	Recruit/m ²	Qualitative & Quantitative using quadrat	Env Consultant	Once a year
Marine water quality	DO, Turbidity	Onsite Analysis	Env Consultant	Every two months during work thrice a year thereafter
Siltation	Sediment deposited on reef substrate	Qualitative & Quantitative	Env Consultant	Every other day during work. Every 3 month thereafter

Table 19: Impact monitoring plan

11.14 Cost of monitoring

The proponent has committed fully for the monitoring programme outlined in this report (Commitment letter from the proponent is attached as an annex). The cost indicated below is for monitoring the project during the construction stage and operational stage. Monitoring will be undertaken by subcontracting the work to Water Solutions Pvt. Ltd. This amount indicated is the total cost of monitoring during the construction and operational phase. Monitoring will include, Marine and Coastal environmental monitoring plans identified in the report. Summary monitoring reports will be provided every two months and final report will be provided at the end of the construction stage and will adhere to Schedule M of the EIA Regulations, 2007. The proponent has allocated one percent of the total project cost for the environmental management including monitoring during the construction stage and after the project.

Table 20: Cost of monitoring programme

DESCRIPTION	TOTAL (US\$)
Transport to Lily Beach (Huvahendhoo) via sea plan. (total of 3 consultants @ \$ 250 per person)	750.00
Accommodation	To be provided by the proponent.
Food	To be provided by the proponent.
Consultants fee (monthly fee) including report writing during the construction period and operational period. Monitoring of both coastal and marine components.	12,00.00
Monthly Total (One thousand nine hundred and fifty US Dollars only)	19,50.00

12 Public Consultations

For the purpose of this project, public consultations were limited to relevant government agencies, the proponent and the designer / Architects. As the project is a redevelopment of an existing resort, these key stake holders were identified relevant to undertake public consultations. Methodology for undertaking these discussions was through interviews and discussions.

12.1 Consultation with the proponent / staff

- In general, discussions were held with the proponent to obtain information about the need for this redevelopment and to justify the project. The major outcome of these consultations is outlined below.
- The proponent wishes to develop the resort to a higher standard with additional rooms and facilities thereby generating more profit by providing more options and services for the clients. The need was felt as the current setting does not allow any profit increase without upgrading. Since the island is limited in area, without expansion in to the lagoon, any new concept would not simply be feasible.
- There is also the issue of refurbishments for the existing facilities since the resort has been in operation since 1994. Since then, no major renovation has been undertaken and most of the facilities including the designs do not match the current market conditions where new and up market clients can be attracted to the island. The existing rooms and other facilities are old and require major upgrading such as changing the interior walls, lighting, painting, decking and much more.
- Increase profitability does not mean that it is only beneficial for the proponent. Naturally, it will increase the government's revenue.
- At present, price of service and goods are increasing rapidly. In order to maintain a healthy benefit from the resort, its services and facilities need to be designed and developed.
- Discussions were also held with the mid level managers and staff of Lily Beach resort. They also felt that the island is too old and does not fit the current market conditions.
- Most of the guest rooms and public facilities are old fashioned and require upgrading.

12.2 Consultations with the Ministry of Tourism and Civil Aviation.

Consultations were held with Ms. Aishath Ali, Assistant Director-General of Ministry of Tourism and Civil Aviation. Following are the main outcome.

- Tourism Ministry's policy is very clear on such redevelopments and all such projects are required to undertake an EIA prior to commencement. Before undertaking and EIA, the proponent also have to obtain the approval of the concept design from Tourism Ministry before commencing an EIA.
- Tourism Ministry's aim is to support developers and resort owners and work in close collaboration. Therefore, most of these projects are closely discussed and consulted between the Ministry and the developers / owners. Tourism Ministry does not restrict the design. As long as the Tourism Regulations are not violated, the concept development is left for the developer. This is left open in order to provide flexibility since different market segments require different concept. For example, Chinese market may require Chinese concept.
- Tourism Ministry also monitors and cross checks whether the concept designs are followed and the development process is undertaken according to what is proposed. They also make sure that the services proposed will be suitable for the number of guests for a given island.
- There is currently no time frame for redevelopment projects, but the Ministry is in the process of developing a minimum time frame where such projects have to be completed.
- Small and minor changes to the concept design can be accommodated and accepted, such as changing a glass window to a timber window. However, major changes, such as relocating a structure and other major changes will not be acceptable, unless proper permits are obtained.
- Tourism Ministry undertakes regular monitoring and as part of this, such redevelopment projects will also be monitored.
- There is demand for up market resorts and therefore such developments will meet the expectations.

12.3 Consultations with Ministry of Environment, Energy and Water.

Consultations were held with Mr. Mohamed Zuhair, Assistant- Director-General of Ministry of Environment, Energy and Water. Following are the main outcome.

- Environment Ministry strongly believes that such projects should only be allowed after conducting proper assessment, such as EIA.

- Only EIAs will allow decision makers to make sound decisions.
- Environment Ministry's interest lies in protection of the environment at the same time allowing development to take place.

12.4 Consultations with the Architect/Designers

Consultations were held with Mr. Hannan Yusuf /Chief Architect, Hannan Yusuf Architects regarding the proposed redevelopment. Following are the main outcome.

- The design concept has been developed after considering similar projects elsewhere in Maldives.
- Several alternative designs were considered, including locating the water villas on the eastern side. However, this side would be rough during the peak tourist season, which is during the north-east monsoon. Hence, it was decided to relocate to the western side.
- The spa has also been initially planned to be located towards the base of the access jetty for water villas. However, the present location is more favorable as it is more isolated.
- Various shapes and orientations of the water villas were also explored, but the current design was adopted as it suits the environment and is more visually pleasing to the eye.

Since no contractors have been selected, it was not possible to undertake consultations with a contractor as outlined in the TOR.

12.5 List of persons consulted

Following are the names and designation of persons consulted.

NAME	DESIGNATION	OFFICE
Ms. Aishath Ali	Assistant Director-General	Ministry of Tourism and Civil Aviation
Mr. Mohamed Zuhair	Assistant Director-General	Ministry of Environment, Energy and Water
Mr. Ahmed Hafeez	Chairman and Managing Director	Lily Hotels
Mr. Hannan Yusuf	Architect	Hannan Yusuf Architects.

13 Alternatives

There are a few alternatives that can be suggested. Since the EIA Regulations require two alternatives to be suggested, two alternatives have been suggested in addition to the no project alternative. These alternatives are discussed below:

13.1 No Project Option

The no project option takes the following into account.

- The existing product continues to deteriorate in quality.
- No additional products are introduced, therefore, price cannot change and profit margin will decrease year by year
- May not be able to compete in the tourism market even if service is improved

The main advantages and disadvantages of these are given in Table 21.

Table 21: Advantages and disadvantages of the no project option

Strategy	Advantages	Disadvantages
Allow the existing product to deteriorate in quality	Environmental problems related to upgrading can be avoided No upgrading costs to the Proponent, short term benefit	Guest complaints resulting in dissatisfied clients and eventually negative publicity and low occupancy Low occupancy would mean lower returns and therefore reduced bed tax, therefore, reduced national revenue
Existing beaches would be left as they are	Environmental problems related to beach nourishment can be avoided Environmental problems related to sand pumping can be avoided	Value of the tourism product may deteriorate Guest complaints

13.2 Design Alternatives

As the island is very limited in space, it was not practical to increase room capacity without developing additional facilities on water. Therefore, at the design stage, the option of constructing additional facilities in the island environment were abandoned due to limited space. Hence, it would violate the Tourism regulation on maximum space usage on resort islands. Some of the options that could be considered as discussed below.

13.2.1 *No jetties for the water villas and Spa*

The water villas and spa could have been built in the lagoon without a shore connecting jetty. However, this means that access to these structures would have to be provided by

float or mechanised or non-mechanised dinghy. This will involve lot of inconveniences to tourists in addition to the logistic difficulties and high operational cost. Therefore, this option has been rejected. However, there is a small environmental benefit in that there will be less influence on the longshore sediment transport. The impact of the structures would be similar, which mainly includes some degree of siltation/sedimentation. Therefore, there is only little environmental advantage in this option while there are several economic and logistical disadvantages.

