SECOND ADDENDUM

EIA for Proposed Coastal Protection Works in

Dh. Maaenboodhoo

Addendum Proposal: Revised Design

February 2018

Prepared for: Ministry of Environment and Energy
Prepared by: Mohamed Zuhair (EIA01/15)

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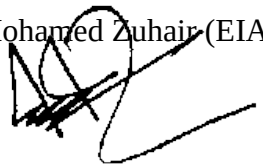
CONSULTANT DECLARATION

I, Mohamed Zuhair, Registered EIA Consultant at the Ministry of Environment and Energy of Maldives with the Registration Number EIA 01/15, hereby declare that the statements in this Second Addendum to the EIA Report for Proposed Coastal Protection Works in Dh. Maaenboodhoo, which involves a revised design and location, are true, complete and correct to the best of my knowledge and abilities.

Name: Mohamed Zuhair (EIA01/15)

Signature: 

Date: 26 February 2018

PROPONENT DECLARATION

بسم الله الرحمن الرحيم

Ministry of Environment and Energy
Male', Republic of Maldives.

ފަރުމާތާއި ވަޒާރާތް
ދާދި، ދިވެހިރާއްޖެ.

ދިވެހިރާއްޖެ ގަވަރުމަންޓް - ތިލޭދޫ ގަދަރުގެ

Date: 28th February 2018

No: 438-ENV/203/2018/38

Mr. Ibrahim Naeem

Director General

Environmental Protection Agency

3rd Floor, Green Building

Male' , Maldives

Dear Mr. Naeem,

Sub: Proponent's Declaration

Ministry of Environment and Energy herey declare that the contents of this Environmental Impact Assessment (EIA) Report for the the EIA Addendum prepared for the proposed coastal protection project at Dh. Maaenboodhoo has been read and understood by us.

Also, we are aware that theis EIA Report has been prepared to fulfill the requirements of EIA Regulation 2012 with regards to obtaining environmental clearance for the project from Environmental Protection Agency.

Sincerely,

Abdulla Ziyad,
Minister of State

Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
+(960) 301 8300
+(960) 301 8301
www.environment.gov.mv

ފަރުމާތާއި ވަޒާރާތް، ހަނޑުވަރީ ހިންގުން،
ދާދި، ދާދި، 20392، ދިވެހިރާއްޖެ.
secretariat@environment.gov.mv
www.twitter.com/ENVgovMV
www.facebook.com/environment.gov.mv

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1. NON TECHNICAL SUMMARY

I. This is the Second Addendum to the project's approved main EIA, which has been prepared for obtaining permit and environmental clearance for revised coastal protection measures in Dh. Maaenboodhoo. The Proponent of the project is Ministry of Environment and Energy and the contractor of the project is SAS e Senok JV Pvt. Ltd.

II. It is a legal requirement under the Amended EIA Regulation 2012 EIAs/Addendums for projects that are believed to generate negative environmental impacts. This Addendum has been prepared as per the approved Terms of Reference (TOR) on 6 February 2018.

III. The scope of this Addendum is to assess the existing environmental condition of the proposed project areas and surrounding environment, identify potential environmental impacts, propose environmental management and mitigation measures to minimize environmental impacts as well as propose an environmental monitoring plan with appropriate environmental parameters to monitor changes on a regular basis.

IV. The locations and design of the geo-bag revetment has been altered as part of the revised new design which was approved and awarded to the contractor on 6 December 2017 as the second phase of the project. The main reason for the revision is that erosion on the island has shifted to the new locations where coastal protection measures are now required on the NW shoreline of the island.

V. A detailed environmental assessment was undertaken as part of the main EIA and marine and coastal environmental assessments relevant for the proposed project have been used as the baseline environmental condition in this Addendum.

VI. The project involves excavation of fill material, land filling and development of geo-bag revetments and groynes to be constructed as part of the overall coastal protection works. The environmental impacts from sedimentation and direct destruction and loss of habitat from these activities have been identified to be the most significant environmental impacts from the project. Especially in areas where dredging and land

filling occur, irreparable damages in these areas of the environment have been identified. To some extent, the revetments itself is also an impact to the environment in terms of permanently replacing the habitats within the area.

VII. Environmental monitoring has been planned to undertaken in conjunction with the main EIA environmental monitoring plan.

VIII. Although there are a number of environmental impacts from the proposed development, some of these can bring permanent changes to the environment of the island, other impacts can be reduced and mitigated by use of appropriate methodology. The effectiveness of these methodologies can be documented by implementing a comprehensive monitoring programme. Also, with positive social outlook of the project and considering the overall need for the project, it is concluded that the project should go ahead as planned.

2. INTRODUCTION

2.1 BACKGROUND

The proposed project involves protection of areas affected by beach erosion on the NE, SE, NW and SW of Dh. Maaenboodhoo Island by means of rock boulder revetment breakwater and geo-bag revetment. In this regard, it is proposed to build a 220m long rock boulder revetment breakwater along the NE side, 550m long rock boulder revetment breakwater along the SE side, 225m long geo-bag revetment along the NW shoreline and 190m long geo-bag revetment along the SW shoreline of the island.

The required material for filling, beach profiling and core material for the geo-bag revetment and rock boulder revetments is proposed to be obtained from two burrow sites (western side and southern side) initially approved by EPA on 26 August 2015. This Dredging and Reclamation Permit has been attached in **Appendix 1 (Dredging and Reclamation Permit).**

With regards to undertaking the above-mentioned project, the Environment Impact Assessment (EIA) was prepared by Mohamed Zuhair (EIA01/15) and Ibrahim Shakir and approved by Environment Protection Agency (EPA) in November 2015.

A First Addendum of the EIA Report was also prepared in November 2015 for changing the burrow site outlined in the main EIA report to a new location, which was also approved in November 2015.

The aim of the proposed project is to protect areas affected by beach erosion on the NE, SE, NW and SW of the island by means of rock boulder revetment breakwater and geo-bag revetment. In this regard, construction of 220m long rock boulder revetment breakwater along the NE side, 550m long rock boulder revetment breakwater along the SE side has been completed in the first phase of the project.

The locations and design of the geo-bag revetment has been altered as part of the revised new design which was approved and awarded to the contractor on 6 December 2017 as the second phase of the project. The main reason for the revision is that erosion on the island has shifted to the new locations where coastal protection measures are now required on the NW shoreline of the island.

This is the Second Addendum to the project's approved EIA, which has been prepared for approval due to changes in the design and location of coastal protection now requires to be undertaken on the island.

This addendum document was prepared upon approval of a Terms of Reference for the Addendum by EPA on 6 February 2018**. (Appendix 2: EIA Addendum Terms of Reference).**

This Addendum is part of the approved main EIA for the project, hence it shall be read in conjunction with the approved EIA for Proposed Coastal Protection Works in Dh. Maaenboodhoo, which contains detailed information on the project and site conditions.

