March 2010

Environmental Impact Assessment Report for Coastal Modification of V. Alimatha Eastern Shore Line

Prepared by

La Mer GROUP

Land and Marine Environmental Resources Group Pvt Ltd, Maldives

Prepared for

Safari Tours Pvt Ltd

Declaration of the Consultant

I certify that statements made in this Environmental Impact Assessment report are true, complete and correct.

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Date: 31 March 2010

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1 NON TECHNICAL SUMMARY

The non technical summary outlines the findings of the Environmental Impact Assessment of the proposed coastal modification of Alimatha eastern side. The resort at Alimatha is operated by Safari Tours Pvt Ltd.

The proposed project involves construction four groyne segments constructed using the rock debris from the demolition of revetment wall. The groyne segment will have a length of 20m, while the width will be 1.5m. The groyne will have a plastered finish, while the groyne head will be circular and landscaped to make it aesthetically pleasant.

The existing seawall is very weak and damaged at some areas, therefore it will not be difficult to demolish manually. No heavy machinery will be used for the demolition work.

The existing burrow area for beach maintenance work is located approximately 350m North West of the project site, sand will be transported by the pipeline to western side where wand will be filled on gunny bags which will be transported to project site. Total volume of sand required for beach fill work is 1,500m^3. The length of beach fill area is approximately 114m, while the beach fill width is 10m. The berm height of the area will be 1.5MSL. Since the wall section is quite high, during removal of retainment wall, the ground will be sloped; therefore sand requirement will be low. In terms of increase of land area, approximately 650m^2 of land will be increased due to the coastal modification work, which is just about 1% increase of land area.

A scoping meeting was held at EPA on 2nd of February 2010 with personnel from EPA, project proponent, Ministry of Tourism, Arts and Culture, Ministry of Housing, Transport and Environment and the Environmental consultant to formulate a ToR for the EIA. The ToR was approved by EPA on 23rd February 2010.

Data collection or field was carried out during February 2010 for assessment of existing environment. Since the scope of work of the proposed project is small, existing environment data was limited to beach profile collection and seawater quality assessment.

Since the proposed projects scope is small and project boundary restricted on land, direct impact to environment was minor. Impacts identified were possible sedimentation impacts during beach fill work and demolition of retainment wall.

Mitigation measures are discussed for the construction and operational stage of the project. During the construction stage it is important to take measures to minimize sedimentation impacts and noise impact.

Considering alternatives for the proposed project it has to be note that the scope of work for the proposed project is small. In terms of type of coastal protection, the proposed method is setting up of a groyne field along with removal of existing retainment wall. Alternatives can be off shore breakwaters to reduce wave energy received at the area along with removal of existing retainment wall and beach fill work. In this regard the groyne field at the western side (existing groyne field) seems to functioning well along with routine maintenance of beach. Therefore in terms of coastal protection measures, the groyne field seems to be most ideal option considering functionality and cost.

In regard to the alternatives to burrow area, the proposed burrow area is an existing burrow area for beach maintenance work, therefore using this area would avoid be the most ideal option. Choosing this option would reduce overall impact to the reef, since additional burrow areas will not be created, this limits the boundary of impact area.

2 INTRODUCTION

Alimatha Aquatic Resort is located at the north eastern side of Vaavu Atoll located south of Dhiggiri Resort. Alimatha Aquatic Resort is among the oldest tourist hotels in the Maldives. Like all the other resorts of Maldives, Alimatha Aquatic Resort has its largest share of clients from Western Europe. Like all old resort in Maldives, the coastline of the island has undergone considerable modifications over the years, to mitigate the erosion and to maintain beach around the island. The entire eastern side of Alimatha is at present composed of a coral rock retainment wall. Similarly, the western side area also has a retainment wall at some areas while at other areas groyne fields have been constructed. Regular beach maintenance work is also done at the island, using sand pumps.

At present, near the eastern side retainment wall, especially during NE monsoon, erosion is observed. The waters near the retainment wall at times exceed 1.5m, and are not safe for children to walk around. Also due to the retainment wall wave wash over is observed during NE rough spells. The management of the resort therefore wants to change the eastern side shoreline from retainment wall to a more natural looking beach area, by constructing groyne field similar to western side of the island. Therefore this report is prepared to fulfill the environmental clearances necessary under the EIA regulation before commencement of the construction works.

The client for the project is Safari Tours Pvt Ltd. The client engaged Land and Marine Environment Resource Group Pvt Ltd to carry out the EIA assessment for the proposed works.

2.1 PURPOSE OF THE REPORT AND NEED FOR THE EIA

This EIA covers the environmental reporting requirements in preparation for construction of groyne field and creation of beach at the eastern side of Alimatha as stipulated by the environmental regulations of Maldives. Developments such as coastal construction works that are likely to a have a significant impacts to the environment are required to submit an EIA report by Environmental Act of Maldives. Article 5 (a) of the Environmental Protection and Preservation Act of Maldives (Law No. 4/93) provides for an impact assessment study to be submitted to the Ministry of Housing, Transport and Environment (MHTE) before implementation of any activity that may have a significant impact on the environment. The Environmental Impact Assessment Regulation of Maldives (EIA Regulations, MEEW, 2007) provides a list of development proposals requiring environmental impact assessment reports which are outlined in Schedule D where EIAs are mandatory for such development projects.

Therefore, in accordance with the above requirements and procedures to follow under the EIA regulations, a scoping meeting to discuss the development proposal and determine the Terms of Reference (TOR) for the EIA report was held between the Client (Safari Tours Pvt Ltd), LaMer Group Pvt Ltd as the EIA Consultant, Ministry of Tourism, Arts and Culture and representatives from Environment Protection Agency (EPA) as the Regulator on 2nd February 2010. This report provides the results of the field work carried out at Alimatha in February 2010 based on the TOR approved by EPA.

2.2 STRUCTURE OF THE REPORT

The structure of this report follows the Terms of Reference (TOR) discussed in the presence of the client (Safari Tours Pvt Ltd), the EIA consultant, representative from Ministry of Tourism Arts and Culture and representatives of Environmental Protection Agency (EPA) as the EIA regulatory body. Upon submission of a draft TOR by the EIA consultant it was approved by the EPA on 23rd February 2010, based on discussions between the consultant, the client and the other stakeholders. The approved Terms of Reference (TOR) for this report is attached in Appendix 1 of this document. In the scoping meeting it was decided by the EPA that Public consultation is not necessary for the project due to its scale of work, although this was agreed in the scoping meeting the approved ToR states that public consultation is needed with MHTE and tourism ministry. Also in the scoping meeting it was decided that marine environment assessment is not needed, but in the approved ToR marine environment assessment was also included. Although the ToR includes components which was agreed to be omitted, the report is prepared in accordance to the approved ToR.

3 PROJECT SETTING

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 a registered consultant. Furthermore, it adheres to the principles underlined in the regulations, action plans, programs and policies of the following Ministries of the Government of Maldives.

- Ministry of Housing, Transport and Environment
- Ministry of Tourism, Arts and Culture

3.1 MALDIVES TOURISM ACT (LAW NO. 2/99)

This act encompasses the issues related to the development of tourism in the Maldives. It came into effect on the November, 1999, repealing the Law on Tourism in the Maldives (Act No. 15/79) and the Law on Leasing of Uninhabited Islands for the Development of Tourist Resorts (Act No. 3/94). Act No. 15/79 was the primary legislation that was passed by the Citizen's Majlis in November of 1979 and the main aim was to provide for the collection of a bed tax from the visiting tourists and to control their movement in the Maldives. While this Act only dealt with tourist resorts, hotels and guest houses, the amended act (Act No. 2/99) incorporates the determination of zones where tourism development can occur, as well as the development and management of marinas and the operation of tourist vessels, diving centre's and travel agencies. This is evidence that the tourism industry has expanded since the enactment of the initial laws, both in magnitude and in the diversity of facilities that are provided for the visiting tourists.

The environmental legislation that directly applies to the development is outlined under article 15(a) and (b). Article 15(a) provides for the felling of coconut palms and trees, dredging of lagoons, reclamation of land or any other activity that may cause permanent change to the natural environment of an island leased as a tourist resort. It states that the activities mentioned above can only be carried out after obtaining written permission from the Ministry of Tourism, Arts and Culture and in accordance with the relevant regulations.

Under Article 15(b), a justification has to be provided for such an activity, as well as an environmental impact assessment, which has to be submitted to and approved by the Ministry of Housing, Transport and Environment.

3.2 ENVIRONMENT PROTECTION AND PRESERVATION ACT OF MALDIVES

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 MHTE.
- 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 MHTE 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 transboundary 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.

3.2.1 PROTECTED AREAS AND SENSITIVE AREAS

Under Article 4 of the Environment Protection and Preservation Act, the Ministry of Environment (now known as MHTE) 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 or regulations made public on the designation and protection of habitats and heritage areas.

3.3 SECOND NATIONAL ENVIRONMENTAL 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 wellbeing
- 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 urbanization.

3.4 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.

3.5 REGULATION ON SAND AND CORAL MINING

Under Article 7(c) of the Regulation on Sand and Coral Mining issued by the Ministry of Fisheries, Agriculture and Marine Resources (now known as Ministry of Fisheries and Agriculture) on the 13th of March 2000, it is an offence to mine sand or coral from the beach, lagoon or reef of any island leased for the purpose of building a tourist resort. Mining of coral or sand for the construction of resorts and associated facilities is discouraged under the policy of the Ministry of Tourism and Civil Aviation (now know as Ministry of Tourism, Arts and Culture, and utilization of alternative construction material is encouraged. As an incentive, import duty is exempted under Sub clause 3, Article 9 of Law No. 31/79 for the import of cement, iron, steel, roofing sheets and timber for the construction of tourist resorts. However, sand mining is allowed for beach replenishment projects, predominantly from the immediate lagoon of the resort and in the case of a lack of sand on the island, from an area that is designated by the Ministry of Fisheries and for such use.

4 PUBLIC CONSULTATION

Public consultation in terms of discussions and interviews were done with the following stakeholders identified in the ToR.

- Ministry of Housing, Transport and Environment
- Ministry of Tourism, Arts and Culture
- Resort Management

Personnel from MHTE, engineering department was consulted in regard to the coastal modification at Alimatha. Consultant briefed the personnel about the scope of the project and envisaged environmental impacts, the personnel from MHTE, engineering department stated that groyne field is often used in the resorts to stabilize beach therefore they have no issues regarding the coastal modification project at Alimatha.

Personnel from Tourism ministry was consulted in regard to the coastal modification work, personnel from Tourism indicated that they forward EIA application to EPA after approving the concept and will give go ahead to project after environmental clearance is granted by EPA. He also informed that beach creation work should follow the guidelines of EPA (10m width of beach creation area).

Personnel consulted from the resort management stated that the eastern side is not safe for elderly and children to use a recreational area due to the jagged beach rock and deep lagoon area near the retainment wall. He also stated that during NE monsoon rough periods wave wash over is observed at the area. The retainment wall also gets badly damaged, especially after each rough period, therefore routine maintenance has to be done.

5 METHODOLOGY

The approach to data collection and compilation of this report includes;

- Consultation and discussion with the proponent with regard to design and work methodology that would be used to implement the proposed activities of the project,
- Examination of the existing environment to identify significant environmental components that are likely to be affected,
- Consultation with major stakeholders to exchange information on the project and to follow the EIA procedures required for the report, and
- Evaluation of available and relevant literature on environmental impacts associated with similar projects.

Information on existing environment was collected during the field visit to the project site during February 2010. General information on the existing environment was based on available secondary data, such as climatic data for Male' atoll region in general (National Meteorological Centre at Hulhule). Oceanographic data and information used to determine the current patterns around the island were also based on monsoonal wind patterns, wind generated waves, tidal flushing, geographic setting, the topography of the lagoon and shape of the shoreline.