13.2.2 Solid structure for the proposed Ala Carté Restaurant

The proposed Ala Carte restaurant is proposed to be built on piled columns. However, the proposed structure can also be a solid structure standing on the swash zone. Such a structure would disturb the longshore sediment transport to some degree, which will affect erosion-accretion processes. This may result in erosion in some of the downdrift locations, which may have to be essentially replenished with additional sand in the future in order to mitigate such erosion. Therefore, there are several environmental disadvantages in addition to the cost. This option is, therefore, not feasible.

13.2.3 Piled structure for the proposed Reception/Pool/Bar Complex

As has been described earlier, piled structures help to minimize the impact on shore processes such as longshore sediment transport. In addition, wave scour of the structure would also be smaller if piled structures are used. It would also help to minimize wave action on the structure to some extent as some energy will be dissipated on the columns and waves would be broken up. Therefore, it may be necessary to consider piled structure for the proposed Reception/Coffeshop/Pool/Bar Complex as the structure is placed in the swash zone.

13.3 Alternative locations

13.3.1 Location of the Water villas.

The only alternative location for the water villas are on the eastern side lagoon. However, this side will receive strong winds and experience rough conditions during the peak season, which is the north-west monsoon. Furthermore, the existing swimming pool and pool bars are allocated on the eastern side. If the water villas are located on the eastern lagoon, it would mean that there will be obstruction for guest using the eastern, side beach. There will also be the issue of constructing access jetty where it will connect the water villas to the island. It would not be a very suitable location and therefore, this alternative has not been considered.

13.3.2 Location of the Spa

The spa has also been considered to be located on the western side, towards the base of the water villas. This would provide a common jetty to access the spa and water villas, hence reducing the number of piled columns constructed on water. However, this design

alternative has not been considered for the following reasons. Firstly, the objective of this redevelopment is to raise the standard of the resort and tap up market clients. Having a common jetty for the spa and water villas mean that all guests staying in water villas will pass the spa every time they move to and from the jetty. This would not be a very ideal situation for the spa, where guests would expect total isolation. The idea of a spa is to provide treatment facilities with minimal disruption. Hence, The spa has been isolated and moved slightly to the east, with a separate access jetty. Hence, only spa users will use the access jetty.

13.4 Alternatives construction technologies

The foundations or the footings of the water villas and spa will be constructed using concrete pads and erecting piled columns on it. The villas will then be constructed using pre-fabricated materials. During the concept development stage, drilling the sea bed to a depth of 6 m to erect the columns were considered in order to ensure that water villas will be structurally strong. However, the cost of this operation would be much more than placing concrete padding. Similar water villas have been constructed in other resorts in Maldives, using concrete pads and therefore, drilling the columns in to the sea bed was not considered a cost effective method, since the area is relatively calm. It would also mean, there would be more damage to the lagoon bottom during the construction period.

13.5 Preferred alternative

Several alternatives have been preferred including alternative locations for the proposed new over water structures and construction technologies. The locations have been selected as there are very limited options for developing them elsewhere. Therefore, the selected location is the preferred.

Pile drilling has been selected as alternative construction method for the supporting columns. Pile drilling will provide more structural support and strength for the over water structures and although it may be expensive, it may be justifiable in the long term.

13.5.1 *Mitigation measures for the proposed alternative*

Following mitigation measures are proposed for pile drilling.

- Drilling only to the required depth that would provide the optimal strength and support.
- Confining the perimeter with silt curtains or any similar materials such as nets to trap sedimentation and prevent the plume from spreading.
- Undertake the drilling works in the shortest possible time to minimize vibration of and other disturbances to the sea bed and the marine environment.

14 Conclusion

This EIA report has identified the major impacts of the proposed redevelopment. The project will only have its environmental impact on the project boundaries which is confined mainly to the marine and coastal environment of Huvahendhoo. Mitigation measures have been proposed to these anticipated impacts including a detailed environmental monitoring programme. It has been assessed that the most significant negative impacts from the proposed development will be on the lagoon bottom, water column and the coral reef system as a result of developing water villas. More specifically, the most significant impact period will be during construction stage. In the coastal environment, construction of Reception/Coffeeshop/Pool/Bar complex takes place on the western side at the foreshore between the vegetation line and low tide line. Therefore, this structure is also expected to have some degree of influence on the longshore sediment transport patterns. Similarly, the Ala Carte restaurant will also have similar impacts. Mitigation measures to reduce the impact on the marine environment have been proposed. They include measures such as use of silt curtains and other appropriate retention method to reduce spreading of sediment and silt plumes in order to minimize the damage on the marine environment during construction period. In addition, several other mitigation measures including limiting the time frame of construction, proper supervision and other measures are also proposed. Although the social impacts of the project were not assessed in detail, public consultations were undertaken with key stakeholders. There will also be positive impacts of the project. This will be mainly induced through creation of more employment opportunities and increasing the governments revenue from the resort. There will also be indirect positive economic benefits with the expansion by creating more demand for local food produce, goods and services.

Although several alternatives to the proposed project were considered, these alternatives cannot be implemented for various reasons. The development concept and objective for this redevelopment is to transform the island in to a high class tourist destination with additional and enhanced services. At the same time, the environmental protection and preservation and operational costs have also been taken in to consideration. Therefore, several design considerations, although initially were considered, it has been avoided due to these reasons. For example, the preferred method of developing water villas is to build them on piled columns so that the current patterns and sediment movement will be least disrupted. Jetties will be developed to access the water villas, similarly built on piled columns. Alternatives were considered to avoid a jetty, but it has not been considered since it would not be very practical in justifying the operational costs and it would be too much of an inconvenience for the guests if they have to access the water villas via small boats, especially during bad weather. Another example is the Ala Carte restaurant, which can also be a solid structure standing on the swash zone. Such a structure would disturb the longshore sediment transport to some degree, which will affect erosion-accretion processes. Hence, it has also been proposed to be developed on piled columns rather than a solid structure.

The monitoring programme for this project will mainly focus coastal and marine components and for this reason, sedimentation levels on the reef, water quality and visibility and the

coral cover has been considered in the monitoring programme. Monitoring of coastal aspects will include, high and low tide lines, beach profiles and water quality of the lagoon in selected areas.

15 Declaration of the consultants

DECLARATION OF THE CONSULTANTS

We certify that the statements made in this Environmental Impact Statement are true, correct and complete to our understanding and knowledge of the proposed project and its location.

Name: Ahmed Zahid

Signature:

Date: 25 June 2007



Name: Abdul Aleem

Signature:

Date:

16 References

- Allison W R. (1996). Snorkeler damage to reef corals in the Maldives Islands, *Coral Reefs* 15: 215-218
- Carsten, M., Alan, H. and White, T. (2002). *Sustainable coastal tourism handbook for the Philippines*. Department of Tourism.
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- Medio, D., Ormond, R. F. G. and Pearson, M. (1996). Effects of briefing on rates of damage to corals by SCUBA divers. *Biological Conservation* 79: 91-95
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- Tissot, B. N. and Hallacher, L. E. (2000). Diver Impacts on Coral Reefs at Kealakekua Bay, Hawaii, p8.
- Twinning-Ward, L and Butler, R. (2002), Implementing STD on a Small Island: Development and Use of Sustainable Tourism Development Indicators in Samoa, *Journal of Sustainable*

Tourism **10(5)**

Viles, H. and Spencer, T. (1995). *Coral Reefs* pp. 206-252, Coastal Problems: Geomorphology, Ecology and Society at the Coast, Edward Arnold, a division of Hodder Headline PLC, 338 Euston Road, London.

WTO (2002), Final Report of the Asia Pacific Ministerial Conference on Sustainable Development of Ecotourism, Malé, Maldives, 11-13 February 2002

17 Annex: Terms of reference

Terms of Reference (TOR) for the Environmental Impact Assessment (EIA) for

The Redevelopment of Lily Beach Resort (Huvahendhoo)

The EIA will be undertaken according to the instructions given in the EIA regulation. The format and structure of the EIA report will adhere to the format given in "Schedule E" of the EIA Regulation. As such a title page, non-technical summary and this TOR (as agreed by the Ministry of Environment) will be included in addition to the following project specific topics.

