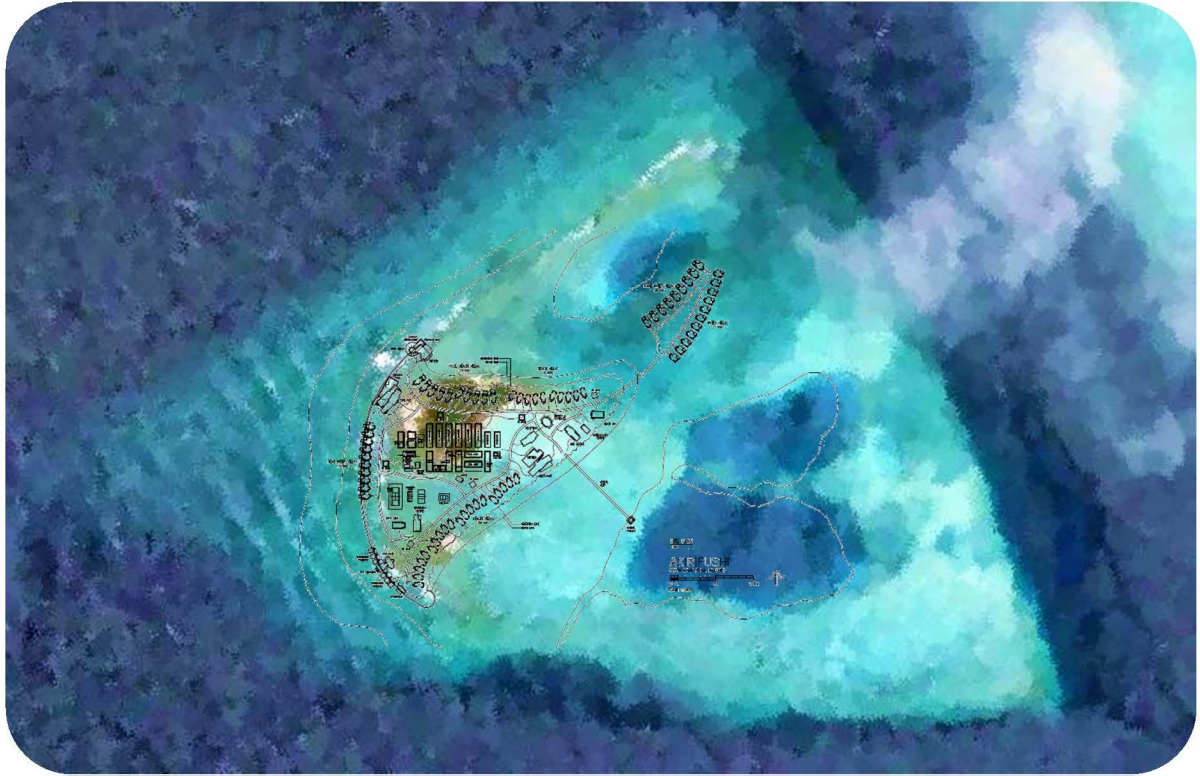


ENVIRONMENTAL IMPACT ASSESSMENT FOR RESORT DEVELOPMENT IN K. AKIRIFUSHI, NORTH MALE ATOLL



AUGUST 2014

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Declaration of the Consultant:

I certify that the statements made in this Environmental Impact Assessment are true, complete and correct to the best of my knowledge and available information at the time of writing this report.

Mahmood Riyaz (EIA03/07)
August 2014

Acronyms used in the text

BOD	Biological Oxygen Demand
BOH	Back of the House (all the utility function and its services on the resort)
COD	Chemical Oxygen Demand
FOH	Front of the House (guest rooms, reception restaurant, arrival pavilion etc)
DNP	Department of National Planning
EPA	Environmental Protection Agency
EPAA	Environmental Protection and Preservation Act
MBR	Membrane Bioreactor (Sewage Treatment Plant)
MHTE	Ministry of Housing, Transport and Environment
MoFA	Ministry of Fisheries and Agriculture
MoFT	Ministry of Finance and Treasury
MoHE	Ministry of Housing and Environment
MoT	Ministry of Tourism,
MPL	Maldives Ports Limited (a state-owned enterprise)
MSL	Mean Sea Level
NPC	National Planning Council
SBR	Sequence Batch Reactor (Sewage Treatment Plant)

2 NON TECHNICAL SUMMARY

This is the Environmental Impact Assessment (EIA) report carried out for Akirifushi Investmentt Pvt. Ltd to develop and operate a resort in Akirifushi Island located in North Western part of Male Atoll. Akirifushi development project involves creation of land through reclamation and develop and operate 70 room high-end tourist resort with all the necessary facilities and amenities. The EIA was prepared as fulfilment of the requirement by the Ministry Tourism (MoT) for granting permission for the project. Environmental Impact Assessment (EIA) of development projects is a requirement by the Environmental Protection and Preservation Act (EPPA) (law 4/93) of the Government of the Republic of Maldives.

The total cost of the proposed project is approximately 20 million USD. The project will be developed within 18 months. The project will create a relatively large number of direct and indirect employment opportunities for the Maldives. Therefore the project will significantly contribute to the economic growth, particularly tourism sector, and other relevant socio-economic activities

This report has been prepared in accordance with the Environmental Impact Assessment Regulations published by the Ministry of Environment and Energy 2012 and covers both negative and positive environmental and socio-economic impact arising from the proposed project in Akirifushi Island. Major findings of this report are based on information gathered during the field inspection of both the existing environment and possible effects of the project activities, through extensive literature review and experiences gained from similar projects elsewhere in the Maldives.

The proposed project activity will take place on Akirifushi Island and Falhu. Akirifushi Island is an uninhabited island and lies in an E-W oriented triangular shape reef on the western periphery of North Male Atoll. The island is situated on the south western end of Akirifushi Falhu in a north south orientation. Akirifushi Island is a vegetated rubble cay (Huraa). Vegetated area of Akirifushi is approximately 8000 m² and island area is approximately 1.4 hectares. Total area of the reef where Akirifushi Island is situated is approximately 75 hectares. After the land reclamation the area of the island will be 8.2 hectares.

The island is characterized by fairly young natural vegetation mainly consisting of *Kaani*, *Hirundhu*, *Dhigga*, to a great extent and *Magoo*, *Kuredhi*, *Boa Kashikeyo* and *Boashi* to a smaller extent in the coastline. A small area covered in *Kandoo* (mangrove) is found on the northern side of the island in a slight depression where the ground gets occasionally flooded from tidal fluctuations. Only a couple of planted young *Ruh* were found in the middle of the island. The dominant vegetation on the island was observed to be *Kaani*, which was mostly found on the eastern parts as well as mixed with other vegetation such as *Dhigga* and *Hirundhu* in the middle parts. On the southern side, patches of *Magoo* were observed while on some of the northern parts mixed coastal vegetation including *Magoo*, *Kuredhi*, *Boa kashikeyo* and *Boashi* were found

Akirifushi Island is found in a single reef on the NW rim of North Male' Atoll. The reef is triangular in shape with western side slightly curved and the island is located almost at the edge of this curvature. The length of the reef including the reef slope from west to east is estimated to be 1km and the width of the reef from north to south is estimated to be 960m. The total area

of the reef is estimated to be 75ha with most parts found in shallow lagoon. The large and deep *Vilu* on the eastern side of the island occupies almost 15% of the whole reef, while the island and the smaller *Vilu* on the northern side occupy approximately only 3% each of the whole reef. Hence, the shallow lagoon of the reef is approximately 79% and mostly comprised of sand and rubble, while the western side mostly composed of dead rocks. The general condition of the reef in terms of percent live coral cover is low approximately 10%.

During the preparation of the EIA report an impact matrix, which is a standard tool for identifying the possible impacts of project activities, has been created for proposed development project in Akirifushi Island. The activities carried out during the construction and post-construction or operational phases are arrayed against a selection of environmental factors that may be affected directly or indirectly as a result of project activities.

The report has identified and described in detail possible change that would occur to the existing condition of the environment caused during the construction phase and have suggested appropriate mitigation measures for each and every impact identified in the report. Dredging has been identified as the most significant negative environmental impact that could be associated with the proposed development. Liquid, solid and other forms of wastes and particularly hazardous waste generated during the construction and operational phase has also been identified as significant impact associated with the project and appropriate mitigation measures are suggested for each and every waste related impact identified in the study.

The study has evaluated alternative options for some components of the project and has suggested some modifications to the shape of reclaimed area. Also the report found, based on the similar project activities elsewhere in the Maldives, the island and the reef will recover from the expected impacts rapidly and will re-establish a new ecological balance soon. However the report has come-up with an extensive monitoring programme that will keep on monitoring the environmental changes associated with the development and make necessary adjustment to the activities of the project based on the findings of various measured environmental parameters suggested in the monitoring plan.

The report has identified the following beneficial effects form resort development in Akirifushi:

- Increased direct employment and training opportunities;
- Improvements in environmental quality of the island;
- Stimulation of local economy, cultivation and small business opportunities for nearby island communities; and
- Increased government revenue and increased GDP.

The report found no evidence that the resort development in Akirifushi requires or involves any of the following environmental or socio-economic impacts.

- loss of unique habitat or wilderness areas;
- resettling of local communities;
- removing or destroying cultural properties;

- contravening national government of the Republic of Maldives, or island community policies, regulations, criteria, customs or aspirations concerning environment, economy, employment, cultural traditions or life styles.

On the basis this environmental impact assessment study and the impact mitigation measures proposed in the report will be duly implemented and recommendations are given due consideration, it is concluded that the benefits of the planned resort development in Akirifushi Island will substantially outweigh its imposition on the environment.

3 INTRODUCTION

3.1 BACKGROUND

Akirifushi Island located on the north western end north Male Atoll was allocated for tourism development by the National Planning Council in 2011. A strategic approach of the government at that time was to give concessions on the land for resort development in lieu with the national infrastructure developments. In this context Akirifushi was awarded to Mr. Sim Ibrahim Mohamed to develop a tourist resort in the island in lieu with the water and sewerage system development in one of the inhabited islands as part of Cooperate Social Responsibility (CSR) of the developer. In 2013 the island was sold to Akirifushi Investment Pvt. Ltd., and the island was leased to the company after paying the acquisition cost to the Government.

Akirifushi is a vegetated small rubble cay situated in a fairly large reef, Akirifushi Falhu in north Male` Atoll. The vegetated part of the island approximately 8000m² and the total area of the island is about 1.4 hectares. Due to the small size of the island government's plan was to develop a resort after increasing the size of the island through reclamation. Therefore Akirifushi Island was lease to Akirifushi Investment Pvt. Ltd., to develop a tourist resort after creating required land area through land reclamation.

Akirifushi Investment Pvt. Ltd., is a company created for the purpose of developing a high end tourist resort in Akirifushi Island. Akirifushi development project involves creation of land through reclamation and develop and operate 70 room high-end tourist resort with all the necessary facilities and amenities.

Development of Akirifushi will add 140 beds to the existing tourist bed capacity of the country. Overall the project will contribute to strategic targets outlined in the tourism master plan and overall tourism development in the Maldives and to create employment opportunities particularly for locals. The project will also generate much needed foreign currency and contribute to the economy through tax revenue and annual rent

3.2 PROJECT SETTING

Akirifushi Island lies in an E-W oriented triangular shape reef on the western periphery of North Male Atoll. The island is situated on the south western end of Akirifushi Falhu in a north south orientation. (Figure 1). Geologically it is a vegetated rubble cay (Huraa). Vegetated area of Akirifushi is approximately 8000 m² and island area is approximately 1.4 hectares. Total area of the reef where Akirifushi Island is situated is approximately 75 hectares. After the land reclamation the area of the island will be 8.2 hectares.



Figure 1: Map showing the location of Akirifushi in North Male Atoll

3.3 METHODOLOGY

The EIA methodology followed in the Maldives has evolved to an internationally recognized standard even to the standard to being advocated by IAIA¹. Started in Maldives around 1995/1996 the EIA Regulations underwent a major revision in 2007. The EIA Regulation² stipulates the complete process including EIA screening, scoping, review and issuing of decision notes, including the registration of the EIA consultants.

The EIA process in the Maldives is in many respects similar to international best practice. The process is shown in Figure 2. What has been lacking in the Maldives is strategic environment assessment which gives directions for environmental management including spatial planning and development strategy.

The EIA process starts with the screening where following an initial environmental examination³, a decision is made whether the project requires an EIA or not. If an EIA is required a full scoping of the project takes with stakeholder consultations. Following the Regulation on Reclamation and Dredging (Regulation 2013/R-15) a separate permit is required before proceeding to EIA screening. Dredging and reclamation permit of Akirifushi is shown in Annex 1.

Following the issuance of a Terms of Reference (ToR) of a project, the EIA consultants will undertake field work to examine the baseline conditions or existing environmental conditions to determine the impact analysis. The report is peer-reviewed anonymously by the two reviewers and comments and issues will be addressed before the decision statement is issued.

¹International Association for Impact Assessment (IAIA) which is the leading global network on best practice in the use of impact assessment, <http://www.iaia.org/default.aspx>, accessed December 2013.

²Environment Impact Regulations, 2007. Ministry of Environment, Energy and Water, Malé, Maldives, 74 pages.

³Initial Environmental Examination technically involves the Screening Form, Schedule #1, Development Proposal Screening Form, page 30, EIA Regulations, 2007.

Post-development monitoring of EIA is most neglected in the Maldives, partly because due to lack of enforcement measures from the authorities. The ToR for the complete EIA is given in Annex 2.

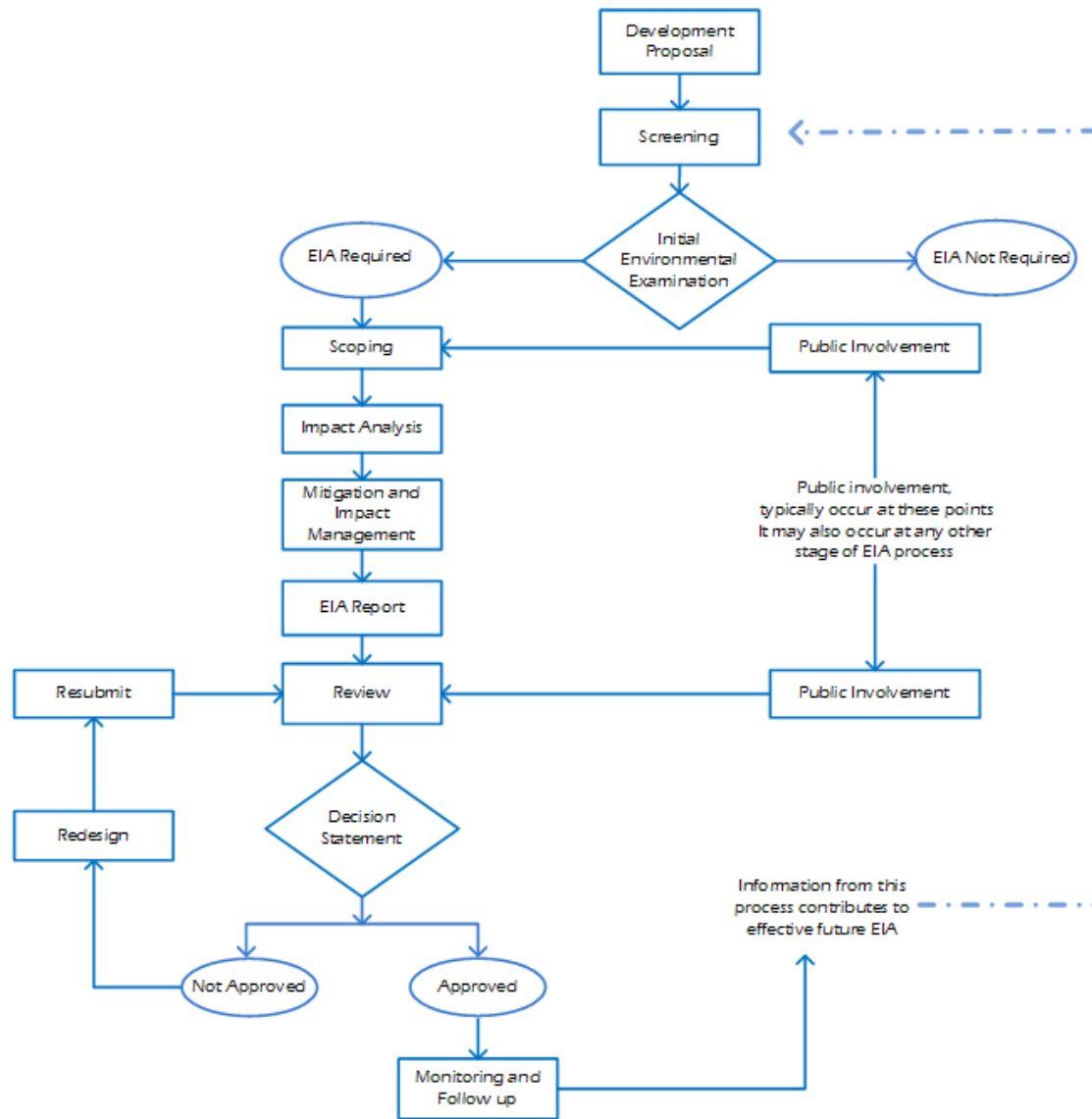


Figure 2: A general flow-chart of the EIA process that is followed in the Maldives

3.4 EIA REPORT AND EIA IMPLEMENTATION PROCESS

In general the objective of an EIA report is to address the environmental concerns of the development project. The EIA will help to achieve efficient planning, aid in identifying impacts and their potential mitigation measures. The EIA report will also help to promote informed environmental and sound decision making during the development of the project.

The aim of the EIA is to identify, describe and assess in an appropriate manner, proposed development, in accordance with the provisions of guidelines and regulations of the GoM, the direct, indirect and residual effects of the project on the following factors:

- Physical and chemical characteristics of the earth (soil, landform, force fields and background radiation, unique physical features), water (marine and underground), atmosphere (air quality and climate),
- biological conditions including flora (trees/shrubs and endangered species), fauna (birds, land animals, coral and endangered animals) habitats (environmentally sensitive areas protected area etc);
- cultural factors including aesthetic and human interest (scenic views and vistas, wilderness qualities, landscape design, historical and archaeological sites and objects), and cultural status (employment); and
- ecological relationships including eutrophication, disease and insect vectors, and introduction of alien species etc..

This EIA report has been prepared by registered freelance EIA consultants selected by the proponent. EIA preparation process is as follow:

- 1- The consultant prepares EIA application form for the proponent for submission to EPA, and the proponent submits the application along with the approved site plan and concept design.
- 2- EPA calls for a scoping meeting with proponent, consultant and relevant stakeholders from government agencies to determine the scope of the EIA study
- 3- Based on the discussion of the scoping meeting the consultant submits a draft TOR of the EIA.
- 4- EPA reviews the drafts ToR finalize and send to the proponent and consultant
- 5- The consultant undertakes literature review and gathers relevant data and information on the project.
- 6- Consultant undertakes the field assessment work
- 7- The consultant analysis data and information gathered and identify environmental impacts, determine mitigation measures, rationally evaluate and suggest alternatives and limitations and propose a monitoring plan.
- 8- The consultant will discuss major findings with the proponent and suggest possible changes to the project/project component.
- 9- Based on the discussion with the proponent the consultant reviews the EIA and makes necessary changes to the document.
- 10- The proponent should provide written commitment to undertake Post-development monitoring of EIA as per the proposed monitoring plan in the EIA report.
- 11- The consultant submits the final EIA to the proponent who subsequently will submit the EIA report to EPA for review and issue decision note.

Once the decision note is issued from EPA the proponent is obligated to implement the EIA and matters highlighted in the decision note. Also the proponent shall implement the periodic monitoring programme during construction and operational phase of the project and submit monitoring report as indicated in the EIA report

4 DESCRIPTION OF THE PROJECT

4.1 THE PROPONENT

The proponent of the project is Akirifushi Investment Pvt Ltd. A company registered in the Maldives (Registration no: C0472/2013) for the purpose of developing and operating a resort in Akirifushi Island.

4.2 PROJECT JUSTIFICATION

Akirifushi is recently been allocated for development of a high-end 70 rooms resort in the north western end of north Male Atoll. The main objective of resort development in Akirifushi is to meet current and projected bed capacity needs in the Maldives to reach the strategic targets outlined in the 4th Tourism master Plan 2013-2017. The basis for tourism development in the Maldives in the next master plan period, 2013 to 2017, is projected as follow:

- Increase tourist arrivals from 1million to over 1.6 million, maintaining a 10% growth
- Increase average stay of tourists from 6.8 days to 7.2 days
- Increase operational tourist bed capacity from 25,000 beds to 35,500 beds
- Increase occupancy rate from 73% to 85%
- Increase bed nights from 6.5 million to 12 million, with an average growth of 10% p.a.

Development of Akirifushi will add 140 beds to the existing tourist bed capacity of the country. Overall the project will contribute to strategic targets outlined in the tourism master plan and overall tourism development in the Maldives and to create employment opportunities particularly for locals. The project will also generate much needed foreign currency and contribute to the economy through tax revenue and annual rent.

4.3 PROJECT COST

The total investment cost of the for resort development project in Akirifushi (construction phase) is estimated to be 20 Million USD and this will be completed within the eighteen months of the project construction phase. Table 1 gives a breakdown of costs for resort development project in Akirifushi Island. Major part of the investment of Akirifushi during construction phase will be on land reclamation.

Table 1: Investment cost (construction Phase) of resort development project in Akirifushi.

Development	Cost in US\$ millions
Land reclamation and coastal protection	7
Front of the House (FOH) (buildings, guest accommodation, jetty restaurant Spa etc)	6
Back of the house facilities (BOH) and Utilities	4

Contingencies	3
Total	20

4.4 MAIN DEVELOPMENT FEATURES OF THE PROJECT

The proposed resort development project involves addition of 6.8 hectares to the existing island through reclamation as per the approved development concept. The scope and magnitude of the land reclamation is based on the requirements outlined in Table 1. Resort related development facilities are given in Table 3

Table 2: Resort development requirements.

Requirement	Details
Guest accommodation	70 rooms, 140 beds, beach villas, beach suits with pool, semi-water villas, water villas and water suits
Executive and junior staff accommodation	Accommodation for 214 staffs residing in the island
Harbour and entrance	Small harbor to accommodate 4-8 vessels
Arrival and service jetty	Guest arrivals and supply for the resort
Reception and arrival pavilion	Main reception and front office
Restaurants and bars	Main restaurant, lagoon restaurant pool bar with swimming pool, terrace bar and staff restaurant
Dive Center	Diving and snorkeling equipment and compressor room
Laundry	Guest, staff and resort laundry
Powerhouse and desalination plant	Three Gen sets 450 KVx2 and 500 KVA
Fuel and water storage	600,000 liter of fuel and 500m ³ water storage
Incinerator, bottle crusher and compactor	140-160kg incinerator, 12.Kg compactor, 600-1200 bottles/hr crusher
Workshop and carpentry	Maintenance and repair of equipment and furniture
Spa treatment pavilion	Spa and relaxation treatment for the guests
Waste collection area	Collection and segregation of waste
Sewerage treatment plant	300m ³ /day treatment plant

The main development activities of the project are:

1. Initial mobilization and reclamation (6.8 hectares from the shallow reef flat around the island).
2. Sand required for reclamation will be extracted from locations indicated in Figure x and approved by EPA (approval letter Annex 1)
3. Excavation of a 30m wide 120m long and 3m deep, entrance channel
4. Laying of geotextile, geomembrane to create beach
5. Coastal protection

6. Landscaping of the reclaimed land

Table 3: List of building and facilities in the resort

<p>1. Guest Accommodation</p> <ul style="list-style-type: none"> • Beach Villa • Beach Suite • Semi Water Villa • Water Villa • Water Suite 	<p>2. Services infrastructure</p> <ul style="list-style-type: none"> • Sewage Treatment plant • Desalinated Water Storage Tanks • Recycled Water Storage Tanks • Fuel Storage Tanks
<p>3. Public area (new)</p> <ul style="list-style-type: none"> • Reception Lobby • Library & Boutiques • Main Restaurant • Pool Bar & Swimming Pool • Beach Bar • Lagoon Restaurant, Terrace Bar & Wine Cellar • Recreation Centre • Gymnasium • Kid's Club • Spa Main & Changing • Spa Treatment Pavilion • Dive Centre • Water Sports Centre 	<p>4. Support facilities</p> <ul style="list-style-type: none"> • Executive Staff Bungalows • Executives & Assistant Managers Rooms • Supervisor Rooms • Junior Associates Quarters • Senior Associates Quarters • Staff Restaurant & Kitchen • Staff Services • Staff Recreation • Resort Administration Office • Laundry, Dry & Cold Stores • Maintenance Office & Workshop • Maintenance Stores • Service Centre • Mosque • Recycle House • House keeping • Communication Hut

The approved concept drawings for the project is given in Annex 3 and the reclamation permit is given in Annex 1

4.4.1 Site Planning and Design

All buildings have been located so as to maximize the use of sunlight and natural ventilation. The existing vegetation in the original island will be kept intact. The build-up area is designed to ensure that the existing vegetation remains intact and untouched. Due to the nature of the island large part of the island being reclaimed, artificial landscaping will be used which will only consists of salt and spray tolerant coastal vegetation and coconut trees that usually grows on this kind of environments. The reclaimed land will be landscaped using indigenous plants and trees and will have a protective perimeter bush that will help retain the created beach. The total land area of the island will reach 68, 414 m² after reclamation and the total built up area will be 10,143m². Therefore only 14% of the island will be used for development of resort facilities and guest accommodations. Details of key structures and components of the project

are described in this section and site plan is shown in Figure 3. Space allocation for buildings and facilities in the island is given in Table 4.