5.1 PHYSICAL SURVEYS

Beach profiles were taken using Digital Level instrument from 4 locations, GPS coordinates of beach profiles are given in Figure 1. Beach profiles were taken perpendicular to the shoreline.

5.2 MARINE SURVEYS

Qualitative assessment method was used to assess the benthic condition of the burrow area located north western of the island. Estimate of benthic catergories were done by visual observation. Fish life assessment was done by counting major fish groups.

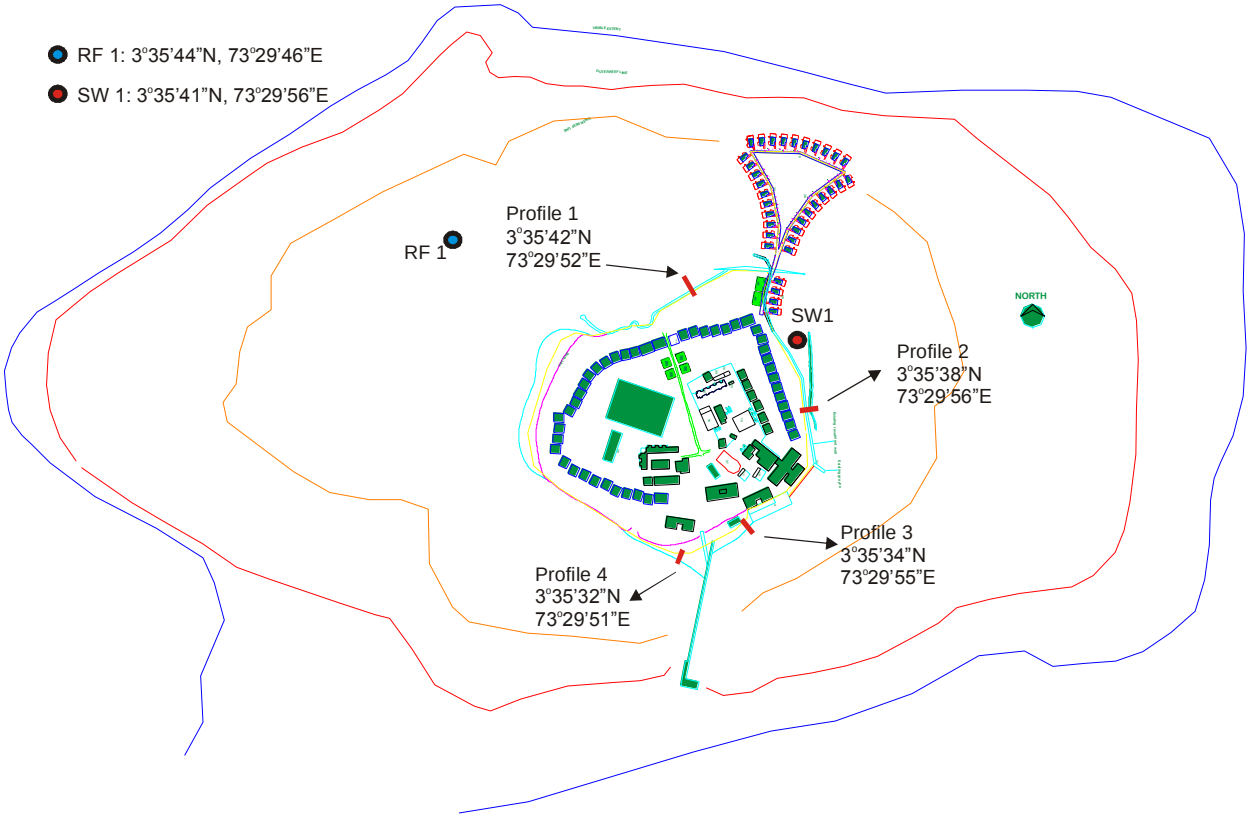

Figure 1 Location of beach profiles, reef survey site, and water sampling site and GPS coordinates of the sites

5.3 WATER QUALITY ANALYSIS

In order to assess the sea water quality, seawater sample was taken from beach fill area and was tested by the National Health Laboratory, Maldives Food and Drug Authority (MFDA). Seawater from the sites was sampled on 27 March 2010. Results of the tests were received from the National Health Laboratory on 29 March 2010. Dissolved oxygen and salinity was tested using portable water test instrument (Hanna multiprobe water test kit).

6 PROJECT DESCRIPTION

6.1 PROJECT PROPONENT

The project proponent of the proposed development project at Alimatha Aquatic Resort is Safari Tours Pvt Ltd.

6.2 THE PROJECT

The proposed project involves construction four groyne sections and creation of beach at the eastern side of Alimatha, where at present a retainment wall is observed (see Appendix 2 for site plan).

6.3 NEED FOR THE PROJECT

Alimatha Aquatic Resort is among the oldest tourist hotels in the Maldives that is built on the island of Alimatha in Vaavu Atoll. Like all the other resorts of Maldives, Alimatha Aquatic Resort has its largest share of clients from Western Europe. According to the Tourist Opinion Survey Report (2004) the Maldivian tourism is based upon six main types of attractions which include beach, underwater life, the tropical climate, clear unpolluted waters surrounding the islands, tropical vegetation and the culture of Maldivian people. This survey showed that the main attraction of 22% of the tourists is the soft white sandy beaches followed by the 21% for the rich life of underwater. It is therefore evident that maintaining a good quality beach on the resort is essential for a successful resort hotel business in the Maldives. However, maintaining good quality beaches all around the island throughout the year on many resort islands in the Maldives is not an easy task because of the dynamic nature of the beaches. Like so, the management of Alimatha is also faced with the daunting task of maintaining the beach around the island and preventing coastal erosion. Over the years of operation of the resort hotel on the island the management of the hotel have constructed a number of coastal protection and beach stabilization structure around the island and within the islands' lagoon. These include seawalls and groins constructed mainly of coral rocks and rubble.

The eastern side of the island has a long retainment wall extending all the way from the south east to northern tip of the island. Presently this area is observed to be deepened (near shore area just in front of the structure) due to the wave action and long shore current in between the retainment and beach rock formation. At times the top level of the retainment and lagoon bottom can exceed 1.5m, which creates a safety issue for guests, especially the elderly and children. The main reason for the deepening is due to reflection of waves hitting the wall instead of breaking and decomposing of wave. It has to be noted that wave over wash is observed during NE monsoon at this area, when wind wave and swell waves are coupled. Therefore the management wishes to create a more natural looking beach area at the eastern side instead of the coral rock retainment wall, also in the meantime making the area safe for children and elderly. The project will also increase the aesthetic value of the area.

6.4 LOCATION AND EXTENT OF SITE BOUNDARIES

The island of Alimatha is located at the eastern side of Vaavu atoll south of Dhiggiri (Figure 2). The island is at geographic coordinates 73° 29'.52''E, 3° 35'.37''N. Alimatha is a very small located at the eastern side of Vaavu atoll, which has an area of 0.01km^2. The island is located on a rim reef at the north eastern side of Vaavu Atoll. It is one of 203 reefs making up the atoll and has an area of 1.1km^2. Alimatha reef extends in an east to west direction on its long axis. The island is located centrally on the reef. The near shore shallow reef flat of Alimatha reef is on average 1-2m deep. The proposed beach creation area is at the eastern side of the island, while the burrow area for beach sand is located at the northern side of the island (existing burrow area for beach maintenance work).

Figure 2 Project location and boundary

6.5 CONSTRUCTION PHASE AND SCHEDULE FOR IMPLEMENTATION

Initially sand for beach fill will be extracted from the burrow area using sand pumps and transported to the western side of the island, sand will be transported to project site in gunny bags. Afterwards the retainment wall will be demolished, material generated will be used for construction of groyne field. Once groyne field is constructed beach fill material will be using to create the beach in between the groyne structures.

Table 1 Schedule of implementation of project

Item	**duration**
Extraction of beach sand	7 days
Demolition of retainment wall	3 days
Construction of groyne field	9 days

Beach fill work, and extraction of additional sand if required	7 days

6.6 MAJOR INPUTS AND OUTPUTS

6.6.1 INPUTS (DESCRIPTION OF THE PROJECT IN TERMS OF RAW MATERIALS, PROCESSES, EQUIPMENT AND WORK FORCE)

6.6.1.1 MOBILIZATION AND MATERIAL UNLOADING

Since the scope of work is small, only very little material is needed for the proposed project. Only cement has to be brought to the island, which can be transported on supply boat to site. All materials will be unloaded at the service jetty. Coral rock from existing retainment wall will be used for construction of groyne field therefore no additional material will be needed.

6.6.1.2 WORKFORCE

Since the project is of small scale, resort maintenance staff will be utilized for the demolition of retainment wall and construction of groyne structures. The sand pump operators (existing employed personnel) will be used for beach fill work. Therefore no additional workers will be brought in for any of the construction work.

6.6.1.3 CONSTRUCTION METHODS

❖ **DEMOLITION OF SEAWALL**

The existing seawall is very weak and damaged at some areas, therefore it will not be difficult to demolish manually. No heavy machinery will be used for the demolition work.

❖ CONSTRUCTION OF GROYNE STRUCTURES

Groyne structure will be constructed using the coral rock removed during the demolition of retainment wall. The groyne structure will have a plastered finish. The end of groyne structure will be circular and finished with a sun umbrella to make it aesthetically pleasing. The groyne field will consist of 4 groyne sections, while the existing groyne at the south eastern side will the end of groyne field to south, while the northern side wall near water bungalow walkway will be the limit at north side.

❖ BEACH FILL

Beach fill material will be burrowed from the existing sand pumping area at the northern side of the reef, where sand is pumped for beach maintenance works (using 2 sand pumps). Sand will be loaded to bags and transported to site on carts. Sand spreading and unloading will be done manually since the fill area is small. Also it is envisaged that natural accretion will also fill the beach area. At present large sand spit is observed at the eastern side of jetty area, and it expected to accrete at the groyne field area during the NE monsoon.

Figure 3 Two sand pumps used by the resort for beach maintenance work

6.6.2 OUTPUTS

6.6.2.1 GROYNE FIELD

Total of 4 groyne segments will be constructed using the rock debris from the demolition of revetment wall. The groyne segment will have a length of 20m, while the width will be 1.5m. The groyne finish will be a plaster, while the groyne head will be circular and landscaped to make it aesthetically pleasant.

6.6.2.2 BEACH FILL WORK

The existing burrow area for beach maintenance work is located approximately 350m North West of the project site, sand will be transported by the pipeline to western side where sand will be filled on gunny bags which will be transported to project site. Total volume of sand required for beach fill work is 1,500m^3. The length of beach fill area is approximately 114m, while the beach fill width is 10m. The berm height of the area will be 1.5MSL. Since the wall section is quite high, during removal of retainment wall, the ground will be sloped; therefore sand requirement will be low. In terms of increase of land area, approximately 650m^2 of land will be increased due to the coastal modification work, which is just about 1% increase of land area.

6.7 EXPECTED ENVIRONMENTAL CONDITIONS DURING THE CONSTRUCTION STAGE

Since the project will be timed during transition period, wind waves is expected from varying directions, and sustained to west afterwards. The project is estimated to take a month to complete therefore; weather condition will affect the work schedule. At present major accretion is observed at the main jetty area, where at some areas high berms are formed, this sand can be transported to project site as beach fill material.

7 EXISTING ENVIRONMENT

7.1 GEOGRAPHIC LOCATION AND GENERAL SETTING OF ALIMATHA

Alimatha is a very small located at the eastern side of Vaavu atoll, which has an area of 0.01km^2. The island is at geographic coordinates 73° 29′.52″E, 3° 35′.37″N. The island is located on a rim reef at the north eastern side of Vaavu Atoll. It is one of 203 reefs making up the atoll and has an area of 1.1km^2. Alimatha reef extends in an east to west direction on its long axis. The island is located centrally on the reef. The near shore shallow reef flat of Alimatha reef is on average 1-2m deep.