2.2 PROPONENT AND CONTRACTOR

The details of the project proponent is outlined below;

Ministry of Environment and Energy
Green Building
Handhuvaree Hingun
Male'
Maldives
Tel: 301 8300
Fax: 301 8301

The contractor of the proposed project is SAS e Senok JV Pvt. Ltd., a private company registered in the Maldives having the following contact details;

SAS E Senok JV Pvt. Ltd.
M. Ibage, 1st Floor
Iramaa Magu
Male'
Maldives
Tel: 333 1682
Fax: 330 1682
Email: saud@saseconstruction.com

2.3 RATIONALE AND JUSTIFICATION

Although the project initially involves protection of areas affected by beach erosion on the NE, SE, NW and SW of Dh. Maaenboodhoo Island by means of rock boulder revetment and geo-

bag revetment, the first phase of the project involving development of a 220m long rock boulder revetment along the NE side, 550m long rock boulder revetment breakwater along the SE side has been completed. The 225m long geo-bag revetment along the NW shoreline and 190m long geo-bag revetment along the SW shoreline of the island has not been implemented yet.

During project implementation, it was noted that erosion previously identified on NW and SW shorelines of the island has been shifted along the northern sides of the island. Present condition of the island shows most parts of the shoreline on the northern side are severely affected by erosion and requires immediate action due to risks to some island infrastructure.

Figure 1: Severe erosion on the northern shoreline

Based on extensive discussions and consultations among Maaenboodhoo Island Council, Ministry of Environment and Energy, SAS e Senok JV Pvt. Ltd as well as Member of Parliament for Dh. Kudahuvadhoo Constituency, it was decided that due to shifting of erosion to the northern shoreline, immediate protection measures are required, hence a revised scope and design was finalized to be implemented as part of the project to be done as the second phase.

Additionally, two other activities are also proposed to be executed as part of the EIA Second Addendum. This include development of a drain system for flood prevention at the harbor area

and development of a public swimming area on the eastern side of the island. These two activities will also be executed by the project proponent and the contractor.

This Addendum to the approved main EIA has been prepared in order to obtain approval and environmental clearance for undertaking coastal protection in the new locations with a revised design layout.

2.4 SCOPE AND APPROACH

The main scope of this Addendum is to assess the existing environmental conditions of the proposed new areas affected by erosion, predict and evaluate environmental impacts, propose environmental management and mitigation measures to minimize environmental impacts as well as propose an environmental monitoring plan with appropriate environmental parameters to monitor changes on a regular basis as a result of obtaining fill material from the proposed new burrow site.

This Addendum has been prepared based on information collected from the baseline environmental assessments undertaken to prepare the project's main EIA as well as information obtained from key stakeholders such as Maaenboodhoo Island Council, Ministry of Environment and Energy, Contractor and the Member of Parliament for Dh. Kudahuvadhoo Constituency.

2.4.1 Review of Relevant EIAs

Additionally the Consultant's previous experience in preparing EIAs in similar environmental settings and similar projects has been used in this report.

- Environmental Impact Assessment Report for Proposed Coastal Protection Works in AA Ukulhas, prepared by Mohamed Zuhair and Ibrahim Shakir in 2015.
- Environmental Impact Assessment Report for Proposed Coastal Protection Works in Dh. Maaenboodhoo prepared by Mohamed Zuhair and Ibrahim Shakir in 2015
- Environmental Impact Assessment Report for Coastal Protection Measures in Veymandoo, Thaa Atoll, prepared by Mohamed Zuhair and Ibrahim Shakir in 2015

These EIAs prepared for the above mentioned projects outlines obtaining fill material by means of sand excavation. The environmental impacts identified from these projects are similar,

however, their extent and magnitude have been identified to be different due to the scale of the development. Major environmental impacts discussed in the studies as a result of sand excavation, include sedimentation and direct destruction of lagoon and reef habitats.

2.5 ADDENDUM STRUCTURE

A summary of the main contents of this EIA Addendum is presented below;

- **Project Description:** A description of the overall project proposal including justification, main project inputs and outputs, project schedule;
- **Legal Considerations:** An assessment of the most relevant laws and regulations that the proposal has to comply with;
- **Existing Environment:** An assessment of the existing environmental status of the proposed new locations and surrounding environment. Most of the information were taken from the main EIA;
- **Potential Environmental Impacts:** Prediction of potential environmental impacts and evaluation of the magnitudes of environmental implications that will be associated with the proposed new burrow site;
- **Mitigation Measures:** Identification and assessment of the ways in which the environment of the project site be appropriately managed and minimized;
- **Alternatives:** Assessment of alternatives sites and no development option,
- **Stakeholder Consultation:** Presentation of views of important stakeholders with regards to the proposed change of burrow site of the project; and
- **Environmental Monitoring:** Development of an environmental monitoring plan with regards to long-term monitoring of various environmental aspects related to the project.

2.6 IMPACT PREDICTION AND EVALUATION

The key environmental impacts from the proposed new locations site have been identified by means of simple descriptive check list and evaluated by using comparative matrices. These methods are widely used for identifying and evaluating environmental impacts and their magnitudes, and based on these assessments, environmental management and mitigation

measures have been proposed. Additionally, Expert judgment and professional opinion have also been widely used throughout the impact assessment and evaluation process.

2.7 CONSULTANT

This EIA Addendum was prepared by Mr. Mohamed Zuhair (EIA01/2015), a registered EIA Consultant.

Mr. Mohamed Zuhair, EIA Consultant (EIA01/15) is a freelance Environment Consultant who has many years of experience in the field of environmental management, assessment and monitoring, implementation of environmental laws and regulations and has involved as lead consultant and a team member in preparing several EIAs in the Maldives.

3. STUDY AREA

Although the project scope has slightly changed, the main focus area of the project, which is coastal protection around Maaenboodoo Island remains same.

The new locations for coastal protection and extent of the study area can be found in the following figure.