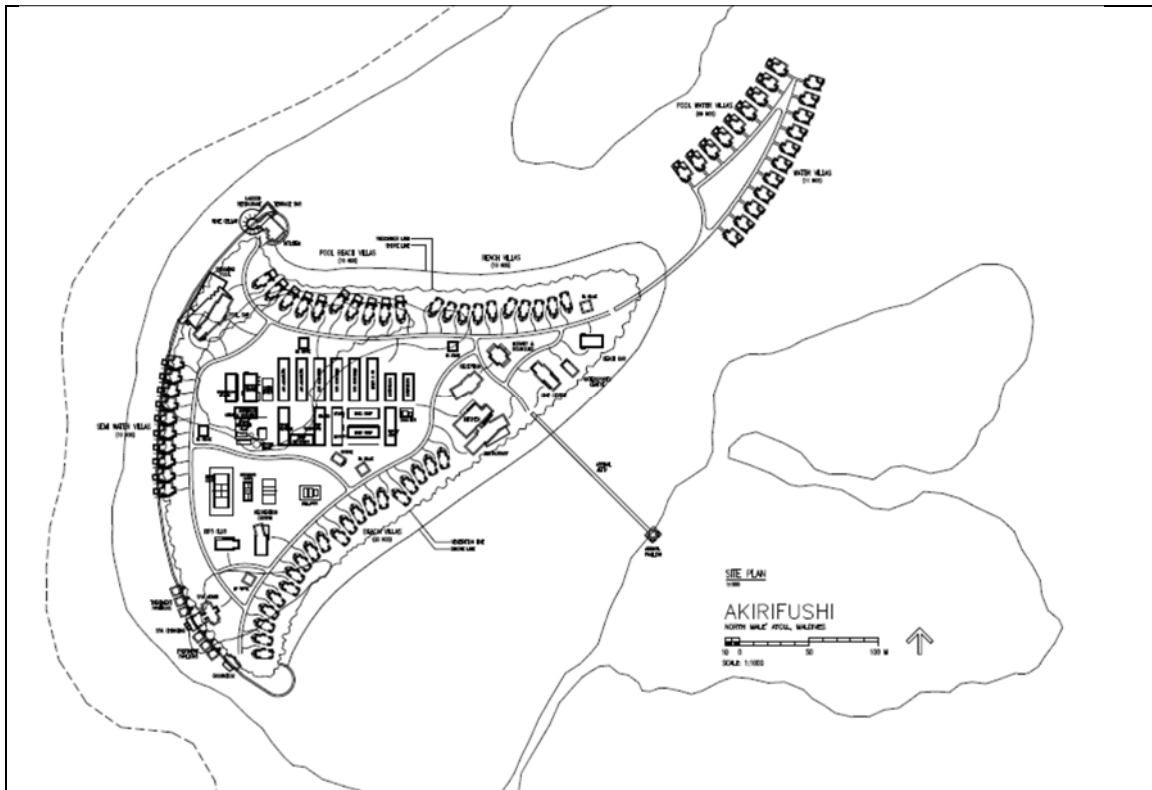


Figure 3: Akirifushi site plan and design, enlarged detail map is presented in Annex 3

Table 4: Land allocation for buildings and facilities in Akirifushi

ITEM	BUILDING / FACILITY	NO	UNIT	QTY	UNIT	QTY	UNIT
1.00 GUEST LODGING (NEW)							
1.1	Beach Villa	30	rooms	57.18	sqm	1,715.40	sqm
1.2	Beach Suite	10	rooms	57.18	sqm	571.80	sqm
1.3	Semi Water Villa	10	rooms	60.34	sqm	603.40	sqm
1.4	Water Villa	11	rooms	60.34	sqm	663.74	sqm
1.5	Water Suite	9	rooms	60.34	sqm	543.06	sqm
	TOTAL	70	rooms	140	beds		
2.00 PUBLIC AREA (NEW)							
2.1	Reception Lobby	1	unit	179.13	sqm	179.13	sqm
2.2	Library & Boutiques	1	unit	145.19	sqm	145.19	sqm
2.3	Main Restaurant	1	unit	572.40	sqm	572.40	sqm
2.4	Pool Bar & Swimming Pool	1	unit	279.47	sqm	279.47	sqm
2.5	Beach Bar	1	unit	111.89	sqm	111.89	sqm
2.6	Lagoon Restaurant, Terrace Bar & Wine Cellar	1	unit	206.60	sqm	206.60	sqm
2.7	Recreation Centre	1	unit	136.56	sqm	136.56	sqm
2.8	Gymnasium	1	unit	49.87	sqm	49.87	sqm
2.9	Kid's Club	1	unit	104.69	sqm	104.69	sqm
2.10	Spa Main & Changing	1	unit	160.72	sqm	160.72	sqm
2.11	Spa Treatment Pavilion	6	unit	29.62	sqm	177.72	sqm
2.12	Dive Centre	1	unit	152.13	sqm	152.13	sqm
2.13	WaterSports Centre	1	unit	54.58	sqm	54.58	sqm
3.00 SUPPORT FACILITIES							
3.1	Executive Staff Bungalows	2	unit	143.14	sqm	286.28	sqm
3.2	Executives & Assistant Managers Rooms	1	unit	204.40	sqm	204.40	sqm
3.3	Supervisor Rooms	2	unit	131.24	sqm	262.48	sqm
3.4	Junior Associates Quarters	2	unit	204.40	sqm	408.80	sqm
3.5	Senior Associates Quarters	3	unit	204.40	sqm	613.20	sqm
3.6	Staff Restaurant & Kitchen	1	unit	169.44	sqm	169.44	sqm
3.7	Staff Services	1	unit	169.44	sqm	169.44	sqm
3.8	Staff Recreation	1	unit	99.75	sqm	99.75	sqm
3.9	Resort Administration Office	1	unit	169.44	sqm	169.44	sqm
3.10	Laundry, Dry & Cold Stores	1	unit	169.44	sqm	169.44	sqm
3.11	Maintenance Office & Workshop	1	unit	99.75	sqm	99.75	sqm
3.12	Maintenance Stores	1	unit	127.36	sqm	127.36	sqm
3.13	Service Centre	1	unit	177.74	sqm	177.74	sqm
3.14	Mosque	1	unit	37.91	sqm	37.91	sqm
3.15	Recycle House	1	unit	36.68	sqm	36.68	sqm
3.16	House keeping	6	unit	37.21	sqm	223.26	sqm
3.17	Radio Hut	1	unit	10.55	sqm	10.55	sqm
4.00 SERVICES INFRASTRUCTURE							
4.1	Sewage Treatment plant	1	nos	105.25	sqm	105.25	sqm
4.2	Desalinated Water Storage Tanks	1	nos	192.00	sqm	192.00	sqm
4.3	Recycled Water Storage Tanks	1	nos	64.00	sqm	64.00	sqm
4.4	Fuel Storage Tanks	1	set	88.00	sqm	88.00	sqm
TOTAL BUILT-UP AREA						10,143.52	sqm
TOTAL LAND AREA						68,414.21	sqm
TOTAL BUILT-UP AREA PERCENTAGE						14.83	%

4.4.2 Guest Accommodation

Akirifushi is developed as a high end five star tourist resort; therefore, there will be five categories of accommodation on the resort with a combination of beach, semi-water and water villas. The beach villas are set along the beaches on the South East and North side of the island while the semi-water villas will be on the western stretch of the island set half on land and half on water.

The water villas stretch out towards the North East of the island into the shallow lagoon. Each villa will have a front covered veranda backed by a spacious bedroom set at the back of the bedroom and a bathroom with a private courtyard. The most basic category will be the beach villa followed by beach suites which will have a plunge pool at the front of the veranda. The next category will be the semi-water villas with their own plunge pools as well. The higher categories consist of water villas and water suites with plunge pools. All the units will have vanities, bath tubs and indoor and outdoor showers in the bath.

4.4.3 Jetties

The resort will be accessible by two jetties, one for guest arrival and one for services that are set on the Eastern side of the island where the natural deep lagoon is situated. Guest arrival jetty is located on the eastern to the south of service jetty. The location of two jetties are selected to get good access to the existing deep lagoon. Both jetties will be constructed on concrete piles to allow water and sediment flow underneath it.

4.4.4 Public Areas (Front-of-the-House FOH)

The public areas are designed in the island rustic style with sand floors supplemented by cement and terrazzo. The walls will be of adobe finish and the roof ceilings are exposed to give a lofty feel on the interior. The interiors are all open sided to take advantage of the beautiful surroundings and also to merge the exterior with the interior.

The public areas consist of two restaurants, three bars, spa with six treatment rooms, recreation centre, kid's club, dive and water sports centre and a swimming pool set in front of the pool bar. The arrival area will support the reception fronted by a library with boutiques.

Sports facilities include a tennis court, volleyball and badminton court on the island and a state-of-the-art modern gymnasium.

4.4.5 Utilities and back-of-the-house (BOH) facilities

Utilities and Back-of-the-house facilities such as, staff accommodation units, staff facilities, power and desalination complex, sewerage plant, and, store building, waste collection building and mosque etc. will be developed on the central part of the island. All the utilities will be located in a single building fenced and well blocked from guest accommodations. BOH facilities are designed and ideally placed to provide efficient support for the operation of the resort.

4.5 MAJOR CIVIL WORKS

4.5.1 Initial mobilisation and site preparation

Site mobilisation of construction equipment, materials and work force to the island will be undertaken in after the completion of dredging work or towards the end of dredging period. The dredger can access only after dredging the access channel. Therefore first the channel will be cleared to give access to the dredger and after that the dredging work will commence.

Reclamation and resort construction work requires use of heavy machinery and special equipment. Some of these include excavators, lorries, trucks, loaders and the like (Figure 4). A practical solution would be to bring these equipment after clearing the access channel and creating a small landing area, a sand bed extended to the deep lagoon, where a flat top barges, landing crafts or roll-on-roll-offs with the machinery can reach close to the beach. An approach that is commonly used is to create a sand bed from the beach to the deck of the barge. The heavy machinery can then simply drive over the bed on to the island.



Figure 4: Typical heavy machinery and equipment that will be used for resort construction, dredging and reclamation, IHC Beaver® series cutter suction dredger (bottom).

4.5.2 Dredging and reclamation

As mentioned earlier the whole resort development concept in Akirifushi is based on increasing the size of island area through reclamation to accommodate necessary facilities required for the resort operation. At present the land area of the island is 1.4 hectares. Therefore the approved concept of the island includes creation of extra 6.85 hectares through reclamation. Estimated volume of fill material required for reclamations is 135,000m³ which is available from Akirifushi lagoon. Sand burrow areas for reclamation has already been approved by EPA Annex 1. Most of the fill material needed for reclamation will be burrowed from the three deep lagoons (mainly from the edge) that exists on the eastern and northern side of Akirifushi Falhu. Sand burrow areas and amount that will be burrowed from each location is shown in Figure 5. Shape of the existing island and changes after the development is shown if Figure 6.



Figure 5: Akirifushi Falhu showing location of sand burrow areas and quantity of sand burrowed from each area and proposed land reclamation and total quantity of sand required

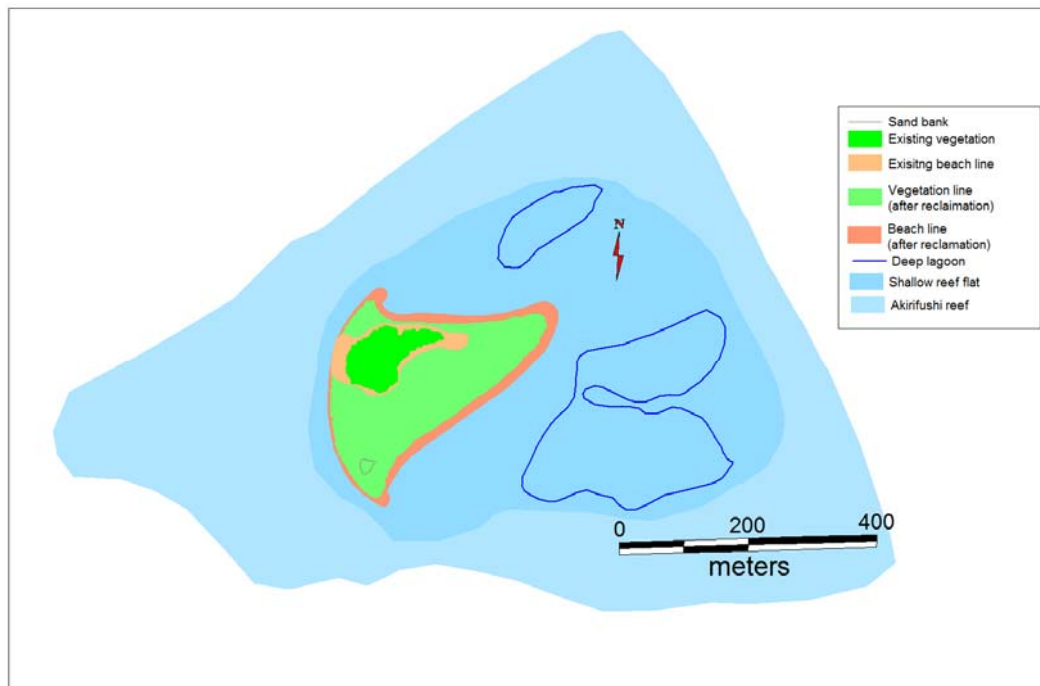


Figure 6: Akirifushi showing shape of the existing island and the changes after the proposed reclamation

4.5.3 Equipment used for dredging

The dredging and reclamation work related to Akirifushi development will be contracted to dredging company. As per the information from the contractor will use a IHC Beaver® series cutter suction dredger. These types of dredgers have a dredging depth range of 14-18m and draught range 1.5-2.1m. The dredger has the capacity to pump 500-1500m³ of sand and gravel mixtures to a distance of 500-600m from burrow area to the reclamation area.

4.5.4 Reclamation method and justification for selecting method and equipment

A bund wall be constructed using geo bags around the perimeters of the area to be reclaimed. To minimise the sedimentation and subsequent environmental problems a silt screen will be install out of the bund wall around the perimeters. Reclamation areas will then be further divided into smaller blocks using geobags. Dredged sand will then be displaced from burrow area by rainbowing, which is a method of choice for discharging large volume of sand, to the smaller reclamation blocks. When one block is reclaimed then move to the adjacent blocks and so on. Dredger spud and the dredger positioning will be controlled by the GPS assisted navigations system in the dredger, while the cutting depth will be controlled sensors installed in the cutter. The proposed dredging method is selected because of its availability and low cost and effectiveness. The dredging and reclamation work is expected to be completed in 6 months.

4.6 MAJOR WORKS OF THE RESORT

4.6.1 Entrance clearance and deepening

There is a no natural entrance to Akirifushi Island. Therefore a 30m wide 120m long and 3m deep, entrance channel will be cleared and cut through the reef flat into the existing natural deep lagoon during the initial commencement of site mobilization process. Extracted material from channel clearance and excavation will be used for reclamation of the island.

4.6.2 Excavation, Foundations and Construction systems

For construction of buildings and guest accommodations conventional building methods that do not require deep foundation structures will be used. Such shallow foundation based structures does not require any dewatering and removal of soil will have negligible impact on the environment. Therefore all buildings would consist of masonry work, reinforced concrete and structural steel work using manual labours and a mini excavator. In water structure such as foundation of the water villas and jetties and semi-water villas would be constructed using Spun concrete ICP piles which will be driven to sea bed using crane mounted piling rig. Although some damage and alteration is expected during this process this is expected to be insignificant and temporary.

Beam foundations are most common and probably most cost effective foundation type being adopted in the Maldives. Since low rise buildings do not require withstanding heavy loads. Beam foundations however, require excavations along the beams with larger footings at the columns. This would mean some excavations and piling up of sand around the building footprint. For single storey buildings, the practice in the Maldives has been to excavate about 0.3 – 1.2 meter for foundation. They are sufficient and are known to last for 20-30 years.

Power cables, sewer, drainage and water pipe grids will be connected through underground trenches. Mini excavators will be used for trenching work.

Fuel storage tanks will be built using steel plates. A bund wall will be constructed around the fuel storage tanks as fuel storage handling and safety regulation stipulates. The tanks will be built on reinforced concrete foundations.

Guest and service jetty will be constructed on ICP piles. The footings of the piles will be precast on land and transported to the site. Footing area will be cleared using excavators. Footing clearance work will be conducted at low tide to minimize sediment plume dispersal.

Feed water for the RO plant will be sourced through a borehole located near the RO plant at BOH area. Borehole construction and installation process will strictly follow the regulation on borehole construction by EPA. The brine outlet and sewage outfall will be located on the north western side of the island to the outer atoll waters where maximum flushing is ensured (at a depth not more than 5 meters).

4.6.3 Workforce and Services

A large construction workforce will be maintained on the island during the construction period. In this regard, around 150 construction staff will be stationed on the island initially, which will be gradually increased at the peak of the construction. All the construction staff will be stationed in the islands in temporary accommodations. A total of 300 construction staff is expected to work on the island at different stages during the construction phase.

4.6.4 Site office and temporary accommodation

A site office and temporary accommodation blocks will be constructed at the initial phase. In locating temporary accommodation as well as material storage and other construction-related infrastructure and services in Akirifushi special attention would be given to ensure there is minimal impact on island vegetation. Temporary infrastructure such as sewage disposal and water supply would be kept to a minimum to avoid damage to the environment.

4.6.5 Utilities

Existing water, electricity and sanitation facilities will be provided for construction workers and staff during the construction period. Since large of the island will consists of reclaimed land ground water lens will not developed. 2500-5000 litre rain water tanks will be kept on site for rainwater collection from the roofs of temporary accommodation blocks. Rainwater will be supplemented by 150m³/day desalination plant which will be installed to supply portable water need for the workforce and once the construction is over this plant will be added to the water production facility in the island. Electricity need for the island during the construction period will be generated through a 250-kVA Generator set which will be installed at the commencement of initial mobilization. Sanitation facilities will be provided using toilets and temporary septic tanks attached to them.

4.6.6 Services health and safety

The Proponent would not be responsible for any of the services that needs to be provided for the workers. Resort construction contractor is expected to provide the workers with daily meals and necessary entertainments facilities. The contractor will ensure that the construction activities are carried out under the supervision of a suitably experienced person and reasonable precautions and safety measures are implemented at the site throughout the construction period. Warning signs barricades or warning devices will provided for all the worker and will be obligated to wear them at the construction site at all times.

4.6.7 Construction Waste management and Disposal

General domestic waste generated from material consumption by construction workforce and the construction will be managed according to the tourism regulations and waste regulations and the contractor is obligated to dispose all construction related waste during demobilizations along with other wastes. The contractor is responsible to clear all areas of work before handing over the site to the proponent.

4.6.8 Pollution control measures

The following pollution control measures will be strictly implemented during the construction stage:

- All the machinery and equipment will be properly tuned and maintained to reduce emission leakage and spill.
- Proper fuel paints, lubricants, and other chemicals handling and transport measures will be strictly implemented and the fuel storage will be banded.
- To handle any accidental liquid spills, spill kits will be maintained in the construction site.
- Existing septic tanks system will be utilized for sewage and wastewater disposal during the construction period

4.6.9 Fire prevention

Water based fire extinguishing will be preferred during the construction period. Pumps connected to the sea will be installed prior to commencement of major construction activities and other fire extinguishing equipment would also be readily available and employees will be trained to use it in case of fire breakout in the construction area. Potential fire prone activities such as welding and cutting will be carried out by experienced personnel and proper precautionary measures will be strictly followed in the construction site.

4.6.10 Landscaping and Terrestrial Habitat

Due to the fact that 6.85 hectares of land will be added to the existing island, artificial landscaping will be used which will only consists of salt and spray tolerant coastal vegetation and coconut trees that usually grows on this kind of environments. At present the vegetated area of the island is approximately 8952m² only. With the reclamation 68500m² of barren unvegetated land will be added to the island. Therefore large amount trees are needed to vegetate and landscape the island. The proponent is planning to landscape and vegetate the island through transplantation of trees from islands where large amount of trees are discarded for various projects, such as airport developments, and resort development etc. Also the proponent will establish a nursery within the island using available seeds from the trees in the island to use for landscaping. The detailed design for natural landscaping has not yet been prepared but it should be noted that there is no intention to import exotic plants that has potential to introduce alien species to the environment. As the regulation on cutting down trees stipulates prior permission must be obtained for removal and/or relocation of 10 or more trees or palms. For indiscriminate removal and land clearances and EIA and Decision Note is required. The size of the trees and palms that are allowed to be relocated should have more 15feet from lowest point to the crown spread for palms and 8 feet from the lowest point to the trunk to tip of the highest branch for trees other than palms. Every attempt will be made to utilize native and local plant species in a manner to create a habitat that will support even more diverse fauna on the island. Most of the mature trees at the vegetated area of the island will be left intact as mentioned earlier.

4.7 POWER GENERATION

At present the island has a 50kVA unit which was left by the previous caretaker of the island. Availability and condition of the generator sets is unclear at this stage. With the commencement of reclamation work a temporary powerhouse with a capacity of 450kVA will be installed at the island. , Since the power requirements will be increasing as the development progresses the

proponent is proposing to have works of the permanent powerhouse complete quite early in the project. To this end once the reclamation work is over and footprints of the all the buildings have been marked out, transmission cables will be laid out. The permanent power house of the island will be located at BOH in the service infrastructure area at the southern side of the island. The total area of the service infrastructure facilities is 450 m². At the end of construction phase the resort will power generation capacity of 1000kVA, consisting of 450x2 kVA and one 500 kVA units to provide the energy needed for effective operation of the resort.

The current regulation requires power generation systems to be registered at the Maldives Energy authority. Registration of power plants requires environmental impact assessments with detailed technical documentation of the power generation system (cable layout, engine specifications, and synchronization panel specific) and addressing of safety issues. Important safety issues lightening earth rods, fire-fighting equipment (liquid carbon dioxide), ear-mufflers, etc. It is strongly recommended the developer obtain the full details and make necessary arrangements for registration of the power production system as before commissioning the work.

Diesel storage tanks with a total capacity of 300,000 litres will be required to accommodate fuel requirements for the resort operation, in addition 300,000 litres of petrol. Fuel will be stored on site in appropriately banded storage tanks as stipulated in the fuel safety regulations and distributed to generator sets. Fuel will be transported into the island from the service jetty through fuel transportation vessels and fed into the storage tanks through pipelines. The island being close to Male and space limitations in the island the developer is planning to maintain minimal necessary fuel storage for resort operations in the island.

All lighting in the resort will be energy saving light bulbs. Energy efficient Inverter type air conditioner system with ozone friendly refrigerants will be used for the air conditioning of the buildings/areas such as the guest rooms, kitchens, guest facilities, laundry and staff accommodation. All air-conditioning ducts and condensation pipes will be insulated as appropriate. Electrical machinery will also be energy efficient machinery. Waste oil from the generators will be collected and incinerated appropriately.

4.8 WATER PRODUCTION

Ground water analysis result shows that the salinity of water is 5.48 therefore, it is suitable for human consumption. During the construction period rain water will be harvested from the roofs of temporary buildings and consumed as portable water for the worker and for watering plants in the island. In addition at the commencement of construction a temporary desalination plant with a production capacity of 150m³/day will be installed for production of fresh water supply. This capacity supplemented with rainwater harvested from roofs of the temporary buildings will be sufficient during initial period of development. It is expected that a 2 x 150 m³/day desalinated water will be required during the resort operation period. The RO plants will be housed in BOH area in the service infrastructure building. For emergency proposes during the operational phase of the project 500m³ water storage tanks, each with 250m³ storage capacity will be installed at the BOH area.

The source water for the RO plants will be from boreholes. The borehole will be located at BOH near the utility building. Standard guidelines produced by EPA will be followed in drilling boreholes.

It is proposed to discharge the rejected brine into the lagoon. The discharge will have no effect on the surrounding environment as it will be instantly mixed with water column reducing the concentrations to negligible amounts.

Government regulation requires that water production plants with capacity of > 10 cubic meters / day be registered at EPA. The requirements, in addition to addressing environmental issues, need to undertake comprehensive water quality tests.

4.8.1 Hot Water Installation

Solar water heaters complete with storage will be installed in guest villas to preheat the incoming coldwater to approximately 35-40°C. Energy efficient water heating technologies, such as use of heat from AC and similar options will be explored during the development of the island, if cost effective and suitable for the island environment, the proponent will consider adopting such systems.

4.9 SEWAGE AND SOLID WASTE DISPOSAL

In order to appropriately dispose sewage and wastewater from the resort, installation of a modern high-tech sewage and wastewater treatment plant will be given an important consideration as raw sewage and waste water being disposed into the sea will generate adverse impacts on the marine environment. The island requires having sewage and wastewater treatment plant with a capacity of 200-300 m³/day. The sewage and wastewater treatment plant will be located in the utilities building in BOH area in the service infrastructure building. The sewer network grid of the island will be a gravity flow system with lifting stations (pumping of the effluents) that would eventually take the effluents to the treatment plant. Most commonly used sewage and wastewater treatment plants in the Maldives are Sequence Batch Reactor Plant (SBR) systems.

The developer is considering installing either a modern sewage treatment system such as Membrane Bioreactor Plant (MBR) or a commonly used Sequence Batch Reactor Plant (SBR) system. The MBR system is advantageous because it has a much smaller environmental footprint and allows operating at high biomass concentration. Also typical MBR design will operate 12,000 mg/l of biomass while SBR in the range of 3,000 mg/l. MBR systems have the advantage of using a much smaller process basins overall plant footprint is 50 – 70% smaller than an SBR system. Further, because it relies on phase separation, the SBR cannot operate at elevated biomass concentrations, as the sludge loses its ability to settle into distinct layers once the MLSS gets above 6,000 – 8,000 mg/l. MBR system will produce less waste sludge than an SBR system and MBR technology utilizes a physical barrier for sludge separation.

From the above comparison it seems that MBR systems are more efficient and appropriate for Akirifushi due to the space limitations in the island.

Treated affluent water will be disinfected to eliminate the bacterial load and will be used for watering garden/landscaped area and toilet flushing. Some of these would also be soaked to the ground through soak pits to replenish the groundwater. This will assist in recharging the aquifer and in the conservation of freshwater in the resort. Wastewater from areas including guest, staff, laundry and public areas will be connected to the treatment plant. The sewage sludge will be disinfected before disposal. The disinfected sludge after all treatment processes will be removed from the treatment plant and will be dried in a dry bed before being used as soil fertilizer for landscaping and gardening in order to avoid discharged into the sea.

Solid waste would be disposed according to the tourism industry standards using incinerators, compactors and bottle crushers (see below). Food organic waste non-biodegradable waste and chemical waste generated from various facilities would be disposed off to Thilafushi.

The new Waste Management Regulation that came to effect on 6 February 2014 calls for extended producer responsibility where by producer has to ensure the waste is dealt according to guideline in the regulation. It is likely to take some time before the EPA can effectively ensure the waste management entities comply with the provisions in the regulation.

4.10 PROJECT ACTIVITIES – OPERATIONAL PHASE

4.10.1 Guest Accommodation

The resort will have 70 guest rooms. A 1:1.5 staff-guest ratio will be maintained at the resort at all times. All the staffs will be accommodated in the resort. Greater emphasis will be given to maintain and effectively manage the environment of the island during the resort operation. The following operational activities of the resort will be taken into serious consideration during the overall operation of the resort that will be developed on Akirifushi Island.

4.10.2 Transport

Sea transport, speed boats and launches, will be the mode of transportation for arriving/ departing guest to the resort. The arrival jetty will be used for guest transportation. Resort supply and cargo also will be transported using boats and cargo Dhonis and will use the service jetty extended to the deep lagoon in Akirifushi Falhu.

4.10.3 Water demand, supply and conservation

Using a factor of 300litres /person/day and a guest staff ratio of 1:2, at full occupancy, the estimated daily water consumption of the resort is about 105m³, inclusive of the requirements for irrigation of the grounds. The island's groundwater will neither be used for construction nor for the operations. All water will be generated using desalination plants. Resort water supply will be metered and the water will be stored in reservoirs with a capacity of 10 days consumption. The main reservoir for drinking water will be divided into two sections to facilitate cleaning and maintenance and it will be fitted with a chlorinator. A separate tank will store water for fire protection.

Measures that will be considered to reduce water consumption include:

- Water pressure booster system used to maintain a constant water pressure which could allow considerable savings of water each day,
- Efficient hot water delivery system to reduce volume of water wasted while waiting for hot water in the tap,
- WC cistern with double flushing mechanism (3/6 litres) or flush stop mechanism. Its effectiveness depends on the guest's choice,
- Taps with flow and temperature restrictors could potentially save up to 20 m³ per day,
- Use of treated sewage effluent for irrigation,
- Grey water from taps, tubs and showers could be reused, once filtered and treated, in WC cisterns or for irrigation.