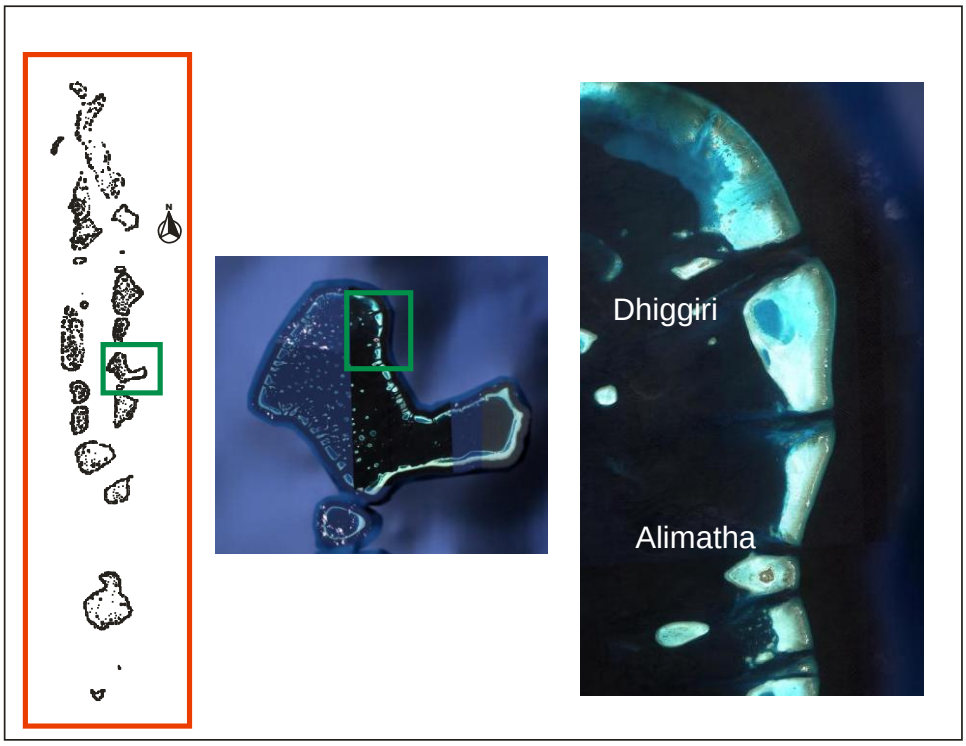

Figure 4 Geographic location of Alimatha and its satellite image (satellite image taken from Google earth)

Table 2 General physical attributes of Alimatha reef system

Physical Attributes	
Area of the island (Area inside edge of vegetation in m^2)	62,375
Island length (m)	308
Island width maximum (m)	315
Area of the reef, including the islands (sqm)	826,270

Reef length (m)	1328
Reef width (m)	853

7.2 CLIMATOLOGY AND OCEANOGRAPHY

7.2.1 WIND CLIMATE

The wind climate at Alimatha is driven by the monsoons. The locals divide climate of the Maldives into four periods that are characterised by very different wind climate, rain fall. These four periods are (Table 1) the NE monsoon (Iruvai moosun), Transitional period from NE monsoon to SW monsoon (Hulhangu halha), SW monsoon (Hulhangu moosun) and Transitional period from SW monsoon to NE monsoon (Iruvai halha).

Table 3 The four seasons experienced in the Maldives

Season	Month
NE-Monsoon	December
	January
	February
Transition Period 1	March
	April
SW-Monsoon	May
	June
	July
	August
	September
Transition Period 2	October
	November

Generally the SW monsoon generates westerly winds and the seas are rough and the period is wetter than the NE monsoon. The NE monsoon in the Maldives archipelago is marked by north-northeast winds (Woodroffe, 1992) which are generally lighter and the period is dryer. Storms and gales are infrequent in this part of the world and cyclones do not reach as far south as the Maldives archipelago (Ministry of Construction and Public Works, 1999).

A detail analysis of the wind climate for Vaavu Atoll was carried out using daily averaged wind data from Male International Airport (nearest meteorological center)

from 2002 – 2006 (Figure 5). In this analysis wind directions and speed were plotted as wind rose diagrams and the frequency distributions of the wind speeds from different directions were obtained. A spectral analysis of the wind speed data was also performed to determine the cyclic nature of the winds.

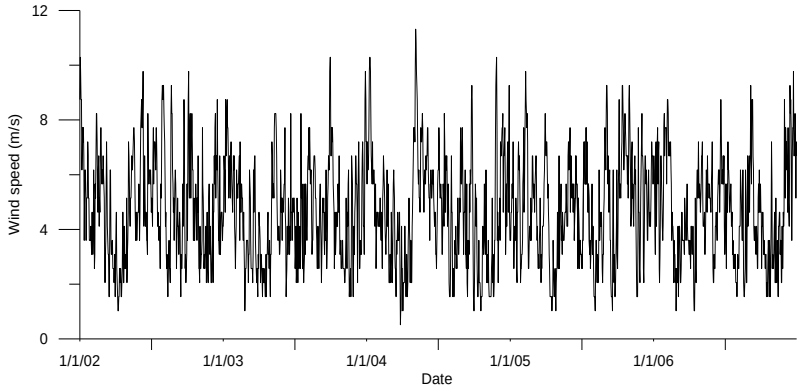

Figure 5 Time series plot of wind speed data from Jan 02- Dec 06

Wind rose plot (Figure 6) and the frequency distribution of the wind speed (Table 4) shows that the prevailing directions of the westerly winds are between WSW and WNW. Wind from these directions sums up to 47.85% of the year. The prevailing directions of easterly winds are between ENE and E that sums up to 22.24% of the year. Winds from all other directions sums less than 30% of the year. These prevailing westerly and easterly directions are also the directions from which the strongest winds blow. Wind speed distribution (Table 4) shows that for winds stronger than a light breeze (>8m/s), the westerly prevailing wind directions contribute up to 52.56% while the easterly prevailing directions contribute up to 39.49%. Based on these results it is evident that the winds at are almost confined to 5 directions, WSW, W, WNW, WNW and E.

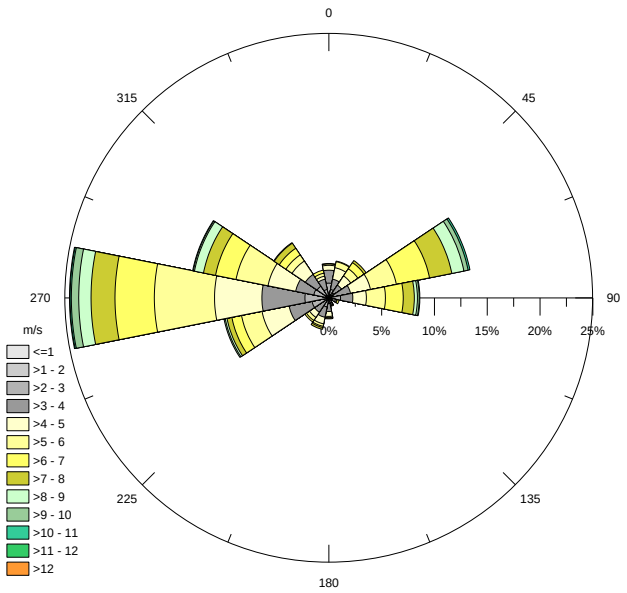

Figure 6 Wind speed and direction at Hulhule for various seasons

Table 4 Frequency distribution of wind

Wind Direction	Frequency of occurance Speed (m/s)											
	1	2	3	4	5	6	7	8	9	10	11	12 Sum (%)
N		0.06%	1.34%	1.22%	0.47%	0.12%	0.06%					3.26%
NNE			0.81%	0.99%	1.11%	0.58%	0.06%					3.55%
NE			0.58%	0.87%	1.05%	0.81%	0.70%	0.23%				4.25%
ENE			0.47%	1.63%	1.92%	2.50%	3.20%	2.15%	1.16%	0.41%	0.17%	13.62%
ENE		0.17%	0.93%	1.16%	1.28%	1.80%	1.69%	1.05%	0.29%	0.17%	0.06%	8.61%
ESE			0.35%	0.29%	0.12%	0.06%	0.17%					0.99%
SE			0.06%	0.06%	0.23%							0.35%
SSE			0.52%	0.12%	0.06%	0.06%	0.06%					0.81%
S		0.06%	0.47%	0.76%	0.47%	0.12%	0.06%	0.06%				1.98%
SSW		0.06%	0.81%	0.99%	0.64%	0.23%	0.12%	0.17%				3.03%
SW			0.35%	1.28%	0.58%	0.35%	0.17%					2.74%
WSW			1.63%	2.21%	2.62%	1.98%	0.93%	0.47%	0.17%	0.12%		10.13%
W			2.27%	4.07%	4.48%	5.70%	3.73%	2.27%	1.16%	0.70%	0.12%	0.06% 24.56%
WNW		0.06%	1.40%	1.75%	2.68%	3.08%	1.98%	1.16%	0.87%	0.12%	0.06%	13.15%
NW		0.29%	1.05%	1.34%	1.51%	0.70%	0.76%	0.58%		0.06%		6.29%
NNW			0.81%	0.99%	0.29%	0.29%	0.29%					2.68%
Sum (%)		0.70%	13.85%	19.73%	19.50%	18.39%	13.97%	8.15%	3.67%	1.57%	0.41%	0.06%

Spectral analysis of the wind speed data for the period between the years 2002 and 2006 indicates that the changes in seasonal wind patterns have very regular periods. The strongest four peaks on the power spectral density graph (Figure 7) Tp1, Tp2, Tp3 and Tp4 corresponds to periods of 4.0months, 6.1months, 2.4months and 1.6months respectively. The strongest of these periods is the 4 monthly period which has a magnitude 1.3 times higher than that of the 6 monthly period.

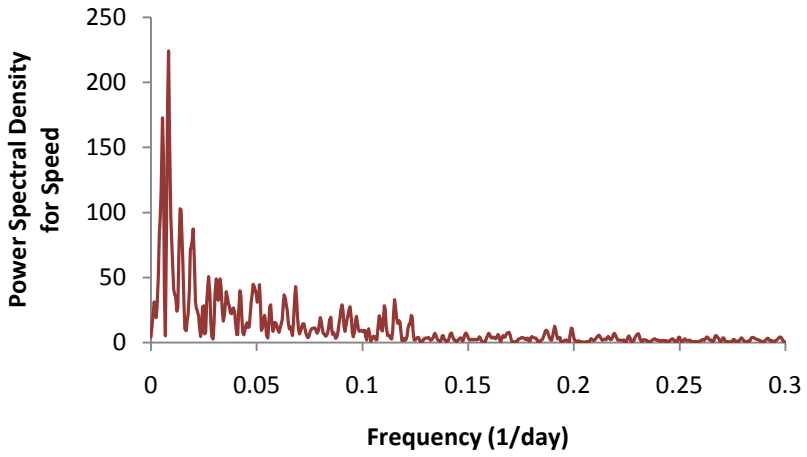

Figure 7 Power spectral density graph for the wind speed data from Male International Airport for the period between the years 2002 and 2006

Examining the spectrum for the wind direction data (Figure 8) indicates that although the predominant period for wind speed is 4 months, the wind directions change on a predominantly 6 month period. The magnitude of the 6 month cycle on the wind direction spectrum is 1.7 times greater than that of the 4 month cycle. This evidently

shows that the reversals in the wind directions occur on a biannual cycle rather than the commonly believed 8 months of westerly winds and 4 months of easterly winds.