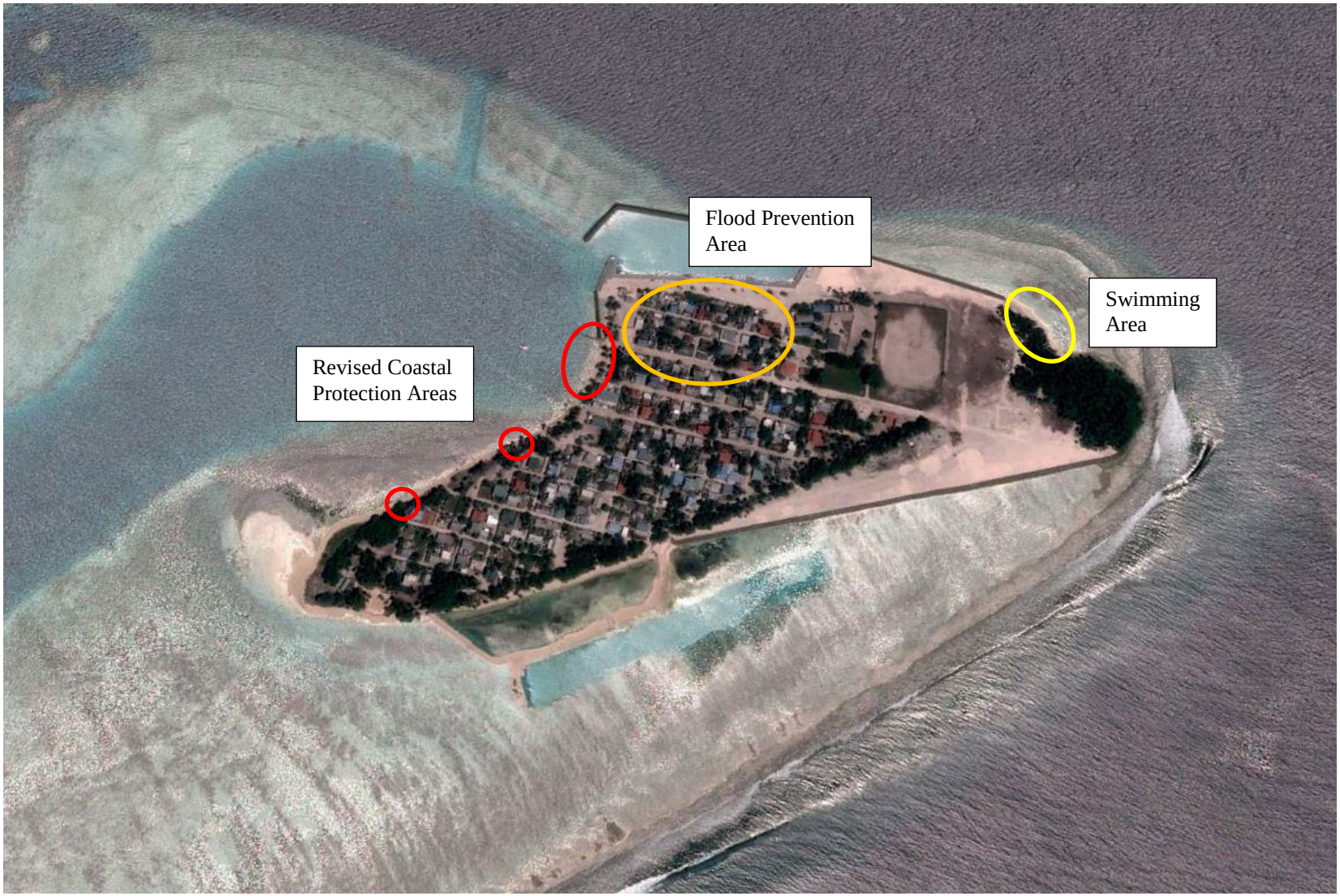


Figure 2: Study areas according to the new scope of the project

4. PROJECT DESCRIPTION

4.1 PROJECT LOCATION

The proposed revised coastal protection area, flood prevention area and swimming area is outlined in Figure 2.

4.2 PROJECT OUTLINE

Following are the key activities proposed to be underaken.

4.2.1 Revised Coastal Protection Measures

a. Geo-bag 20m revetment and 10m groyne from existing rock revetment and 5 wide sand filling (Figure 3)

Figure 3: Geo-bag revetment and sand filling area

b. Geo-bag 50m long revetment with 2 groynes on either side and inside filled with sand having 50m by 10m area (Figure 4)

Figure 4: Geo-bag revetment, groyne and sand filling area

c. Construction of 2 x Y groynes having 15m long with 10m arms and inside filled with sand (Figure 5)

Figure 5: Locations where Y groynes will be developed

d. Development of drain system for preventing flooding from the harbor area by pacing two underground wells to collect storm water
e. Development of a public swimming area on the eastern side of the island having an approximate area of 100m by removing rocks from the nearshorelagoon

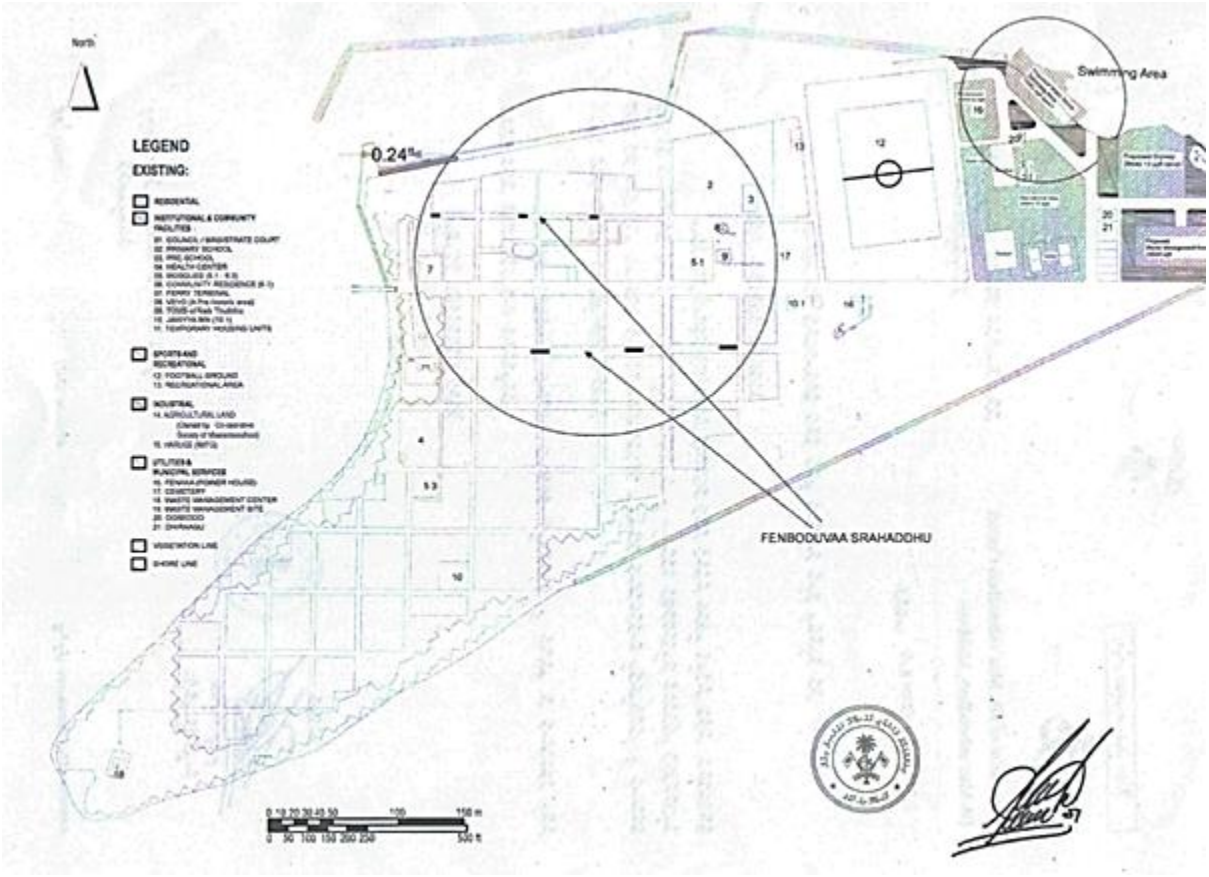


Figure 6: Areas where drain system and swimming area development

Justification

The northern side shoreline has been undergoing serious erosion which is now threatening some of the existing infrastructure on the island and poses risks to important development areas on the island including the new council office if coastal protection measures are not implemented soon.

Figure 7: Erosion impacts on the northern side

After the harbor was developed on the island, flooding on the adjacent areas occur as a result of harbor area which was done slightly above the existing island level. Storm water accumulates in areas where community lives. This has become a public nuisance on the island and requires to be addressed urgently.

There is no area on the island now to be used as a public swimming area due to harbor development and recent rock boulder revetment development along the shorelines of the island. The north-western side cannot used du to close proximity of the inner deep lagoon and ongoing erosion. The southern area has the burrow site for sand filling for the ongoing coastal protection project. The northern side has the habour and revetment. This only leaves a small area on the eastern side where the community can have a public beach and a swimming area.