4.10.4 Waste Management

The different types of waste during the resort operation can be divided into two broad categories; inorganic and organic waste. The main types of inorganic waste include paper and cardboard items such as stationary and packaging, glass and plastic bottles, plastic bags, cans and tins, building material, and furniture and will be sorted accordingly. Organic waste will mainly consist of food and kitchen waste and green waste from garden trimmings. The other type of waste that will be generated during the resort operation is hazardous waste, which will mostly consist of batteries, solvents, paints and anti-fouling agents that will have high chemical content.

Both organic and inorganic as well as hazardous waste will be collected daily and will be taken to the waste collection area, which will be established in close proximity to the staff and back of the house area for easy management. Different types of waste will be initially sorted and contained at the waste collection area, which will have bottle crusher, incinerator and can compactor. The organic waste will be sorted into kitchen and garden waste, while inorganic waste will be sorted into plastics, paper, glass and tins. Hazardous waste will also be kept separate at the waste collection area.

The solid waste management unit at the resort will be equipped with all the necessary machines and technologies to effectively manage the solid wastes generated from its operations as stipulates in tourism regulations. The following order of waste management hierarchy will be established as part of the resort operation. These include; avoid, reduce, reuse and recycle.

The waste generated on the resort will be carefully managed by use of waste management equipment. For instance, all flammable waste will be incinerated, glass bottle will be crushed, aluminum cans and tins will be compacted and food and garden waste will be composted. The residual waste such as crushed glass and compacted cans as well as hazardous waste will be transported and properly disposed at Thilafushi Island.

4.10.5 Sewage and Wastewater Disposal

At full occupancy, using a factor of 300 litre/person/day, an estimated 105m³ of sewage will be generated on a daily basis. This sewage will be collected and pumped via ducts to the sewage treatment plant. On site, the sewage pipes will be trenched underground with manholes provided at every angle and positioned at almost every 50-100 meters. Kitchen waste water will be connected to the sewage line after first passing through a grease trap. Given the flat

nature of the island it may be necessary to install lift stations to pump sewage to the sewer mains.

4.10.6 Power Generation, Fuel Management, and Waste Oil Disposal

Electricity demand, supply and conservation: The generator sets run on diesel fuel. This fuel will be stored in a 300,000 litre tank placed above ground and surrounded by a spill-containment wall to retain a volume of at least 1.25 times the volume of the tank.

In order to minimise the use of electrical energy, the resort intends to implement the following:

1. Install fluorescent lighting throughout, but preferably LED lights which is more efficient
2. A/C controlled with switches on room windows
3. Central lighting control system for common areas
4. Rooms outfitted with body detectors or card switches

Waste oil from the generators will be collected and incinerated. Storage and transport of waste oils will be controlled through introduction of SOPs and management plans on waste oil management and handling as well as through limitation of transport paths sealed containers and specific transport mechanisms.

4.10.7 Marine and Water Sports

Snorkeling diving and recreational fishing will be the main tourist activities. The deep lagoon in Akirifushi reef is excellent for water sports activities. The resort therefore will offer the usual suite of water sports including small boat sailing, snorkeling, wind surfing and scuba diving etc. Fishing excursion will also be an important activity the resort will offer. Water sports will be operated by licensed service providers. It is anticipated that the resort will ensure that guests are well informed about the marine protected areas and that it will encourage adherence to the relevant diving and snorkeling regulations. It is also expected that the resort will use mooring sites for dive boats so as to avoid anchor damage on the reef.

4.11 INPUTS AND OUTPUTS

The input / output analysis of a project helps us to define and understand the potential environmental impacts of the project in more informed manner. Linking inputs to processes and activities leads us to outputs and consequently impacts. The inputs and outputs relating to the construction and operation of tourist resorts maybe primarily derived from the project concept and the project description and site plan of the Island.

Table 5: Matrix of major inputs to the project construction and operational phase

Input resource(s)	Source/type	How to obtain resources
Construction phase		
300 construction Workers	Foreign/ local	Contractor's employees, 10 engineer and a 7 site supervisor Recruited through bidding and announcement in local papers, and recruiting agencies etc.
Construction material	Reinforcement steel bars, river sand, cement, aggregates Timber; Thatch for roof, electrical cables and wires, DBs, MMCBs and MCBs, PVC pipes, light weight concrete blocks, light weight, telephone cable CAT, PVC conduits, core armored cables, PP-R pipe, Multi pump, UPVC (T1000, T600) for sewerage grid, floor and wall tiles, gypsum boards, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner, dry walls etc.	Imported and locally purchased where available
Trees for landscaping	Discarded trees from islands where developmental activities are taking place and from nursery	Locally from islands and transported to the island
Heavy machinery (dredger, excavators lorries, dumpers, concrete machine and a crane and operational tools)	Contractor's machinery	Hire locally/ contractors machinery
Maintenance tool and equipment	Maintenance parts and fluids required for the machinery	Import or purchase locally where available
Fuel and lubricant for machinery	Diesel, Petrol, Lubricants	local suppliers/ contractor
Fresh water	Desalinated water	Desalination plant capacity 150m ³ , existing rain water tanks.
Electricity/ energy during construction	Diesel generator	Existing 450kVA diesel generator

Electrical appliances/machinery	Energy efficient machinery and appliances	Local suppliers if available if not import
Firefighting equipment	Fire pumps, Fire protection system, and Foam fire extinguishers.	Local suppliers if available if not import
Operational Phase		
154 operational staff	114 locals and 40 expatriate	Recruited through bidding and announcement in local papers, and recruiting agencies etc.
60 labourer	25 locals and 35 expatriate	Recruited through bidding and announcement in local papers, and recruiting agencies etc.
Water supply	Desalinated water, hot water and water storage	2x150m ³ /day RO plant, solar water heaters and water storage tanks
Drinking water	Bottled water	Locally purchased empty bottles will be sent back to the company for recycling
Electricity/ energy	Diesel generator	450kVA x 2 units and a 500kVA generator set
Maintenance material	Timber, wooden shingles for roof, electrical cables, electrical appliances, paint, thinner etc.	Locally purchased
Telecommunications	PABX system, fax machines, email and internet facilities to all guest facilities, communication hut at BoH area	Local telecom companies
Transport	International airlines, domestic by sea	Launches and speed boats
Food and beverages	Mainly imported sources. Preference will be given to locally grown agricultural items and produced food items.	Import and purchase locally (fruits, fish and vegetables).
Laundry chemical	Detergent, all-purpose cleaners, glass cleaners, bathroom cleaners, destainer, softener, alkali neutralizer, detergent, detergent plus, stain spots remover, etc. preference will be given to bio-degradable compounds	Imported and locally purchased

Paper products	issue roll, tissue boxes, hand tissues, guest room paper amenities/ brochures office use paper products	local supply if available if not import. Recycle products and fabric material tissues will be preferred
Fertilizers	Compost and fertilizers	disinfected sludge after all treatment processes will be dried and used as soil fertilizer
Firefighting equipment	Fire Pumps, Fire Protection System, Smoke Detectors, Carbon Dioxide and Foam Fire Extinguishers, etc.	Local suppliers
Fuel, Kerosene and LPG	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

Table 6: Matrix of major outputs construction and operational phase

Outputs (s)	Anticipated quantities	Disposal method
Construction phase		
Dredged material	Large quantity 130,000 m ³ approximately	Reclamation and ground levelling
Green waste	Small quantities	Burnt or mulched on site and used for nursery and landscaping needs
Demolition waste	Large quantities	concrete and masonry blocks will be used for backfilling combustibles burnt/ incinerated others sent to Thilafushi
Construction Waste	Small quantities	combustibles burnt/ incinerated others sent to Thilafushi
Fuel and lubricant for machinery	Minor quantities	Gathered in a barrel and sent to Thilafushi
Waste water from workers	Minor quantities	Managed through temporary sewerage system
Operational Phase		
Non portable water	50-100 liters/day	Reused for gardening and landscaping toilet flushing, aquifer recharge

Portable water	1000-2000 plastic bottles/ month and 500-1000 glass bottles/month	Plastic Bottles – crushed and sent to the bottling company Glass Reused or Returned to manufacturer
Sewage and wastewater	300 liters/person/day gray water laundry waste water	treated wastewater reuse and excess pumped to sea, bio-degradable chemicals
General Domestic waste	Over 300 kg/day	Sent to Thilafushi
Kitchen and organic waste	Over 400kg/day	Sent to Thilafushi
Waste oil and grease	Over 500 liters/ month	Incinerated or reused
Scrap metal/cans/plastics	20-100kg/ month	Sent to Thilafushi
Paper and Plastics, packaging waste	10-50 kg /month	Sent to Thilafushi
Glass and glass bottles	10-50 bottles/ day	Sent to Thilafushi
Hazardous waste	Minor quantities	Properly sealed in containers and sent to Thilafushi

4.12 DEVELOPMENT SCHEDULES

Under the agreement between the Government and the developer, the resort is to be completed within 18 months. Additional two months were given to complete the EIA and administrative clearances. An indicative schedule of activities is given in **Error! Reference source not found.**Table 7.

Table 7: Project Schedule

Activity	2014												2015							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
EIA preparation and approval	█	█	█																	
Site mobilisation																				
Temporary facilities																				
Dredging and reclamation																				
Arrival Jetty																				
Supply jetty																				
Beach Villa																				
Beach Suite																				
Semi Water Villa																				
Water Villa																				
Water Suite																				
Reception Lobby																				
Library & Boutiques																				
Main Restaurant																				
Pool Bar & Swimming Pool																				
Beach Bar																				
Lagoon Restaurant, Terrace Bar & Wine Cellar																				
Recreation Centre																				
Gymnasium																				
Kid's Club																				
Spa Main & Changing																				
Spa Treatment Pavilion																				
Dive Centre																				
WaterSports Centre																				
Executive Staff Bungalows																				
Executives & Assistant Managers Rooms																				
Supervisor Rooms																				
Junior Associates Quarters																				
Senior Associates Quarters																				
Staff Restaurant & Kitchen																				
Staff Services																				
Staff Recreation																				
Resort Administration Office																				
Laundry, Dry & Cold Stores																				
Maintenance Office & Workshop																				
Maintenance Stores																				
Service Centre																				
Mosque																				
Recycle House																				
House keeping																				
Radio Hut																				
Sewage Treatment plant																				
Desalinated Water Storage Tanks																				
Recycled Water Storage Tanks																				
Fuel Storage Tanks																				
Finishing and clearing																				
Interior furnishing and fitting inspection																				
Commencement of operation																				

5 REGULATORY CONSIDERATIONS

5.1 INTRODUCTION

The proposed tourist resort development project in K. Akirifushi Island will be subject to the laws in particular Environmental Protection and Preservation Act (No. 4/93) of Maldives. Thus, it must satisfy the EIA process and get approval before the project starts implementation. This section outlines and summarizes key policies, applicable laws and regulations and regulatory bodies regarding environmental protection in the Maldives.

5.2 POLICY GUIDANCE

The environmental management and policy direction is taken from a number of policy documents prepared by the Government of Maldives. Key documents outlined in this EIA are currently being implemented towards sustainable development of the country. They key policy direction is taken from most recent policy documents that were available at the time of the EIA preparation.

5.3 NATIONAL FRAMEWORK FOR DEVELOPMENT (2009 -2013)

One of the most important environmental policy guidance is given in the Strategic Action Plan (SAP) of the National Development Framework for 2009-2013. Due to the fragile nature of the country's environment, all the development activities must ensure that appropriate care is taken to protect the environment. Environmental sustainability is the basis for socio-economic development, hence, the SAP outlines the key environmental policies that will be implemented in the country for environmental protection and sustainability, while one of the key environmental goals of the country is to protect and preserve the natural environment to ensure prosperous economic development. The environmental policies outlined in the SAP include;

- Policy 1: Strengthen EIA process with an emphasis on EIA monitoring*
- Policy 2: Conserve and sustainably use biological diversity and ensure maximum ecosystem benefits*
- Policy 3: Develop resilient communities addressing impacts of climate change, disaster mitigation and coastal protection*
- Policy 4: Strengthen adaptation and mitigation responses for beach erosion and develop a system to assist communities where livelihood and property are affected by beach erosion*
- Policy 5: Ensure management of solid waste to prevent impact on human health and environment through approaches that are economically viable and locally appropriate*
- Policy 6: Ensure protection of people and the environment from hazardous waste and chemicals*

Policy 7: Improve air quality to safeguard human health

Policy 8: Enable a fully functional decentralized environmental governance system

Policy 9: Develop a low carbon economy to achieve Carbon Neutrality by 2019

Policy 10: Inculcate environmental values in the society and enable environmentally friendly lifestyle

The Ministry of Environment and Energy and Environmental Protection Agency takes the lead role in implementing the above national policies through various strategies and regulatory measures.

5.4 THIRD NATIONAL ENVIRONMENT ACTION PLAN (2009 – 2013)

NEAP 3 sets out the agenda for environmental protection and management in the Maldives for the five year period 2009 – 2013. This plan is targeted to achieve measurable environmental results that matter to the people of the Maldives.

The aim of developing NEAP 3 is to protect and preserve country's environment and properly manage natural resources for sustainable development of the country and encompasses ten principles, six strategic results with targeted goals to be achieved under each result.

The key principles of the NEAP 3 are;

Principle 1: Environmental protection is the responsibility of every individual

Principle 2: Achieve results

Principle 3: Promote and practice sustainable development

Principle 4: Ensure local democracy

Principle 5: Inter-sectoral co-ordination and co-operation

Principle 6: Informed decision making

Principle 7: Precaution first

Principle 8: Continuous learning and improvement

Principle 9: Right to information and participation

Principle 10: Environmental protection complements development

The six strategic results of NEAP3 are: resilient islands; rich ecosystems; healthy communities; safe water; environmental stewardship; and a carbon neutral nation with 30 result oriented environmental goals that will be achieved in the span of the NEAP 3.

5.5 MALDIVES NATIONAL STRATEGY FOR SUSTAINABLE DEVELOPMENT (2009)

The Maldives National Strategy for Sustainable Development (NSSD) outlines the key objectives, principles and goals that the country will embark toward achieving sustainable development. Hence, the overall direction of the NSSD is to build a nation which appreciates the true value of the natural environment, utilizes its natural resources in a sustainable manner for national development, conserves its limited natural resources, has built the capacity to learn about its natural environment and leaves a healthy natural environment for future generations.

The guiding principles outlined in the NSSD are;

Principle 1: Promotion and protection of fundamental human rights

Principle 2: Equity within and between generations

Principle 3: Democratic and open society

Principle 4: Full participation of businesses and civil society

Principle 5: Policy coherence and coordination

Principle 6: Use best available knowledge

Principle 7: Precaution first

Principle 8: Make polluters pay

While the country will be steered in accordance with the underlying principles of NSSD, the country aims to achieve very important environmental goals, including; adapting to climate change, protecting coral reefs, achieving carbon-neutrality in energy, ensuring food security, establishing a carbon neutral transport system, protecting public health and achieving full employment and ensuring social security.

5.6 FOURTH TOURISM MASTER PLAN (2013 – 2017)

Tourism master plans are for four years, the most recent one being the Fourth Tourism Master Plan (4TMP). The plan is currently in the draft stage. The emphasis of the 4TMP is on six themes.

- 1. Maintaining Maldives position in the world*
- 2. Managing environment and conservation issues*
- 3. Engaging more Maldivians in tourism careers*
- 4. Promoting sensible ways for communities to participate in tourism*
- 5. Promoting investment towards sustainable growth and high product quality*
- 6. Efficient in marketing and destination management.*

Unfortunately it talks little about the guest house or city hotel tourism, but which seems to be booming in the Maldives. The islands around Malé, like Maafushi, are extremely popular among the tourists looking for a cheap holiday packages.

Despite the apparent lack of strategic direction for lower to middle end market, many small case investors are capitalizing on the change in policy, which is gaining ground. In some ways allowing small-scale tourist hotel operations facilitates more Maldives taking tourism as their careers.

5.7 REGULATORY BODIES

5.7.1 Ministry of Environment and Energy (MEE)

The primary environmental institution in the Maldives is MEE. It is mandated with formulating policies, strategies, laws and regulations concerning environmental management, protection, conservation and sustainable development, regulation of the water, sewerage, waste and energy sectors as well as implementation of the international, regional environmental conventions and treaties. The Minister of Environment or a designate gives the environmental approval or clearance to EIA by an Environmental Decision Statement.

5.7.2 Environmental Protection Agency (EPA)

EPA is the key regulatory body on environment, which is an autonomous body formed under the umbrella of MEE. It is mandated with implementing the EIA process in the Maldives, implementing the Environment Act and subsequent regulations on behalf of MHE, regulating water and sanitation, biodiversity conservation, waste management and coastal zone management. Also, it is responsible for developing environmental standards and guidelines in the country.

5.7.3 Ministry of Tourism, Arts and Culture (MOTAC)

The Ministry of Tourism, Arts and Culture is responsible for the sustainable development of the tourism sector in the Maldives. Under the Tourism Law various regulations, standards, controls and measures relating to protection of the environment have been developed and are currently being implemented. Important measures include implementation of carrying capacity limits when developing islands as tourist resorts. In this regard, only 30% of the island shall be used to develop tourist resort infrastructure and facilities. Also, the Ministry of Tourism ensures that appropriate waste management facilities such as incinerators, bottle crushers and compactors and that water production and energy generation methods are environmentally friendly.

5.7.4 Atoll Councils and Island Councils

Under the Maldives Decentralization Law, elected City Councils, Atoll Councils and Island Councils have been formed as regulatory bodies dealing directly with City, Atoll and Island issues. In this regard, the some of the development projects are subject to approval of these councils through a stakeholder consultation process.

5.8 LAWS AND REGULATIONS

There are a number of laws and regulations relating to environment in the country. Only relevant laws and regulations have been outlined in this section.

5.8.1 Environmental Protection and Preservation Act (Law No. 4/93) and Regulations

The Environmental Protection and Preservation Act of the Maldives, EPPA (Law No. 4/93) provides the basic framework for environmental management including Environmental Impact Assessment (EIA) process in the Maldives, which is currently being implemented by EPA on behalf of MEE.

Clause 2 of the EPPA mandates the Ministry of Environment and Energy to formulate policies, rules and regulations regarding the environment.

Clause 5 of this Act specifically provides for environmental impact assessment (EIA), a tool implemented to attempt to integrate environmental issues into development decisions. According to the Clause, environmental impact assessments are a mandatory requirement for all economic development projects.

Clause 6 of the EPPA gives the Ministry of Environment and Energy the authority to terminate any project that has an undesirable impact on the environment.

Clause 7 of the EPPA refers to the disposal of oil, wastes and poisonous substances in to the Maldivian territory. According to this clause, any type of waste, oil, toxic gas or any substance that may have harmful effects on the environment should not be disposed within the Maldivian territory. If, however, the disposals of such substances become absolutely necessary, the clause states that they should be disposed only within the areas designated for that purpose and if incinerated, appropriate precautions should be taken to avoid harm to the health of the population.

Furthermore, clause 9 sets a fine between five and five hundred Rufiyaa for minor offenses in breach of this law and a fine of not more than one hundred million Rufiyaa for major offenses. The fine shall be levied by the Ministry of Housing and Environment or by other government authorities designated by that Ministry in case of minor offenses.

Finally, Clause 10 of EPPA gives the government of the Maldives the right to claim compensation for all damages caused by activities that are detrimental to the environment.

The Environmental Act or Law 4/93 is the single most important legal instrument with regards to environmental management and it gives very high prominence towards safeguarding the environment with regard to all the development activities. Under this Act, the Ministry of Housing and Environment have developed regulations and guidelines concerning the environmental protection through implementation of EIA procedures.

5.8.2 EIA Regulation of the Maldives, 2012

The most important regulation concerning the proposed development is Environment Impact Regulations, 2007, which was amended in 2012 is enforced under Environment Protection and Preservation Act (Law No. 4/93) by the Environmental Protection Agency (EPA). The Clauses of Environment Protection and Preservation Act address the following that relate to the proposed project development and implementation.

- An impact assessment study shall be submitted to the relevant Government authority before implementing any development project that may have a potential impact on the environment
- The relevant Authority of Government shall formulate the guidelines for environmental impact assessment and shall determine the projects that need such assessment as mentioned in above.
- The Termination of projects. The relevant Government Agency has authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation
- Waste Disposal, Oil and Poisonous Substances. Any type of waste, oil, poisonous gases or any substance that may have a harmful effect on the environment shall not be disposed within the territory of the Maldives
- Government of Maldives reserves right to claim compensation for all the damages that area caused by the activities that are detrimental to the environment.

In addition to EIA regulations, other relevant regulation will be followed in development and implementation of the proposed project. These regulations include ban on coral mining. Coral mining from house reef and atoll rim reef has been banned since 1990. Sand mining from any island has also been banned since March 2000. Coral or sand will not be used for any purpose for the proposed project.

5.8.3 Regulation on Uprooting, Cutting and Transportation of Palms and Trees, 2006

Cutting down and relocating of mature trees is regulated in Maldives under the By-law on Cutting down, Uprooting, Digging out and Export of Trees and Palms from One Island to Another. In the preamble of the law, made in pursuant to Law No. 4/93⁴, it states the purpose of the law is to educate citizens and developers about the importance of trees including sound management to maintain trees and provide standards for the preservation of trees in the Maldives.

Under the law certain tree are prohibited to remove from island. They include:

- The coastal vegetation growing around the islands extending to about 15m into the island
- All trees and palms growing in mangroves and wetlands spreading to 15m of land area
- All trees in Government protected areas
- Trees that are being protected by the Government in order to protect species of animal / organisms that inhabit on such trees
- Trees / palms those are unusual in nature.

The regulation states that prior permission must be obtained for removal and/or relocation of 10 or more trees or palms. For indiscriminate removal and land clearances and EIA and Decision Note is required. The size of the trees and palms that are allowed to be relocated should have more 15feet from lowest point to the crown spread for palms and 8 feet from the lowest point to the trunk to tip of the highest branch for trees other than palms.

The law also states that cutting down and uprooting of the trees shall be made under supervision of the island / atoll offices (in the current context Atoll / Island Councils).

5.8.4 Regulation on Management, Use and Control of HCFC Substances, 2010

The HCFC Regulation is developed under the Environmental Protection and Preservation Act (4/93) towards regulating phasing out of import, use, selling of HCFC substances by 2011 and completely eliminating use of HCFC substances in the Maldives by 2020 through controlling importers, registering importers, establishment of a quota system, control mechanisms for selling, maintenance of import, selling, purchase and service providers statistics.

5.8.5 Regulation on Environmental Damage Liabilities, 2011

Under the Environmental Protection and Preservation Act (No. 4/93), the Ministry of Housing and Environment formulated the Environmental Damage Liabilities Regulation in February 2011, which encompasses the basis to avoid environmental deterioration, extinction of biological resources, environmental degradation and avoid wastage of natural resources. The main purpose of this regulation is to stop unlawful activities on environment and adequately implement a fining procedure for violations as well as implement a compensation mechanism on environmental damages. Its Schedules form the basis for levying fines on various environmental components and activities. Hence, the proposed project will be subject to this Regulation for any activity outside of the EIA scope and Environmental Decision Statement.

5.8.6 Dredging and Reclamation Regulation, 2013

Regulation on Reclamation and Dredging of islands lagoons (Regulation 2013/R-15) came into effect in April 2013. The regulation requires having permission of EPA on projects requiring

alternation of the island, either by reclamation or dredging. Specifically the regulation requires producing scaled-maps of the island before and after the proposed intervention. Special provisions have been made on protected and sensitive area restricting changes to the environment of the islands.

5.8.7 Waste Management Regulation, 2013

Waste management Regulation (No. 2013/R-58) is more recent coming into effect on 6 February 2014. The Regulation was gazetted on 05 August 2013. The regulation provides set of comprehensive guidelines and on collecting, storing, transporting and managing waste as well as management of hazardous waste. The waste management regulation identifies the following areas prohibited from dumping of waste; protected areas under the Environmental Protection and Preservation Act, mangroves, lagoons of islands, coral reefs, sand banks, beaches of islands, coastal vegetated areas of islands, harbours, parks and roads. Additionally, waste management regulation states that those involved in waste management must be permitted by the Environmental Protection Agency.

5.8.8 Other Environment-related Laws and Regulations

Other laws and regulations that have direct bearing to environmental protection include, the Law relating to Uninhabited Islands (Law No. 20/89) and the Law relating to Coconut Palms and Trees of Inhabited Islands (Law No. 21/89), both define the policy with respect to conservation and use of terrestrial flora and living resources in the Maldives. The Law on Uninhabited Islands provides that trees and plants on uninhabited islands must be planted, cared for and protected by the party entrusted with the management of the island. Both these Acts regulate protection of vegetation, removal of trees and sustainable use of timber. The Law on Uninhabited Islands is implemented by Ministry of Fisheries and Agriculture, and the Law relating to Coconut Palms and Trees of Inhabited Islands is now implemented by Ministry of Home Affairs and Island Councils.

Coral and sand mining in the Maldives is regulated through Regulation of Sand and Coral Mining issued and implemented by Ministry of Fisheries and Agriculture. The Regulation restricts and prohibits mining of sand and coral from certain areas in the Maldives. It also identifies areas where mining of coral and sand is permitted through approval.

5.9 TOURISM LAW (NO. 2/99) AND REGULATIONS

The Tourism Law recognizes a number of regulations, standards and controls with regard to the development of tourist resorts in an environment friendly manner in the Maldives and is implemented by the Ministry of Tourism, Arts and Culture. Under the Tourism Law the Ministry has developed regulations comprising of important regulatory measures and controls as well as standards including building standards, food and sanitation standards, waste disposal, electricity code, carrying capacity, diving regulation, windsurfing and tourist behavior.

5.9.1 Carrying Capacity

As an important basis for deciding the number of rooms and extent of resort facility development allowed on each resort island, the government has established carrying capacity standards. These are based on several factors including; cutting of trees is controlled so that the natural appearance and façade of the island are maintained and no buildings are allowed to appear above the tree tops, the maximum land area occupied shall not exceed 20% of the total land area. The total development area has been recently changed to 30%.

To preserve the tourist's perception and image of beach orientation, all guestrooms should be facing the beach, with a minimum of 5m of linear beach available in front of each room. Only 68% of the beach length shall be allocated to guestrooms, 20% has to be allocated to public use and 12% left as open space.

5.9.2 Architectural and Design Controls

The design of tourist resorts are controlled so that they are well integrated into the island environment, use local building materials, such as thatch roofs to the extent possible. The use of coral is restricted and the use of imported building materials is encouraged. Coral and sand mining from the resorts and their house reefs are strictly prohibited.

Hard engineering solutions for dynamic coastlines are discouraged and construction of solid jetties and groynes are controlled and shall only be undertaken after conducting an impact assessment study. Design of boat piers, jetties shall be in such a way that these shall not obstruct the current patterns of the island.

5.9.3 Biodiversity Conservation

In order to protect and preserve marine environment a number of measures have been prescribed. Spear, poison and dynamite fishing are strictly prohibited. Net and trap fishing are controlled and confined to certain areas. Removal of shells, juvenile lobsters and lobsters ready to lay eggs are strictly prohibited.

The catching of turtles is strictly prohibited and trade in all turtle products is banned. The commercial exploitation and export of many other marine species are banned. Reef fishing from the resort house reef is also discouraged. Also, as a measure for protecting and conserving marine biodiversity, 25 marine protected areas have been designated and fishing, removal of coral, anchoring and other destructive activities are prohibited.

The Ministry of Tourism recognizes the importance of vegetation in maintaining the natural beauty of the island and there a number of regulations in terms of conserving the vegetation of the islands. These include a limit of 30% of the island for development and a setback limit of

5 linear metres from the vegetation line of the island and that no buildings shall appear above the treetops.