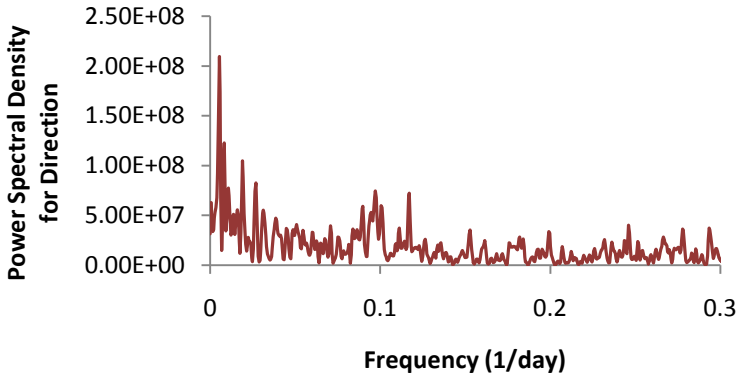

Figure 8 Power spectral density graph for the wind speed data from Male International Airport for the period between the years 2002 and 2006

7.2.2 TIDE

Long-term water-level records for Male International Airport are available from the web site of University of Hawaii. All coastal development projects require determination of the water level or water datum. Tide which consists of number of wave forms, termed tidal constituents generate many different water levels that are used as different datum. The most commonly used tidal datum in the Maldives is the Mean Sea Level (MSL). The astronomical tide at Alimatha has been assumed to be same as that at Male International Airport.

Spectral analysis of one years (year 2007) tidal records from Male International Airport (Figure 9) allowed establishment of the main tidal constituents M2 (Principal lunar semi-diurnal constituent), S2 (Principal solar semi-diurnal constituent), K1 (Luni-solar declinational diurnal constituent) and O1 (Lunar declinational diurnal constituent) (Table 5). Summation of M2, S2, K1 and O1 gave the approximate level of LLWL and approximate HHWL relative to MSL. Summation of M2 and S2 gave the approximate MHHWL and approximate MLLWL while the summation of K1 and O1 gave the approximate MLHWL and MHLWL relative to MSL (Table 6).

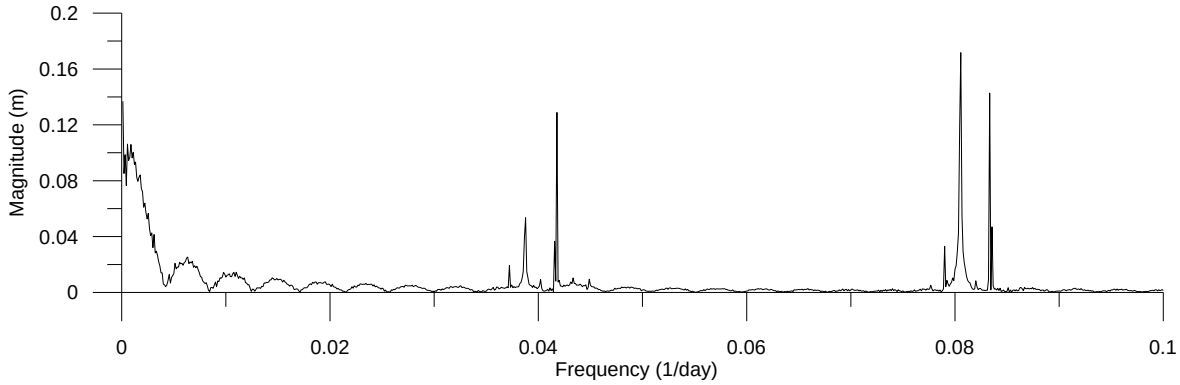

Figure 9 Spectral density for the tide (year 2007) from Male International Airport

Table 5 magnitude of the dominant tidal constituents for the tide at Male International Airport

Tidal Constituent	Magnitude (m)
M2 (Principal lunar seim-diurnal constituent)	0.1716
S2 (Principal solar semi-diurnal constituent)	0.1427
K1 (Luni-solar declinational diurnal constituent)	0.1289
O1 (Lunar declinational diurnal constituent)	0.0535

Table 6 Table summarizing tide levels at Hulhule, Male' Atoll

Tide level	Water level referred to Mean Sea Level (MSL) (m)
Highest Astronomical Tide (HAT)	+0.64
Mean Higher High Water (MHHW)	+0.34
Mean Lower High Water (MLHW)	+0.14
Mean Sea Level (MSL)	0.0
Mean Higher Low Water (MHLW)	-0.16
Mean Lower Low Water (MLLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

7.2.3 WAVE AND CURRENT

Information on the waves in the Maldives is limited, but local wind generated wave climate for the Maldives can be estimated from the long term wind data available from the Department of Metrology, Maldives. Wind generated waves for the years between 2002 and 2006 have been calculated (Figure 10 and Figure 11) using the wind wave

formula [$H_{m0} = 5.112 \times 10^{-4} U_A F^{1/2}$, $T_m = 6.238 \times 10^{-2} (UAF)^{1/3}$] (Shore Protection Manual, 1984). These estimates indicate that the local wind generated waves around Alimatha have an averaged wave height of 0.3m and the wave height does not exceed 1.3m. The averaged wave period is 2.1sec and the maximum wave period is 4.8sec.

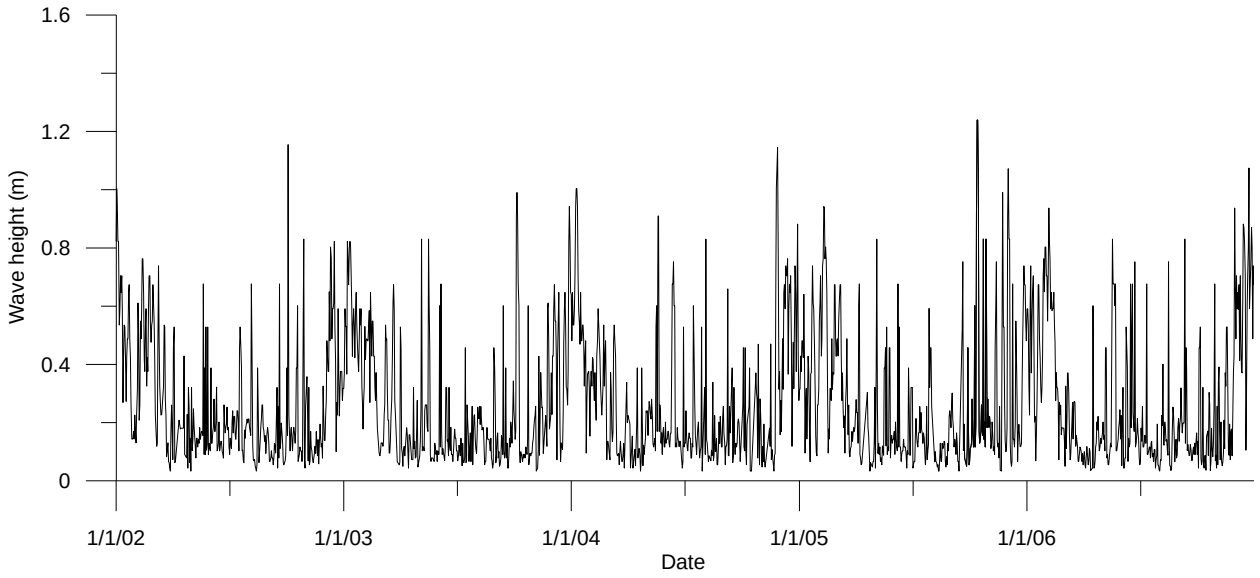

Figure 10 Time series plot of wind generated wave heights, estimate4d using local wind data

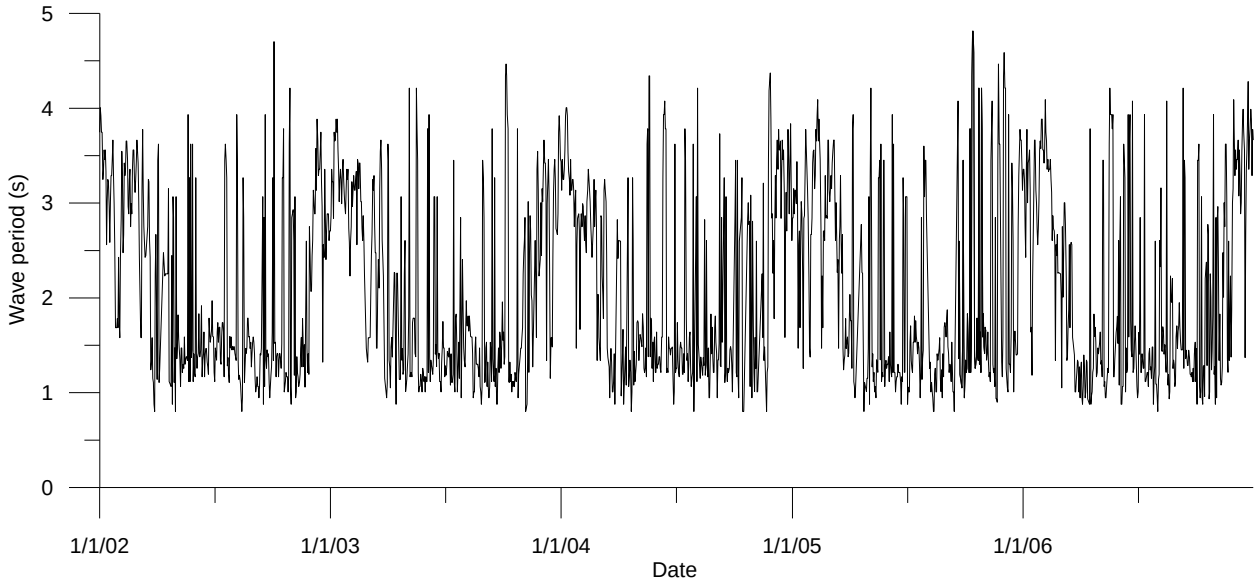

Figure 11 Time series plot of significant wave period for the estimated wind generated waves

Detail analysis of frequency of wave height distributions (Figure 12, 13, and 14) for the most prevailing wind directions indicate that during the 176days when winds prevail between WSW and WNW the wave heights higher than 0.5m exceeds for 10.1% of the time (17.6days a year). When the winds prevail from the directions between ENE and E (81days a year) the wave heights higher than 0.5m exceeds for 50.26% of the time (40.8days a year). For wave from all the directions the frequency of exceedance of waves of height greater than 0.5m is 17.29% of the time (63.1days a year).