As part of project, it is proposed to clear the lagoon area by removing existing large rocks along a 100m stretch on the eastern side lagoon. These rocks will be removed by an excavator. No major dredging or deepening of the lagoon will be undertaken in the area.

Figure 8: Maaenboodhoo before (left) and after harbor and coastal protection (right)

4.2.2 Mobilization

Mobilization of the project in terms of required machinery and equipment has already been done at the site. However, the project is waiting for the approval and environment clearance for the activities proposed in the addendum from EPA.

4.2.3 Dredging Works

It is proposed to dredge by means of excavation of all the required fill material for the fill areas and geo-bags. The project already has an approved burrow site from EPA (First Addendum). The estimated total fill material requirement is 4,000m^3, which will be excavated from the approved burrow site. Since the project has changed the locations for placing geo-bags to new locations, sourcing fill material from the approved burrow site has not reached approved volume that can be excavated. Thus, no new burrow site has been proposed as part of the addendum. In order to access the burrow site, the temporary sand bed laid from the island to the site will be used.

It is planned to complete the excavation works soon in order to reduce environmental impacts exposure to the surrounding environment.

4.2.4 Project Duration

A total of 174 days will be required to complete the second phase.

4.3 MATERIAL INPUT AND OUTPUT

Following are the key project inputs and outputs.

4.3.1 Main Project Inputs

Project Input	Type	Source
Labor	Foreign and local	Contractor (3-5 persons)
Technical personnel	Foreign and local	Contractor (2 persons)
Machinery	Excavator 330 and dump truck,	Contractor's machinery
Geobags	660 – 700 Geofabrics	Contractor supplied
Spare parts	Spare parts for all machineries	Contractor and local suppliers
Water supply	During construction	From the island
Fuel supply	Diesel, petrol, lubricants	Contractor and locally purchased
Food and accommodation	During construction	Locally arranged from the island
Health and safety	Fire extinguishers, first aid, safety equipment	Contractor

Table 1: Key project inputs

4.3.2 Main Project Outputs

Project Output	Quantity	Disposal Method
Excavated material	4,000 cbm	Used as fill material and core material for the revetments
Geobag revetment, groynes and fill area	70 geobag revetment, 30m groynes, 600m^2 fill area	Placed in designated locations and areas
Oil and lubricant waste	Small	Stocked to transfer for final disposal in Thilafushi
Air and Noise Pollution	Small	Fixed working hours

Table 2: Key project outputs

4.4 KEY IMPACTS AND IMPACT BOUNDARY

A notable environmental impact from the proposed activities of dredging and excavation works will be from sedimentation and subsequent impacts from it. However, it is believed that sedimentation will be mainly distributed within the lagoon found on the southern side of the island and eastern side of the island during excavation, which some of its effects may be felt on the adjacent reef itself.

Figure 9: Impact boundaries of the project

The above figure shows key project activity areas and anticipated impact areas, mainly areas that will be affected by sedimentation, which may be distributed within the neashore lagoon and to parts of the southern and eastern side reef.

5. LEGAL CONSIDERATIONS

A detailed legal, administrative and policy framework relevant for the proposed project have been outlined in the main EIA; **Environmental Impact Assessment Report for Proposed Coastal Protection Works in Dh. Maaenboodhoo.** All major activities of the proposed project including development of geo-bag revetments and rock boulder revetments, beach profiling works have been approved by Environment Protection Agency (EPA) in November 2015.

The approval was granted by the **EIA Regulation 2012.** The Dredging and Reclamation Permit was granted under the **Dredging and Reclamation Regulation 2013.** These regulations are developed under the main **Environmental Protection and Preservation Act of Maldives (Law No. 4/93).** The Environment Act and regulations developed under the Act are regulated and implemented by **EPA** on behalf of **Ministry of Environment and Energy**.

An Amendment to the EIA Regulation 2012 is now under enforcement since November 2015. As part of this Amendment, application for permit of dredging and reclamation works can now be submitted together with EIAs/Addendums to the Environment Protection Agency.

Hence, this Addendum to the main EIA falls under this Amendment to the EIA Regulation 2012 and therefore, the required dredging and reclamation permit of the new burrow site has been attached with this EIA Addendum.

6. EXISTING ENVIRONMENT

This section outlines the key existing environmental conditions of the project area, ie, the proposed new locations and the surrounding environment where the project is believed to impact the environment.

A detailed assessment on the various components of the environment was undertaken in the main EIA prepared for undertaking coastal protection works in Dh. Maaenboodhoo Island.

6.1 METHODOLOGY

The main EIA discussed in detail the types of the methods used to gather data from the existing environment of the island. For the purpose of this EIA Addendum, only relevant information for the proposed dredging works in the new burrow site has been used.

Beach Profiles - Beach profiles around the island were undertaken by using a standard leveler and profile locations were geo-referenced. Information on two beach profiles can be used as part of this Addendum.

Currents – current speed and direction was collected by drogue technique from the southern side of the island.

Bathymetry – echo sounder was used to collect depth information from around the island, hence from the proposed new burrow site.

Seawater Quality – a seawater sample was collected from the southern side of the island and analysed from the laboratory of MWSC.

Marine Environment - coral reefs and lagoon environments that may be impacted from the proposed activities were assessed visually and by use of 1x1 several and random photo quadrats on the northern and southern side of the lagoon. Information obtained from the southern side of the lagoon is used in this Addendum.

6.1.1 Uncertainty on Data Collection Methods

Limited time spent on site has been the key limiting factor to get a more detailed assessment on all environmental aspects surrounding the project area. Some of the methods used are quite rapid, such as those undertaken on the marine and lagoon environment. Nonetheless, most of the assessments, including seawater, beach profiles, reef health, bathymetry and drogue were done in accordance with the TOR and reflect the general existing environment of the island at the time of these assessments.

6.2 BEACHES

Beach dynamics of the project area was studied by taking beach profiles, transacts, comparison of aerial photographs in 2010 and 2013 from Google Earth and that of the shoreline survey undertaken in 2015. It was found that no major changes have occurred since 2010, however, development of the harbor on the north may have triggered some erosion on the north as well as placement of the fill material from the harbor may have affected the NW and SW beach areas, which now requires coastal protection.

Also, beach profiles taken from the immediate area on the southern side relating to the proposed new burrow site indicate heavy scouring of beach material from the areas. As can be seen from the profiles, P3 and P4 have drastic drops in the beach slope which indicates heavy scouring in the area.