5.9.4 Food, Water and Sanitation

The tourism regulation also requires the restaurants and kitchens of tourist resorts to be structurally sound, clean and properly maintained. Rat proof ceiling and rodent control mechanisms shall be in place in the kitchens and other food handling areas. Hygienic food handling and cleanliness of staff is also encouraged.

According to these regulations, safe and adequate water must be made available and water supplies must be clean and well maintained. Drinking water must be sufficiently disinfected to prevent water-borne diseases.

All catch pits and manholes shall be made water-tight and shall not leak. Stagnant waters shall not be left uncovered for mosquito breeding. Tins, bottles and cans that will hold water shall not be left anywhere. The tourism regulation also specifies that the sewage system shall be installed such that pollution of water supplies, beaches, lagoons, and other areas are prevented. It also emphasizes the need of dispose of sewage and wastewater in such a way that it will have minimal or no implications on the environment of the island and surrounding seas.

5.9.5 Waste Disposal

According to the regulations issued by the Ministry, garbage from tourist resorts shall be disposed of in a manner that would not cause any damage to the environment. All garbage disposed into the sea shall be done as far away into the sea as necessary in order to ensure that it does not get washed onto the beaches of the islands.

All tourist resorts are required to have incinerators and compactors adequate in size to burn and compact all waste materials generated from the resort. It is also important to have bottle crushers to crush glass bottles. Those that lack these facilities are not allowed to operate. Plastic or hygienic bags shall not be thrown into the sea and such materials shall be burnt.

These regulations also require sweep cleaning of the entire resort at least once every day. Refuse is required to be disposed in closed containers and disposed of daily.

5.9.6 Dredging, Reclamation and Other Coastal Activities

The Ministry of Tourism does not encourage hard engineering solutions such as heavy breakwater structures, groynes, solid jetties, seawalls and revetments on tourist resorts of the Maldives in order to ensure the natural environmental qualities of the island are maintained. Clause 15 of the Tourism Regulation requires that such activities shall only be undertaken after approval from the concerned government agencies and through its Circulars CIR/64/96 and CIR-ES/98/07, the Ministry of Tourism has reminded tourist resorts of the need to obtain

necessary approvals after submission of EIA reports to the Ministry of Housing and Environment before commencing any coastal development activities.

5.9.7 Construction Practices

All infrastructure development areas in the islands designated for tourist resort developments have to be clearly demarcated and these areas will be inspected by the planning officials of the Ministry of Tourism. The number of mature trees that need to be felled and the vegetation that needs clearing will have to be noted and prior permission is required for any vegetation clearance.

5.9.8 Regulation on the Protection and Conservation of Environment in the Tourism Industry, 2006

The purpose of this regulation is to protect the environment in the tourism industry and to encourage and facilitate sustainable development of tourism. It is strictly enforced to islands and land areas leased for development tourist resorts and tourist facilities by the Ministry of Tourism.

The key attributes of the Regulation include;

1. Protection of the environment during resort construction where the following activities are subject to prior approval of MOTAC;
 - a. Dredging of the lagoon and reclamation of land
 - b. Construction on the beach and lagoon
 - c. Beach enhancement by pumping sand
 - d. Construction of breakwater
 - e. Construction of sea wall, revetment and groyne
 - f. Dredging of lagoon for safe access
 - g. Dredging of reef
 - h. Felling trees
 - i. Importing and exporting living species
 - j. Conducting research of land, sea and lagoon
 - k. Demolition of a building or facility
 - l. Anything that may adversely affect the vegetation or freshwater lens of the island
2. An environmental impact assessment report prepared in accordance with the Protection and Conservation of Environment Act of Maldives (Law No. 4/93) shall be submitted to the Ministry of Tourism, Arts and Culture prior to the commencement of any construction project or any activity.
3. Protected birds or marine living species shall not be caught or kept in cages or other enclosed space in an island or land leased for the development of tourism.

4. All soils and chemicals used as pesticides and fertilizers imported for use in a tourist resort, Picnic Island, marina or such a place shall be imported after obtaining written permission from the relevant government authority.
5. Waste disposal in tourist resorts, picnic islands, and marinas operating in the Maldives shall be carried out in a manner that would have the least impact on the environment, and in accordance with the laws and regulations and in accordance with the rules prescribed by the Ministry of Tourism, Arts and Culture.
6. For the purpose of provision of clean and safe water sufficient for use in the resort, every resort shall have a desalination plant. The plant shall be registered with the Environmental Protection Agency in accordance with the “Regulation on Desalination Plants”, and shall comply with such regulation in the operation of the desalination plant.
7. Sewage shall be disposed in a manner that is least harmful to the environment.

If any provision of this regulation is contravened by any tourist resort, picnic island, marina, hotel, guest house, or tourist vessel, shall be guilty of an offence, and shall be liable to a fine, taking into consideration the seriousness of the non-compliance, between MRF 1,000.00 and MRF 10,000.00 in the first instance. Parties repeatedly in non-compliance shall be liable to a fine between MRF 50,000.00 and MRF 100,000.00. If non-compliance of a provision occurs more than once, the Ministry reserves the right to revoke the license.

5.10 INTERNATIONAL AND REGIONAL CONTEXT

The major global issue facing the Maldives is climate change, global warming and subsequent sea-level rise. The small size of the islands and their low elevation above MSL makes possible impacts of it very seriously. Consequently, the country plays a prominent role in fore-fronting environmental issues faced by many other small islands developing states including the Maldives in the international arena. The Maldives is therefore, a party and signatory to various international conventions and declarations. These include;

- *UN Convention on the Law of the Sea – UNCLOS (1982)*
- *International Convention for the Prevention of Pollution of the Sea by Oil (1982)*
- *Vienna Convention for the Protection of the Ozone Layer (1985)*
- *Montreal Protocol on Substances that Deplete the Ozone Layer (1987)*
- *Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989)*
- *The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990)*
- *Agenda 21 and the Rio Declaration of the United Nations Conference on Environment and Development (1992)*

- *Convention on Biological Diversity (1992)*
- *United Nations Framework Convention on Climate Change (1992)*
- *The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992)*
- *The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997)*
- *The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999)*
- *Washington Declaration on Protection of the Marine Environment from Land-Based Activities*
- *Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998)*
- *Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002)*
- *United Nation Convention to Combat Desertification (2002)*
- *Convention in International Trade in Endangered Species of Wild Fauna and Flora (CITES) 2013*

The Maldives is also a key player in formulating and adopting various regional plans and programmes to protect the environment by continuously participating in various activities organized by regional bodies such as SACEP, ESCAP and SAARC. As a result the Maldives is committed to the following;

- *SAARC Environment Action Plan adopted in 1997 in Male'*
- *SAARC Study on Greenhouse Effect and its Impact on the Region*
- *South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994)*
- *SAARC Study on Causes and Consequences of Natural Disasters, and*
- *South Asian Seas Programme initiated by SACEP*
- *Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998)*

6 EXISTING ENVIRONMENTAL CONDITIONS

6.1 GEOLOGY AND GEOGRAPHY

Akirifushi is a vegetated rubble cay formed through accumulation of coral rubble boulders, gravel and sand. Rubble cays are formed in high energy environments where the island is continuously exposed to wave action. Akirifushi Island is situated on the south western end of the N-S oriented triangular shape Akirifushi Falhu and located on the northwestern end of North Male Atoll. North Malé Atoll is at the central region of Maldives and it is located on the eastern side of the double chain of atolls of Maldives. The nearest resorts to Akirifushi is Eriadhu Island 5.5km to the south, and Makunudhoo Island is 10.4 km to the south. The capital island Malé is 52km to the south of Akirifushi (Figure 1). The total length of Akirifushi Falhu along the long axis (N-S) is 0.8km Along (E-W) is 0.9km. At present Akirifushi Island is approximately 180m long and 80m wide, and has an area of 1.4 hectares. Total area of Akirifushi Falhu is 75 hectares. The island occupies 0.01% of the total reef area. With the completion of the proposed reclamation the land area of Akirifushi will be 8.2 hectares that is about 5times of the present land area of the island and that accounts of 0.1% of the total reef area of Akirifushi Falhu.

6.2 OBJECTIVES

The main aim of surveys and assessments was to establish the existing baseline environmental conditions of Akirifushi Island. Environmental monitoring during construction and operation phase of the islands to ensure the changes in environment are captured and remedial actions for the observed negatives impacts are addressed in a timely manner. The objectives of the present assessment were:

1. To determine the general soil characteristics, fauna and flora of the project area
2. To determine the quality of groundwater of the project area and sea water quality
3. To determine the coastal conditions near the project area
4. To assess the changes that will be associated with land reclamation

6.3 STUDY AREA AND SURVEY LOCATIONS

The study area covers the terrestrial environment of the island is given in Figure 7 below shows the ground and sea water sampling locations, beach profile and marine survey locations with their respective GPS co-ordinates are given in respective sections of the report.

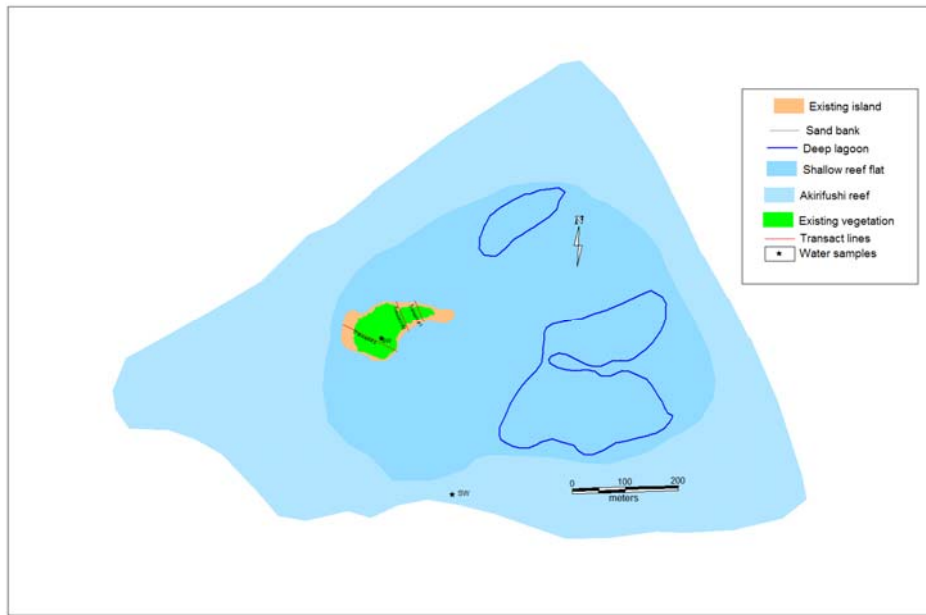


Figure 7: study area, sampling locations and transect lines

6.4 METHODOLOGIES

Both qualitative and quantitative methods have been used to collect data. Under water assessment was carried out by snorkelling in three locations. Terrestrial environment was assessed and type of vegetation in the island was determined. Ground water and soil of the island was assessed by digging a well and taking the soil profile of the island. Ground water was analysed from the laboratory in Maldives Water and Sewerage Company. Bathymetric survey of Akirifushi Falhu were carried out by using an echo sounder and a GPS. Island profiles were measured using a dumpy level to assess the topography of the island. Beach surveys were conducted by using a differential GPS and existing maps.

Vegetation Assessment: The flora of the island was assessed by using both qualitative and quantitative assessment methods. The percent cover of the vegetation was assessed by undertaking 5x5m quadrat on two sections of the island. Visual assessment was also carried out within the island and coastal areas. Aerial photography to some extent was used to locate main trees that are found on the island.

Soil and groundwater Assessments: A water sample was collected from the central part of the island in clean 1.5 L PET bottles after washing them with water to be sampled. Parameters tested for ground water quality assessments were physical appearance, temperature, pH, electrical conductivity, total suspended solids. Necessary parameters to assess the overall quality of the ground water was analyzed at the laboratory in Maldives Water and Sewerage Company (MWSC) laboratory. The location of sampling area given in Figure 7. and geographic coordinates are given in Table 8.

Table 8: Geographic coordinate of ground water sampling and soil profile location

Well No	Latitude	Longitude
GW1	4.637549	73.400569

Soil structure of the island was assessed from the well dug to extract ground water sample. Unlike the similar small islands elsewhere in the Maldives Akirifushi has fairly thin layer with rich humas content. The ground water is heavily influenced by the tidal variation as it rise and falls with the tide

Coastal Environment Assessment: Aerial photographs and Digital globe, Google earth and island surveys are comparatively evaluated using GIS technology to assess the developments of the island. Three transects across the island were taken during the field visit to evaluate differences in beach morphology of the island and evaluate the island topography.

Bathymetric survey of Akirifushi Falhu, reef entrance and Falhu were carried out by using echo sounder and a GPS. Differential GPS technique is used for correction of GPS locations points. Echo sounder measurements are corrected and related to the mean sealevel for the area. Bathymetry of the Akirifushi Falhu is in Figure 8.

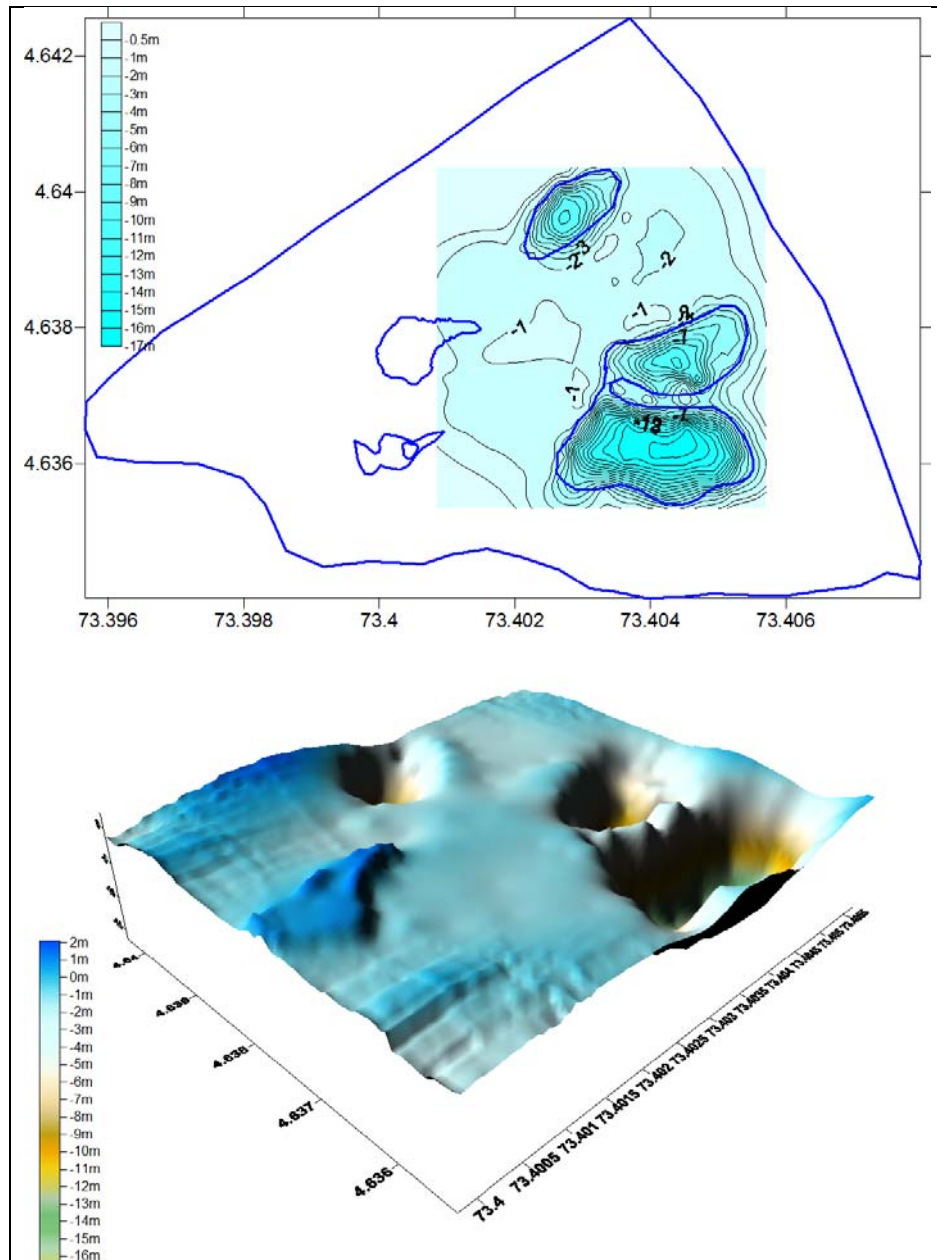


Figure 8: Bottom contours of Akirifushi Falhu (top) and digital elevation of the Falhu including the island (bottom).

Marine Environment Assessment: Quantitative and qualitative assessments on the coral reef were carried to determine the general health of the reef. Coral reef was assessed by using several photo quadrats, visual assessments and fish census. Together with findings of the quadrats, visual assessment and census, data were analysed to determine the health of the reef. Coral reef assessments were carried out on three sites of the island with main concentration on the proposed area.

6.5 METEOROLOGY AND CLIMATE

6.5.1 Monsoons

The climate of Maldives is characterised by the monsoons of Indian Ocean. Monsoon wind reversal significantly affects weather patterns. Two monsoon seasons are observed in Maldives: the Northeast (Iruvai) and the Southwest (Hulhangu) monsoon. The parameters that best distinguish the two monsoons are wind and rainfall patterns. The southwest monsoon is the rainy season while the northeast monsoon is the dry season. The southwest monsoon occurs from May to September and the northeast monsoon is 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 (see Table 9).

Table 9: General Meteorological Information about the Maldives

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

6.5.2 Winds

Winds affect sedimentation process both during the formation and development of islands. Winds help regenerate waves that are weakened by traveling over reefs and also cause locally generated waves over lagoons. The following figure (**Error! Reference source not found.**) is an analysis of wind data for the period July 2002 to December 2012, which shows a general picture of winds in terms of direction and strength. The analysis was done on www.windfinder.com, which was accessed on 15 March 2014.

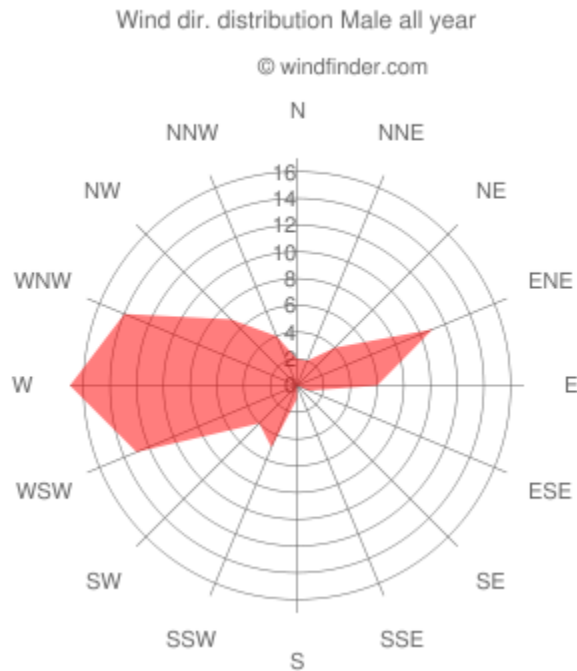


Figure 9: Average wind speed and direction (from www.windfinder.com)

The average wind speed for the sum of the years (2002-2011) is 9 knots for the entire country and the predominant wind directions are W, WSW and WNW, which is the main feature during the SW monsoon. During the NE monsoon, predominant wind occurs from ENE direction with an average wind speed of 6-7 knots. Thus, strong winds are associated with the southwest monsoon season. Gales are uncommon, and cyclones are very rare in the Maldives.

The below figure (Figure 10) is a regionalized prediction of wind direction for the Indian Ocean done on www.windfinder.com, which shows that the predominant wind direction during the month of December 2014 will be from the East with a wind speed of 6-8 knots.

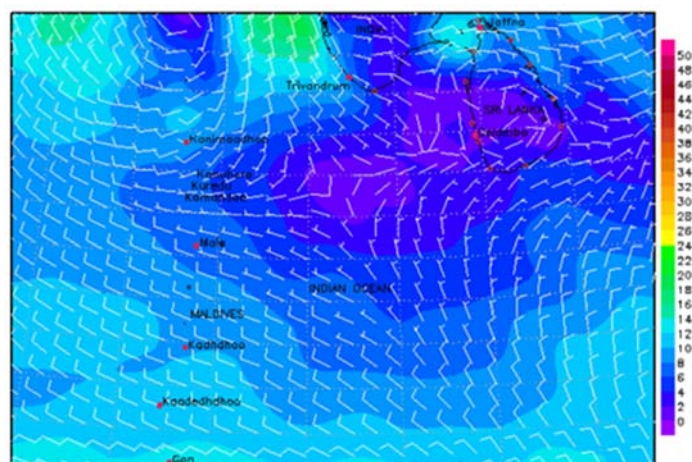


Figure 10: Wind speed and direction prediction for December 2014

6.6 HYDROLOGY

6.6.1 Currents, Tides and Swells

Tidal currents as well as oceanic currents are felt in the atoll. The exposure of the Atoll to the vast Ocean ensures that an immense body of water is constantly flowing across the atoll. The currents can be extremely strong in the channels between the reef systems around the atoll especially during ebb and flow into the atoll.

Current speeds of four knots or more have been recorded in the atoll channels in the country. Oceanic currents are largely influenced by the direction of trade winds and can be of great strengths. Tidal currents which flow according the height of the tide and the direction of prevailing wind are much weaker than oceanic currents.

A regionalized swell prediction for the month of December 2014 for the Indian Ocean (Figure 11) done on www.windfinder.com, shows that the areas near the Maldives will experience a swell rage of 1 – 1.5m.

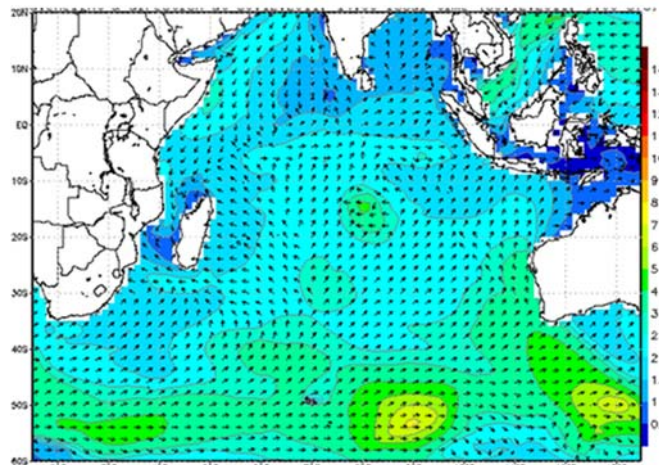


Figure 11: Indian Ocean swells prediction for December 2014 (www.windfinder.com)

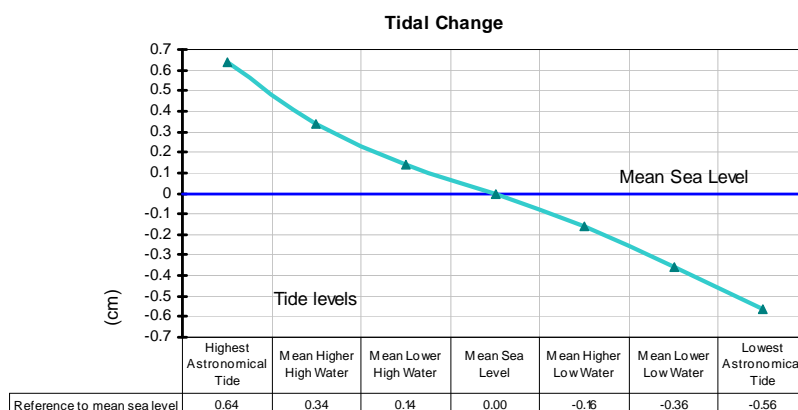


Figure 12: Astronomical tidal variation in Maldives

Like most of the places semidiurnal tides are experienced in the atoll, that is two high tides and two low tides a day. The tide varies from place to place, depending on the location and on the shape and depth of the basin, channels and reefs and also time of the year.

Figure 12 shows the astronomical tidal variation recorded in the country with respect to the mean sea level. Astronomical tides are related to the motion of the earth-moon-sun system, and have a range of periodicities. The highest astronomical tide was recorded as 0.64 cm above the mean sea level and the lowest astronomical tide was recorded as 0.56 below the mean sea level. Tidal variation of 1.2m from lowest to the highest tide levels were recorded in the country.

6.6.2 Surface Temperatures

The surface water temperature in the Indian Ocean in December 2013 is recorded to be around 30°C (Figure 13).

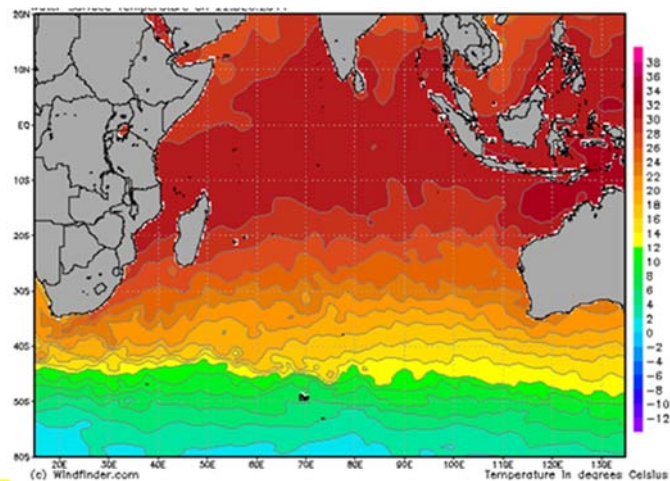


Figure 13: Surface water temperature in December 2013 (www.windfinder.com)

6.6.3 Waves

Two major types of waves are observed along the coast of Maldives. The first type is wave generated by local monsoon wind with a period of 3-8 seconds and the second type is swells generated by distance storms with a period of 14-20 seconds. The local monsoon predominantly generates wind waves which are typically strongest during April-July in the south-west monsoon period.

Maldives experiences occasional flooding caused by long distance swell waves that are generated by South Indian Ocean storms. The swell waves of height 3m that flooded Malé and Hulhulé in 1987 are said to have originated from a low pressure system off west coast of Australia. More recently in May 2007 swell waves that originated from the south western side of the Indian Ocean caused flooding in 35 inhabited islands across 13 atolls, including Addu atoll. In 2004 Maldives was subject to earthquake generated tsunami inundation heights reaching of 4.0m on land (UNEP, 2005).