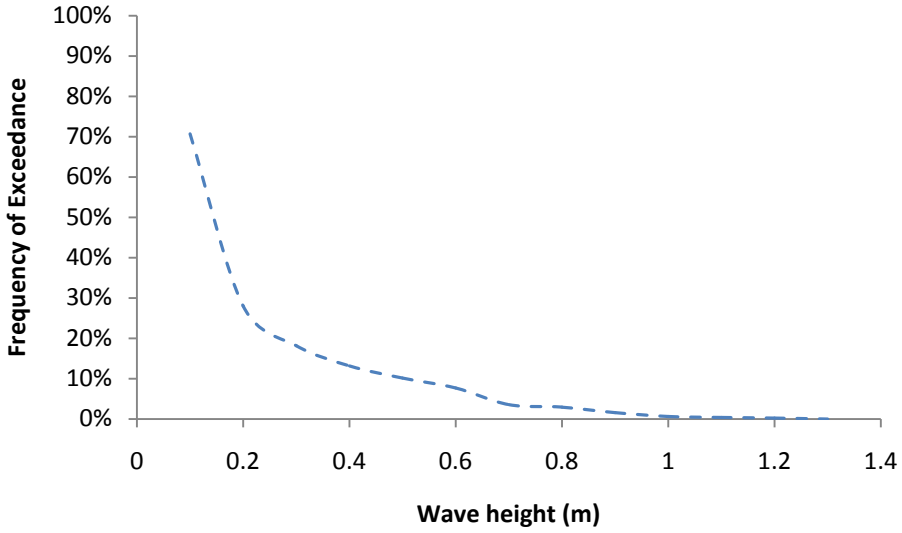

Figure 12 Wave height Hs, exceedence curves for the southern region of Maldives (source DHI, 1999)

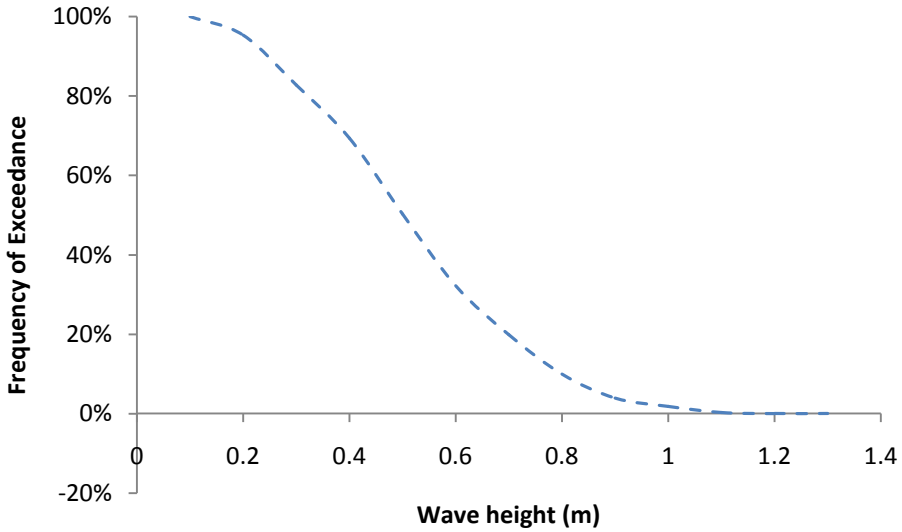

Figure 13 Frequency of exceedance of wave heights for waves from prevailing easterly wind directions

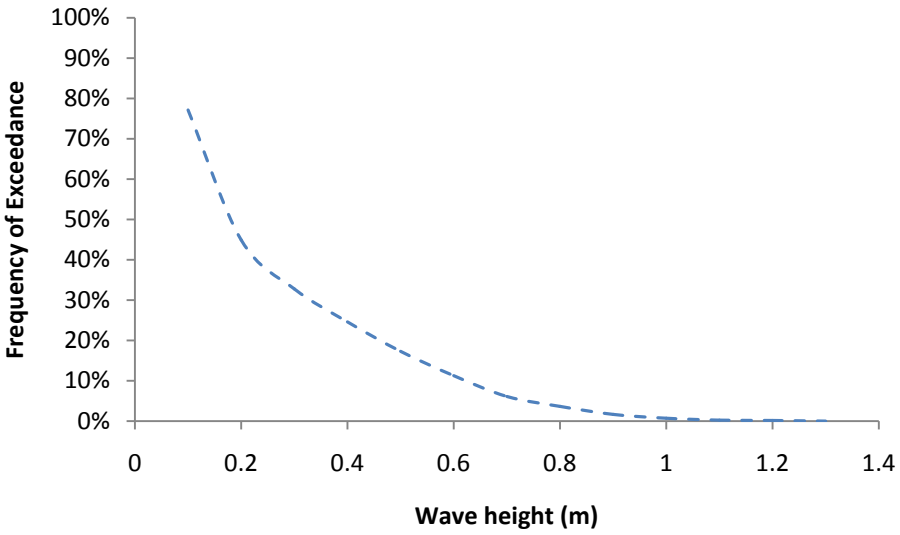

Figure 14 Frequency of exceedance for waves from all directions

Swell wave climate data for the Indian Ocean region surrounding the Maldives (Young, 1999) indicate that the dominant swell approaches from southerly quarters. On a seasonal basis, swell is from the south-southwest from April to November with a peak significant wave height (Hs) of 1.8 m in July, and from the southeast from December to March with a minimum mean Hs of 0.75 m in March (Kench and Brander, 2006).

Assumed wave condition based on wind data is given in figure 15, the dominant wave type received at the eastern side of the reef is oceanic swell waves, while during NE monsoon this will be coupled with the NE monsoonal wind induced waves. Due to the various coastal modifications made over the years, the hydrodynamic patterns have been altered. The most important change that is considered in this report is the increased intensity of long shore current at the eastern quadrant of the island. Due to the presence of the revetment wall at the eastern side of the island, the waves received at the area are reflected instead of dissipating its energy, churning up the sediment in the process. Due to swell waves received at the eastern corner of the island, a current is experienced north to south at the area, which transports sediment south wards. This is evident from sediment accretion at the northern side of the groyne located south eastern side of the island.

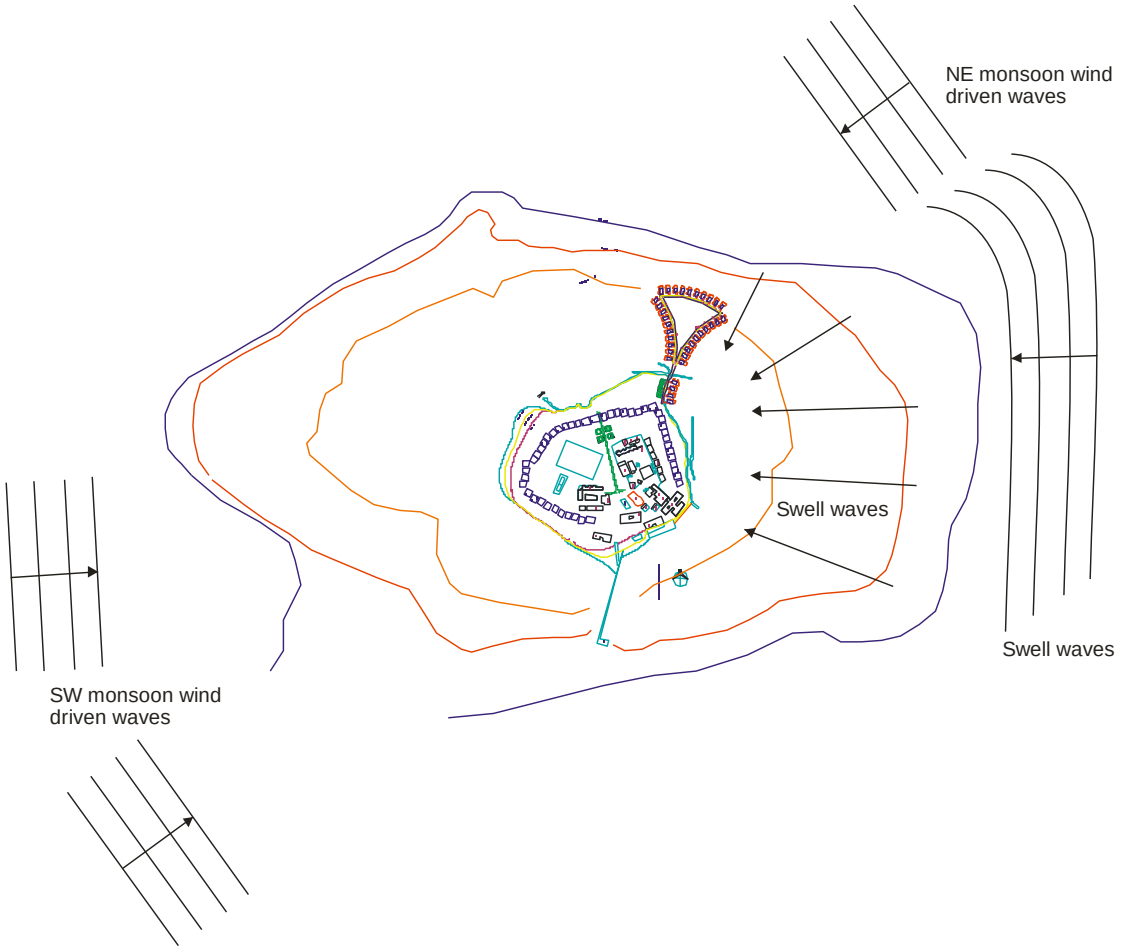

Figure 15 Map showing the assumed wave climate for the ref system

7.2.4 BEACH ENVIRONMENT

The beach environment at Alimatha has been modified over the past years by managements of the resort. The most notable features are a retainment wall along the entire eastern quadrant, retainment wall at the northern tip of the island and groyne fields at the western side of island. Frequent beach nourishment activities are carried out to maintain the beach especially at the northern and western side by use of sand pumps.

The shoreline at the proposed project area is modified with a retainment structure, therefore no beach is observed apart from the southern eastern corner area near the last groyne before the main jetty. Beach rock is also exposed at the eastern side of the island possibly due to erosion and creation of long shore currents at the area (which deepens the near shore area). At present major accretion is observed at the south eastern and south western side of the island, at some areas accretion is almost

up to the top level of existing retainment wall (figure 16, profile one figure 18 profile three).

Natural beach is only observed at the south western and part of western side of the island, while rest of the shoreline is either retainment wall or groyne field. Regular beach maintenance work is done at the island, since construction of groyne field at the western side. At areas where major accretion is observed sand is extracted and transported to areas where beach is facing erosion. Although this activity is done, main beach maintenance work is done beach replenishment work.

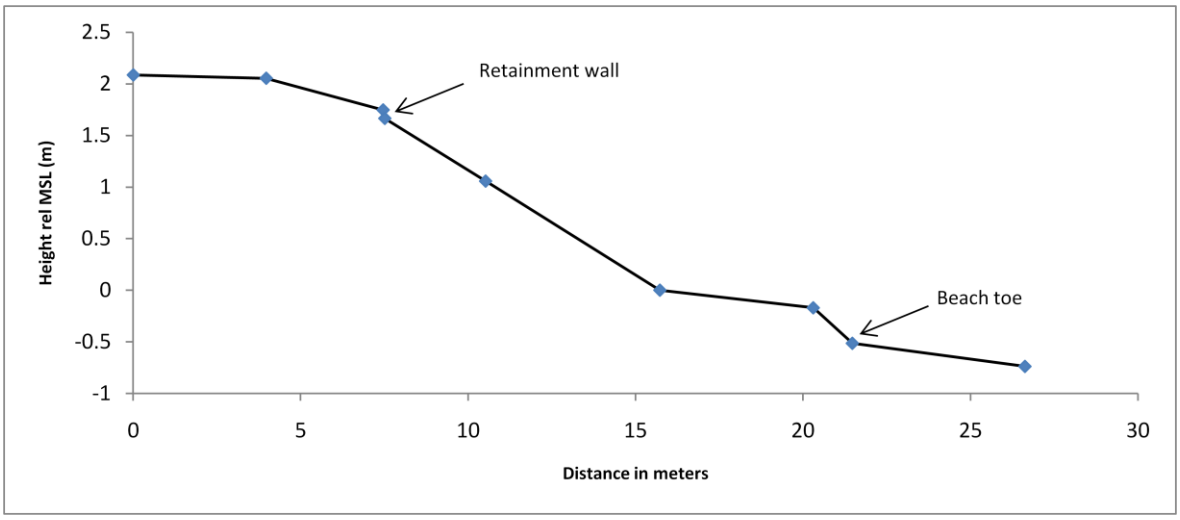

Figure 16 profile 1 located at the north western side of the island

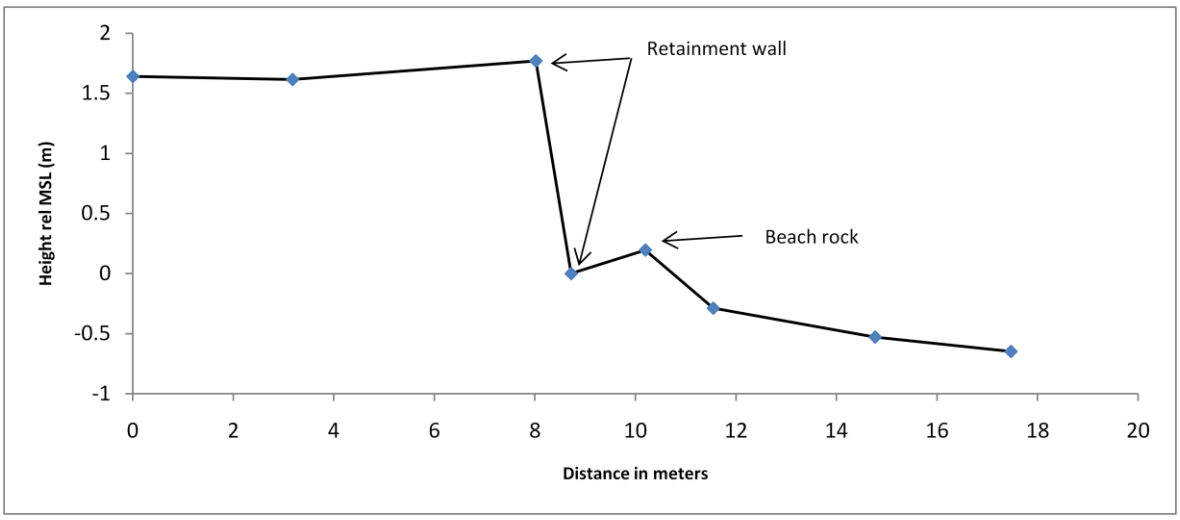

Figure 17 Profile 2 located at the eastern side of the island (at project site)