Project Setting

The project takes place in the Maldives Environment and therefore, the extent to which the project conforms to existing plans, policies, guidelines, regulations and laws of the Maldives will be considered. This EIA will specifically consider the national Environmental Protection and Preservation Act, relevant regulations on coral and sand mining and Tourism Regulations of the Maldives. Reference will also be made to most relevant international conventions which have strong linkages to the proposed development such as the Montreal Protocol on the Substances that Deplete the Ozone Layer with reference use of Ozone Depleting Substances and ODS based equipment.

Project Description

The EIA report shall fully describe the proposed redevelopment including the proposed physical infrastructure, timelines and justification of the proposed changes, and brief description of the Proponent.

The EIA should provide a clearly labeled site plan of the redevelopment indicating all changes. A separate site plan indicating all existing structures shall also be included as Appendix to the report.

The report should also provide a detailed description of how the project activities will be undertaken including work method for constructing structures in the coastal environment, how mature trees will be removed (if it is to be done) and how construction materials and workers will be obtained and how wastes and emissions will be managed. Sketches of foundation pads and columns of over-water structures may be provided.

Existing Environment

The EIA report should properly describe the project site environment with particular focus on the areas earmarked for re-development. The emphasis should be on describing the coastal and marine environment in detail. Particular attention should be given to ecologically sensitive habitats in the project area.



Due to time constraints, wave and currents data may be avoided or spot readings included. General patterns of wind, wave, tide and currents must be provided.

A quantitative assessment on the quality of the marine water should be undertaken with focus on areas that are likely to be impacted by the project component. GPS locations of data collection should be given in the report.

Terrestrial environmental conditions may be limited to an assessment of the significant trees and vegetation that are found in the project area (both inland and coastal concentrated on areas with large significant vegetation and areas from which trees may be removed) provided as a vegetation map, quantitative information on groundwater in terms of electrical conductivity or total suspended solids, pH and nitrates and phosphates should be tested and results provided.

The report should also outline the detail methodology of data collection utilized to describe the existing environment.

Public Consultation

The EIA report should include a list of persons consulted and the methodology of consultation. Stakeholder consultations shall be carried out with the Ministry of Environment, Energy and Water, Ministry of Tourism and Civil Aviation, construction contractor for the project, the project engineers/designers (Hannan Yousuf Architects) and current management and staff.

Impacts

The EIA report should identify all the impacts and shall determine and analyze all the significant impacts for the proposed redevelopment. It should also describe the methods used identify the significance of the impacts outlined. In particular, the impacts should be described for both during the construction stage and also during the operational stage.

The report should outline the uncertainties in impact prediction and also outline all the positive and negative impacts.



Alternatives

Alternatives for the proposed structures and the overall development should be discussed. Alternative technologies, material, locations and mitigation options should be specified for each component of the proposed project.

Mitigation

The EIA report should follow the mitigation hierarchy (avoid, minimize and mitigate). This hierarchy should be applied to identify mitigation measures for the significant impacts identified in the section 'Impact' of the EIA report. The most cost effective mitigation option should be determined.

The report should also outline the cost of mitigation measures and the commitment of the proponent to undertake the mitigation measures.

Monitoring

A reasonable time period should be outlined for environmental monitoring. Monitoring should focus during construction stage and operational stage. Therefore a detailed monitoring plan needs to be outlined in this section which should outline the physical and chemical parameters for monitoring, frequency, duration, the responsible person, detailed reporting timetable and ways and means of undertaking the monitoring programme. The proponent is also required to engage a consultant during the monitoring period.

The report should also provide a detailed cost breakdown for implementing the monitoring plan.

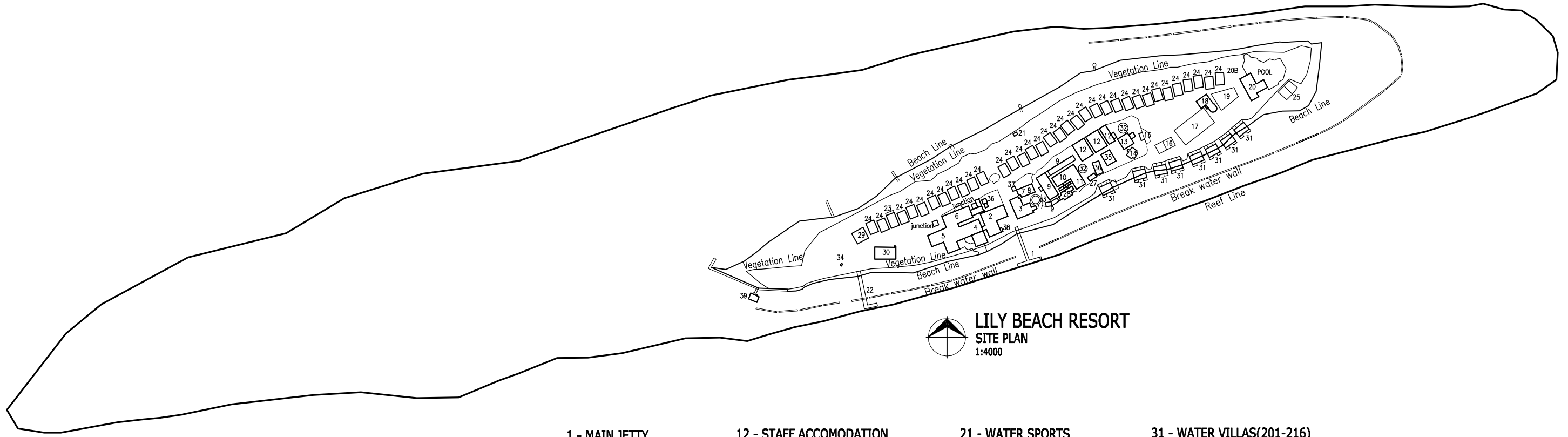
The report should also provide the full commitment of the proponent for monitoring.

Presentation

The report shall be presented to the Ministry in the format detailed in the EIA Regulations 2007.