General wave and current pattern around Akirifushi Falhu was assessed using available information and data. The dominant wave direction during NE monsoon will be from north and

north eastern side of the reef while during SW monsoon the dominant wave direction is expected to be from west, south and south western side of the reef. The reef is exposed to swell waves from the south western side. Assumed current and wave pattern around Akirifushi island extrapolated from available data is shown in Figure 14

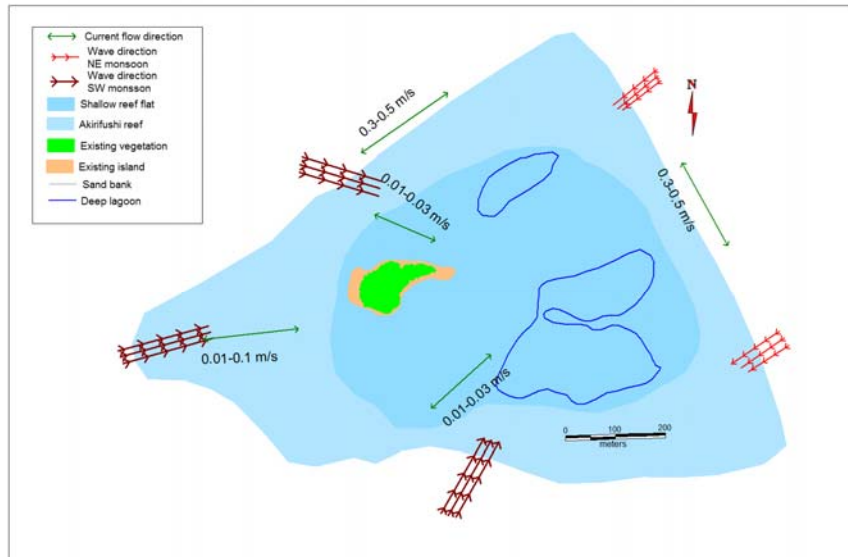


Figure 14: Observed general wave directions and assumed current flow pattern around Akirifushi Falhu.

7 TERRESTRIAL ENVIRONMENT

7.1 INTRODUCTION

Following is an account on the existing status of the terrestrial environment of Akirifushi Island based on field data obtained during field assessments undertaken on the island. Field assessments were carried out during April 2014.

7.2 DATA COLLECTION METHODOLOGY

During site visits to the island, a number of field surveys and observations were undertaken to understand the existing environmental status of flora and fauna of the island. In order to understand the vegetation content, qualitative and quantitative methods such as visual assessments, aerial photography and 5x5m terrestrial quadrats were used during the surveys to collect site-specific information. Faunal presence was assessed by field observation, calls and encounters during surveys.

7.3 STATUS OF FLORA

7.3.1 General Description

Akirifushi is a fairly small island found on the NW tip in North Male' Atoll in a single reef system. The island is located at 4°38'15.89"N and 73°24'1.58"E and is found on the western side of the reef, which is triangular in shape. The current land area of the island is estimated to be only 1.4ha having approximately 165m in the length and 85m in the width.

The island is characterized by fairly young natural vegetation mainly consisting of *Kaani*, *Hirundhu*, *Dhigga*, to a great extent and *Magoo*, *Kuredhi*, *Boa Kashikeyo* and *Boashi* to a smaller extent in the coastline. A small area covered in *Kandoo* (mangrove) is found on the northern side of the island in a slight depression where the ground gets occasionally flooded from tidal fluctuations. These mangrove trees found on the island are also observed to be young (Figure 15).

As the island was previously given for management on *Waruva* basis, the natural vegetation of the island has been somewhat altered or trimmed by the previous management. Almost all vegetation was observed to be trimmed near the ground area, thus resulting in containing the trees in a smaller area. Only a couple of planted young *Ruh* were found in the middle of the island.

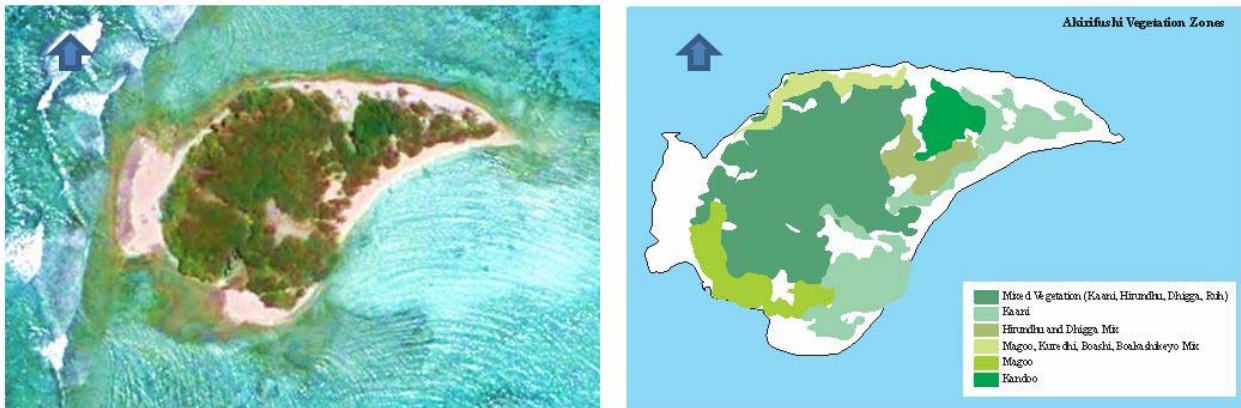


Figure 15: Aerial photograph of Akirifushi Island (left) and major vegetation zones found on the island (right)

The dominant vegetation on the island was observed to be *Kaani*, which was mostly found on the eastern parts as well as mixed with other vegetation such as *Dhigga* and *Hirundhu* in the middle parts. On the southern side, patches of *Magoo* were observed while on some of the northern parts mixed coastal vegetation including *Magoo*, *Kuredhi*, *Boa kashikeyo* and *Boashi* were found. Also, some mangroves were observed on NE inside of the island (Figure 16).



Figure 16: Kaani found on the eastern side of the island (top left) and Kaani mixed with Dhigga in the middle of the island (top right) and the mangrove area found on the NE side of the island (bottom).

7.4 VEGETATION ASSESSMENTS

Assessments on the vegetation of the island were carried out at 3 locations. Vegetation site (VS1) was located in the middle of the island; vegetation site 2 and site 3 were located on the southern and northern sides respectively. For all sites, 5mx5m vegetation quadrats were used to assess the major vegetation content. The locations of the vegetation quadrats and the percent cover in each site are outlined in Figure 17.

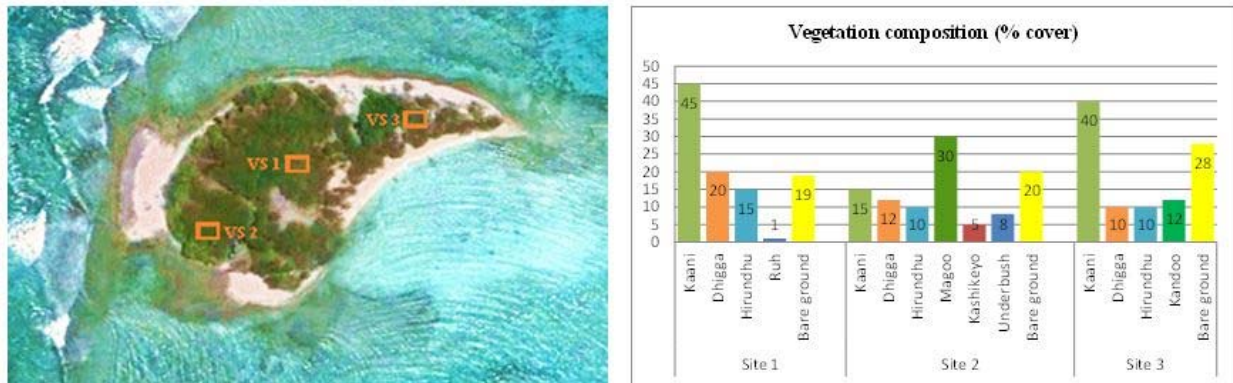


Figure 17: Vegetation survey (VS) sites (left) and the vegetation composition of the surveyed sites (right)

A generalized picture indicate that the dominant vegetation content of the island was young *Kaani* trees, which exceeds about 30% of all the vegetation found on the island. Other key vegetation includes *Dhigga* and *Hurundhu* both of which had overall 10% cover. In terms of the vegetation composition, the mangrove cover was estimated to be around 5% of all the vegetation.

Specific site assessments indicate that at VS 1 and VS 3, the dominant vegetation content was *Kaani* having 45% cover and 40% cover respectively. *Magoo* was the dominant vegetation at VS 2 as it was located close to the coastal environment. Also, VS2 had more vegetation diversity than other two sites, such as *Magoo*, *Kashikeyo* and some areas of underbush, which was not observed at other two locations surveyed (Figure 18 and Figure 19).



Figure 18: Trimmed Kaani trees found at the area of VS 1



Figure 19: Young Kaani by the existing arrival area (left) and a young palm tree planted in the middle of Kaani trees at the area close to VS2 (right)

7.5 COASTAL VEGETATION

Typical local coastal vegetation on the island is rare and is only restricted to some parts on the south and a little area on the north and mostly comprised of *Magoo*, *Boa kashikeyo* and a couple of *Boashi* trees, which were only found on the north. From NE to most of the eastern areas, no coastal vegetation was observed, yet these areas had most of the beach found on the island (Figure 20).



Figure 20: Main coastal vegetation found on the island, Magoo and Boa kashikeyo on the southern side (top left), Boashi on the western side (top right) and Boa kashikeyo mixed with other vegetation on the SW (bottom left) and absence of coastal vegetation on the eastern parts with beach areas (bottom right).

7.6 STATUS OF FAUNA

As the island is very small with limited vegetation and habitats, it does not support rich fauna. Except for few shore crabs and insects such as spiders and common geckos, no native animals were observed on the island. However, some domestic chickens and a large turkey have been introduced to the island by the previous management and are still found on the island. A couple of crows were also observed on the island, which does not seem to be residing on the island.

It was also observed that the island is used by visiting shorebirds and seabirds such as eastern grey herons, black-naped terns and brown noddies in small numbers as a resting and frequenting place. The frequenting of these birds may also be related to feeding. No nests of any birds were observed on the island, hence the island does not have any resident birds, except for those introduced domestic chickens and the turkey (Figure 21).



Figure 21: Some fauna observed on the island; introduced domestic chickens (top left), a large turkey (top right), frequenting of eastern grey herons for feeding (bottom left) and a brown noddy at the entrance pole (bottom right)

7.7 HABITATS AND SPECIES OF CONCERN

The island does not support rich habitat diversity except for a small area of mangroves found in a slight depression on the northern side of the island. Tidal flooding was observed within the mangrove area as the ground was observed muddy at the time of assessment (Figure 22). No animals or birds were observed to be associated with the mangrove environment. It is recommended that the vegetation of the area be integrated as part of the resort development as an environmental enhancement area as it the only such habitat found on the island on land.

Almost all bird species observed on the island including eastern grey heron, black-naped tern, noddy and the common crow are protected birds under the Environmental Protection and Preservation Act (Law No 4/93) of Maldives.



Figure 22: Inside the mangrove habitat found on the northern side (left) and protected black-naped tern and eastern grey heron (right)

7.8 SOIL AND GROUNDWATER ASSESSMENTS

The measurements of ten water quality parameters were obtained from Akirifushi ground water sample. The measurements are presented in (Table 10). The pH values of the sample is 7.3. Based on health considerations, the guidance value of 50 mg/L for nitrate has been set to protect infants. However, nitrate level up to 100 mg/L can be safely consumed by adults and children over three months of age. Based on these references, the present nitrate levels in the groundwater sample at Akirifushi is not likely to pose a health risk as the nitrate levels as the nitrate level recorded from the sample is 9.2 mg/L. The obtained values for salinity for the sample was well below the recommended value. For sulphates it is generally considered that taste impairment is minimal at levels below 250 mg/litre. The sulphate level indicated from the water sample obtained from Akirifushi water sample is 320 mg/l which exceed this recommended value. According to the present levels of inorganic constituent in groundwater, they are not likely to have direct consequences to health. Nevertheless, concentrations of certain inorganic constituents in the groundwater is such that, the island's groundwater may be objectionable to some consumers for drinking purposes based on taste, odour and for aesthetic reasons. Based in this analysis ground water of Akirifushi is safe to use for all purposes.

Generally the soil of coral islands of the Maldives is formed of coral fragments, mollusc shells, foraminiferan test (skeleton), calcareous algae skeletons, and other biogenic coralline detritus material. These materials are the constituents of beach sand of cay island, and as the island grow older and plant and other biogenic activities increases these materials possess a humus layer forming proper soil in the island.

To assess the soil of the composition of the island a well was dug till the groundwater level at the central part of the island and soil samples were collected down the (pit) where distinct soil profile was observed. Three layers were observed (**Error! Reference source not found.** and **Error! Reference source not found.**): the top layer is made up of humus or dark soil mixed

with rubble and sand with high amount of tree roots (12 cm thick). Second layer (4cm thick) contains relatively high concentration of humus content and with large amount of rubble and sand. The third layer is about 7cm thick and consists of mixed rubble and sand with minor traceable amount of humus content. A soil profile of the island is shown in Figure 23. Groundwater level is observed approximately 17cm deep from the ground level. Geographic coordinates of the location is given Table 8 and the original test result from MWSC laboratory is given in Annex 6.

Table 10: Water quality, laboratory results copy of the laboratory report is in Annex 6.

Parameter	Ground water
Physical appearance	Pale yellow
Conductivity ($\mu\text{s}/\text{cm}$)	9800
Nitrate	9.2
pH	7.3
Sulphate (mg/l)	320
Salinity (%)	5.48
Phosphate (mg/l)	0.2
Total dissolved solids (mg/L)	5048
Total suspended solids (mg/L)	<5LOQ5 (mg/l))

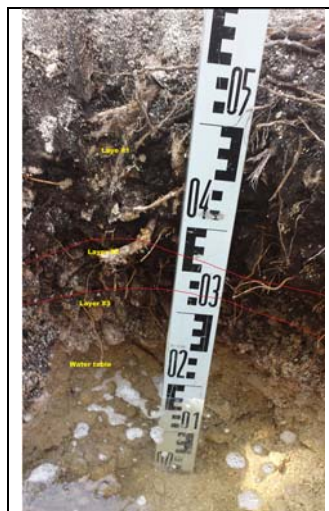


Figure 23: Soil profile Akirifushi Island showing three distinctive soil layer of the island

7.9 BEACH PROFILES AND ISLAND TOPOGRAPHY

Beach material around Akirifushi Island varied on the eastern and western side. On the eastern side beach is fairly wide on the eastern side ranging from 5-7 meters and composition of beach material consists uniform well sorted medium to fine-medium grained coral sand and biogenic material. This is composition of low energy environment beach material. Beach material on the western side consists of coral rubble and coral boulders. Beach material is sorted along the coastline from coral rubble on the northern part and gradually increases the size to coral

boulders on the southern end of the coastline. Destitution of beach material along the coastline is an indication of energy dissipation along the coastline.

3 transacts were taken across the island to measure the land elevation of Akrifushi. Digital Elevation Model (DEM) of the island was developed using the elevation data to study the topographic features of the island. The DEM shows that the island has a higher elevation on the edges at the vegetation berm and a dipping land wards towards the center. The lowest elevation of the island on the northwestern end of the island where mangrove trees are located and the highest part is on the southern end of the island. In general the island has S-N slope dipping northwards (Figure 24). **Error! Reference source not found.** shows the transact lines and **Error! Reference source not found.** shows the geographic coordinates and bearings of transact lines. Measured beach profiles and the photographs of the profile locations are in **Error! Reference source not found.**. Geographic coordinates of location of transacts and their bearing directions are given in Table 11.

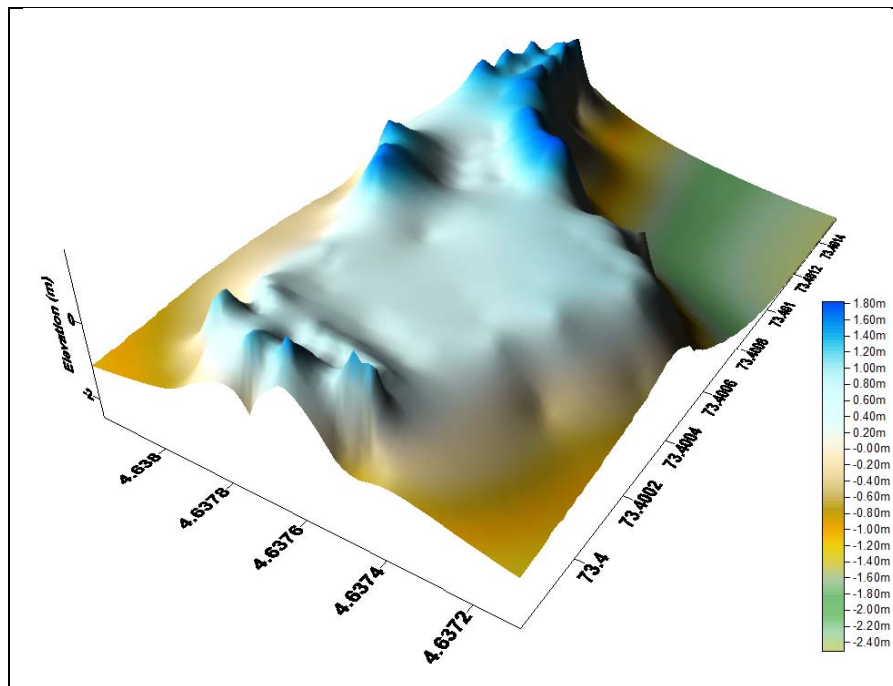
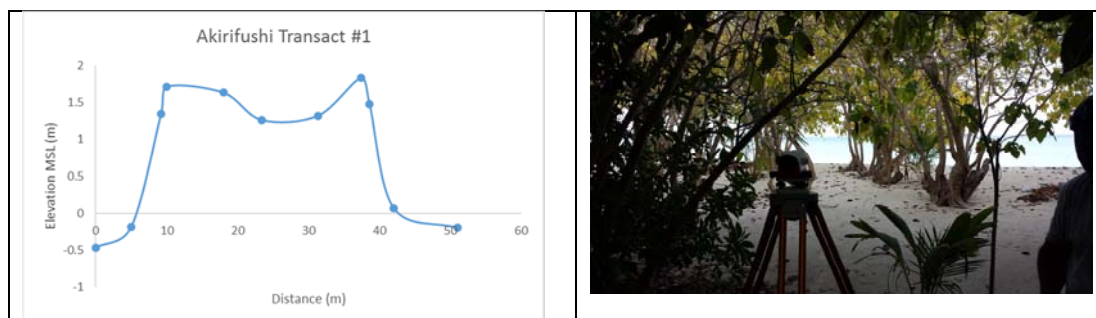


Figure 24: Digital Elevation Model (DEM) of Akirifushi.



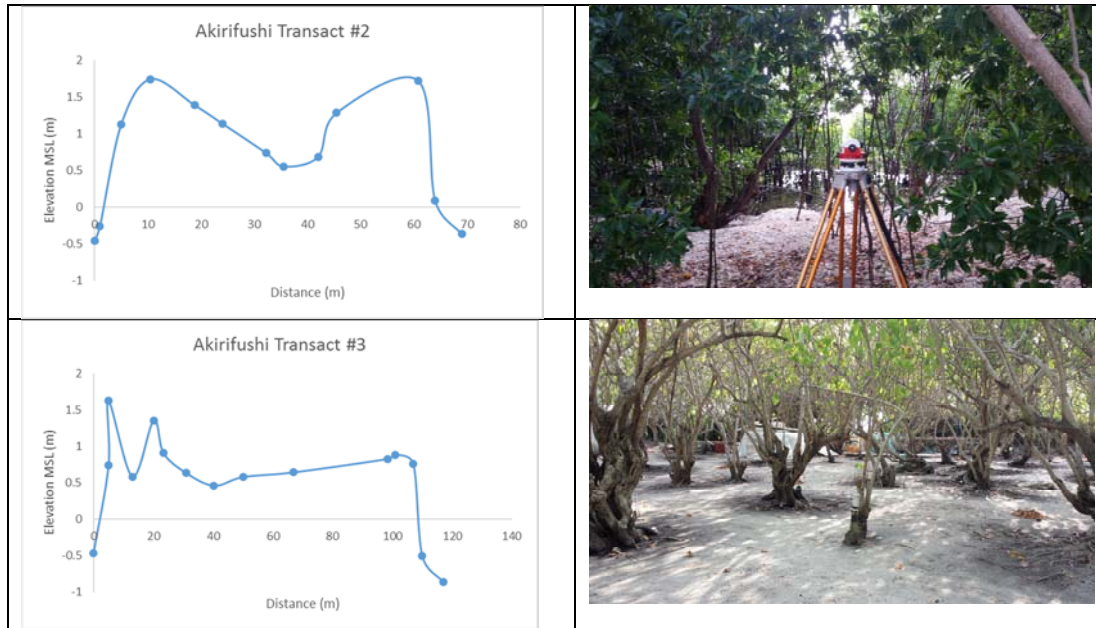


Figure 25: Akirifushi transacts across the island

Table 11: Geographic coordinates of transact and bearing direction

Transact location	Latitude	Longitude	Bearing direction (degrees)
Transact #1	4.637962	73.401248	145-330
Transact #2	4.637855	73.400966	125-320
Transact #3	4.637638	73.400251	265-95

8 MARINE ENVIRONMENT

8.1 INTRODUCTION

In order to determine the general reef health of the reefs surrounding the island, several 1x1m photo quadrats in order to assess the substrate and coral content in three locations have been carried out in 3 different locations on the reef. Qualitative methods such as visual observations and expert judgements also assisted in assessing the general existing marine environmental condition around the reef of the island. The reef fish diversity within the surveyed areas was assessed by visual fish census along 20m transects. Following is an outline of the existing status of the marine environment found around Akirifushi Island, which is based on field assessments undertaken during on the marine environment during April 2014.

8.2 DATA COLLECTION METHODOLOGY

In order to understand the status of the marine environment around the island, both qualitative and quantitative field assessments were carried out on the coral reef during the field visit. In this regard, the coral reef composition was determined by manta towing and use of several 1mx1m reef quadrats along 4 different locations on the reef. The reef fish diversity was assessed by using visual fish census along a 50m length of the reef on two different locations.

8.3 STATUS OF CORAL REEFS

8.3.1 General Reef Characteristics

Akirifushi Island is found in a single reef on the NW rim of North Male' Atoll. The reef is triangular in shape with western side slightly curved and the island is located almost at the edge of this curvature. The length of the reef including the reef slope from west to east is estimated to be 1km and the width of the reef from north to south is estimated to be 960m. The total area of the reef is estimated to be 75ha with most parts found in shallow lagoon. However, on the eastern side of the island, a large *Vilu* is found having approximately 7.5ha. Also on the northern side a smaller *Vilu* is found having approximately 1.5ha. The total area of the island is 1.4ha (Figure 26). From the north to the west and parts of SW, a large stretch of slanted reef slope is found. As the western side of the reef is exposed to the outer atoll, the area is characterized by wave action.

The large and deep *Vilu* on the eastern side of the island occupies almost 15% of the whole reef, while the island and the smaller *Vilu* on the northern side occupy approximately only 3% each of the whole reef. Hence, the shallow lagoon of the reef is approximately 79% and mostly comprised of sand and rubble, while the western side mostly composed of dead rocks. The furthest distance from the island to the edge of the reef is found on the eastern side having 810m, while shortest distance to the reef edge is found on the west having less than 20m. As

mentioned before, the western side of the island is exposed to wave action and strong currents, hence the formation of the island is eastwards.

The coral reef system of Akirifushi is entirely separated from main reef systems of the atoll rim on both sides. Two extensive channels exist on either sides of this reef system. It is very much exposed to tidal currents as well as monsoon currents and waves as the western side of the island is exposed to the outer atoll.

It is a fairly complex reef system consisting of well-developed reef on the eastern side and small reefs at the eastern periphery of the two *Vilu* found as well as sandy slopes on the western sides of the two *Vilu*. The eastern side of the island is observed to generally calm and protected.

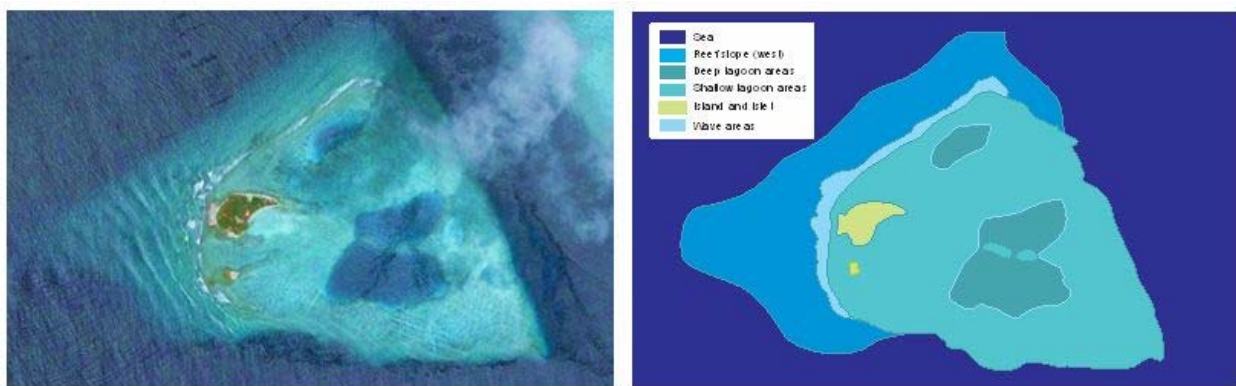


Figure 26: Aerial view of the reef (left) and characteristic zones of the reef (right)

The key zones of the reef are quite extensive with reef slopes on the western side, wave area or surf area on the west as well as deep lagoons on the eastern and northern sides of the island. As the island will be reclaimed for the proposed resort development, it is recommended that the required sand be obtained from the western periphery of the *Vilu* areas found within the reef, which is believed to be a good sand source.

8.3.2 Coral Reef Assessments

Marine environmental surveys and assessments were conducted to collect data on key environmental components (i.e. the coral reef system and the lagoon system) for the purpose of defining and establishing marine environmental baseline conditions and impact evaluation during and after the proposed work of developing the island as a 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 resort. These surveys should be continually repeated to assess the long term and short-term impacts on the marine environment.

The purpose of these surveys are to assess the status of the reef system and gather quantitative and qualitative baseline data in order to monitor both natural and human induced impacts

including boating activities, diving and snorkeling, coastal development, littering, sewage discharge and various other activities carried out by the resort on a long term basis for better environmental management.

Four areas from the reef of Akirifushi were surveyed to gather information on the existing status of the marine environment (Figure 27).



Figure 27: Marine survey locations around the reef of Akirifushi (RS (red) = reef survey, FS (orange) = fish survey)

As the proposed development of the island for a tourist resort involves reclamation of parts of the lagoon, the marine environmental survey undertaken around the island included assessments on parts of the lagoon where there are likely impacts as part of the proposed development.

8.3.3 Lagoon Environment

The lagoon system of Akirifushi is very extensive and complex in terms of morphology hydrodynamics and bottom substrate. It consists of two lagoon areas; a very large shallow lagoon and two smaller deep lagoons. The small deep lagoon on the northern side of the island is estimated to be 1.5ha and the larger deep lagoon on the western side of the island is estimated to be around 7.5ha in area. Apart from these two deep lagoon areas, the overall lagoon in which the island is found is fairly shallow having approximately 1m MSL.

The locality of the lagoon bottom consisted of mainly coarse and fine sand in most areas and unconsolidated rubble in few areas. The live coral cover within the lagoon is only limited to the western periphery of the two deep lagoons and mostly consisted of small and patchy new coral colonies. These colonies mostly belong to fast growing *Acropora* branching corals of colony sizes ranging 5- 60cm. These colonies were found as patch reefs on the western side of the lagoon on the upper portion of the sandy slope. Also, numerous numbers of dead corals

were also seen on the upper slope which was mostly covered with sand. Presence of rubble towards the upper slope on the lagoon bottom was high on the western side.