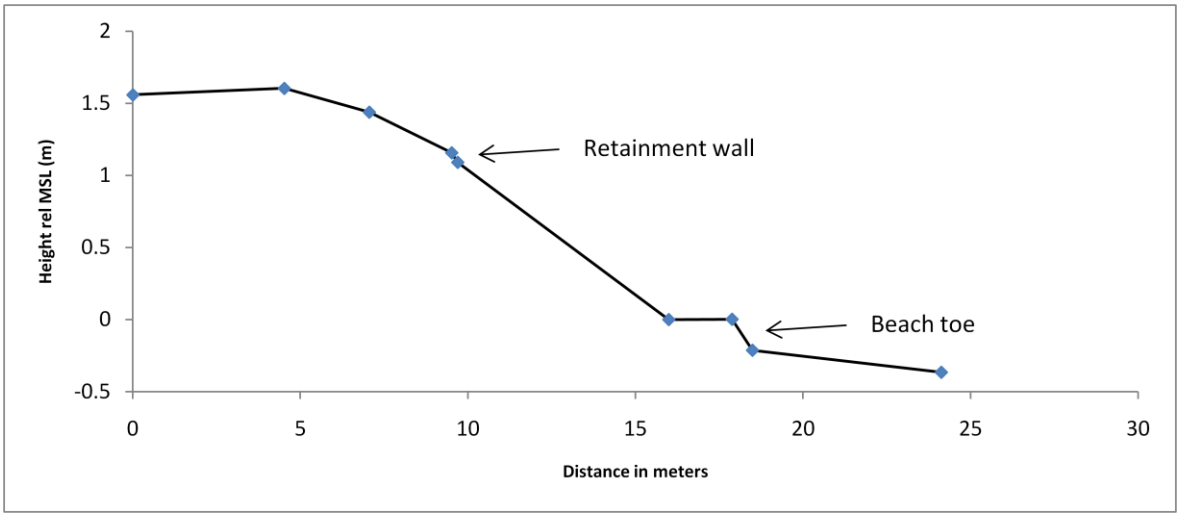

Figure 18 Profile 3 located at the south eastern side of the island, north of main jetty

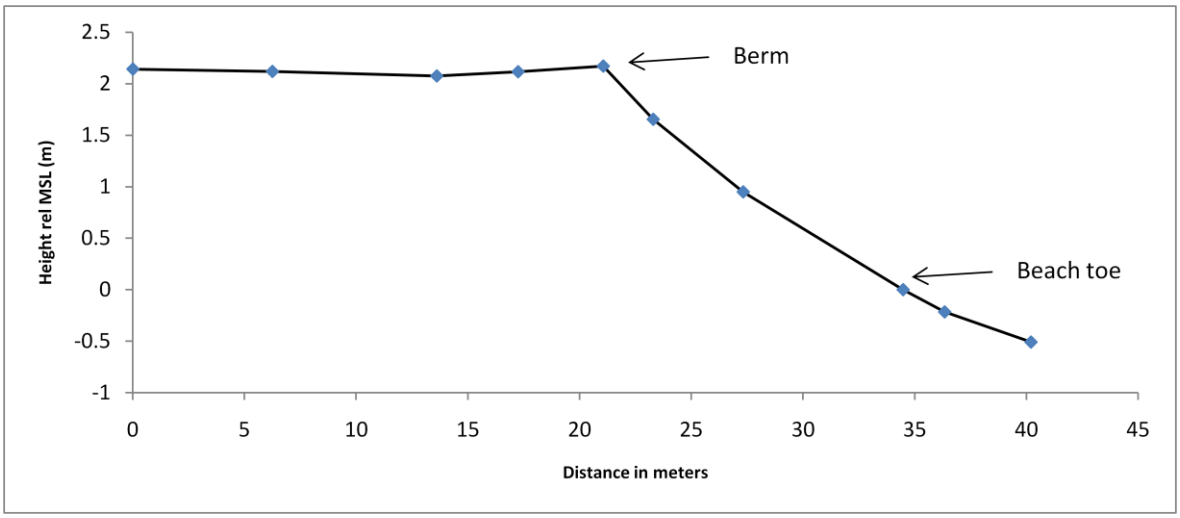

Figure 19 Profile 4 located west of main jetty

Figure 20 Retainment wall structure at the eastern side of the island, beach rock is also exposed at most of the area

Figure 21 At present major accretion is observed at the eastern and south eastern side of the island, in the figure the it can be seen that accretion height has exceeded the height of existing retainment wall at this area (north of main jetty)

Figure 22 large sand spit observed at the southern side of the island

7.2.5 MARINE ENVIRONMENT

Marine environmental data was collected at the burrow area located north western side of the island. The burrow area was entirely composed of sand with few patches of rubble. No live coral was observed at the area. While fish life was most Labrids and Pomacentrids.

The proposed project area, nearshore habitat is mostly sand and rubble, no live coral was observed at the area. Few patches of massive life form of porites and pocillopora was observed apprpximately 100m east of project area near the rubble mounds.

7.2.6 SEAWATER QUALITY

The condition or quality of coastal water is important for ecological functioning of the organisms living in the habitat, for health and safety reasons and also for visual and aesthetic impacts. The water quality is generally determined by the level of nutrients. There are several sources that can lead to increased nutrients in coastal waters, e.g.

sewage effluents, terrestrial storm water runoff. Sediment stirrup can also lead to release of nutrients within the sediments especially when there is excavation and dredging involved.

The most important nutrients of concern in coastal waters are nitrates and phosphates. In excessive quantities these can cause rapid growth of phytoplankton and result in algal blooms. Visual quality of the water is also important, a beach environment is much more attractive when the water is clean and one can see the sea bottom. However, even clear water may sometimes be polluted. Dredging and excavation often carry heavy load of sediments increasing sediment load in the water column causing discoloration of the of the impact area for a prolonged period.

It is worthwhile to note here that there is no direct input source of nutrients in the coastal waters as a result of the proposed activities. A list of parameters tested and their values for two locations are given in Table 7.

Table 7 Seawater quality parameter tested and their results at the sampling location at Alimatha. Data analysis was carried out by National Health Laboratory, Maldives Food and Drug Authority.

Parameters	SW1
Physical appearance	clear
pH	8.2
Salinity (mg/l)	37400
Turbidity (NTU)	0
Apparent color (TCU)	4
Nitrite (mg/l)	0
Nitrate (mg/l)	0
Dissolved oxygen (mg/l)	5.3

7.3 HAZARD VULNERABILITY, AREA VULNERABLE TO FLOODING AND STORM SURGE

Hazard vulnerability of Alimatha is assessed based on the literature available and field data collection. The report prepared by the UNDP on disaster risk assessment of Maldives states that the Alimatha region falls in to high risk category in terms of tsunami risk (Figure 23). The Alimatha falls in to category 5, which is high risk given in the risk assessment.

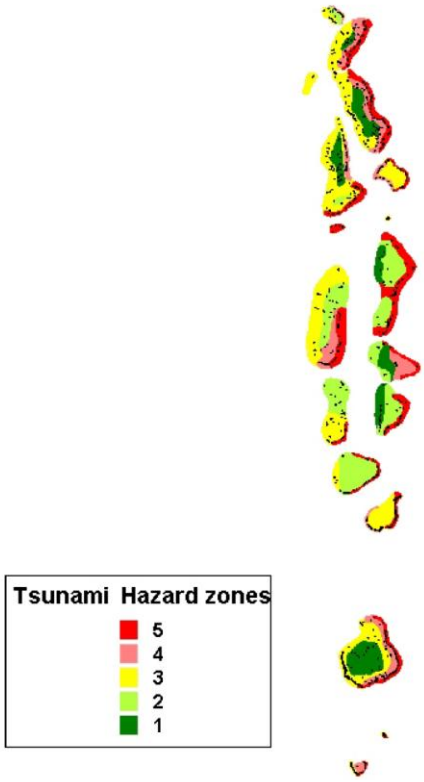

Figure 23 Tsunami hazard zones, category 5 is the highest risk zone while 1 is the lowest (figure derived from UNDP report on Disaster risk profile for Maldives, November 2006)

Hazardous weather systems, other than general monsoons (heavy rain and strong winds) that affect Maldives are Tropical Storms (tropical cyclone) and Severe Local Storms (thunder storms/thunder squalls).Tropical cyclones are extreme weather events with positive and negative consequences. At times, these are very destructive due to associated strong winds (often exceeding 150 kmph), heavy rainfall (often exceeding 30 to 40 cm in 24 hours) and storm tides (often exceeding 4 to 5 meters). Strong winds can damage structures, houses, communication systems, roads, bridges and vegetation. Heavy rainfall can cause serious flooding. Storm surge is a sudden rise of sea level elevation along the coast caused by cyclonic winds. Sea level also rises twice daily due to astronomical reasons. The combined effect of surge and tide is knows as storm tide. Storm tides can cause catastrophe in low lying areas, flat coast and island territories such as Maldives.

Islands of Maldives are also affected by severe local storms (thunder storms/thunder squalls). Hazards associated with thunderstorms are strong winds (often exceeding 100kmph), heavy rainfall, lightning and hail. They give birth to tornadoes in some preferred regions (other than equatorial regions). In general thunderstorms are more frequent in equatorial region compared to other areas (Figure 24). Land areas get more thunder storms compared to open ocean areas. However, thunderstorms close to the equator are less violent compared to those of other parts of tropics and extra-tropics. Maldives being close to the equator thunderstorms are quite frequent here but

are less violent. Strong winds generated by severe local storms consequently generate larger wind driven waves, which are hazardous to the islands of the Maldives.

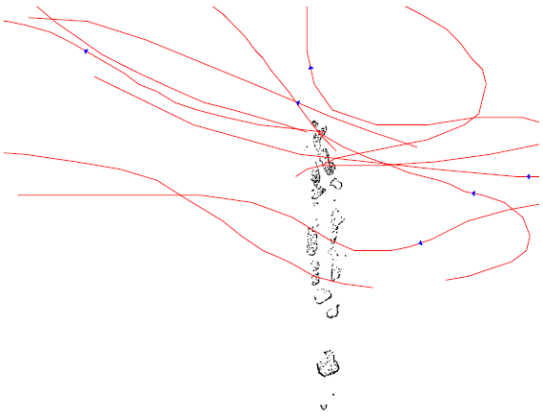

Figure 24 Track of severe storms affecting the Maldives during 1877-2004

The Alimatha falls in to category 3, which is the moderate scale given in the risk assessment of cyclones or storms (see Figure 25). The major zones affecting are the mid and northern parts of the Maldives.