18 Annex: Annex: Site plan indicating the existing resort facilities



LILY BEACH RESORT
SITE PLAN
 1:4000

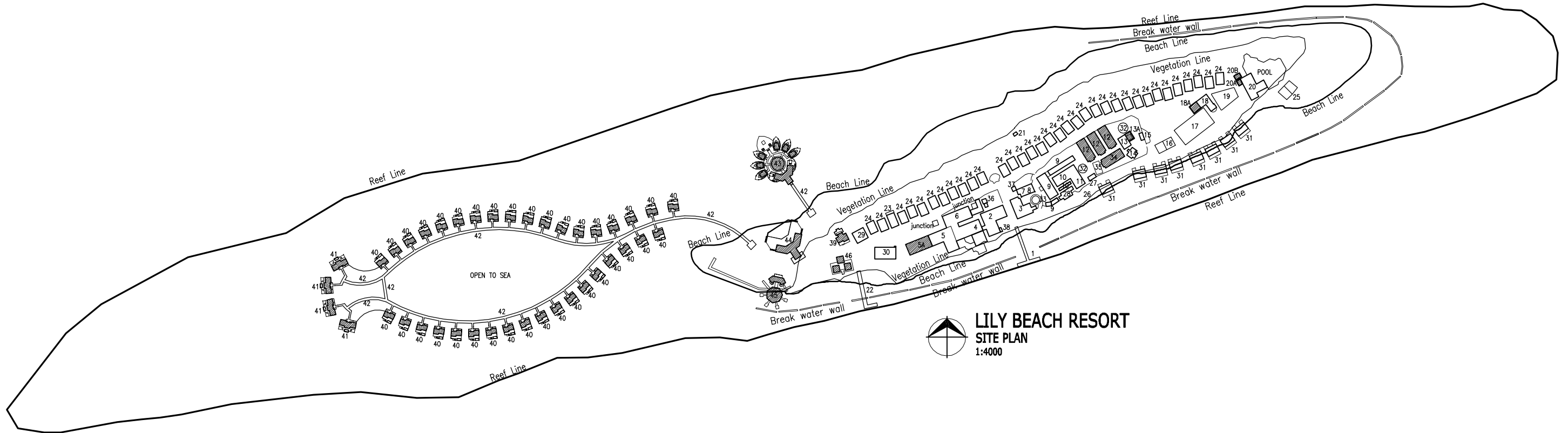
- | | | | |
|------------------------|--|-------------------------|-----------------------------|
| 1 - MAIN JETTY | 12 - STAFF ACCOMODATION | 21 - WATER SPORTS | 31 - WATER VILLAS(201-216) |
| 2 - RECEPTION/OFFICE | 13 - LAUNDRY | 22 - SERVICE JETTY | 32 - WATER TANK |
| 3 - DIVING SCHOOL | 14 - MOSQUE | 23 - DELUXE SUITE | 33 - DIESEL TANK |
| 4 - MAIN BAR | 15 - INCINERATOR/BOTTLE CRUSHER/CAN-TIN COMPACTOR/SHREDDER | 24 - SUP-ROOMS(101-168) | 34 - PETROL STORE |
| 5 - RESTAURANT | 16 - VOLLEYBALL COURT | 25 - BEACH VOLLEY COURT | 35 - STAFF RECREATION |
| 6 - MAIN KITCHEN | 17 - TENNIS COURT | 26 - PUMP HOUSE | 36 - CARPENTRY |
| 7 - STAFF MESS | 18 - GYM/SPA | 27 - WORKSHOP | 37 - DHIRAAGU TOWER AND HUT |
| 8 - STAFF ACCOMODATION | 19 - CHILDREN'S PARK | 28 - ROOMS(401-402) | 38 - FIRE STATION |
| 9 - STORES | 20 - POOL BAR/COFEE SHOP | 29 - ROOMS(301-303) | 39 - TURTLE CAGE |
| 10 - POWER HOUSE | | 30 - ROOMS(304-308) | 40 - CYBER CAFE |
| 11 - PLANT ROOM | | | |

ARCHITECT

Hannan Yoosuf Architects
 RADIUMGE (1ST FLOOR) RAHDHEBAI MAGU
 GALOLHU MALE' 20004 MALDIVES
 TEL: (960) 331 8765 FAX: (960) 331 8763
 EMAIL: info@hyarch.net WEB: hyarch.net

SITE PLAN
LILY BEACH RESORT

19 Annex: Site plan indicating the proposed redevelopment to the resort with additional facilities





LILY BEACH RESORT
SITE PLAN
 1:4000


BUILDINGS

- | | | | |
|---------------------------|-------------------------------------|----------------------------|-----------------------------------|
| 1 - MAIN JETTY | 13 - LAUNDRY/HOUSEKEEPING | 22 - SERVICE JETTY | 34 - STAFF RECREATION / EDUCATION |
| 2 - RECEPTION/OFFICE | 13A- LAUNDRY/HOUSEKEEPING EXTENSION | 23 - DELUXE SUITE | 35 - CARPENTRY |
| 3 - BOUTIQUE/GEM SHOP | 14 - MOSQUE | 24 - SUP-ROOMS(101-168) | 36 - DHIRAAGU HUT/TOWER |
| 4 - MAIN BAR | 15 - INCINERATOR/COMPACTOR/ | 25 - BEACH VOLLEY COURT | 37 - FIRE STATION |
| 5 - RESTAURANT | 16 - VOLLEYBALL COURT | 26 - PUMP HOUSE | 38 - CYBER CAFE |
| 5A - RESTAURANT EXTENSION | 17 - TENNIS COURT | 27 - WORKSHOP | 39 - GM VILLA |
| 6 - MAIN KITCHEN | 18 - GYM/SPA | 28 - ROOMS(401-402) | 40 - STANDARD WATER VILLA |
| 7 - STAFF MESS | 19 - CHILDREN'S PARK | 29 - ROOMS(301-303) | 41 - SUNSET WATER VILLA |
| 8 - STAFF ACCOMODATION | 20 - POOL BAR/COFFEE SHOP | 30 - ROOMS(304-308) | 42 - WALKWAY JETTIES |
| 9 - STORES | 20A - KITCHEN EXTENSION | 31 - WATER VILLAS(201-216) | 43 - SPA COMPLEX |
| 10 - POWER HOUSE | 20B - TOILET BLOCK | 32 - WATER TANK | 44 - RECEPTION/COFFEESHOP/POOLBAR |
| 11 - PLANT ROOM | 21 - WATER SPORTS | 33 - DIESEL TANK | 45 - ALA CARTE' RESTAURANT |
| 12 - STAFF ACCOMODATION | | | 46 - DIVE CENTRE |

NOTE:

-  PROPOSED EXTENSION AND UPGRADING AREAS
-  EXISTING BUILDING AREAS

ARCHITECT



Hannan Yoosuf Architects

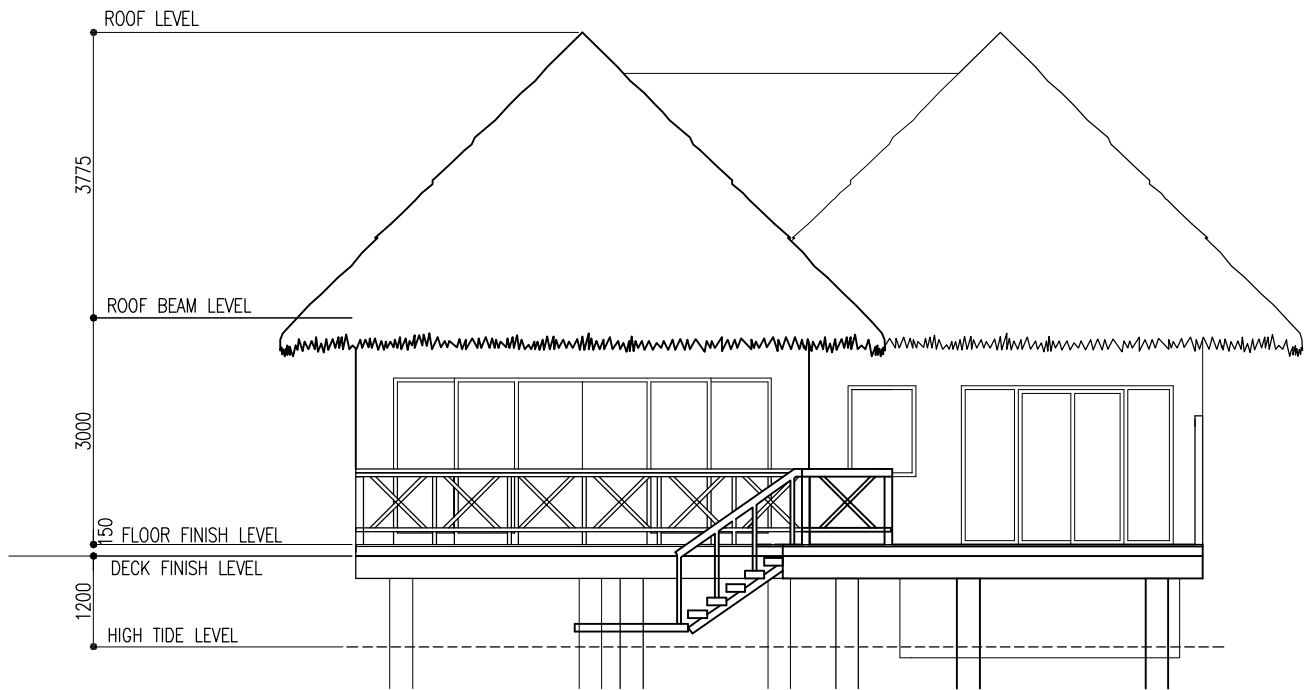
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SITE PLAN
PROPOSED EXTENSION AND UPGRADING
LILY BEACH RESORT