Other epibenthos and in-fauna of the lagoon bottom was not assessed however, other such 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 belonging to Carangidae, goatfishes belonging to Mullidae and emperors belonging to 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.

8.3.4 Coral Reef Environment

The general condition of the reef in terms of percent live coral cover is average on the two sites located on the southern parts of the reef (RS 1 and RS 2), while sites located on the east (RS 3) and west (RS 4) were observed to have low live coral cover percentages. Key findings of the coral reef survey carried out around the island of Akirifushi is shown in (Figure 28).

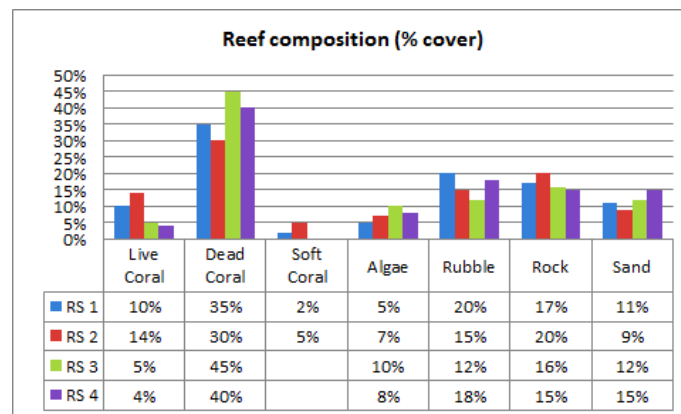


Figure 28: The reef composition of the survey sites around Akirifushi reef.

Amongst the sites surveyed RS 2 had the highest live coral cover with 14%, while RS 4 had the least live coral cover with only 4%. The composition of dead corals amongst all the sites was observed to be quite high with over 30% on all the sites. Most of the live corals found on the sites were branching and finger corals of *Acropora* and massive corals of *Porites* and most of the corals were observed to be young coral colonies. Sites 1 and 2 (RS 1 and RS 2) had very steep slopes where most of the live corals were found on the upper reef slope, while the dead components such as rocks, dead coral and sand were observed on the bottom part of the reef

slope. Out of the four sites surveyed, live soft corals were also found on these two sites only (Figure 29).

Unlike the first two sites, sites 3 and 4 (RS 3 and RS 4) slanted reef slopes, which is quite prominent on site 4. The two sites were generally characterized by high cover of dead corals and rock and rubbles (Figure 30). As site 4 is exposed to high wave action and strong currents, the live coral mostly belong to massive corals that are quite settled. Sand is also quite prominent on these sites where its cover is mostly on the upper slope and reef flat areas.

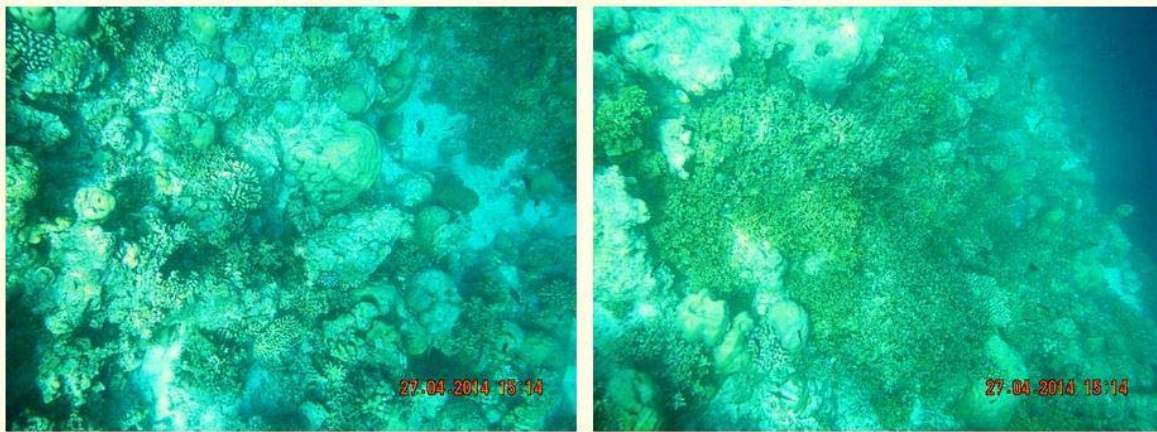


Figure 29: The general characteristics of RS 1 with young coral colonies (left) and steep reef slope (right).



Figure 30: Live coral cover on RS 2 was slightly increased with massive corals and new coral recruits (left) and also had similar reef slope as RS 1 (right).

The reef composition as well as the general characteristics of the sites 3 and 4 (RS 3 and RS 4) was quite different with low levels of live coral cover as well as slanted reef slopes and in particular, the site 4 (RS 4) was exposed to high waves and currents originating from the out atoll, hence the composition was highly different (Figure 31).



Figure 31: Site 3 had a slanted reef slope mostly covered with dead coral, rubble and sand to a great extent (left) while site 4 was exposed to wave action and dead rock was quite high (right).

Most significant pelagic life of the reef system is the variety of fishes inhabiting the different habitats of within the reef system. Abundance and diversity of selected families of fishes which are most commonly found in day time were estimated by visual fish census on a 50m line along the reef. Reef fish assessments on two locations (FS 1 and FS 2) corresponding reef assessment sites RS 1 and RS 3 respectively were carried out.

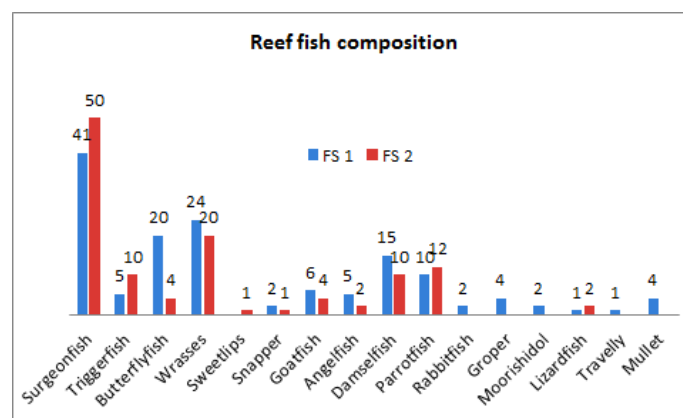


Figure 32: Number of reef fish and types encountered from the two sites surveyed.

The results of the reef fish assessments indicate that the reef fish abundance and diversity found at both sites were average, although site 1 (FS 1) contained slightly increased reef fish numbers and species. The total reef fish found from both sites were 142 fish belonging to 16 families for FS 1, and 116 fish belonging to 11 families for FS 2 (Figure 32). Out of the reef fish found at both sites, surgeonfish, wrasses and damselfishes dominated both sites. This may be as a result of high algal contents found at each site despite their live coral cover. The FS 1 contained high live coral cover hence, total number of butterflyfish, angelfish, damselfish, parrotfish, groupers and Moorish idol records were higher than FS 2. Fishes belonging to families from rabbitfish, grouper, Moorish idol, travelly and mullet were not recorded from FS 2 (Figure 33).



Figure 33: The number and diversity of reef fish found from FS 1 was higher than FS 2 probably because the site had more protection and exposure was minimal.

8.3.5 Structural Complexity

Structural complexity is a subjective category designed to indicate the topography of the reef slope in general. The structural complexity of reef system was assessed based on presence of caves, overhangs, reef terraces, vertical drop-offs, spur and groves and various habitat types. This category is included in the surveys as it is an important aspect with regard to diversity of habitats of reef fishes and other life of coral reefs. The reef system of Akirifushi is structurally quite complex at all sections of the reef system having lot of gullies, reef protrusions and other features such as caves and overhangs.

8.3.6 Natural Reef Aesthetics

This is a subjective attribute assessed by visual observations based on the observer's judgment and experience of the relative merits of a reef and the inner lagoon areas. This value judgment incorporated coral cover, diversity of life forms, fish life, reef structure and general appeal.

The following categories were used to determine aesthetics of the reef system:

- | | |
|--------------|--|
| a. Very poor | (mostly dead corals, pelagic life not abundant and diversity very low, structure uniform) |
| b. Poor | (Lot of dead corals, pelagic life not abundant and diversity low, some differences in structure) |
| c. Average | (Live corals about 10%, pelagic life abundant, diversity low, some structural variations exists) |
| d. Good | (Live corals about 20% pelagic life abundant, diverse, structural variations exist) |

- e. Very good (Live corals about 30%, pelagic life abundant, diverse, overhangs, and other structures)
- f. Excellent (Live corals over 30%, pelagic life very abundant, very diverse, lots of different structures, overhangs, caves, gullies, and different habitat types exists.)

The reef system of Akirifushi is regarded as average, given that it is structurally complex, average live coral cover, diversity of life forms, fish life and abundance are high and the generally very interesting for snorkelling and diving. Table 12 summarizes the overall condition of Akirifushi reef system

Table 12: Summary of condition of the coral reef system of Akirifushi

Reef attribute	Condition
Live coral cover	Approximately 10%
Fish life	Average
Biological diversity	Average
Structural complexity	Complex
Reef aesthetic	Good
Coral bleaching	Nil
Crown-of-thorn starfish	Nil
Anchor damage	Low
Garbage	Nil

The coral reef of Akirifushi as most other coral reefs is regenerating after being adversely impacted by the 1998 coral bleaching. Signs of coral re-growth were observed in many areas of the reef.

8.3.7 Marine Water Quality Tests

A sea water sample from the reef area in Akirifushi was obtained and analysed at the MWSC laboratory. Results of this sample will be used as a baseline for comparison during seawater quality monitoring.

Table 13: Water quality test results for Akirifushi Island. Copies of the test results are given in Annex 6.

Parameter	Sea water
Physical appearance	clear
Conductivity (µs/cm)	54310
pH	8.0
Salinity (%)	34.40
Hardness Magnesium (mg/l)	5229
Total dissolved solids (mg/L)	26523
Total suspended solids (mg/L)	<5LOQ5 (mg/l)

8.4 MARINE PROTECTED AREAS AND SPECIES

Under the Environmental Protection and Preservation Act of Maldives (Law No. 4/93) several Marine Protected Areas (MPAs) have been established in the Maldives. Currently there are 32 MPAs established throughout the central atolls of the Maldives. These MPAs have been established for various reasons including protection of rich biological diversity, protection of rare and threatened species, protection of flagship species, protection of seascapes as well as protection of popular dive spots amongst tourists.

Out of the 8 MPAs found in North Male' Atoll, only *Makunudhoo Kandulhi* MPA is in close proximity, which is found 8km south of Akirifushi Island in a large single reef system found on the western side of Makunudhoo Tourist Resort (Figure 34). The significance of the MPA is frequenting of white tip reef sharks, sea turtles as well as great numbers of lionfish and Napoleon Wrasses are known to occur at the reef.

As the MPA is found on the southern part of a large reef system, any impacts from the proposed tourist resort development on Akirifushi is not believed to occur due to the reason that it is located at 8km south, the protected area is sheltered by the large reef system itself as well as having another large reef in between Akirifushi and the reef in which the MPA is found.



Figure 34: Location of Makunudhoo MPA in relation to Akirifushi Island

A number of marine species currently protected, exploration, fishing and export banned under the Fisheries Law of Maldives (Law No. 5/87) have been found from the reef of Akirifushi. These include giant clams, parrotfish and moray eels. Although the reef is known for frequenting of reef sharks, sea turtles and rays, these species were not observed at the time of the assessments.

9 SOCIO-ECONOMIC ENVIRONMENT

9.1 INTRODUCTION

As part of outlining general socio-economic environmental condition for the proposed project of developing a tourist resort on Akirifushi Island in North Male' Atoll, only socio-economic conditions of the inhabited islands found in North Male' Atoll has been considered and in particular inhabited islands closer to Akirifushi such as Gaafaru and Kaashidhoo are given prominence.

9.2 GEOGRAPHIC CONTEXT

Akirifushi is located in North Malé Atoll approximately 52 kilometer north west of Malé in North Malé Atoll. Malé atoll consists of two Atolls North and south Malé Atoll. There are 9 inhabited island in both North and South Malé Atoll administratively known as Kaafu Atoll. The two atolls hosts over 40 operational tourist resorts and few industrial islands.

9.3 POPULATION STRUCTURE

The registered population of Kaafu Atoll (excluding Mal, resort and industrial islands) according to Department of National Planning in 2012, is 20,224 in the 9 inhabited islands and the registered population of Malé is 62,567 of which 32590 are male and 29,977 are female. The total population of Malé as per the senses 2007 is over 130,693 inclusive of migrant population from islands and foreigners who are not registered as in Malé. Figure 35 shows registered population of inhabited islands in Kaafu atoll excluding Malé.

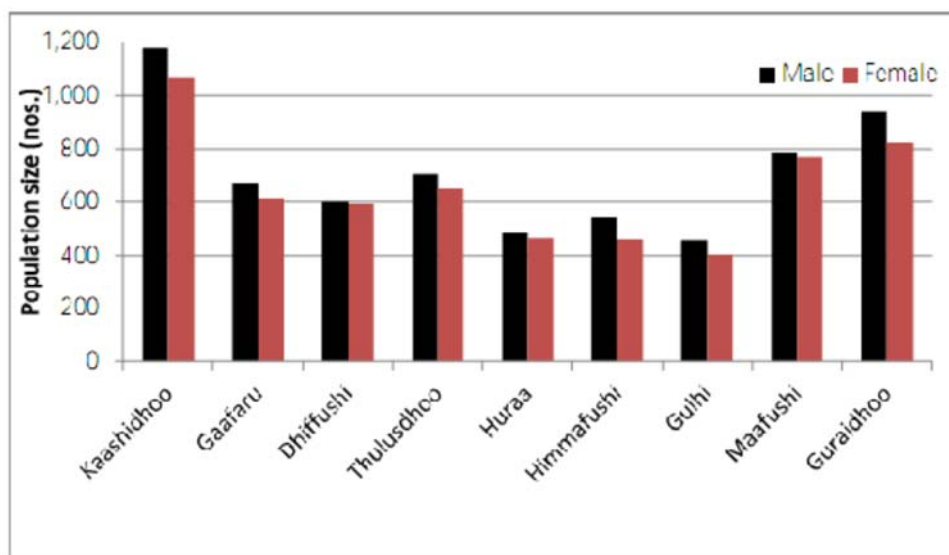


Figure 35: Registered population of inhabited islands in Kaafu Atoll

9.4 POPULATION AND HOUSING

There are six inhabited islands in North Male' Atoll namely Kaashidhoo, Gaafaru, Dhiffushi, Thulusdhoo, Huraa and Himmafushi. The overall population based on 2006 Census for these six islands were 6,109 with the highest population residing in Kaashidhoo Island having 1,696

and the lowest in Dhiffushi Island having a population of only 767. The total number of households found on these six islands is 966 with an average 6 persons per household. Kaashidhoo Island has the highest number of households having 277 and Dhiffushi Island having the lowest number of households having only 120. The average population growth for the six islands is estimated to be 1% per annum. Hence, based on this population growth projection, the current population (2014) of these six islands combined is estimated to be 6,597.

9.5 HEALTH AND EDUCATION

Kaashidhoo is the largest island amongst the five inhabited islands found in North Male' Atoll having approximately 280ha, which is also amongst one of the largest islands found in the Maldives in terms of land area. Currently there are 11 schools in the six islands with Kaashidhoo Island having 3 schools, where one of the schools is providing education up to GCE A' Levels, while 10 schools in other islands including Kaashidhoo is providing education up to GCE O' Levels. The current student population is estimated to be around 2,200 for all six islands. The current student/teacher ratio for North Male' Atoll is estimated to be 10 students/teacher. Each island has one Health Service Provider or a Health Center providing necessary health services. All islands have established pharmacies. As all these islands are close to Male', most people fulfill their health needs by travelling to Male'.

9.6 INFRASTRUCTURE AND UTILITIES

All six islands have access to harbor facilities and access to 24 hours electricity. However, water and sanitation services on the islands are limited. Only few islands have a planned sewerage network such as Huraa and Thulusdhoo. All islands use rainwater and bottled water as the main drinking and cooking water source. Both water and sanitation facilities are currently being planned by the government and as part of CSR development projects by private parties. All islands have a designated waste management centres (WMCs) developed after the 2004 tsunami through assistance from international donors and as well as government assistance. However, only few islands use the facility on a proper manner. Also, there are issues with collection of from the islands to the final waste disposal site, hence, most of the WMCs found on the islands are filled up with waste. All islands have two or more mosques.

9.7 LOCAL ECONOMY AND TRADE

As all the six inhabited islands found in North Male' Atoll have easy and daily access to Male', trade of general goods can be easily undertaken in all the islands. These general trade merchants play a key role in the local island economies and have good establishments such as small general stores to mini marts in almost all islands. There seems to be a good diversity in local economy of these islands. For instance, Kaashidhoo is a known agricultural island where most of the agricultural products are brought to Male' local market. Gaafaru is generally a fishing village, while Thulusdhoo is the only industrial island with many bottling factories of water and soft drinks as well as a number of leased godowns. Himmafushi has a boatyard for boat repair and servicing and Huraa has an Ice Plant for supplying ice to fishermen. Both Dhiffushi and Huraa has good establishment of tourist shops for selling souvenirs to visiting tourists from nearby resorts on a daily basis.

9.8 TRANSPORT NETWORK

Connectivity to all the inhabited islands of North Male' Atoll to Male' is easily. There is an established ferry service to all the islands on a daily basis by the Maldives Transport and Contracting Company (MTCC) since 2010 and a lot of people from these islands are currently using this ferry service. Also, some private parties organize chartered transportation services especially in weekends to Gaafaru and Kaashidhoo, the furthest two inhabited islands found in the Atoll, which is now quite popular among locals.

9.9 TOURISM

Tourism is very well established in North and South Male Atolls with 42 operating tourist resorts representing 39.9% share of all the bed capacity in the resort islands found in the Maldives (Ministry of Tourism, 2013). By far, Male' Atoll has the highest concentration of tourist resorts in the Maldives. Also, there are new tourist resort development projects such as Akirifushi, Kodhipparu, Kuda Bandos, Maadhoo Finolhu, Dhifushi Falhu and a number of reefs found in North Male' Atoll already dedicated for resort and marina development. Most of the inhabited islands located in close proximity to tourist resorts such as Dhifushi, Thulusdhoo Huraa, and Himmafushi already have very good ties and relationships with the resorts. These islands have a number of benefits from the resorts in terms of contributing to development of local economies, human resources development in the hospitality industry as well as contribute to education, health and socio-economic development.

9.10 NEW DEVELOPMENTS

Thirt three hectares of land has already been reclaimed in Thulusdhoo Island. The newly created land will be allocated for housing and various economic development purposes. Currently there are a number of guesthouse development projects in all the islands, with Dhiffushi, Kaashidhoo, Thulusdhoo and Gaafaru now highly engaged in new development projects for guesthouses. Kaashidhoo Island already has an approved city hotel development project for 80 beds in a large land area. Gaafaru Council has announced a slipway development project on reclaimed land adjoining with a small reclaimed island found on the southern side of Gaafaru Falhu. A large area in Dhiffushi lagoon is already allocated for a large tourist resort development project. Some social housing development projects are also found on Kaashidhoo and Dhiffushi islands. Also a large number of guest houses already exists in Himmafushi and Huraa Island and more are developing in this two islands.

9.11 EMPLOYMENT

According to the DNP census 2007 economically active population of Kaafu atoll is 9595 which is about 32 % of the total population of the Atoll. As per the statistics 92% (8843 people) of the economically active population is employed. Majority of the employed people, approximately 44% are employed in tourism sector. Figure 36 shows distribution of employment sectors occupied by Kaafu Atoll population.

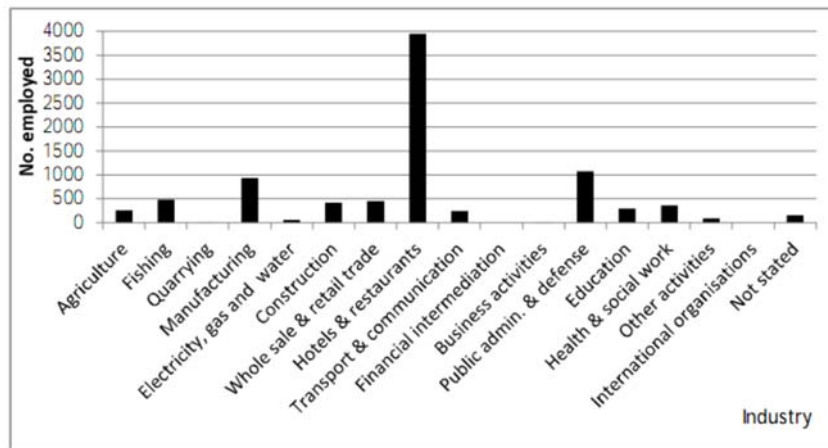


Figure 36: Number of people employed in industrial sectors

9.12 SOCIOECONOMIC BENEFITS

The resort development on Akirifushi Island is expected to bring a number of socio-economic benefits to the local communities as well as assist in the overall development of the Atoll. These include direct and indirect benefits including both direct and indirect employment during both construction and operation phases, market for agriculture, fish as well as local handicrafts. Indirectly development of cottage industries and indirect benefits such as development of infrastructure and service facilities are some of the benefits that the communities of the Atoll are expected to obtain as a result of the development of the resort in the Atoll.

In general tourism development in Akirifushi will increase the direct employment and training opportunities for the people of Kaafu Atoll and stimulate local economy, through cultivation and providing small business opportunities particularly for the nearby island in Kaafu Atoll.

10 POTENTIAL IMPACTS AND MITIGATION MEASURES

Various methods are available to identify the extent, magnitude and significance of socio-economic and environmental impacts of a development project, for instance checklists, matrices, expert opinion, modelling etc. Impacts from various activities of the proposed project both construction and operational phases have been identified through consultation with the project management team, field surveys, observations and assessment, as well as based on field experience and expert opinion on resort development projects in the country.

Other sources of information have been used wherever possible. Data collected during field surveys can be used to predict outcomes of various operational and construction activities on the various related environmental components. Data presented in this report can also be used as a baseline for environmental monitoring of the project activities.

Possible impacts arising from the construction and operation works are categorized into reversible and irreversible impacts. Reversible and irreversible impacts are further categorized by intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken. Below are the impact categories

- **Negligible:** the impact is too small to be of any significance (Reversible)
- **Minor:** the impact is undesirable but accepted (Reversible)
- **Moderate:** the impact give rise to some concern but is likely to be tolerable in short-term, or will require value judgment as to its acceptability (May or may not be Reversible)
- **Major:** the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project (Irreversible)

Leopold Matrix (Leopold et al. 1971) has been used to classify the magnitude and importance of possible impacts which may arise during the constructional and operational phase of the resort development project in Akirifushi Island. Leopold Matrix is the most widely used methodology for identifying the impact of a project on the environment. It is a two dimensional matrix which cross references between the activities which are foreseen to have potential impacts on the environment and the existing conditions (environmental and social) which could be affected. Leopold Matrix of development project is provided in Annex 4.

The impact matrix should not be misinterpreted to mean that all the identified impacts would occur during implementation of the project. However, the matrix does serve to identify the potential impacts and significant concerns and this leads to the next step of the EIA process, mitigation, which considers the appropriate measures to remove or ameliorate the adverse impacts that have been identified. At this stage measures to enhance the positive aspects of the development can also be devised.

Severity of impact is assessed by reviewing the engineering design, detailed site plan as well as comparison of development with the existing environment and construction methodologies employed. Mitigation measures are derived based on the site specific assessment as well as similar project elsewhere in the Maldives.

The resort development project involves addition of 6.8 hectares through land reclamation and development of 140 guest beds and necessary infrastructure in the Island.

10.1 IMPACT IDENTIFICATION

The following section describes in detail and discusses the main potential environmental impacts that have been identified and predicted for the proposed tourist resort development on Akirifushi Island. Identified potential impacts are divided into construction phase and operation phase environmental impacts.

10.2 LIMITATION/UNCERTAINTY OF IMPACT PREDICTION

The methods used to predict and evaluate the environmental impacts that may be associated with the proposed resort development on Akirifushi Island may not be the most comprehensive. The main shortcoming of these methods is that impacts are predicted by reviewing the survey data collected during the field visits and information revealed by the designers and engineers, therefore the assumptions have been made to predict the impacts which may or may not be accurate. Also, the data collected during the field visit is limited, which subsequently limits the overall understanding of even the short term environmental conditions (wave condition, currents, and littoral movement). Nonetheless, within the time limitation of EIA field data collection and report preparation the methods used are concise and provide a general overview as well as the range of impacts that can affect the environment.

10.3 IMPACTS AND MITIGATION MEASURES CONSTRUCTION PHASE

Construction phase can be considered as the period in any developmental project that causes major direct and indirect long and short-term impacts on the environment. Anticipated potential direct and indirect environmental impacts from the proposed development in K. Akirifushi includes the following:

- Mobilization of Equipment and Labour
- Marine habitat and coastal environment
- Dredging reclamation and subsequent sedimentation
- Ground water extraction
- Loss of Aesthetic quality
- Noise, Vibrations and Air Pollution
- Loss of Flora and Fauna during construction
- Equipment & vehicle maintenance
- Impact from waste
- Installation of water, powerplant,
- Socioeconomic impacts

10.3.1 Impacts from Mobilization of Equipment and Labour

Heavy machinery equipment and material needed for the resort development particularly for dredging and reclamation work will be transported to Akirifushi via barges and cargo boats. The natural deep lagoon of Akirifushi can access and accommodate large vessels and barges,

this will minimize the physical damage to the reef that may cause if barges carrying heavy equipment and material tried to access the island from elsewhere.

A temporary workforce of around 300 persons will be stationed on the island during the initial stages of construction activities. Construction workforce would be accommodated in temporary shelters in the island during the construction phase.

One of the most important environmental impacts may be generated from improper sewage and waste disposal mechanisms. Raw sewage may harm the marine environment as a result of contamination, which may cause an increase in coliform levels in seawater, eutrophication and coastal water pollution. Such impacts have potential in threatening the survival of both coral and fish communities found in the reef environment.

Improper and inappropriate methods of domestic waste such as kitchen garbage, construction waste such as cement, iron and concrete as well as other waste such as paints, wastewater and waste oil disposal will impose serious implications on the environment through various negative impacts. The most significant impacts associated with such waste disposal on the island environment range from reduced aesthetic beauty of the of the island and reef environment, marine pollution to water quality degradation, increased sedimentation and turbidity as well as changes in the reef community structure.

During constructions, a number of construction machinery will be used on the island including loaders, concrete machines, earth moving vehicles, pickups, cranes, etc which may have direct impacts on the island including compaction and cracking of the ground due to the heavy load. Akirifushi as discussed before is a small island and such machinery and heavy load have the potential to damage the environment of the island. In addition to environmental damages, use of construction machinery generates sound, vehicular emissions and dust, may however, temporary in nature.