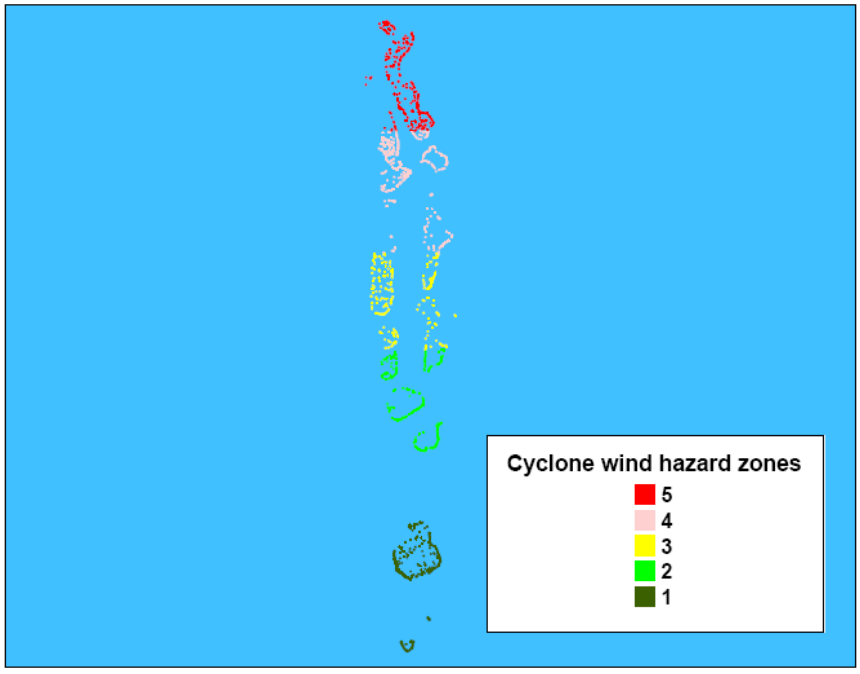

Figure 25 cyclone hazard zones (figure derived from UNDP report on Disaster risk profile for Maldives, November 2006)

Bathymetry around Maldives shows that the ocean slope close to east coast is steep compared to the same on the west coast. This led us to conclude that eastern islands of Maldives are vulnerable to higher surge hazard compared to western islands. Alimatha region falls in to zone 3 (moderate risk zone) in the cyclone hazard zoning categories (Figure 26).

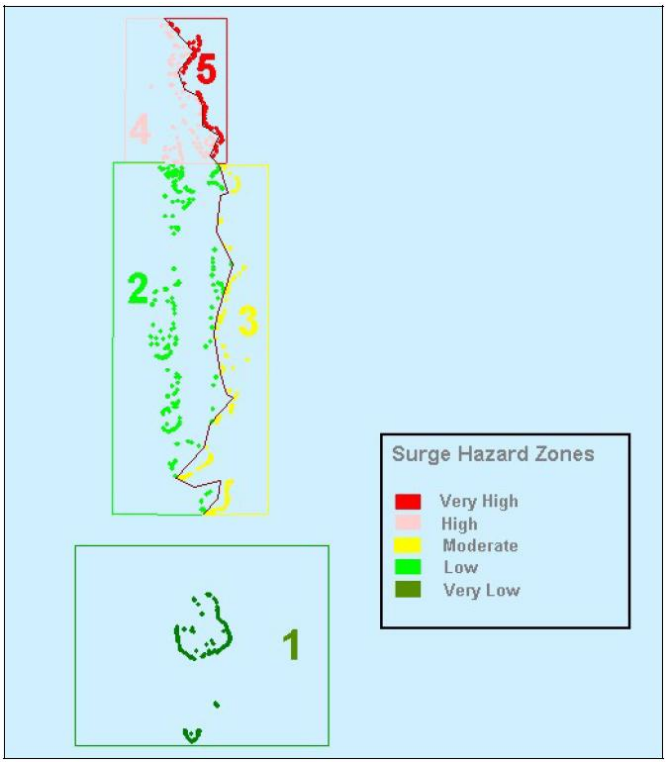

Figure 26 Surge hazard zones (figure derived from UNDP report on Disaster risk profile for Maldives, November 2006)

Based on these finding, Alimatha has probability of high impact of tsunami, moderate impact from storm surge and cyclones. During the December 2004 tsunami extensive damages were received on the island, although no structural damages were reported. The eastern side of the island is a surf zone, where during NE monsoon heavy swells and wind waves are experienced. To protect the eastern side of the island previous management have modified the eastern quadrant coastline with retainment wall.

8 ENVIRONMENTAL IMPACTS

8.1 IMPACT IDENTIFICATION

Impacts on the environment from various activities of the proposed development works (constructional impacts) and operation impacts have been identified through interviews with the project management team, field data collection surveys and based on past experience in similar development projects.

Possible impacts arising from the proposed development and operation works are categorized in to reversible and permanent (irreversible) impacts. The impacts identified are also described according to their location, Extent (magnitude) and characteristics. Reversible and irreversible impacts are further categorized in to intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken. Below (Table 8) are the impact categories:

Table 8 Categorized scale of impact prediction

Impact category	Description	Reversible/ irreversible	Cumulative impacts
Negligible	the impact has no significant risk to environment either short term or long term	Reversible	no
Minor	the impact is short term and cause very limited risk to the environment	Reversible	no
Moderate	Impacts give rise to some concern, may cause long term environmental problems but are likely short term and acceptable	Reversible	May or may not
Major-	impact is long term, large scale environmental risk	Reversible and Irreversible	Yes, mitigation measures has to be addressed

The project boundary is limited to the eastern side of the island, between the water bungalow walk way and groyne east of main jetty. The length of beach fill area is 114m, while the burrow area is located at the north western side of the island.

The severity of impacts is predicted by reviewing the design plans and construction methodologies. Mitigation measures are formulated in light of the information revealed by the project engineers.

8.2 LIMITATION OR UNCERTAINTY OF IMPACT PREDICTION

Uncertainty of impact prediction are mainly due to the lack of long term data (shoreline, local currents and wave climate), Inherent complexity of ecosystem (hydrodynamic regime) and lack of coordinated monitoring programs with inconsistent methodologies which can be used to predict outcomes or reliability of predictions of previous projects.

The impacts are predicted by reviewing the survey data collected during the field visits and information revealed by the designers and engineers. The data collected during the field visit is limited to a week or more days, which limits the overall understanding of even the short term environmental conditions (wave condition and currents).

The time limitation of EIA field data collection and report preparation is also a hindrance to properly understanding the environmental factors dictating the conditions of the habitat.

8.3 CONSTRUCTIONAL IMPACTS

In any development project major direct impacts to the environment (either short term or long term) occur mainly during the construction phase. Potential direct or indirect impacts on the environment (on land and reef system) from the proposed works are limited since the scope of work is small; envisaged impacts from the proposed project are due to activities given below

- Construction debris blown away by wind or spillage during transportation
- Possible impacts to seawater quality due to construction of groyne field and beach fill work

8.3.1 DEMOLITION WORK

Sediment plume is expected during the demolition or existing retainment wall, although this would be minor impacts since demolition will be done manually. Substrate at nearshore area is sandy devoid of live coral therefore impact will be negligible. The project area will be fenced off during construction period to avoid visual and dust impact.

8.3.2 CONSTRUCTION OF GROYNE FIELD

Groyne field construction will be done after demolition of retainment wall. Since cement and masonry work will be done some level of water quality impact is envisaged, but this would be minor and short termed. Demolished material from retainment will be used for construction of groyne field therefore this is a positive impact in terms of reuse and recycling.

8.3.3 SEAWATER QUALITY AND SEDIMENTATION IMPACTS

Seawater quality impacts are expected during construction of groyne field and filling of beach area. These impacts will be minor and short termed since nearshore substrate is entirely composed of sand. The burrow area is located north western side of the island at a submerged sand flat, since sand pumps will be used for extracting sand sedimentation impacts will be minor. It has to be noted that this area is used as a burrow area for the regular beach maintenance work of the resort.

8.3.4 AIR AND NOISE POLLUTION

Since construction work will be done manually, no heavy machinery will be used, thus air pollution and noise pollution is not envisaged. Demolition work will be done manually, but noise generated will be minor since the structure is already very weak therefore minimum effort is necessary for demolition work.

8.4 OPERATIONAL IMPACTS

Environmental impacts associated from the operational phase of the current proposed development project envisaged to be minor or insignificant. Below are some of the impacts envisaged;

- Possible erosion at the main jetty area

8.4.1 POSSIBLE EROSIONAT THE MAIN JETTY AREA

At present due to the retainment wall accretion is more at the main jetty area, while retainment wall area is deepened due to longshore currents at the area. In the operational stage this effect will be minor since wave will be breaking and losing energy thereby reducing the longshore currents. Also the groyne field will limit the movement of sediment. During NE monsoon major accretion is observed throughout the south eastern side possibly due to the retainment wall, this accretion will be less but is not expected to be a negative impact.

8.4.2 GUEST SAFETY

The existing retainment wall area is quite deep and beach rock is observed which makes it a safety issue especially for the elderly and children. The proposed project will increase the safety of the recreational area. Hence the modification will be a positive impact.

8.4.3 AESTHETICS

The proposed project will increase the visual indemnity of the eastern side, which at present is composed of retainment wall and beach rock. The proposed project will make the eastern side more natural and increase the commercial value of the beach

bungalows at the area. Therefore the proposed project will have positive impacts in terms of aesthetics and visual indemnity.

9 ALTERNATIVES

The proposed project is a small scale project which involves modification of a small stretch of coastline (already modified), and impacts associated are thought to be minor to insignificant. Considering alternatives, type of coastal protection and location of burrow area can be discussed.

In terms of type of coastal protection, the proposed method is setting up of a groyne field along with removal of existing retainment wall. Alternatives can be off shore breakwaters to reduce wave energy received at the area along with removal of existing retainment wall and beach fill work. Considering both options, the groyne field system seems to be most ideal in terms of beach stability and visual indemnity. Since significant modification of coastline has been done by present and previous management, almost entire shoreline now composed of hard engineering components to mitigate erosion. In this regard the groyne field at the western side seems to functioning well along with routine maintenance of beach. Therefore in terms of coastal protection measures, the groyne field seems to be most ideal option considering functionality and cost.

In regard to the alternatives to burrow area, the proposed burrow area is an existing burrow area for beach maintenance work, therefore using this area would avoid be the most ideal option. Choosing this option would reduce overall impact to the reef, since additional burrow areas will not be created; this limits the boundary of impact area.

Apart from the discussed alternative, the "do nothing" option would mean high probability of harm to guest especially the elderly and the children. Also the retainment wall is aesthetically unpleasant, therefore loss of revenue is also envisaged. Therefore it is thought that the "no project scenario" is not feasible, in terms of safety and loss of business.

10 MITIGATION PLAN

There are a number of actions that can be taken to minimize or avoid impacts altogether. Those that are explored below emerged out of the discussions and consultations during this EIA and from the past experience of the consultant. Mitigation measures are selected to reduce or eliminate the severity of any predicted adverse environmental effects and improve the overall environmental performance and acceptability of the project.

Commitment letter for financing and carrying out of mitigation measures and monitoring works outlined in this EIA report is given in Appendix 3.