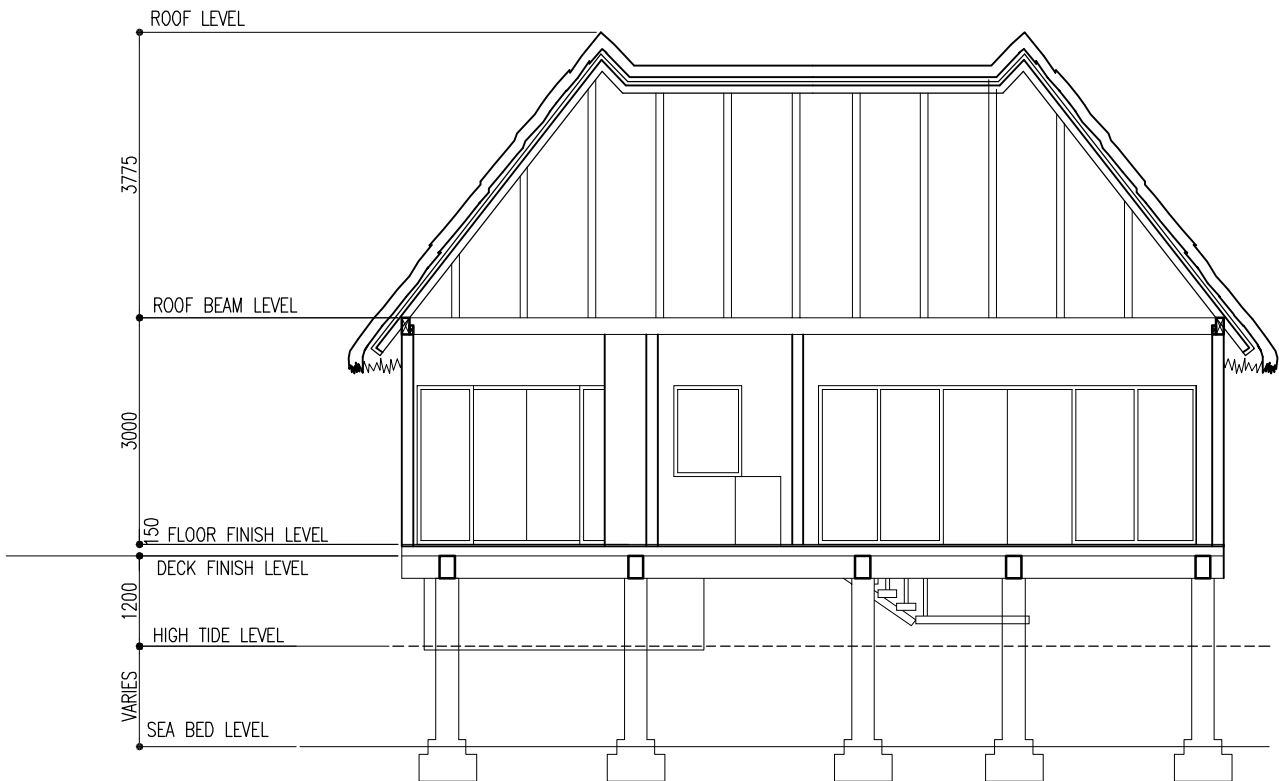
20 Annex: Construction Schedule

ID	Task Name	Duration	Start	8	May '08	Jun '08	Jul '08	Aug '08	Sep '08	Oct '08	Nov '08	Dec '08	Jan '09	Feb '09	
				14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24	1 8 15 22 29	5 12 19 26	2 9 16	
1	LILY BEACH UPGRADING PRJCT	197 days	Thu 1/05/08												
2	Project Start	0 days	Thu 1/05/08												
3	Staff Accommodation Building	90 days	Thu 1/05/08												
4	Standard Water villas	180 days	Mon 19/05/08												
5	Sunset Water villas	75 days	Mon 30/06/08												
6	GM Villa	25 days	Mon 30/06/08												
7	Reception	80 days	Mon 26/05/08												
8	Coffee Shop	90 days	Mon 26/05/08												
9	Pool	90 days	Mon 30/06/08												
10	Bar	100 days	Mon 4/08/08												
11	Spa	145 days	Mon 14/07/08												
12	Ala Carte Restaurant	120 days	Mon 7/07/08												
13	Dive School	40 days	Mon 23/06/08												
14	Main Restaurant	90 days	Mon 14/07/08												
15	Gymnasium	40 days	Mon 17/11/08												
16	Pool bar kitchen /Toilet Block	45 days	Mon 27/10/08												
17	Laundry / House keeping	30 days	Mon 8/12/08												
18	Refurbishment of existing villas	130 days	Mon 28/07/08												
19	Project Completion	0 days	Fri 30/01/09												