Table 14: Impacts of mobilization of labourers, machineries and equipment

Impacts	Causes	Significance	Mitigation measures
Degradation of existing groundwater	- Increased abstraction of groundwater for the use of labourers.	- Minor adverse	- Use water from the existing desalination plant
	- Oil spillage from vehicles (lorries, excavators)		- Fuel handling should be done under careful supervision and regular monitoring
	- Mishandling of solid (non-biodegradable) waste		- Construct proper sewage treatment plant at an early stage of development
	- Vegetation clearance to make roads		- Litter bins should be kept at easily accessible locations with proper warning signs to reduce

Shift in existing ecological regime of the island	- Disturbances to the existing fauna on the island by the labourers (e.g. collection of turtle eggs, birds etc., increased noise and vibration levels)	- Minor adverse	- littering and dumping waste on the island
	- Lack of awareness or concern to preserve the environment may lead to deliberate or inadvertent damages to the existing flora and fauna of the island		- Areas should be clearly marked for tree clearance area - Vegetation that needs to be retained should be clearly marked and communicated to the workers - Signs should be placed to guide the workers on proper environmental care - Project managers should control the workforce and confine their activities to the project area

Mitigation Measures:

- Areas should be clearly marked for construction activities.
- A specific area should be designated in the coastal area for landing and material loading/unloading.
- Large trees and vegetation that needs to be retained must be clearly marked and communicated to the construction workers.
- Signs should guide workers to proper environmental care.
- Use water from the existing desalination plant for potable water
- Special arrangements should be made to use the existing harbour for loading and unloading.
- The supervisor should check compliance of the workers to the environmental guidelines set for the project including avoidance of removal of unmarked vegetation, proper waste management, marine water pollution and ground water pollution.

10.3.2 Marine habitat and coastal environment

Direct impact to Akirifushi marine and coastal environment associated with the proposed project will mainly be from dredging and reclamation work, clearance of natural entrance channel, construction of arrival and service jetty, water villas, beach villas and coastal protection related work. These activities will have a direct irreversible negative impact to the ecological habitat in the Akirifushi reef. Direct impact of this activity is limited to Akirifushi reef only and to the island. This includes:

- Loss of habitat in reef flat and lagoon area
- Physical damage on live coral and loss of live coral: The effect of this would be in the immediate to medium term with the loss of substrate and its fauna.

- Disturbance to the area during dredging activity: Normal procedure for dredging using excavator involves creating temporary causeway or beds to move the excavator to the required site. This involves shifting of material to several places to transfer the material. Release of sediments and potential loss of the faunal composition underneath sediment material will undoubtedly occur.
- Physical damage to live corals and loss of live corals
- Change of near shore hydrodynamic and longshore current pattern
- Degradation of sea water quality due to turbidity
- Sedimentation and associated impacts explained
- Physical disturbance of the lagoon substrate will result in loss of habited for some lagoon infauna such as polychaete amphipods, worms, and mollusks etc.

Mitigation Measures: A range of possible outcomes is expected as have been mentioned. The most important mitigation measure is to monitor the area and respond to the changes in the coast line.

In order to minimize the impact from sediment, dredging should be completed in shortest time possible. Dredging ought to take place during low tides or slack tides to minimize the release of sediment to the area.

10.3.3 Dredging, reclamation and subsequent sedimentation

Entrance channel clearance, dredging and reclamation work will have a direct irreversible negative impact to the ecological habitat in the area. Direct impact of this activity is limited to Akrifushi reef only and to the island.

Given below are relevant impacts that should be considered:

1. Physical damage on live coral and loss of live coral: The effect of this would be in the immediate to medium term with the loss of substrate and its fauna.
2. Disturbance to the area during dredging activity: Normal procedure for dredging using excavator involves creating temporary causeway or beds to move the excavator to the required site. This involves shifting of material to several places to transfer the material. Release of sediments and potential loss of the faunal composition underneath sediment material will undoubtedly occur.
3. Dredging and reclamation will change in the flow patterns. Tidal flows can be quite significant on the shallow reef flats and deeper areas will dampen the flow. The unexpected outcome may be erosion or accretion of the island or coastal areas.
4. Alteration of reef flat and lagoon substrate habitat and infauna approximately 6.8 hectares will be altered from reclamation, three deep lagoons within Akirifushi Falhu will be altered from dredging.

Mitigation Measures: A range of possible outcomes is expected as have been mentioned. The most important mitigation measure is to monitor the area and respond to the changes in the coast line.

In order to minimize the impact from sediment, dredging should be completed in shortest time possible. Dredging ought to take place during low tides or slack tides to minimize the release of sediment to the area.

As a mitigation measure it is recommended to relocate the live corals on both dredging and reclamation area to the shallow reef flat on the North eastern side of the reef prior to starting dredging and reclamation activities.

10.3.4 Sedimentation

The principal determinant of sediment mobility during dredging and reclamation process is wave and current action. Suspended sediment mobilised by wave and current action is determined by the prevailing wave energy and the depth. The wave induced water particle motion drops off with the depth. Sediment disturbed in the relatively shallow waters of Akrifushi lagoon will drop out of suspension in the deeper water in the atoll lagoon or the deeper reef. It should be noted that the closer to the reef edge, the higher the wave energy. The increased energy may offset the increase in depth, the sediment may stay in suspension. In its fluid state however the sediment is readily disturbed by any significant wave action anywhere in the lagoon, particularly along the reclamation area on the eastern side of the island. The tidal currents however are not strong enough to mobilise the sediment from the substrate into suspension by themselves, they act only to transport the sediment once suspended. Therefore conducting the dredging and reclamation during low tides will help to limit the mobility of suspended sediments in the area. If dredging and reclamation work is conducted during the SW monsoon period suspended sediments from dredging and will be moving towards northeast into the atoll lagoon. Therefore coral reef-flat on the eastern side will be impacted from the dredging and reclamation activities. Direct impacts related to sedimentation will be limited to Akirifushi reef however nearby reefs might be impacted with sedimentation. Impacts of excessive sedimentation on corals include:

- Direct Physical smothering of corals and benthic organisms
- Reduced light penetration and subsequent reduction in photosynthesis productivity of coral reef growth, calcification and reproduction
- Shifting unstable sediments will form a false bottom
- Increased amount of sediment will cause eutrophication which will increase the amount of nutrients and lead to algal blooms
- Formation of anoxic black bottom beneath the fine sediment
- Suspended sediment in the sediment plume may trap pollutants which are absorbed into the sediments.
- Short term turbidity increase in lagoon water column during dredging and reclamation will result in decrease in fish and other pelagic populations.

Mitigation measures: To reduce the impact of sedimentation dredging work will be carried during low tide and calm water condition to minimize effects on the reef. Construction of sand bunds at the outer boundary of the dredging area will reduce the sedimentation however sand bund itself will cause some degree of sedimentation but not as extensive as dredging. To reduce the sedimentation from bund, rock boulders on top of geotextile can be used. Later this can be incorporated into the coastal protection revetment structure. Installation of silt screen or a geomembrane will reduce the siltation issues related with dredging and reclamation.

10.3.5 Hydrodynamic regime

The proposed dredging and reclamation can only influence the wave energy environment around the island through reflection and refraction of the incident waves.

Waves within Akirifushi generally fall into two categories, locally monsoon derived wind generated waves with a period of 3-8 seconds and swell waves from more distant storms with a period of 14-20 seconds (DHI, 1999) in the western and south western side which breaks on Akirifushi western reef. Wave directions exhibit seasonal variations with local monsoon generated wind waves which are typically strongest during April-July in the south-west monsoon period.

The reclamation part being long and narrow on the northern end effectively acts as a wave direction filter and only waves aligned with the extended area axis can pass into the Atoll lagoon. In reality this is not much of a restriction on wave energy as long period swell waves from the west can refract around reclaimed area to run straight into the atoll lagoon. Only waves from the east are filtered out by the reclaimed area break on the eastern shore of the reclaimed land. The significance of wave reflection is that the incident wave energy is applied to the same area of seabed twice – as the incident wave passes then again as the reflected wave travels back in the opposite direction.

10.3.6 Marine habitat and coastal environment

Direct impact to Akirifushi marine and coastal environment associated with the proposed project will mainly be from dredging and reclamation work. This includes:

- Loss of habitat in reef slope reef flat and lagoon area
- Physical damage to live corals and loss of live corals
- Change of near shore hydrodynamic and longshore current pattern
- Degradation of sea water quality due to turbidity
- Sedimentation and associated impacts
- Physical disturbance of the lagoon substrate will result in loss of habitat for some lagoon infauna such as polychaete amphipods, worms and mollusks etc.

Mitigation Measure: to relocate the live corals on proposed dredging and reclamation area to the shallow reef flat on the north western side prior to starting dredging and reclamation activities. Installation of geomembrane or a net at the outer boundaries of the bund wall.

10.3.7 Ground Water extraction

Ground water lens of the island is not properly developed in the island. As mentioned earlier the water quality of the island is good for human consumption and for water watering plants. However due to the size of the island it is expected the island aquifer will be very small and usage could be minimal. Groundwater also plays an important role in sustaining the ecological system of the island. Extraction of groundwater for construction purposes may prolong the water lens development process and increase the potential for saltwater concentration in the groundwater aquifer. Increased salinity will generate some environmental consequences such

as vegetation that are dependent on freshwater for survival will be deteriorated. As a consequence, more salt tolerant plant species will have the potential to dominate the island environment. Although ground water will not be used for human consumption in the island, it is important for the trees and shrubs in the island. Therefore, special care should be taken when handling oil, solid waste and hazardous waste to entirely avoid any accidental spills and leakage.

Mitigation measures:

- All paints, lubricants, and other chemicals used on site will be stored in secure and banded location.
- Oil, solid waste and hazardous waste will be handled carefully and transported in sealed containers in properly banded vehicles/vessels
- Construction activities will be carried out under the supervision of a suitably experienced person.
- Vessels, equipment and machinery used for the work should be properly maintained at all times during the operation.
- Littering and accidental disposal of any construction wastes can be avoided by pre-planning modalities for waste disposal or re-use wherever possible. Careful planning of the work activities can also reduce the amount of waste generated.

10.3.8 Loss of Aesthetic Quality

Removal of vegetation and soil for construction of facilities and piling up of construction waste as well as a number of construction vehicles on the island often depletes the aesthetic quality or the natural beauty of the island. Since the ecosystem of the island is naturally balanced, such activities may deteriorate the ecological integrity of the island as a result of pollution.

10.3.9 Noise, Vibrations and Air Pollution

During the mobilisation of equipments and operation of heavy machinery, it is anticipated that significant noise will be generated. In addition, dust and emissions from vehicle and machinery exhausts will degrade the air quality. However, these adverse impacts will be short term and can be mitigated to avoid nuisance. With proper mitigation measures, it is unlikely that noise, vibration and air pollution impacts will cause long term effects such as human health risks leading to increased public and private health costs.

Mitigation measures:

- All construction works will be carried out during day time to minimise nuisance and disturbances caused to nocturnal fauna such as birds and fruit bats that uses auditory communication.
- All vehicles and machinery will be tuned and well maintained to minimise air pollution
- To minimize dust from construction works, ground/soil will be kept damp.
- Workers operating equipment that generate noise should be equipped with noise protection gear. Workers operating equipment generating noise levels greater than 80 dBA continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels of 70 – 80 dBA should wear earplugs

10.3.10 Loss of Flora and Fauna during construction

Unlike other islands vegetation clearance is not needed in the island. Most of the areas that are proposed for guest room construction do not have vegetation at the moment. Small number of coastal vegetation clearance may be needed from the eastern and north eastern side of the island.

- Loss of vegetation means, loss of fauna that depend on those vegetation. Such species include birds, rats, fruit bats and invertebrates.
- Degradation of the topsoil due to exposure to sunlight and heavy rainfall.
- Earth work and ground excavations will completely denude epi-fauna, borrowing and sedentary organism on the substrate. Mobile fauna, such as fish will swim away and will not be affected.

Mitigation measures

- Strict guidelines and construction monitoring is required during the coastal vegetation removal stage to ensure that every single tree could be replanted elsewhere in the island.
- All clearing works will be carried out during day time to minimise disturbances caused to nocturnal fauna such as birds and fruit bats that uses auditory communication.
- A draft landscape plan for the resort should be prepared prior to commencement of construction work.
- The landscape plan should seek to utilize low-maintenance native species tolerant of typical coastal conditions which are attractive to birds. It must not include imported and invasive species.

10.3.11 Equipment & vehicle maintenance

All sorts of motorized equipment, from generators to trucks, requiring fuel, lubrication and maintenance will be used on the construction site. Many will be fitted with lead batteries. Therefore the potential will exist on the site for spillage and contamination of the soil and the sea by hydrocarbons as well as the careless disposal of batteries.

Mitigation measures:

- Confine vehicle maintenance to specially prepared areas with impermeable pads.
- Ensure changed engine oil is collected in drip pans and stored in covered drums until it can be properly removed from the site for appropriate disposal
- Ensure used batteries are properly stored and kept under cover.

10.3.12 Impacts from Waste

Inappropriate disposal of construction waste or remains of earth work or temporary waste mounds on vegetation could destroy them or will cause significant negative impact on the environment. Often construction activities generate large amounts of construction waste and disposal of such waste material into the island and surrounding environment often pollutes the island environment. Disposal of construction material such as cement, concrete, oil, paint, cleaning agents will damage both flora and fauna found on the island as well as will contaminate the groundwater lens of the island. Groundwater pollution negatively impacts the environment by deteriorating the flora and fauna of the island. Additionally, disposal of construction waste into the immediate surrounding marine environment will pollute the marine

and coastal waters as well as will have direct and indirect consequences on coral reefs and associated habitats. For instance, corals and reef fish may instantly die off as a result of severe pollution. Strict measures will be followed and implemented on generation, disposal and monitoring of solid waste during the construction period. Solid waste, waste water and sewage generated by the workforce may affect the groundwater and general terrestrial environment of the island

Mitigation measures

- Regular boats will transport the waste to Thilafushi and eliminate any potential accumulation in the island.
- All hazardous and dangerous waste such as fuel, empty paint buckets, broken glass etc will be separated and transported to Thilafushi.
- Contractor will be required to train staffs to ensure appropriate and efficient separation of solid wastes at the point of source;
- A solid waste reduction strategy will be implemented with the goal of decreasing the amount of packaging materials arriving on the island, with specific attention to cans, bottles, and plastics.
- Containment and control of waste
- Daily waste clean-up, collection, containment, removal and disposal
- Awareness of potential waste issues among employees and workers
- Commitment to good solid waste management practice

10.3.13 Impacts from Water and Power Plant

A desalination plant with a production capacity of 100m³/day will be installed to supply portable water need for the workforce and once the construction is over this plant will be added to the water production facility in the island. Impacts of water production plant would be related to intake, brine outfall, noise and issues relating to water quality. Each issue is dealt below.

Intake: The proposed method for water intake is direct from the sea at the construction period. The intake from sea requires expensive maintenance and additional load to membranes – expensive maintenance due to bio-fouling and additional load to the membranes due sediment concentration. Feed water for the RO plant will be sourced through a borehole located near the RO plant at BOH area during the operational phase of the project.

Brine outfall: An inevitable by-product of reverse osmosis is the concentrated brine which is high in salt content. In most cases brine outflow is located in harbour in to a place where there is reasonable amount of water flow. It is unlikely that brine discharge to seas would cause any noticeable detrimental impact as the concentrate becomes immediately diluted on release. On Akirifushi it is proposed that brine outfall be on the western side, out of the reef into the outer atoll.

Noise: Similar to the power generation facility water production facility generated noise from the electric motors. It is recommended that noise level immediately outside the facility be maintained below 65dBA.

Water Quality: A number of precautions have been proposed to be put in place to ensure water quality is maintained to the highest standards. Chlorination and UV filtration before the being store or released to ensure that water is safer. To ensure the quality is maintained regular water testing is required and should keep logs of these records.

The construction, installation, distribution and use of power plant would ensure the power generation facility is safe and secure and that environmental standards are met in the operational phase. Operational aspects that are likely to cause environmental impact would be noise, exhaust fumes, transport and use of fuel, handling of waste oil, safety and security of the operation of the power house, and maintenance of distribution network.

Noise: Power generation facilities in Akirifushi will operate in wide open space during the construction period. Therefore the location and operational aspects of the power house should not be a problem with regards to noise. Use of duct splitter type sound attenuators are common and should be used to keep the noise levels around 65 dBA in the immediate surroundings (3-5 m distance from the power house).

Exhaust: The diesel engine exhaust is a mixture of hundreds of constituents in either gas or particle form. Among the gaseous hydrocarbon components of diesel engine exhausts that are individually known to be of toxicologic relevance are the aldehydes (e.g., formaldehyde, acetaldehyde, acrolein), benzene, 1,3-butadiene, and polycyclic aromatic hydrocarbons (PAHs) and nitro-PAHs. It is know that emissions vary significantly in chemical composition and particle sizes between different engine types (heavy-duty, light-duty), engine operating conditions (idle, accelerate, decelerate), and fuel formulations (high/low sulphur fuel).

Given these observations the exhaust fumes would have to be released to a high enough, ideally above the canopy of the Akirifushi, so that fumes will be quickly carried out by the wind. Use of the high-grade fuels and appropriate filters would minimize the release of these substances. Regular service of the engine is equally important is the minimizing the release of these substances.

Transport and use of fuel: Environmental impacts relating to fuel transport and usage during the construction phase is understandably high as permanent storage and transport services are not in place. It is recommended that arrangements from Akirifushi be made for supplying fuel to the power house.

Waste oil: The waste oil should be properly canned and disposed off to Thilafushi

10.4 SOCIO-ECONOMIC IMPACTS

10.4.1 Positive socio-economic impacts

Socio-economic impacts of resort development in Akirifushi can be summarized largely as beneficial for the Maldives and nearby atolls and islands. Direct benefit of resort development in Akirifushi to the nearby islands and atolls in general include creation of employment opportunities during construction and operational phase of the project, increased income, improved services and flow of much needed foreign currency into the economy. The following direct and indirect benefits are identified for the Maldivians particularly for the islands nearby in Male and Ari Atoll in the following economic sectors

- Agriculture: market for locally grown fruits and vegetables
- Fisheries: market for local fishermen engaged in lobsters, reef fish and tuna
- Employment: Temporary (300 job opportunities during construction period) permanent (over 214 jobs during operational phase)
- Travel and Trade: development of business opportunities in organizing excursions, fishing trips, establishing souvenir shops and other services for guest
- Cultural promotion: opportunity for locals to perform in the resort (eg.: Dhiffushi)

Overall resort development in Akirifushi will increase government revenue and contribute to expansion of service industries as direct benefits of the project. Indirect benefits of the project include improvement of public facilities and infrastructure, general improvement of social conditions and service industry activities, in addition to the increased national tourism and economic infrastructure.

10.4.2 Negative socio-economic impacts

Overfishing is already observed in the reef fisheries sector with the development of Akirifushi as a resort will potentially contribute to the growth of demand for reef fish to meet the needs of the resort.

Male is already experiencing fresh tuna shortage sometimes. Development of Akirifushi nearby may increase the fishermen opting to supply fresh reef fish and tuna to Akirifushi instead of Male. While this may be an economic improvement for fishermen it may have indirect negative impact for the local population of Male on availability of fresh fish, increased demand and price subsequently.

Mitigation measures:

- The resort should conduct awareness programmes for local fishermen on not to overfish the reefs.
- The resort should strategically assess their market to buy reef fish to avoid resource use conflict with the local reef fish exporters in the country.

10.5 OPERATIONAL PHASE IMPACTS

Impacts associated from operations of the resort will generate the greatest concern on the environment of the island. This is mainly due to the continuous activities associated during the operations of the resort, which will probably last for the entire duration of the project, and will continue to generate impacts for lasting periods. Such impacts are characterized as long-term impacts.

10.5.1 Use of water & resource depletion

Operation of the resort implies a net increase in water usage due to better services and increased number of visitors to the island will mean an increase in the demand for water resources. The resort should put the following water conservation devices or technologies in place.

Mitigation measures:

- Provide adequate water storage facilities to ensure adequate supplies for the resort.

- Install aerators/flow restrictors on all taps
- Install water filtration and treatment systems in guest accommodations
- Install low flush and dual flush toilets.
- Install water efficient taps in bathrooms, toilets and operational areas such as kitchen and laundry
- Install high quality water efficient showerheads in all guest showers
- Collect grey-water separately from sewage effluent and re-use for irrigation.
- Install gutters and collect rainwater from building roofs and store for grounds irrigation.

10.5.2 Use of electricity

Electricity needed for the resort will be produced through 3 generator sets 450kVA x2 and 500kVA capacity, 2 serves as duty one serve as stand by. A fully computerized panel board with capacity to optimize electricity generation and to regulate fuel efficiency will be used to synchronize the energy generation and load sharing. The powerhouse will be designed as per the local regulations and will be registered at the Maldives Energy Authority as the regulation stipulates. Despite the low energy consumption and energy efficient measures increased demand for electricity will commensurately increase the utility's use of fossil fuel to generate that electricity, and thus the project will indirectly incur negative impacts associated with greenhouse emissions.

Mitigation measures

- Incorporating and improving energy management and conservation practices and consideration of renewable energy such as solar power.
- Sub-meters and real-time energy monitoring equipment, timers, photoelectric cells, thermostats, etc. should be installed in the room blocks and other facilities.
- Install translucent shades and fluorescent lighting.
- Pipe insulation, tank lagging (not asbestos!) and heat recovery systems should be installed wherever it is practical to do so.
- All lighting in the resort will be energy saving light bulbs
- Energy efficient Inverter type air conditioner system with ozone friendly refrigerants will be used for the air conditioning of the buildings/areas such as the guest rooms, kitchens, guest facilities, laundry and staff accommodation
- All air-conditioning ducts and condensation pipes will be insulated as appropriate.
- Electrical machinery will also be energy efficient machinery.
- Waste oil from the generators will be collected and incinerated appropriately.

10.5.3 Solid waste management & disposal

Inadequate methods of solid waste disposal during the operation of the resort will generate a number of impacts on the island. For instance, waste such as garbage, plastic bags, glass and plastic bottles, aluminum cans and other discarded items will generate marine pollution in the surrounding area, which in turn will have detrimental impacts on coral reefs as well as on reef fish populations. Also, such pollution can be seen on the island as well as washed onto the beaches of the island if not properly taken care of, thus, the island will become aesthetically unattractive, which can tremendously affect the prime use of the island as a tourist resort. Poor waste management at the resort would lead to unsanitary conditions including vermin and fly

infestation, odours and unsightly conditions. However, garbage management and good housekeeping will be practiced at the resort and potential issues related to improper solid waste storage will therefore be avoided. It is anticipated that dedicated waste Dhoni will be engaged to collect and dispose of waste from the resort to Thilafushi dumpster.

Mitigation Measures:

- A designated waste collection and management area will be established in the resort
- The proponent will establish and integrated waste management plan for the resort once its operational
- Ensure all waste management equipments required by the Ministry of Tourism are put in place and maintained in working order and dedicated waste management staff be employed by the resort management and EPA waste regulation is strictly followed.
- Awareness raising among guests are conducted on ways to reduce and avoid solid waste
- Composting be encouraged on the island
- Ensure residual waste is disposed of at the Thilafushi and waste Dhoni to maintain a regular log of waste.
- Dustbins for collection of different types of waste will be placed on the island at various locations including public areas, kitchens and restaurants, etc.
- Waste materials that are not segregated at the source will be manually segregated at the waste management area.
- Metals, glassware, plastics, paper and organic waste like leaves and twigs will be separated from other materials.
- Metals such as tins and cans will be compacted at the waste management area
- Glass bottles and other glass items will be crushed using a bottle crusher and will be taken out of the island for final disposal at Thilafushi
- Paper will be separated from other organic material as it can be more readily recycled into fresh paper.
- Hazardous waste such as used appliances that contain some degree of harmful chemical waste like battery acids and heavy-metals and other chemical and medical waste will be contained in closed containers and will be periodically transported to Thilafushi dumpster.

10.5.4 Boating activities

Sea transport activities will increase with the commencement of resort operations, which are used for guest transfer, daily diving trip and excursions and to bring supplies for the resort. Intense boating activities have proven chronically detrimental to marine environment especially coral reefs both resulting from direct and indirect impacts such as physical damage to the benthos especially to corals through anchor damage and littering by boat crew and indirectly through disturbing the lagoon bottoms especially in shallow areas.

Small usually insignificant amounts of oils will be released from operation of boats in and around the arrival areas. Leaching of antifoulants, maybe insignificant given the flushing rates in the boating areas, but will be considered as an issue in the long-term. Boat grounding and anchor damage to the reef are potential risks especially in bad weather conditions and boat operations at night.

Mitigation measures:

- All supply boats, dive boats and transfer vessels should be equipped with trash bins within easy reach and requested to use of trash bins.
- Crew members as well as passengers should be made aware of that littering to the marine environment is strictly prohibited.
- Effluent from toilets should not be discharged while boats are moored, anchored or close to the island.
- Appropriate safety measures and care should be taken during refuelling boats to avoid any spillage of oils.
- Mooring facilities should be provided to avoid any possible anchor damages to corals and benthic organisms.
- Codes-of-practice for boating should be formulated and implemented. Environmental awareness of boat crew and passengers should be raised on environment friendly practices.
- Mooring buoys should be installed in the reefs used for recreational fishing by tourists to avoid anchor damage.
- Reefs used for night fishing activities should be regularly cleaned of broken fishing lines and any litter.

10.5.5 Tourist activities SCUBA & snorkelling - misuse of coral reef resources

One of the greatest and highly significant impacts on the marine environment is imposed by tourist activities during the entire operation of the Resort, which have both direct and indirect effects. As a large portion of the tourism in the Maldives are marine-based, most of the tourist-related activities and its implications on the environment are somewhat foreseen due to the current state of experience and knowledge gained from the past.

Recreational diving and snorkeling are major tourist activities in the resorts. Studies have shown that approximately 26% of the tourist arrivals in the Maldives were divers and an estimated 1200 dives were performed per month per resort which is 14,400 dives per year per resort. Also studies have shown that over 5000 divers per site per year will deteriorate coral reefs.

The increased demand for tourist boating can also damage coral reefs by anchorage from diving boats and safaris. The most susceptible corals to anchor damage are those of the branching varieties as they are highly fragile. In addition to physical damage, boats can cause chemical pollution of the reef environment. Corals can resist floating pollutants, but high concentrations of compounds that dissolve easily in seawater are a threat. In addition, tourism development increases demand for souvenir collection, which can lead to commercial collection of large number of marine organisms ranging from shells, corals to reef fish.

Mitigation measures:

- Provide educational and environmental sensitization material on coral reefs for guests and for resort staff.
- Promulgate user guidelines.
- Install boat mooring buoys for use of dive boats and ban boat anchoring on coral substrate.

- Ban collection of coral reef souvenirs.
- Institute and support coral reef monitoring programmes.

10.5.6 Mosquito fogging

Resort in coastal areas where mosquitoes are prevalent often use insecticide foggers as a technique to control the pest populations. This of course kills other beneficial insects, such as butterflies, as well. This causes a serious negative impact, especially in a situation where it is desirable to encourage and maintain butterfly populations.

Mitigation Measure: Use trapping as an effective and alternative method to control mosquito populations.

11 ALTERNATIVES

11.1 NO DEVELOPMENT OPTION

It is believed that a number of environmental impacts will be generated from the proposed development of resort on Akirifushi Island. Although no impacts on the environment will be associated if the proposed development of the resort does not go ahead, the development of the resort will bring numerous benefits. Some of these benefits include socio-economic benefits as well as environmental benefits. In terms of socio-economic benefits, the proposed resort will bring socio-economic development, create jobs and improve living standard of the Maldivians. Resort development in Akirifushi will also contribute to meet current and projected bed capacity needs in the Maldives to reach the strategic targets outlined in the 4th Tourism master Plan 2013-2017 and generate much needed foreign currency and contribute to the economy through tax revenue and annual rent.