Table 9 possible environmental impacts and mitigation measures for the proposed project

Phase	Possible Impacts	Mitigation measures	Location	Time frame	Impact intensity	Institutional responsibility	Estimated cost (USD)
CONSTRUCTION PHASE (Temporary impacts)	Littering on terrestrial and marine environment	Littering, accidental disposal and spillage of any construction wastes should be avoided by pre-planning ways of their transportation and unloading at the service jetty area. Careful planning of the work activities can also reduce the amount of waste generated.	Lagoon and service jetty area	During construction	Minor, short term impact	resort management	N/A (no additional cost)
	Damage to reef by unloading works	Awareness raising of project managers on environmentally friendly practices to minimize negative impacts. Avoid disposal of waste at the lagoon	Lagoon area and land	During construction	Minor, short term impact	Resort managment	N/A
	Leaching of cement mixture during construction of groyne field	Construction of groyne field should be limited to low tide periods to avoid excessive leaching	Eastern side lagoon	During construction	Minor, short term impact	Resort management	May increase the cost of work.

	Sedimentation impacts	Avoid beach fill work during high tide, instead carrying out beach fill during low tide	On reef flat and lagoon	During construction	Minor impact, short term	Resort management	N/A should be included in the initial cost
		Reusing the rock debris for groyne field construction	On land	During construction stage	Positive impact (reusing)	Resort management	Inlcuded in the project scope
	Noise pollution/impact on Aesthetics	Avoid demolition work and construction work during night hours Fence off project boundary area	land	Construction phase	Minor/short term	Resort management	N/A (included in the initial plan)

11 MONITORING PROGRAM

Monitoring is the systematic collection of information over a long period of time. It involves the measuring and recording of environmental variables associated with the development impacts. Monitoring is needed to;

- Compare predicted and actual impacts
- Test the efficiency of mitigation measures
- Obtain information about responses of receptors to impacts
- Enforce conditions and standards associated with approvals
- Prevent environmental problems resulting from inaccurate predictions
- Minimize errors in future assessments and impact predictions
- Make future assessments more efficient
- Provide ongoing management information
- Improve EIA and monitoring process

Impact and mitigation monitoring is carried out to compare predicted and actual impacts occurring from project activities to determine the efficiency of the mitigation measures. This type of monitoring is targeted at assessing human impacts on the natural environment. Impact monitoring is supported by an expectation that at some level anthropogenic impacts become unacceptable and action will be taken to either prevent further impacts or re-mediate affected systems. Mitigation monitoring aims to compare and predicted actual (residual) impacts so that effectiveness of mitigation measures can be determine.

Table 10 Monitoring program for construction/Operational phase of the project

Category	Methodology	Sampling frequency	Estimated cost for monitoring
Beach stability	Shoreline mapping of the island using precision GPS (recording the high tide and low tide line)	After completion of project and every 6 months during the operational stage	USD 1000.00 per survey

12 CONCLUSION

The environmental impacts associated with the proposed project are considered to be minor due to small scale of the project. This conclusion is based on the evaluation and various components of the proposed project, implementation methods discussed, finding of the existing environment and environmental components that are likely to be affected. The significant environmental components associated with the project are;

- Near shore lagoon and water quality
- Beach dynamics

Based on the existing setting and the nature and design of the project it is unlikely to cause any significant change near-shore coastal hydrodynamics or terrestrial environment (beyond changes or modifications that have already been done to the area).

The construction workforce would be located in existing accommodation units (resort maintenance staff will be carrying out the work). Therefore staff or workers capacity will not increase, which would avoid stress on existing service facilities.

Therefore, with due consideration to the environmental components identified above and the extent of the project activities and their likely and predicted impacts identified the consultant concludes that the project components and designs are feasible and appropriate mitigation measures have been considered to correct and minimize any unfavorable environmental changes.

APPENDICES

Appendix 1 Terms of Reference (ToR)

Environmental Protection Agency
Ministry of Housing, Transport and Environment
Male', Republic of Maldives

Terms of Reference for Environmental Impact Assessment for the shoreline modification in Alimathaa, Vaavu Atoll, Maldives

The following is the TOR based on the points discussed in the scoping meeting held on 02february 2010 for undertaking the EIA of the proposed **Shoreline modification at Alimathaa, Vaavu Atoll**

This document is a legally binding document prepared after consultation with all relevant stakeholders and the EIA report must strictly follow the activities under this ToR.

1. *Introduction - Identify the development project to be assessed.*

2. *Study Area - Specify the boundaries of the study area for the assessment as well as any adjacent or remote areas that should be considered with respect to the project*

3. *Scope of Work - The following tasks will be performed:*

Task 1. Description of the Proposed Project - Provide a brief description of the proponent, how the project will be undertaken, full description of the relevant parts of the project, using maps at appropriate scales where necessary. This is to include description of the shoreline modification with designs and drawings where necessary, project costs, schedule and life span. The report should also include how wastes and emissions will be managed, project inputs and outputs, details of how construction materials will be obtained, project schedule; and life span.

Task 2. Description of the Environment - Where baseline data is to be collected, careful consideration must be given to the design of the survey and sampling programme. Data collection must focus on key issues needing to be examined for the EIA. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that the data collected is suitable for use as a baseline to monitoring impacts.

Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area (and disposal sites), focused on the marine environment, including the following:

a) Physical environment: geomorphology, meteorology (rainfall, wind, waves and tides), near-shore currents, based on available secondary data and data collected where appropriate.and bathymetry, existing shoreline, set of beach profiles to show the status of the shoreline before the shoreline modification.

b) Biological environment: description of marine flora and fauna, rare or endangered species, coral reefs and any other sensitive habitats and marine water quality. Water quality parameters should include salinity, dissolved oxygen, pH, ammonia, nitrite, nitrate, nitrite, phosphates and turbidity.

c) Hazard vulnerability; vulnerability of area to storm surge.

Characterize the extent and quality of the available data, indicating significant information deficiencies and any uncertainties associated with the prediction of impacts.

Task 3. Legislative and Regulatory Considerations - Describe the pertinent national and international legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project.

Task 4. Determine the Potential Impacts of the Proposed Project – Identify impacts related to the proposed project activities. Distinguish between significant impacts that are positive and negative, direct and indirect, and short and long term both during construction phase and operational phase. Identify impacts that are cumulative, unavoidable or irreversible.

Task 5. Analysis of Alternatives to the Proposed Project. –Describe the alternatives examined for the proposed project that would achieve the same objective including the "no action alternative. Distinguish the most environment friendly alternatives. Report should also highlight alternative locations and how the proposed location was determined and alternative technologies for construction. And justify that the proposed location, design and technology for the project is the most appropriate.

Task 6. Mitigation and Management of Negative Impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Mitigation measures should be identified for both construction and operational phase. Cost of the mitigation measures, equipment and resources required to implement those measures. A commitment regarding the mitigation measures should be submitted by the responsible person.

Task 7. Environmental Management Plan and Monitoring - A time frame should be outlined for monitoring focused on the construction and operational phase. Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management. Monitoring plan needs to include shoreline and other parameters after the construction phase, to be compared with the baseline data. Detail of the monitoring programme including the physical and biological parameters for monitoring, frequency, duration and cost commitment from responsible person, detailed reporting time table and ways and means of undertaking the monitoring programme must be provided.

Task 8. Stakeholder Consultation – Major stakeholder consultation to include Ministry of Housing, Transport and Environment, Ministry of Tourism, Arts and Culture and any other relevant stakeholders and community perceptions of nearby island relative to visual impact. EIA report should include a list of people/groups consulted and the methodology of consultation. The discussions held at the scoping meeting will be also used as a part of consultation.

Presentation - The Environmental Impact Assessment Report, to be presented in print and digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2007.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 3 months from the date of this Term of Reference.

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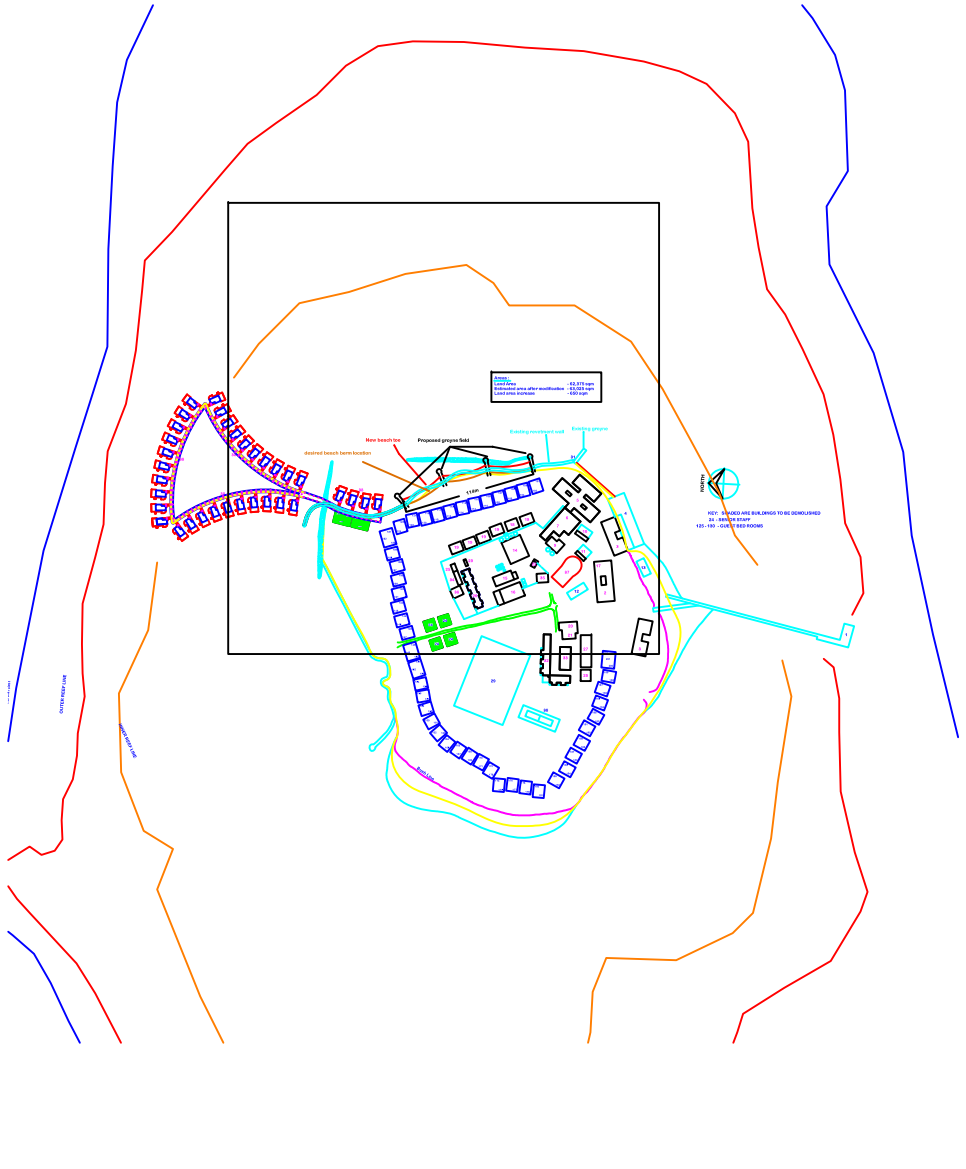
(23 March 2010)

Appendix 2 Site plan



Areas :	
Land Area	- 62,375 sqm
Estimated area after modification	- 63,025 sqm
Land area increase	- 650 sqm

Appendix 3 Commitment letter

بسم الله الرحمن الرحيم

Safari Tours Pvt Ltd

Male' Maldives

31 March 2010

Mr. Mohamed Aslam

Minister

Ministry of Housing, Transport and Environment

Male

Maldives

Dear Sir,

Re: Proposed Coastal Modification work at Alimatha eastern side shoreline

As the developer of the above project, we herby confirm our commitment to carry out and finance the environmental mitigation measures and monitoring program outlined in this EIA report.

Sincerely,

Name:

Designation:

Appendix 4 list of people met

Shifaz Ali	Senior Engineer	MHTE, Construction dept
Mohamed Adly	Assistant Director	Ministri of Tourism, Arts and Culture
Abdulla Nashiz	Manager	Alimatha Aquatic Resort

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