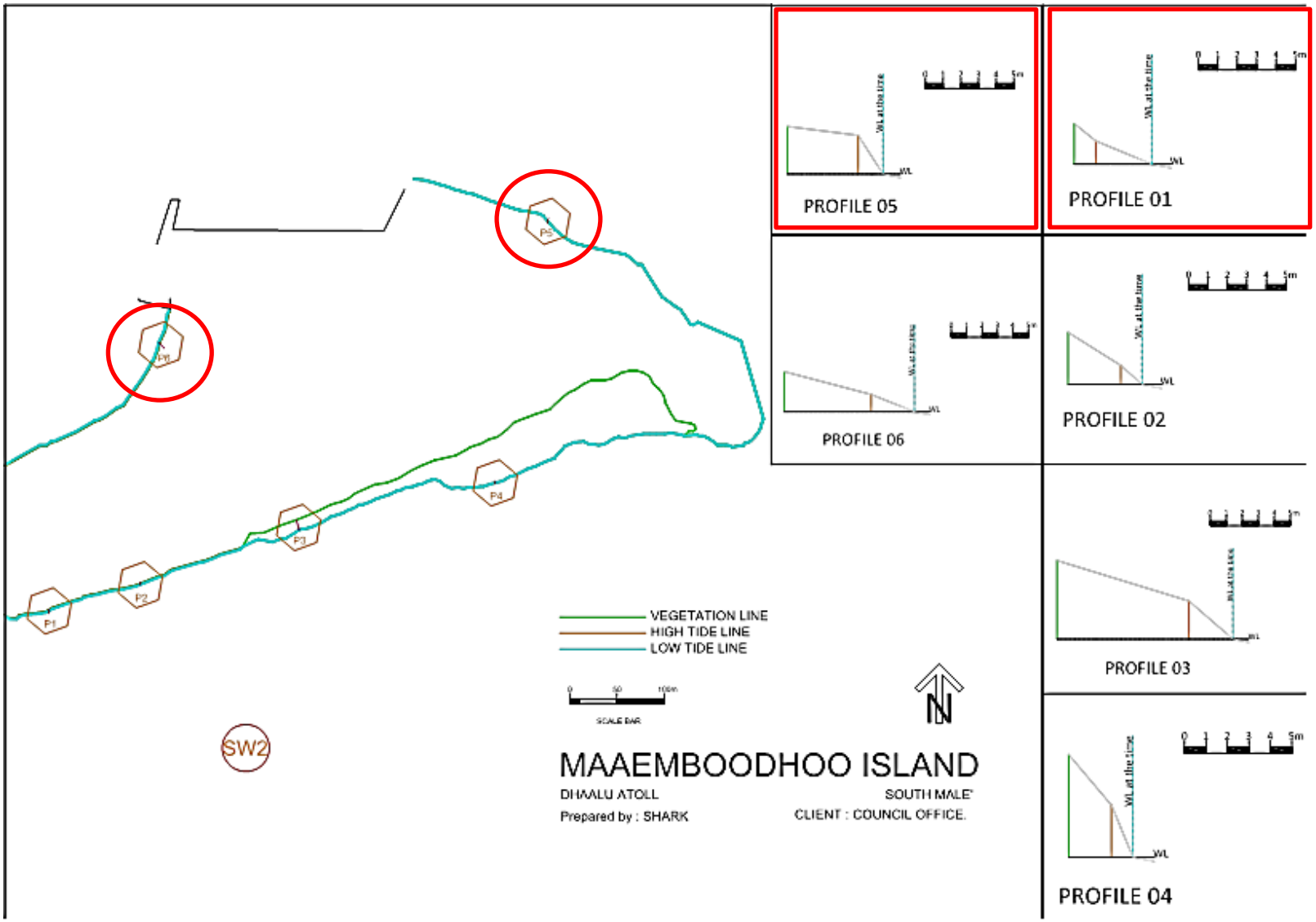


Figure 10: Beach profiles taken around the island (encircled relevant areas)

6.3 CURRENTS

Current measurements have been taken from three locations; north, south and eastern lagoon of the island. Currents on the south had a northerly flow at a speed of 0.07m/s, currents on the north had an easterly flow at 0.16m/s while currents on the eastern side had the strongest currents at speeds of 1.21m/s, which is the strongest current generated from the areas assessed due to natural channel.

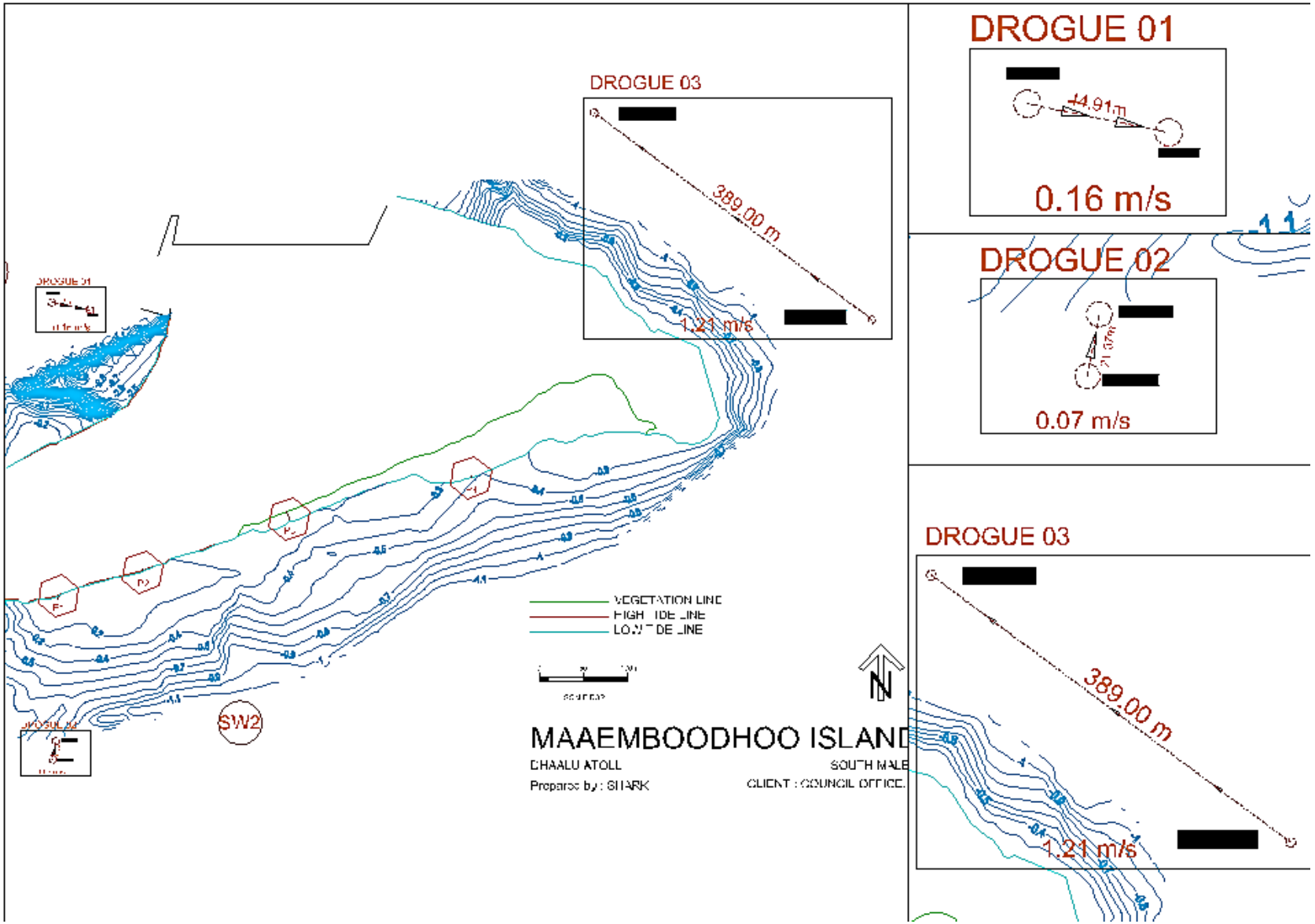


Figure 11: Current measurements around the island (encircled relevant areas)

6.4 BATHYMETRY

Bathymetry taken around the proposed new burrow site indicates that the near shore depths are between 0.5m – 0.7m in most parts of the lagoon around the island.