Also, the environmental benefits are numerous with the proposed resort since environmental matters will be given important status such as environmentally-friendly design, technology and practices for environmental protection. Given the range of benefits that the proposed development of the resort will bring to the local economy and people, the proposed development project has been considered important.

11.2 DEVELOPMENT OPTION

Having decided and followed the development option Akirifushi one has to consider the alternative options in Akirifushi that would have least environment impact. Following have been considered for the alternatives.

11.3 ALTERNATIVE LAND RECLAMATION

At present the proposed land reclamation shape follows the island shape from all side. As mentioned in the in the description of the existing environment, the western side of the island is exposed to strong wave action. It will be difficult sustain and maintain a sandy beach without a strong coastal protection on the western side. Therefore alternative shape for land reclamation is proposed in Figure 37. The main concept of the alternative reclamation shape is to develop the reclaimed land at the lee of the existing island and extend the reclamation on the northern tip of the island following the existing beach contour. The following advantages are envisaged from proposed alternative change in the shape of land reclamation;

- Increase available beach space, beach length to over 1.6km, in the original proposed shape available beach length is 1.1 km
- Reduce the coastal protection structures on the western side of the island, which will bring substantial cost savings for the developer
- Reduce the length of arrival and service jetty which extends from the beach to the deep lagoon
- Increase the overall protection of the reclaimed land due to its location as shape being developed on the lee of the existing island.

- Alternative reclamation is of same size as the proposed reclamation

If the proposed alternative is preferred for the development major adjustments to the overall layout of the resort should be brought without compromising the quality of the resort facilities.

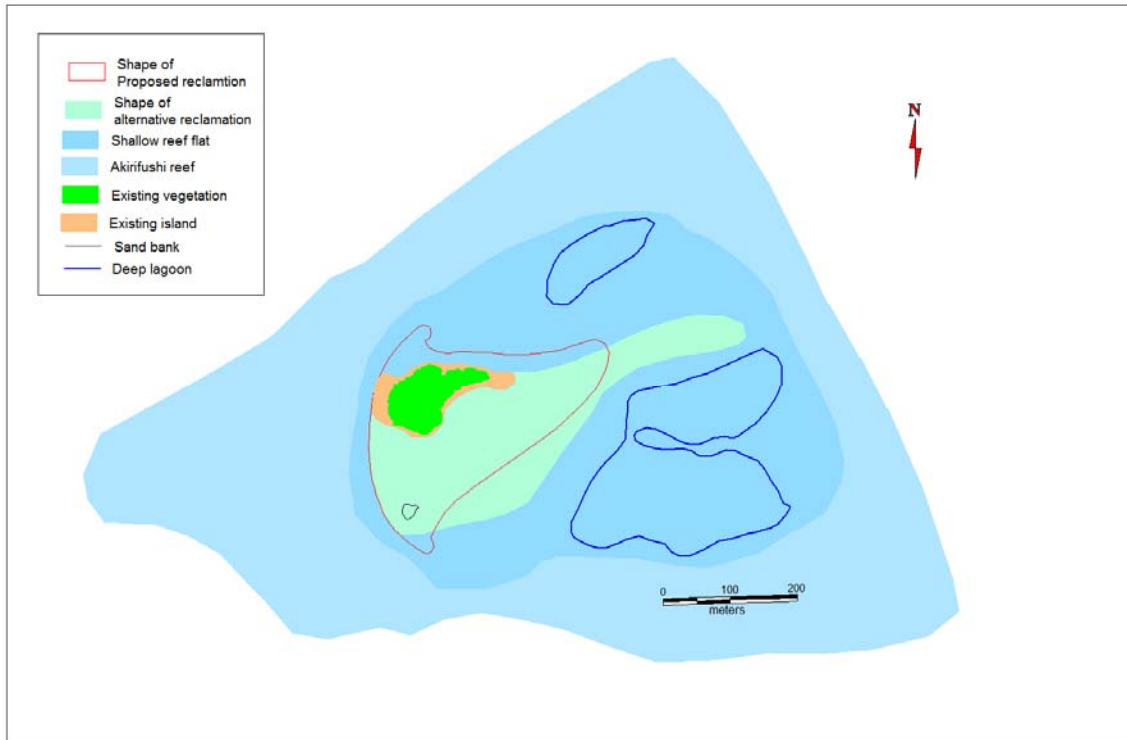


Figure 37: Map showing the proposed reclamation and the alternative shape suggested for the reclamation area.

11.4 LANDSCAPING

Due to the fact that large part of the land being added to the island through reclamation, artificial landscaping will be used which will only consists of salt and spray tolerant coastal vegetation and coconut trees that usually grows on this kind of environments. Number of projects which involves mass removal of trees for airport development and other similar projects are ongoing in the Maldives. Therefore it is recommended that the proponent to keep track of such development activities in the Maldives and transport trees needed for the landscaping rather than uprooting fresh trees from islands. Information on development projects is available through atoll councils and relevant government authorities.

12 MONITORING

Environmental monitoring is essential to ensure that post-construction and operational impacts are known and eliminated in a timely manner. Dealing with impacts earlier would save money and also help planning and operationalize the process.

The parameters that are most relevant for monitoring the impacts that may arise from the proposed project are included in the monitoring plan. These include ground water (pH, dissolved oxygen, electrical conductivity, and faecal coliforms), water quality (turbidity, dissolved oxygen, phosphates, nitrates and BOD), sediment deposition. Monitoring the shoreline changes that may occur due to the medium to long term impacts from the changes in coastal processes.

Shoreline, Beach Profiles and Coastal Process:

Parameter	Indicators	Baseline / Reference Values	Method / Technique	Frequency	Estimated cost in USD
Shorelines (high / low tides)	Beach morphology	Baseline to be re-established immediately after construction is complete	Differential GPS	Bi-annually in the first two year and yearly thereafter	300/ trip
Beach profiles	coastal changes	Requires to re-establish the baseline following the construction	Beach profile surveys	Bi-annually in the first two year and yearly thereafter	300 / trip
Currents	Nearshore currents	Baseline to be collected immediately constructions are over, especially on western side	Drogue survey	Bi-annually in the first two year and yearly thereafter	300/trip

Reef Surveys:

Parameter / Method	Frequency of Monitoring	Purpose	Estimated cost (USD)
Benthic cover by major life forms (live, dead, rock rubble and sand)	Annually	Indicative of the changes in the live coral cover	200/trip

Fish population / visual census	Annually	To assess broad scale change in the ecological status of the coral reefs (increase / decrease of herbivores, etc)	
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Water Quality:

Type	Parameters	Locations	Frequency	Estimated cost (USD)
<i>In situ</i> monitoring / sampling and testing from a laboratory	Dissolved oxygen Turbidity (NTU) Nitrates Sulphates COD TDS	All locations marked	Bi-annually	400/ set of tests

12.1 MONITORING COSTS

It is understood that costs of monitoring be borne by the developer of the Resort. It is also understood the mitigation measures would be accommodated in the contract costs. A commitment letter confirming compliance on mitigation measures is given in Annex 5.

13 STAKEHOLDER CONSULTATION

Unlike other atolls, resort development in Male atoll does not have much involvement of the atoll community nearby. As part of the consultation process the consultant has discussed the development with the atoll council representative who attended the scoping meeting held at EPA on 27th November 2013. The council has no objection or did not request any CSR component in relation to the development. They are very much in favor of the project and they want the resort development in Akirifushi to take place as soon as possible. They believe that the island communities in Kaafu Atoll will greatly benefit from the resort directly and indirectly through creation of employment opportunities during construction and operational phase of the project, increased income, improved services and flow of much needed foreign currency into the economy. Since the development is taking place through a joint venture company with the government, they are on the opinion that the project will contribute to improvement of public facilities and infrastructure, general improvement of social conditions and service industry activities, in addition to the increased national tourism and economic infrastructure. As part of the EIA regulation requirement the proponent has shared the final EIA report with Male Atoll council.

14 CONCLUSIONS

The environmental impact assessment study for resort development Project on Akirifushi Island shows there are three main activities that would cause significant negative environmental impacts. Those, in order of significance, are:

1. Dredging of the lagoon to borrow material for island reclamation and creation of land.
2. Landscaping of the island to plant trees in the reclaimed land.

Of these a long term impact would be from dredging and reclamation. Potential erosion/accretion and adjustment of reclaimed land and to create a new equilibrium with the surrounding environmental conditions are likely to extend to medium to long term. These impacts would be cumulative occurring over long period of time and so can be managed through proper monitoring and addressing them in a timely manner. Based on the scale of infrastructure and development and reclamation work projects that is taking place in Maldives at the time of this writing, impacts associated with this dredging on Akirifushi reef flat is insignificant.

Large number of trees are needed to landscape the newly reclaimed land. Artificial landscaping will be used which will only consists of salt and spray tolerant coastal vegetation and coconut trees that usually grows on this kind of environments. Number of projects which involves mass removal of trees for airport development and other similar projects are ongoing in the Maldives. Trees needed for landscaping will be transported to Akirifushi for such projects sites in the Maldives.

The study has evaluated alternative options for the project activities and has suggested alternative land reclamation shape that will minimise the overall impacts with significant socioeconomic benefit. Also the report found, based on the similar project activities elsewhere in the Maldives, the island and the reef will recover from the expected impacts rapidly and will re-establish a new ecological balance soon. However the report has come-up with an extensive monitoring programme that will keep on monitoring the environmental changes associated with the development and make necessary adjustment to the activities of the project based on the findings of various measured environmental parameters suggested in the monitoring plan.

The study has identified the following beneficial effects form resort development in Akirifushi:

- Increased direct employment and training opportunities;
- Better guardianship of the terrestrial and marine resources of Akirifushi Island;
- Improvements in environmental quality of the island;
- Stimulation of local economy, cultivation and small business opportunities within the nearby island communities; and
- Increased government revenue and increased GDP.

The study found no evidence that the project requires or involves:

- loss of unique habitat or wilderness areas;

- resettling of local communities;
- removing or destroying cultural properties;
- contravening national government of the Republic of Maldives, or island community policies, regulations, criteria, customs or aspirations concerning environment, economy, employment, cultural traditions or life styles.

On the basis of this environmental impact assessment study and the impact mitigation measures proposed in the report will be duly implemented and recommendations are given due consideration, it is concluded that the benefits of the proposed development will substantially outweigh its imposition on the environment.

15 REFERENCES

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16 ANNEXES

Annex 1: Dredging and reclamation permit Akirifushi

Annex 2: EIA Terms of Reference (ToR) Approved by EPA

Annex 3: Akirifushi approved concept drawing

Annex 4: Leopold matrix of Akirifushi development project

Annex 5: Environmental monitoring commitment letter from the proponent

Annex 6: Water laboratory results

Annex 7: Letter from Kaafu Atoll Council indicating that they have received the EIA report

Annex 1



Ref: 203-ADMIN/INDIV/2013/180

19 November 2013

Mr. Ahmed Asraf,
Managing Director,
Akirifushi Investment Private Limited
Male', Maldives

Dear Sir,

Re: Application for Beach Nourishment Works at K. Akirifushi Maldives.

Reference is made to the application that we received on 14th November 2013 regarding the proposed beach nourishment works at K. Akirifushi, Maldives.

We, hereby notify that your application for the beach nourishment works upto 54,000.sqm around the existing island of K. Akirifushi, with an approximated volume of 135,000.cbm has been approved in accordance with the project brief and the map that we received with the application.

So, kindly commence the project after Environmental Impact Assessment process.

Sincerely,

Ibrahim Naeem,
Director General



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DAY 5 JUNE

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Annex 2

EPA/TOR/2014/79

Terms of Reference for Environmental Impact Assessment for a tourist resort development at Akirifushi North Male Atoll

The following is the Terms of Reference (ToR) following the scoping meeting held on 27/11/2013 for undertaking the EIA of the proposed tourist resort development at Akirifushi, North Male Atoll.

While every attempt has been made to ensure that this TOR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report

1. **Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed.. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project. .
- 2.
3. **Study area** – – Submit a minimum A3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites
4. **Scope of work** – Identify and number tasks of the project including preparation, construction and decommissioning phases.

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

The main activities of the resort development are:

- Land reclamation
- Landscaping and vegetation clearance (tree transplantation /burrowing/transportation and handling for landscaping the reclaimed area);
- Channel dredging, jetty and/or harbour construction;
- Sand dredging for beach nourishment and construction activities;
- Infrastructure construction including power house, water desalination plant, sewerage plant, oil storage tanks, waste management facility and hardware workshop;
- Construction and operation of accommodation, restaurants, spa, sports and marine centre facilities (include an A3 land use map);



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- Coastal protection works including groins, breakwaters, sea walls;
- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and operation phase;
- Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills)

Land clearance:

- Preserving the original vegetation of the island
- Define the total area of cleared vegetation from the original Island;
- Methods of clearance and vegetation waste disposal.

Dredging at channel, jetties, harbour and lagoon area for reclamation:

- Location and size of channel and sand burrow areas (s) on a map;
- Sand burrow areas, quantities extracting methods and mitigation measure
- Justification for the selection of these locations;
- Quantity, quality and characteristics of fill material;
- Indication of guarantees for sufficient availability of fill material;
- Method and equipment used for dredging, including description of positioning system, depth control system and operational control procedures;
- Justification for selecting the methods and equipment;
- Duration of dredging activity;
- Labour requirements and (local) labour availability;
- Housing of temporary labour, and
- Emergency plan in case of spills (diesel, grease, oil)

The EIA report should investigate possibilities for alternatives:

- Operation and positioning options;
- Alternative burrow area locations: have these been considered and if so, give arguments why these alternatives have not been selected, and
- Lay out of burrow pits, large shallow pits versus small deep pits to allow quick recovery of the seabed.

Land reclamation refilling:

- Design of the reclamation area, including a justification (from a social and environmental point of view) for the choice of the shape;
- Planning and timing of sub-activities (order of the works, landscaping, dredging and reclamation);
- Method and equipment of transport of fill material and hydraulic filling;
- Distance of transport;
- Need for and location of temporary stockpile (s);
- Location and design of the external bunds for the containment of the sand , together with a description of their stability against waves and current attacks;
- Location and description of any additional coastal protection structures which may be required (e.g. sea walls, break waters, groins). Specify size, number of structures, location, construction materials (rock or sand-cement bags), timing;
- Location (s) and methods of discharging water from the reclamation area;



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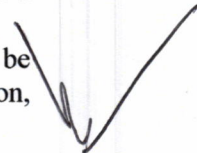
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- Description of safety measures during the construction phases and
- Labour requirements and (local) labour availability.

The EIA should investigate possibilities for alternative:

- Location, routing and design of pipelines;
- Design of bunds, including materials used;
- Design of additional coastal protection structures, including materials used.

Water desalination plant:

- Location, desalination capacity, technology and water quality monitoring system during construction and operation phases;
- Pipeline construction methods, scheduling and drawings;
- Justification for the location of the water intake and brine outfall pipelines;
- Emergency water supply plan.
- Water storage

Power supply plant and oil storage:

- Location and size of generators and facility;
- Fuel transportation technique and volume required;
- Cooling water system including cooling pipe location (if any) and justification;
- Emergency power supply plan;
- Low energy consumption ventures and awareness.

Sewerage plant:

- Plant location, capacity level of treatment and justification;
- Water collection points and pipeline drawings;
- Describe operations for dewatering excavations for pump stations and sewer trenches;
- Describe rain water collection and mechanisms used to avoid pipe leakages protecting ground water contamination;
- Discharge water quality testing system, leakage detection system and emergency plan;
- Justify outfall site selection including the distance from the reef (at least 5m deep out of the reef) and depth of the pipe using oceanographic and ecological information. Currents and waves ought to quickly disperse the discharged water with little to no impacts on marine ecosystems and economic activities. Illustrate the extent of the sediment plume.
- Describe equipment needed and construction methods for laying the offshore pipeline including handling transportation.
- Detail solid waste disposal mechanisms, equipment used and periodicity (how often?).
- Specify materials, equipment, heavy machinery, staff estimate (quantity and period of time), key personnel positions, intermittent technical expertise required;
- Specify an emergency plan if system fails.

Waste management facility:

- Location justification, carrying capacity, materials to be collected and equipment required for waste reduction and recycling;
- Transportation mechanisms and costs;
- Recycling ventures and awareness activities within the resort.



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Harbour and jetties:

- Location justification, capacity and design;
- Construction activities, dock protection and periodical dredging requirements, if any.

Shore protection works and beach nourishment activities:

- Protection structure size, location, number and type, including oceanographic justification with relevant maps;
- Construction materials and function;
- Longevity of protection structures;
- Beach nourishment technique (sand pumping, excavation, etc), volume and type of sand required, periodicity;

Temporary facilities:

- Construction methods, scheduling and operation of temporary facilities including power generation, oil storage, water supply, waste water treatment, accommodation facilities, waste management and decommissioning.

Absence of facilities in the country to carry out the water quality tests will not exempt the proponent from the obligation to provide necessary data. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps and identify studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

The baseline data will be collected before construction and from at least two benchmarks. All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, reef transects, vegetation transects and manta tows sites for posterior data comparison. Information should be divided into the categories shown below:

**There is a description of the specific data collection requirements attached in the appendix of this TOR template.*

Climate

- Temperature, rainfall, wind, waves, evaporation rates (including extreme conditions)
- Risk of hurricanes and storm surges;

Geology and geomorphology

- Offshore/coastal geology and geomorphology (use maps);
- Bathymetry (bottom morphology) (use maps);
- (Seasonal) patterns of coastal erosion and accretion (see appendix for monitoring details), and
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction;

Hydrography/hydrodynamics (use maps)



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- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Sea water quality measuring these parameters: temperature, pH, salinity, turbidity, sedimentation rate, phosphate, nitrate, ammonia, sulphate, BOD and COD.

Ecology

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector.
- Benthic and fish community monitoring around the island (see appendix for monitoring guidelines);
- Landscape integrity, and
- Include ground water monitoring (See appendix for parameter healthy ranges);

Socio-economic environment

- Demography: total population, sex ratio, density, growth and pressure on land and marine resources;
- Income situation and distribution
- Economic activities of both men and women (e.g. fisheries, home gardening, fish processing, employment in industry, government);
- Seasonal changes in activities;
- Land use planning, natural resource use and zoning of activities at sea;
- Accessibility and (public) transport to other island;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);
- Community needs;
- Sites with historical or cultural interest or sacred places (mosques, graveyard).

Hazard vulnerability:

- Vulnerability of area to flooding and storm surge.

Task 3. Legislative and regulatory considerations – Identify the pertinent 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. Include permits and approvals in the EIA document. This should include Reclamation and Dredging Permit and relevant details of Waste Management Regulations and any other relevant regulations.

Task 4. Potential impacts (environmental and socio-cultural) of proposed project, incl. all stages – The EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate the magnitude and significance of each. Particular attention shall be given to impacts associated with the following:



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Impacts on the natural environment

- Loss of terrestrial vegetation and fauna from land preparation works;
- Impacts on marine habitats including damages to coral reefs and seagrass communities, fish stocks, protected areas and protected species;
- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Temporary sediment dispersal in water column (turbidity at the dredging site, reclamation areas and related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts on ground water table and quality as a result of construction and operation activities (leaching of salts in the deposited sediments and change in ground water quantity);
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on employment and income, potential for local people to have (temporary or long term) job opportunities (and what kind) in the execution of the works;
- Disturbance to local natural resource users such as fishing areas, other tourism ventures;
- Impacts to nearby resorts and dive sites;
- Level of protection against hazards like sea level rise, storm surges, etc.
- Impact equity (economic activities, employment, income);
- Impacts on accessibility and transportation of goods to island.

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste);
- Risk of accidents and pollution on workers and local population.

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and professional judgment. Justification must be provided to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Alternatives to proposed project – Describe alternatives including the “no action option” should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the “no action alternative”. The report should highlight how the location was determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Mitigation measures to avoid or compensate habitat destruction, e.g. temporal sediment control structures, coastal protection structures to reduce erosion, coral reconstruction and MPA replacement areas. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources



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required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan (see appendix)– Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for coastal modification, beach morphology, sediment movement around the island. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

- Water quality, especially turbidity;
- Erosion and accretion changes;
- Temporal sedimentation rates on nearby coral reefs, benthic system and seagrass beds;
- Condition of the sensitive ecosystems and marine resources;
- Re-colonization of the benthic organisms in the borrow areas;
- Ground water lens development monitoring;
- Environmentally sound site clearance;
- Environmentally sound removal of dredging and other equipment including construction materials, and
- Employment of available local labour force.

* This TOR contains an outline of the parameters that have to be tested (see appendix). All projects are different, therefore additional or less data will be collected for recovery and impact assessments.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, government authorities such as Male Atoll council and Fisheries Ministry and Tourism Ministry regarding the ownership of the Island. Gaafaru Council and Fisheries Ministry regarding bait fishery and other relevant authorises, government agencies, NGOs, engineers/designers, development managers, staff and members of the general public when need arises. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes.

Presentation- The environmental impact assessment report, to be presented in 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 of 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, 2012



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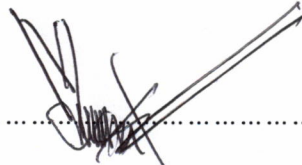
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Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 3 months from the date of this Term of Reference



10th August 2014



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Annex 3

Annex 4

Annex 4: Leopold Matrix for Akirifushi

		Demolition and Construction Phase															Operational phase															
		Actions																														
		Dredging and reclamation	Building foundation and trenching	Building sourcing and building Material	Building material stockpiling and storage	Concret mixer operation	Concrete waste storage and disposal	Dusting- air quality degradation	Construction work noise	Heavy vehicle operation, noise, air quality dust	Sewage and litter management	installation and upgrading of utilities	Construction work water demand	Replanting and land scaping	Visual intrusion on seascape	Jetties and entrance clearance work	Sourcing gravel and placement of jetty columns	material stock pilling	Fuel and chemical storage	solid waste management	Equipment vehicle maintainace	Staff training	water demand	Electricity demand	Sewage collection and disposal	solid waste management and disposal	Guest activities					
I- Physical and Chemical Characteristics	1.Land	a.Soil	Major	Minor	Minor	Minor	Major	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Potential	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Potential	Negligible	Negligible	Minor	Minor	Negligible	Negligible				
		b. landscape	Major	Minor	Minor	Minor	Minor	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Potential	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Potential	Negligible	Negligible	Minor	Minor	Negligible	Negligible			
		c. soil erosion	Major	Minor	Minor	Minor	Minor	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Potential	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Potential	Negligible	Negligible	Minor	Minor	Negligible	Negligible			
	2. Water	a. Ground water																														
		water table contamination	Minor	Minor	Minor	Minor	Minor	Major	Negligible	Minor	Negligible	Negligible	Minor	Potential	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Negligible	Major	Negligible	Minor	Minor	Negligible	Negligible			
		interaction with surface driniage	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Potential	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Negligible	Negligible			
		change in water quality	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Potential	Minor	Minor	Minor	Negligible	Negligible	Minor	Minor	Minor	Major	Negligible	Minor	Minor	Negligible	Negligible			
		b. surface water																														
	3. Amosphere	a. air quality (gases, aerosol)	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor			
b. Climate		Minor	Minor	Minor	Minor	Minor	Minor	Minor	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor				
II-Biological Conditions	1. Coastal and Marine Resources	a.current sediment dynamics	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor			
		b.lagoon water quality (turbidity)	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		c. coral	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		d.sandy bottom creatures	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		e. beaches	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		f. fish and fisheries	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		g. Endangered species	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
	2. Flora	a.trees, shrubs, grass	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		b. endangered species	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
	3.Fauna	a. birds land animals, reptiles	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		b. insects	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
		c. Endangered species	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
	III- Aesthtics, Cultural & socio-economic Condition	1. Aesthetics and Human	a.Scenic view and vistas	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor		
			b.noise/vibration	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	
			c.litter/debris/dust	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
d.ordour			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	
e.Wildness qualities			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	
f.Open space qualities			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
g.landscape desing			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
h.unique physical features			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
i.rare and unique species			Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
2. Cultural Status		a. cultural patterns lifestyles	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	
		b. health and safety	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
		c. Employment	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
economic		bussiness oppertunities	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor

 Minor Negative Impact
 Moderate Negative Impact
 Major Negative impact
 Potential Positive Impact
 Negligible or no impact

Note: **"Major Negative impact"** cannot be completely avoided even if mitigation measures are taken.it is considered as a key factor in decision making process.
"Moderately negative impacts" cannot be completely avoided even mitigation measures are taken but can be minimized to an accepted level
"Minior negative impacts" Have no significance with regard to decision making process

Annex 5

Our Ref: 2014/003

8th June 2014

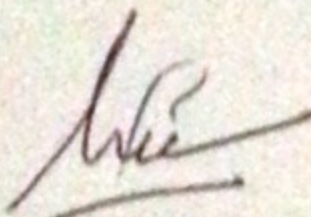
Mr. Thoriq Ibrahim
The Minister
Ministry of Environment and Energy
Ameenee Magu, Maafannu,
Malé-20392 , Republic of Maldives

Dear Mr. Ibrahim,

Re: EIA – Resort development in Akirifushi

As the proponent responsible for environmental compliance for the above project, I hereby give our financial commitment to implement the monitoring plan and to comply with the issues identified in the Environmental Impact Assessment Report submitted to your agency.

Yours sincerely



Ahmed Ashraf
Managing Director



Annex 6

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory

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WATER QUALITY TEST REPORT

Test Report No: 301095/2014/01

Customer Informations :

Akirifushi Investment Pvt Ltd
 2nd Floor, Ma Milano
 Male'
 Rep. of Maldives



Date: 04/5/2014

Sample Description / Location~	Akirifushi Island		TEST METHOD	UNIT
	Ground water	Sea water		
Sample Type~	Ground water	Sea water		
Sampled Date~	27/4/2014			
Sample Received Date	29/4/2014			
Test Requisition Form No.	900156984			
Sample No.	811015	811016		
Date of Analysis	29/4/2014-04/5/2014			
PARAMETER	ANALYSIS RESULT			
Physical Appearance	Pale Yellow	Clear	Visual	-
Conductivity	9800	54310	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	µS/cm
Nitrate	9.2		Method 10049 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
pH	7.3	8.0	Method 4500-H ⁺ B. (adapted from Standard methods for the examination of water and waste water, 21 st edition)	-
Sulphate	320		Method 8051 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Salinity	5.48	34.40	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	‰
Hardness, Magnesium		5229	HACH Method 8329	mg/L
Phosphate	0.2		Method 8048 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Total Dissolved Solids (TDS)	5048	26523	Electrometry	mg/L
Total Suspended Solids (TSS)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L

Keys:

UNITS: mg/L: Milligrams per litre, µS/cm: Micro Siemens per centimeter, ‰: Parts per thousand

LOQ: Limit of Quantification

<p>Checked by:</p>  <p>Mohamed Eyman Senior Quality Control Officer</p>	<p>Approved by:</p>  <p>Adam Rashood Assistant Manager, WQA</p>
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Notes:

Sampling Authority: Sampling was not done by MWSC Laboratory

This report, in full or in part, shall not be published, advertised, unless prior permission has been secured from MWSC.

This test report is ONLY FOR THE SAMPLES TESTED.

~ Information Supplied by the customer

*****END OF THE REPORT*****

Annex 7

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ



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