21 Annex: Architectural Drawings and cross sectional details of Standard Water villas

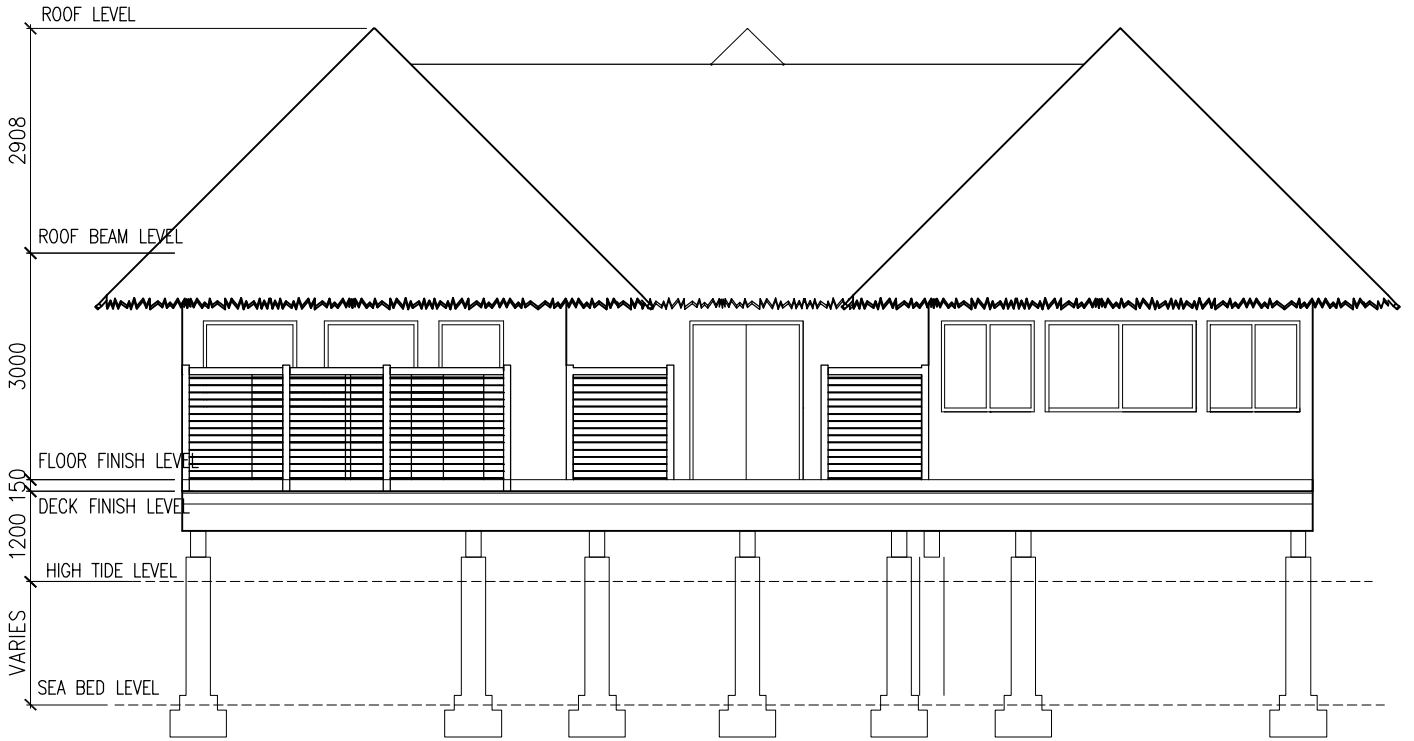


REAR ELEVATION 1:100

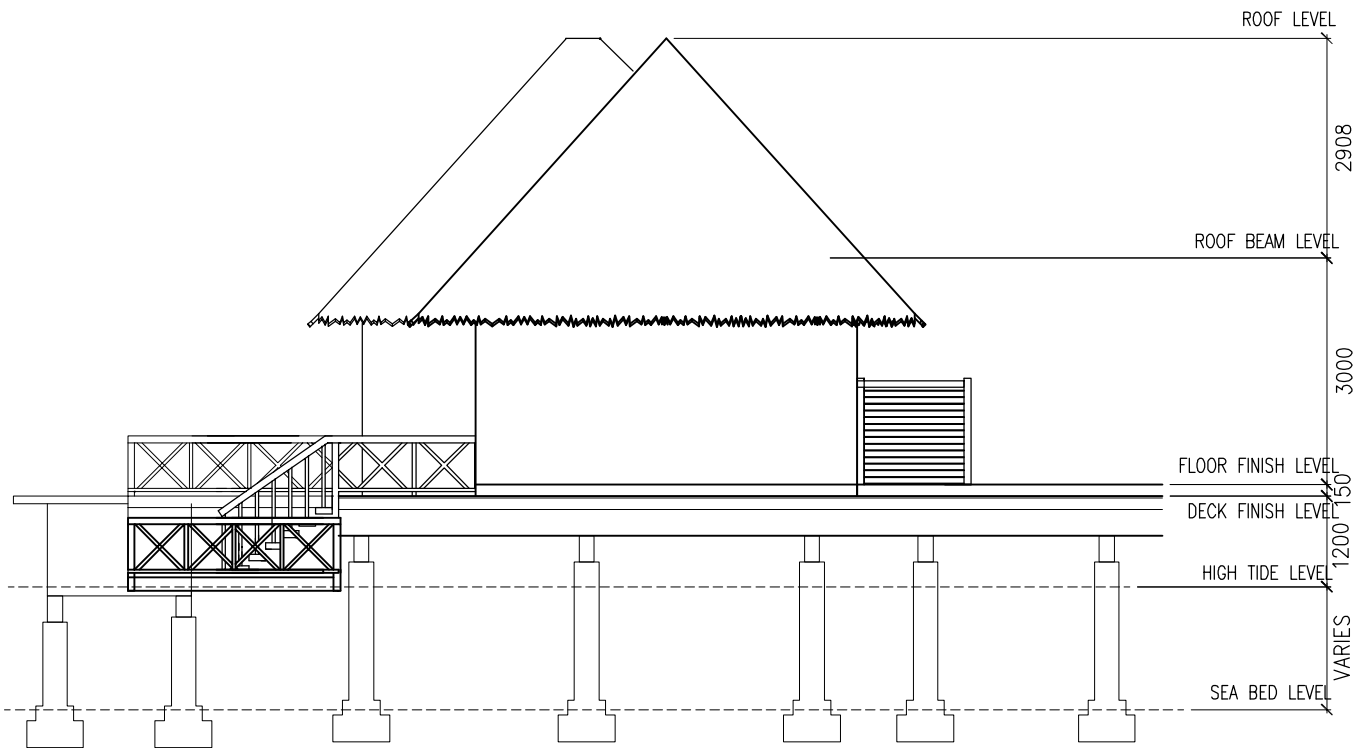


SECTION X-X 1:100

22 Annex: Architectural Drawings and cross sectional details of Sunset Water villas

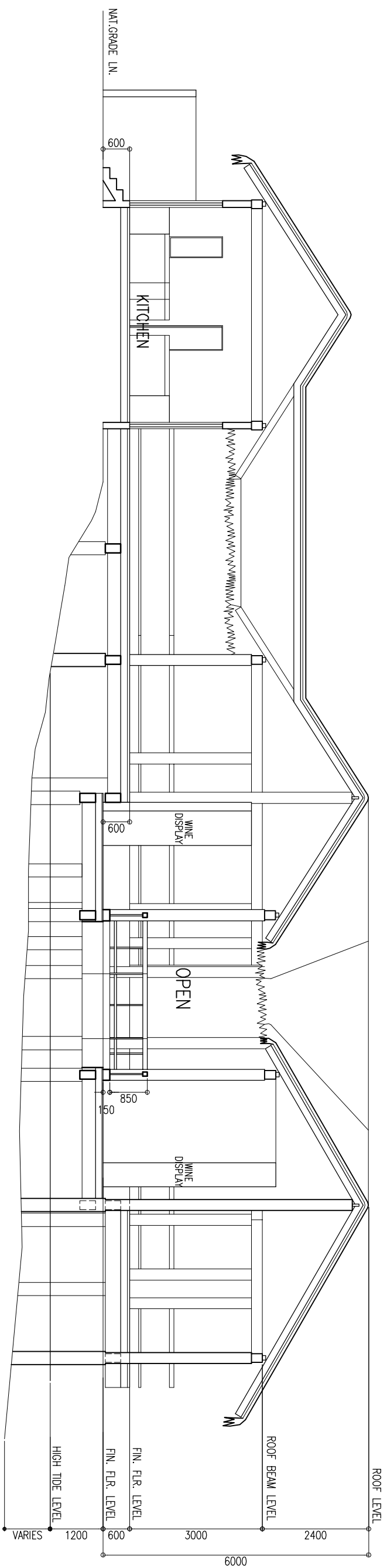


FRONT ELEVATION 1:100



SIDE ELEVATION 1:100

23 Annex: Architectural Drawings and cross section of
the Ala Carte Restaurant



SECTION X-X 1:100

24 Commitment letter from the proponent to undertake monitoring



LILY HOTELS PTE.LTD

2nd Floor , Fasmeeru Building, Boduthakurufaanu
Magu, Male` Phone: 3317464 /3317465 Fax: 3317466
E-mail lilyhtl@dhivehinet.net.mv

Mr. Ahmed Saleem
Assistant Director-General
Environmental Research Centre
Male', Maldives

20 June 2007-06-24

Dear Mr. Saleem,

**Sub: Commitment to undertake the environmental monitoring programme proposed
in the EIA For the redevelopment of Lily Beach Resort**

Lily Beach Resort (Huvahendhoo) island has been proposed for redevelopment beginning 1st May 2008.

Hence we would like to confirm our commitment to the proposed monitoring programme that has been highlighted in the EIA report that has been specifically prepared for the proposed redevelopment project.

Thanking you

Yours Sincerely

Mr. Ahmed Hafeez

Lily Hotels

OWNERS & OPERATORS OF LILY BEACH RESORT

25 Names and Registration Certificate numbers of the EIA consultants

Abdul Aleem – EIA Registration no: EIA09/07

Ahmed Zahid – EIA Registration no: EIA08/07

26 Annex:CV's of unregistered consultants

HUSSAIN NAEEM
Environment Analyst



OFFICE

Ministry of Environment and Construction,
Environment Section
Huravee Building, Male' 20-05 Republic of Maldives
Telephone No. 960 324861 Facsimile 960 322286
E-mail: hussain.naeem@environment.gov.mv

HOME

Felicia, Dhubugas Magu, Henvairu
Male' 2006 Republic of Maldives
Mobile Phone No. 960 7777178
E-mail: huseennaim@hotmail.com

EDUCATION, TRAINING AND QUALIFICATIONS

- **Short term Training in Management Skills**
Open University Malaysia, Kuala Lumpur (8 – 19 December 2003)

- **MapInfo (Basic) Training Programme**
Regional Development Project, Gan, Maldives (September 2001)

- **Bachelor of Science with Honours in Coastal Marine Biology** (Upper second / 2(i))
University of York/University Collage Scarborough, England, UK (July 1998)

- **Higher National Diploma in Applied Biology**
University of Sunderland, Sunderland, England, UK (1st year Summer 1996)

- **First Aid Certificate**
Wearside College, Sunderland, England, UK (June 1996)

- **Advance Level Biology and Chemistry**
South Tyneside College, South Shields, England, UK (Summer 1995)

- **PADI Open Water Diver**
Sea Explorers Maldives, Male'/ PADI Willoughby, N.S.W. Australia (August 1994)