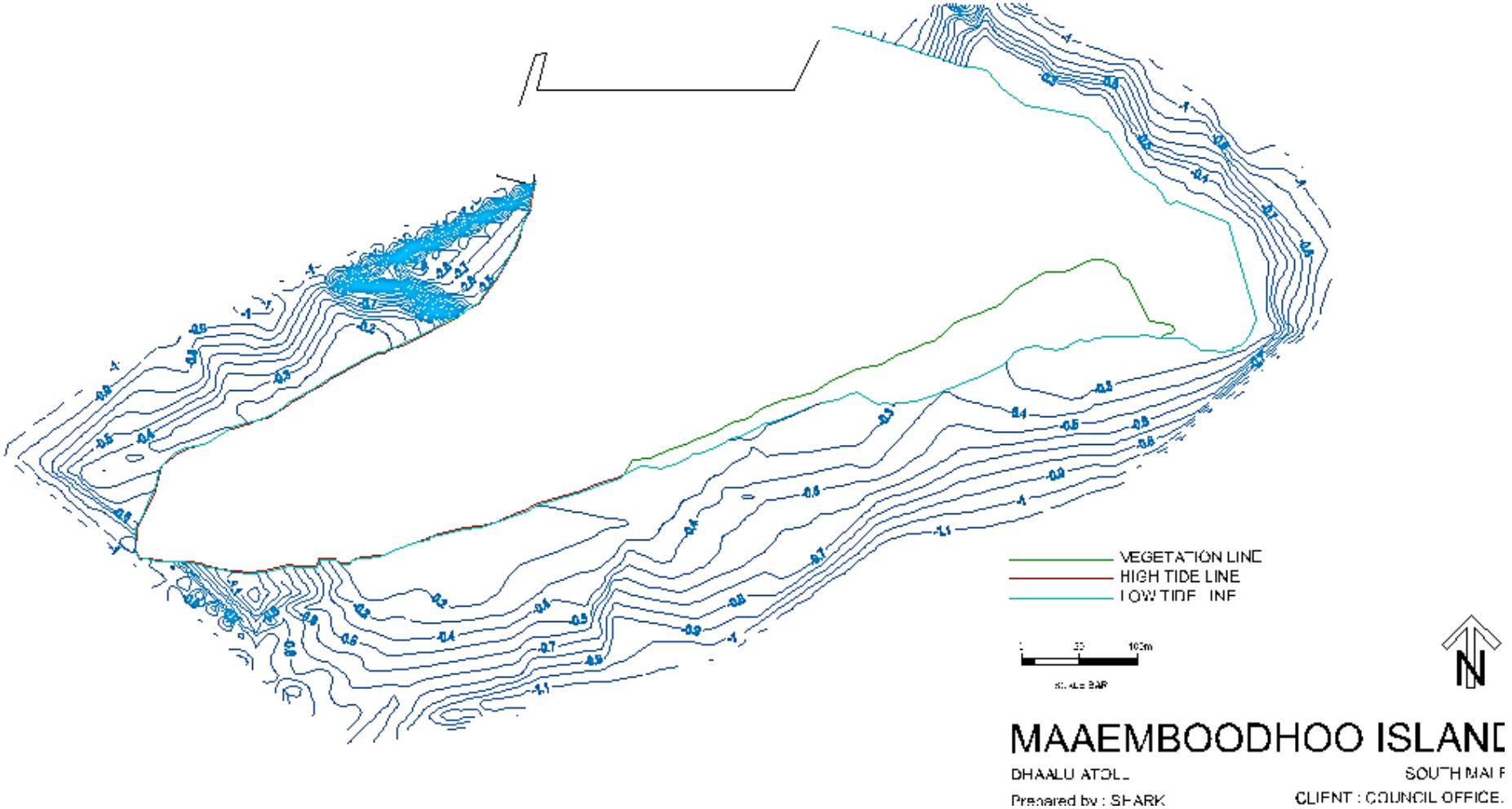


Figure 12: Lagoon bathymetry taken around the island (encircled relevant area)

6.5 MARINE ENVIRONMENT

The following areas of the marine environment have been assessed both qualitatively and quantitatively in order to understand the current status.

Figure 13: Marine survey locations; R=reef assessment, S=seawater sample collection points (encircled relevant areas)

6.5.1 Coral Reef

Coral reef assessments were carried out on two locations, one on the reef crest of north and one on the reef flats of south as indicated in the above figure. The reef extent on the south was observed to large having around 220m with wide reef flat areas. On the north the reef extent is around 88m and there are limited lagoon areas. However, reef flat area are observed to be quite defined and wide.

Both these area fall within the direct impact zone of the proposed project, hence, long-term monitoring will show how the project has impacted the natural environment found in these areas.

The following figure summarizes the main findings of the reef assessment carried out on the two locations of the reef of Maaenboodhoo Island.

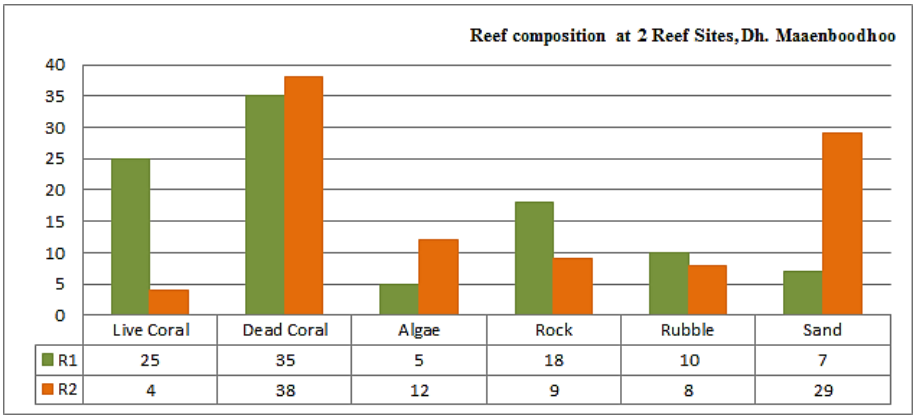


Figure 14: Reef composition at surveyed sites from the reef of Maaenboodhoo

The two sites surveyed have different characteristics. More live coral was found at R1 located on the north with around 25% live coral, with corals of *Acropora* and Porites. In the contrary, R2 located on the southern side of the island had very high sand content with around 29% cover. This area is located quite close to the proposed burrow site, hence it is expected that the burrow site will have similar environmental conditions. Only 4% of live coral was observed and most of which were isolated coral colonies mostly belong to *Acropora* family. Over 30% dead corals and rubble were observed at both sites.

Figure 15: Reef composition distinction between the two sites (R2 is on right)

6.5.2 Reef Fish

Reef fish abundance and diversity was also assessed during the coral reef assessments. Visual fish censuses were carried out on all reef sites along an approximately 20m belt transects. The reef fish assessments were only done at family level. The findings of the reef fish assessments are presented in the following figure.