- **English for Academic Studies**
Edinburgh Language Foundation, Edinburgh, Scotland, UK (September 1993)

- **General Certificate of Education (GCE) 'O' Level**
University of London School of Examination Board (January 1990)

WORKSHOPS, SEMINARS AND CONFERENCE ATTENDED

- **United Nations World Conference on Disaster Reduction**
18 – 22 January 2005, Kobe, Hyogo, Japan

- **Concluding Regional Workshop on Strategic Planning and Management of Natural Resources**
24 – 26 November 2004 Bangkok, Thailand

- **Capacity Development Forum for Millennium Development Goals 7 (Environment in Asia)**
Role of National Capacity Self Assessment and Public Private Partnership.
1 – 5 November 2004. Kuala Lumpur, Malaysia

- **South Asian Association for Regional Cooperation – Meeting of Experts to Strengthen Environment Management Infrastructure**
14 – 15 October 2004. New Delhi, India

- **Global Climate Observing Systems - Regional Workshop for South and South-West Asia**
11 – 13 October 2004. Held in New Delhi, India

- **Renewable Energy Workshop**
Introduction of technical aspects and policy issues related to using renewable energy in rural and urban areas. Solar, Wind, Hydro, Biomass and Hybrid systems.
19 – 20 July 2004. Male', Maldives

- **Dive Seminar 2004**
Diving safety and amendment of diving regulation in the Maldives
29 June, 2004, Male' Maldives. Organised by Ministry of Tourism

- **National Workshop to Review Draft Fisheries Law**
Maldives Fisheries and Marine Resources Management Policy and Legislation Project
21 – 22 January 2004 Male', Maldives. Organised by Ministry of Fisheries, Agriculture and Marine Resources

- **National Workshop on the Code of Conduct for Responsible Fisheries**
Implementation of FAO code of conduct for responsible fisheries
18 – 19 December 2004 Male', Maldives
Organised by MRC, (under BOBP) Ministry of Fisheries, Agriculture and Marine Resources.

- **National Workshop on Bay of Bagal Large Marine Ecosystem Management**
Focusing on a wide range of issues relating to sustainable fisheries development in the country
29 – 30 December. 2003 Male' Maldives. Organized by Marine Research Center,

- **Strategic Approach to International Chemical Management Preparatory Committee 1**
9 – 13 November 2003 in Bangkok, Thailand

- **Fourth session of Intergovernmental Forum on Chemical Safety**
Chemical management with regard to environmental and health safety.
1 – 7 November 2003 Bangkok, Thailand

- **Project Proposal Writing Skills Training Workshop**
Focused on project design, project management tools and project proposal development.
February 2003 Male', Maldives Organized with the assistance of DFID United Kingdom and the British Council – Ministry of Planning and National Development

- **Dive Seminar 2003**
Introduction and discussion of diving regulation in the Maldives,
25 February 2003 Male', Maldives Organised by Ministry of Tourism

- **GCRMN (South Asia) Maldives Coral Reef Workshop**
Inauguration of Coral Reef Forum IOC-UNESCO / UNEP / IUCN
June 2002 Hulhule Island Hotel, Maldives

- **Workshop on Concepts and Application of IUCN Categories to Protected Areas**
November 2001 Male', Maldives

- **GCRMN South Asia Coral Reef Database, Data entry and management Workshop**
July 2001 Male', Maldives (UNDP)

- **Seminar on Population and Development for Policy Makers**
May 2001 Male', Maldives Ministry of Planning and National Development

- **GCRMN South Asia Training Workshop in Coral Reef Survey Design and Data Analysis**
May 2000 Chennai, India

- **Workshop on Coral Reef Ecology, Monitoring and Training**
October 1992 Male' Maldives Organized by Dr. Gudrun Gaudian/Hunting Aquatic Resource, York, England and John Willamere/Hatfield Consultants, Vancouver, Canada

EMPLOYMENT AND WORK EXPERIENCE

- **Environmental Consultant** (February 2002 to present)
Working for private organisations in the Maldives. Organized and conducted extensive field studies and consultations in major development projects including tourist resort establishments, commercial fisheries development projects and commercial agriculture development projects, airport development projects and conducted environmental impact assessments for development projects in the Maldives. Designed, developed and conducted marine environmental monitoring programmes for tourist resort establishments.

- **Environment Analyst** (26 December 2004 to January 2005) in Ministry of Environment and Construction
Worked at National Disaster Management Centre established in Maldives following the Asian Tsunami in 2004. Carried out rapid assessment of Tsunami impacts to the islands in Northern and central atolls. The assessments were focused on overall environmental impacts to the islands including beach, coastal damage, impacts on the vegetations, groundwater, coastal structures and facilities such as harbours, seawalls and beach retention structures. Carried out consultancy work with UNEP and World Bank consultants in identifying tsunami related and other environmental issues in the country. Prepared environmental needs assessments for the country with respect to coastal and marine environment including coral reefs.

- **Environment Analyst** (24 August 2003 to present)
Environment Section, (Ministry of Home Affairs, Housing and Environment), now Ministry of Environment and Construction, Republic of Maldives.
Coordinated and conducted Coastal Zone Management Training Course for participants from all inhabited islands in Ha. Ha. Dh. and Shaviyani Atolls. Preparation of Coastal Zone Management Training Course syllabus and Course Handbook for the trainers and the participants. Carrying out technical and field work related to harbour, jetty and land reclamation.

- **Assistant Environment Analyst** (August 1998 to August 2003)
Environment Research Centre, Ministry of Home Affairs, Housing and Environment
Travelled to all the atolls and most islands in the country to carry out various environment related work such as inspection of harbour construction, reclamation, coastal development sites and organized and conducted various stakeholder consultation. Visited most of the tourist resort islands on assignments related to environmental issues in tourism establishments.

- **Technical Staff** (April 2002 to June 2003)
Worked for Maldives Protected Areas System Project (funded jointly by GoM and AusAid) aimed at biodiversity conservation by establishing PAs in the country.
Extensive work conducted to identify potential sites to declare as national Protected Areas. Conducted a long process of consultations with international experts, locals and government authorities and other stakeholders to establish pilot protected areas in south and north of the country. Organized and participated in stakeholder workshops. Conducted extensive marine and coastal surveys in northern and southern atolls of Maldives

- **Local Counterpart** (May to June 2001)
Worked for the (Global Environment Facility funded Project) Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives. Worked with overseas consultants and experts. Conducted extensive marine and coastal surveys and stakeholder consultations in Baa Atoll and Vaavu Atoll as part of the project preparation.

- **Project Facilitator** (1999)
Worked for GEF funded National Biodiversity Strategy and Action Plan of the Maldives

- **Research Assistant** (1993)
Environment Research Unit, Ministry of Planning and Environment
Worked with overseas consultants and experts in marine environmental and coastal aspects related to tourist resorts, inhabited and uninhabited islands in the country. Worked on identification of coral and sand mining areas for regulation.

- **Research Assistant (Trainee)** (26 Feb. 1992)
Environment Research Unit, Ministry of Planning and Environment
Duties included administrative and technical work related to environmental issues in outer atolls and islands

- **Technician** (1990 to 1991)
Dhiraagu Telecommunication Pvt. Ltd. Maldives
Duties were installation of telephone radios in outer atoll / islands and customer services of telephones.

RESEARCH WORK, REPORTS, DOCUMENTS AND PAPERS WRITTEN

- **Business Proposal for Water-sports Center at island hideaway at Dhonakulhi Maldives Spa Resort and Marina** (11 April 2005)

- **Country paper to South Asian Association for Regional Cooperation Meeting of Experts to Strengthen Environmental Management Infrastructure** (14 October 2004)

- **Earthquake Damage Assessment Report 2003** Report submitted to the Presidents Office (September 2003)

- **Coastal Zone Management Course Syllabus and Hand Book** (August 2003)

- Contributed a project to **National Biodiversity Strategy and Action Plan of the Maldives** (2002)
Published by Ministry of Home Affairs, Housing and Environment

- **Sun Island Resort Environmental Monitoring Report**
Submitted to International Finance Cooperation (August 2002)

- **Royal Island Resort & Spa Environmental Monitoring Report**
Submitted to International Finance Cooperation (May 2002)

- **Marine Environmental Survey and Monitoring Programme**
(A Compilation of relevant Protocols for Coral Reef Ecosystem Monitoring) – A document written for Maldives Protected Areas System Project (January 2002)

- **Proposed Protected Area (Addu Atoll, Hithadhoo) Habited Exploration Report**
prepared for Maldives Protected Areas System Project (October 2001)

- **Survey Report on Olhuveli Resort Re-Development Site Visit** (July 2001)

- **Report on Vaavu Atoll Field Trip** (*for Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives Project – GEF Project*) (June 2001)

- **Report on Baa Atoll Field Trip** (*for Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives Project – GEF Project*) (May 2001)

- **Environmental Issues in Huvadhu Atoll** Produced by Hussain Naeem & Williams (May 1999)

- **The Status of Coral Reef Communities in North Male' Atoll: Recovery Following a Severe Bleaching Event in 1998** (February 1999) Produced by Dr. Susan Clark, Stephen Akester and Hussain Naeem

- **Field Survey Report on Proposed SCUBA diving Wreck at Machchafushi Island Resort**
(October 1998)

- **Field Survey Report on Proposed SCUBA diving Wreck at Ellaidhoo Island Resort** (October 1998)

- **Moofushi Island - Field Visit Report** (September 1998) Produced by Ahamed Ali Maniku & Hussain Naeem

- **Environmental Survey Report on Developing Lh. Landaa Giraavaru as a Tourist Resort** (1998)

- **Coralivor Butterflyfishes as Indicators of Health of Coral Reef Systems in the Maldives**
(April 1998) Dissertation/thesis submitted for Honours Degree in Coastal Marine Biology at University of York

- **Grazing, Mucus production and energetics involved in Littorinid**
(summer 1996) with Dr. Mark Davis at University of Sunderland, Sunderland, UK

REPORTS/DOCUMENTS SUBMITTED TO THE GOVERNMENT

Marine environmental component of the following Environment Impact Assessment (EIA) reports

- **Maadhoo Picnic Island Development EIA**, South Male' Atoll (April 2000)

- **Kandoomaa Resort Re-development EIA**, South Male' Atoll (July 2000)

- **Seagrass Removal & Hudhuveli EIA**, (Lankanfushi) Resort Re-development, N. Male' Atoll (August 2000)

- **Mushimasmigili Picnic Island Development EIA**, North Ari Atoll (November 2000)

- **Hudhufushi Resort development proposal and EIA**, Lahviyani Atoll (December 2000)

- **Resort Development on Villigili EIA**, Addu Atoll (April 2001)

- **Etheremadivaru Picnic Island Development EIA**, North Ari Atoll (April 2002)

- **Improvement of Entrance to Mayafushi Resort EIA**, North Ari Atoll (May 2002)

- **Maamigili Airport Development, EIA** South Ari Atoll (July 2002)

- **Fun Island (resort) Coastal Modification and Renovation EIA**, S. Male Atoll

- **Rehiveli Resort Beach Replenishment EIA**, S. Male' Atoll (February 2003)

- **Landagiraavaru Resort Development EIA** Baa Atoll (April 2003)

- **Channel dredging Soneva Gili Resort (Lankanfushi) EIA**, N. Male' Atoll (May 2003)

- **Alimathaa Resort Beach Replenishment EIA**, Vaavu Atoll (May 2003)

- **Club Boduhithi (resort island) Beach Nourishment EIA**, N. Male' Atoll (May 2003)

- **Club Kudarah (resort island) Beach Nourishment EIA**, S. Ari Atoll (June 2003)

- **Dhiggiri (resort island) Beach Modification and Nourishment EIA**, Vaavu Atoll (July 2003)

- **Traditional Agriculture Development in Udhdhoo Island EIA**, Dhaalu Atoll (August 2003)

- **Velidhoo Beach replenishment Consultation and Inspection Survey Report**
N. Ari Atoll (September 2003)

- **Fish Processing Complex, Ice Plant and Cold Storage EIA**, Fonadoo, Thaa Atoll (Oct. 2003)

- **Environmental Aspects of Anbaraa Picnic Island Development Proposal**, Vaavu. Anbaraa (18 March 2004)

- **Environmental Aspects of Resort Development Proposal at Funamauddoo**, Gaafu Alifu Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Hadaha**, Gaafu Alifu Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Konotta**, Gaafu Alifu Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Hondaafushi**, Haa Dhaalu Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Dholhiyadhoo**, Shaviyani Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Kalhufahalafushi**, (Thaa Atoll (27 June 2004)

- **Environmental Aspects of Resort Development Proposal at Olhuveli**, Laamu Atoll (27 June 2004)

- **Sun Island Resort Channel Deepening** South Ari Atoll, **EIA report**, (2004)

- **Fesdu Sun Island Redevelopment North Ari Atoll EIA report**, (16 November 2004)

- **Alimatha Aquatic Resort Water bungalow Development**, Vaavu Atoll, **EIA** (22 December 2004)

- **Maayaafushi Tourist Resort Water bungalow Development**, orth Ari Atoll, **EIA** (30 December 2004)

- **Baarah channel excavation and harbour development**, aa Alifu Atoll, **EIA** (24 December 2005)

- **Tourist resort development at Olhuveli**, Laamu Atoll, **EIA report** (5 July 2005)

- **Tourist resort development at Konotta**, Gaafu Dhaalu Atoll, **EIA report** (5 July 2005)

- **Tourist resort development at Dholhiyadhoo**, Shaviyani Atoll, **EIA report** (5 July 2005)

- **Tourist resort development at Lodhuhutta**, Gaafu Dhaalu Atoll, **EIA report** (25 June 2005)

PRESENTATIONS AND CONSULTATIONS

- **Environmental Aspects of Tourist Resort Development in Maldives**
Presented to Developers, Managers, Architects and the construction company assigned to develop one of the tourist resorts in the Maldives
Singapore, 21 – 23 June 2005

- **Country paper to South Asian Association for Regional Cooperation Meeting of Experts to Strengthen Environmental Management Infrastructure**
New Delhi, India 14 October 2004

- **Environmental Protection and Conservation in Island Development Planning**
At Island Development Planning Workshop (participated as a resource person), held in Lhaviyani, Hinnavaru organized by Ministry of Atolls Administration and Regional Development Management Office (February 2004)

- **Introduction to Coastal Zone**
For Coastal Zone Management Training Course held at Haa. Dhaalu. Kulhudhuffushi - 17-21 August 2003

- **Environmental Protection and Conservation in Island Development Planning**
At Island Development Planning Workshop (participated as a resource person), held in Haa Dhaalu Kulhudhufushi organized by Ministry of Atolls Administration and Regional Development Management Office (June 2003)

- **Marine Environmental Management in Tourist Resort Islands**
At the International Workshop on Environmental Management and Sustainable Tourism in the Maldives Organized by International Finance Corporation and Villa Shipping and Trading Co. Pvt. Ltd. (October 2002)

- **Environment of Our Islands** – under an awareness raising programme for school children and parents
At Nilandhoo, Faafu Atoll, organised by Kalaafaanu School (August 2001)

BUSINESS AND OTHER PROFESSIONAL WORK

- **Marine Environmental Consultant** working for Commerce, Development and Environment Pvt. Ltd. (Maldives). Consultancy given to a number of development projects (tourist resorts, harbours, reclamation, airports, and environmental monitoring) in the Maldives (February 2002 to present)

- **Founder member of *Maldives Snooker and Billiards Association***
Aimed at promoting cue games in the country - Male', Maldives (March 2001-2003)

- **Founder member/Shareholder of *City Billiards Club*** - Male, Maldives
Aimed at youth promotion and socialization in the capital town (December 1999 to May 2003)

- **Member of Maldives Coral Reef Forum** - Aimed at exchange of information / ideas among stakeholders and coordination (19 June 2002 to present)

REFEREEES

Mr. Abdullahi Majeedh, MSc. Deputy Minister, Ministry of Environment and Construction (Maldives)	env@environment.gov.mv MHAE 00 (960) 324861
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