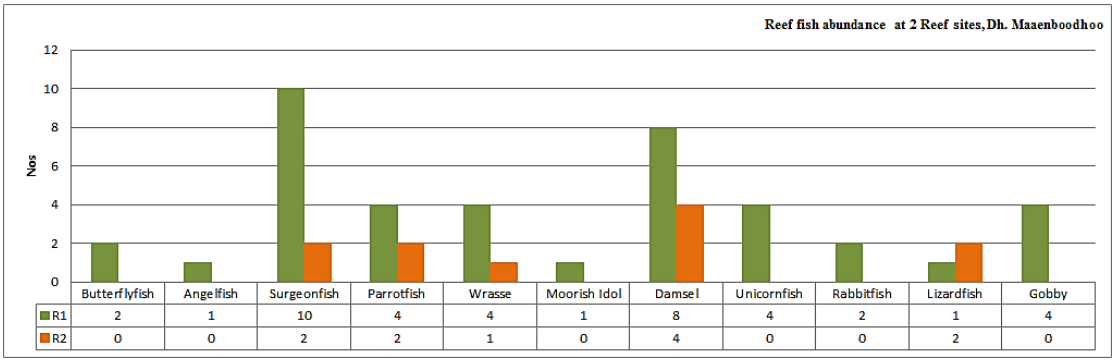


Figure 16: Reef fish assessment results at two locations (R2 is relevant area)

Only 11 fish belonging to 5 families were recoded from R2, of which most were damesels and no groupers, angelfish, Moorish idol, unicornfish, rabbitfish were found from R2.

6.5.3 Seagrass

Patches of seagrass have been observed to be present on the southern and northern nearshore lagoon areas. The seagrass is believed to be *Thalassia* spp. However, no significant or ecologically important marine biodiversity is observed to be associated with the environment. However, some juvenile reef fish were found to be habiting some of the seagrass areas. As a result of erosion, sediment deposition on many parts on the seagrass is apparent.

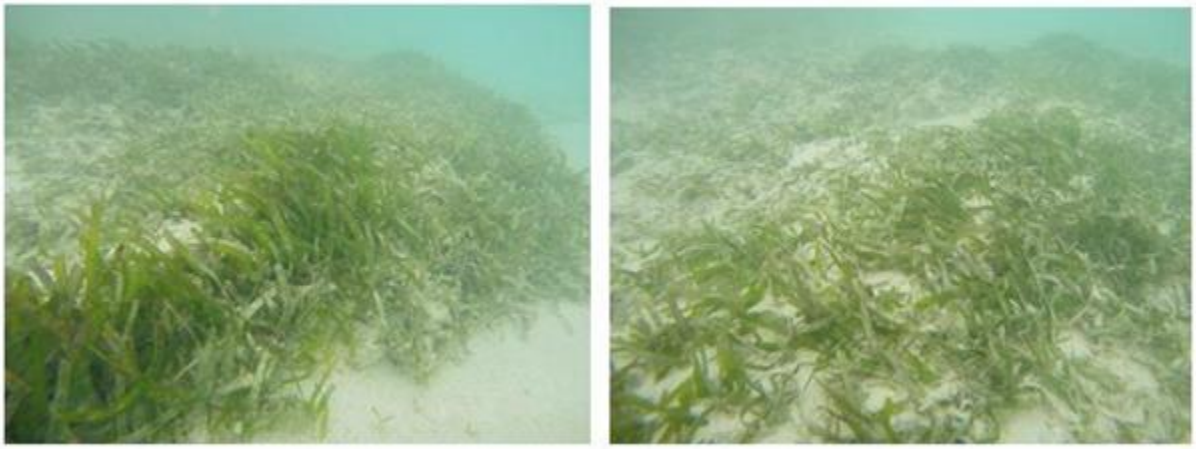


Figure 17: Seagrass patches found on the southern side lagoon

6.6 SEAWATER QUALITY

A seawater sample from the island lagoon on the southern side was tested by the laboratories at MWSC for the parameters in the following table to establish the baseline status of seawater around the island.

Seawater test results are attached in **Appendix 3.**

Perimeter	Unit	SW 1
Physical Appearance		Clear
Conductivity		52300
pH		8.10
Nitrate	mg/L	0.4
Sulphate	mg/L	2980
Salinity	mg/L	34.20
TSS	mg/L	26500
Turbidity	NTU	0.635

Table 3: Seawater analysis results

The seawater quality around the island had no excessive contents of nitrate or sulphates. These data will be used as baseline data for the monitoring purpose.

6.7 HAZARD VULNERABILITY

The following information on the vulnerability of the islands in the Maldives are taken from published literature such as Natural Hazard and Physical Vulnerability Assessment Report by UNDP (2008) as site –specific information on vulnerability of the lagoon was not available. According to the UNDP (2008) the natural vulnerability of the islands and atolls of the country to potential environmental hazards have been modeled to understand the risk factors of the country.

6.7.1 Major Natural Hazards

According to the UNDP assessment report, the natural hazards prevailing in the Maldives can be classified into 4 categories. These are;

- Geological hazards i.e. earthquakes and coastal erosion;
- Meteorological hazard i.e. tropical cyclones and storms, thunder storms, waterspouts, heavy rainfall, and drought;
- Hydrological hazards i.e. floods induced by heavy rainfall, storm surges, swell waves, udha, and tsunamis;
- Climate-related hazards i.e. accelerated sea level rise, sea surface temperature rise, changes in monsoon pattern.

Among those listed above, floods (induced by tsunamis, abnormal swell waves, and heavy rainfall), windstorms, droughts, and earthquake are counted as major natural hazards prevailing in the Maldives.

The general patterns of the major natural hazards prevailing in the Maldives is summarised in Figure 18.

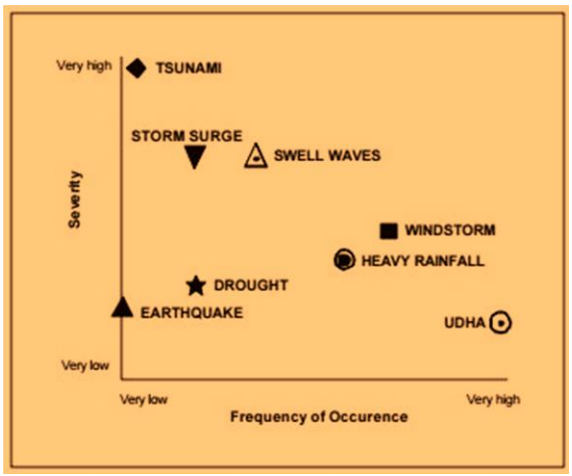


Figure 18: Relationship between hazard intensity and frequency of major natural hazards in the Maldives (UNDP, 2008)

6.7.2 Distribution Pattern of Natural Hazards

The major natural hazards in the Maldives are strictly controlled by their geophysical and climatic settings and show quite different patterns in their distribution, as shown in Figures 19 and 20. Tropical cyclones and correspondingly storm surges and droughts predominantly prevail in the north of the Maldives. In contrast, swell waves and heavy rainfalls are more prominent in the southern and western islands of the Maldives. The southern islands of the Maldives are threatened earthquakes from the seismic zone of Carlsberg Ridge.

There are also longitudinal variations in hazard distribution. The most notable is the occurrence of tsunami waves and their impacts. The eastern rim islands are subject to tsunamis and waves of a higher intensity due to their direct exposure to these hazards, whereas the western rim and atoll lagoon islands are protected by the atoll formation patterns. Impacts of swell waves and udha events are also expected to be highest on the western rim island due to the south westerly and westerly approach of these events. However, their impacts aren't totally reduced on the eastern rim islands due to the propagation of swell waves through reef passes and fetch within atoll lagoon.

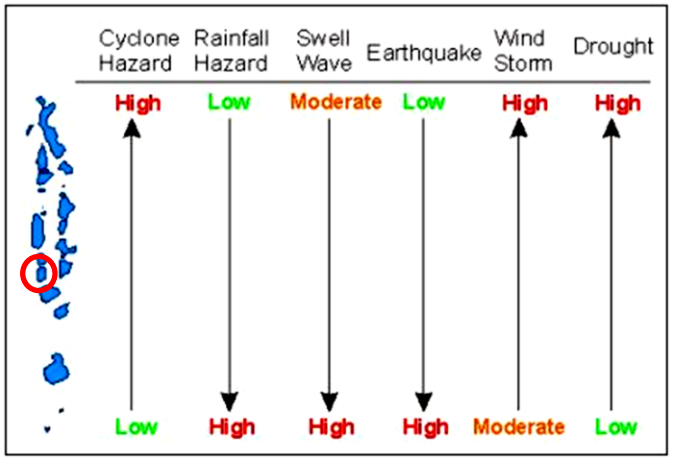


Figure 19: Latitudinal variations of major natural hazards across the Maldives (UNDP, 2008).

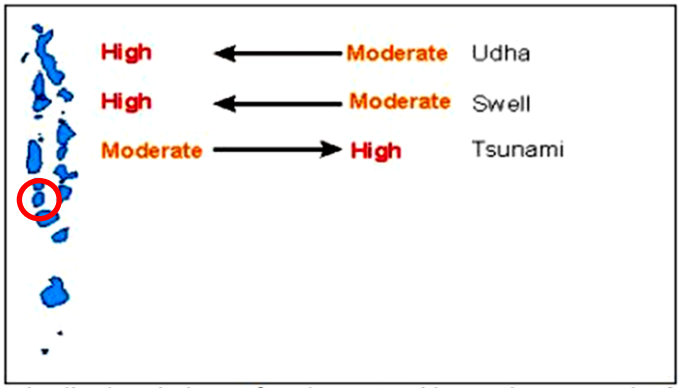


Figure 20: Longitudinal variations of major natural hazards across the Maldives (UNDP, 2008)

Based on the above analysis, it can be said that as Dh Atoll is located on the south central parts of the country, there are potential risks of natural hazards such as rainfall and swells (Figure 19).

The Atoll is quite open to the ocean on the western side, hence has moderate risks from Udha and swells (Figure 20).

As there are no site specific data on site vulnerability of Maaenboodhoo island, the above analysis have been used to understand natural hazard factors in a relative manner. As the coastal protection of the island is undertaken on the north western side of the island, natural risks from westerly Udha and swells may have some impact on the project site.

7. ENVIRONMENTAL IMPACTS

The following section predicts potential environmental impacts from the revised coastal protection and other works to be carried out in Maaenboodhoo coastal protection project. Once the potential environmental impacts are identified, the impacts are evaluated to identify their significance. In order to identify and analyze environmental impacts, the following methods have been used.

7.1 METHODOLOGIES

7.1.1 Impact Prediction

First of all, most of the environmental impacts that may be generated as a result of the project is predicted and is distinguished from construction and operation phases of the project. The impacts have been predicted by using simple matrix method. The prediction of environmental impacts also to a great extent incorporated expert judgment and professional opinions of the EIA consultant involved in the preparation of the report as well as statements addressed in the EIA reports reviewed in this Addendum.

7.1.2 Assessing Impact Significance

The environmental impacts are assessed in terms of significance. Significance is the function of magnitude of the impact and the likelihood of the impact occurring and the impact magnitude is a function of the extent, duration and intensity of the impact. The criteria used to determine impact significance are summarized in the following table (adapted from Environmental Resource Management, 2008).

IMPACT MAGNITUDE		
Extent	On-Site	Impacts that are limited to the boundaries of the development site
	Local	Impacts that affect an area in a radius of 1km around the development site
	Regional	Impacts that affect regionally important environmental resources, administrative boundaries determined by bregional scale
	National	Impacts that affect nationally important environmental resources or have macro-economic consequences
Duration	Temporary	Impacts are predicted to be of short duration and intermittent / occassional
	Short-term	Impacts that are predicted to last only for the duration of the construction period
	Long-term	Impacts that will continue for the life of the project, but stops when the project ceases operation
	Permanent	Impacs that cause a permanent change in the affected receptor or resource
Intensity		*BIOPHYSICAL ENVIRONMENT*
	Negligible	Impact on the environment is not detectable
	Low	Impact affects the environment in such a way that the natural funclions and processes are not affected
	Medium	Where the affected environment is altered but natural functions and processes continue
	High	Where natural functions or processes are altered to the extent that they will temporarily or permanently cease
		SOCIOECONOMIC ENVIRONMENT
	Negligible	There is no perceptible change to people's livelihood
	Low	People/communities are able to adapt with relative ease and maintaine pre-impact case
	Medium	People/communities are able to adapt with some difficulty and maintain pre-impact case but only with a degree of support
	High	People/communities will not be able to adapt to changes or continue to maintain pre-impact case
Likelihood	Unlikely	The impact is unlikely to occur
	Likely	The impact is likely to occur in most consitions
	Definite	The impact will occur

Table 4: Impact significance criteria

Once a rating has been determined for magnitude and likelihood, the following matrix has been used to determine the impact significance.

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	**Likely**	**Definite**
MAGNITUDE	**Negligible**	Negligible	Negligible	Minor
	Low	Negligile	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 5: Significance rating matrix

The different ratings of impact significance are then given a colour scale for easily understanding the overall magnitude of the impact. The following colour scale has been used.

Negative Ratings	Positive Ratings
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table 6: Significance colour scale

7.1.3 Limitations and Uncertainties

The potential environmental impacts from the proposed project are all predicted and assumed, hence there may be variables affecting the accuracy of these impacts due to natural variations and uncertainties.

EIA studies undertaken in similar environmental settings and technical experience as well as professional judgment of the EIA team have been used as support while predicting and evaluating these environmental impacts.

Since the environmental, geomorphological and physical oceanography of the islands of the Maldives are unique, the degree and accuracy of the predicted impacts when applied even in other islands of the Maldives in similar project settings, may differ in accuracy, magnitude and significance.

7.1.4 Justification of the Method Used

There are many ways and a number of methods in which environmental impacts that arise from development projects can be assessed and evaluated. The methods used for the purpose of predicting and evaluating the significance of environmental impacts is an accepted and internationally recognized as well as widely used methods throughout the world in a number of development projects. Although it is adapted for the condition of the project by the EIA consultant from Environmental Resource Management, 2008 literature, the approach as well as intended outcomes still remain same. The method used are quite easy to be understood by non-technical personnel.

7.2 IMPACT PREDICTION

The environmental impacts that may be associated with revised coastal protection are predicted in this section by using a simple descriptive matrix. The following matrix distinguishes the types of environmental impacts that may be associated with various project actions on key environmental components and distinguishes whether these impacts occur during construction period or during post-construction period.

PROJECT ACTIONS	ENVIRONMENTAL COMPONENTS AND ENVIRONMENTAL IMPACTS			IMPLICATION PERIOD
	Beach Shoreline	**Lagoon Habitat Oceanography**	**Reef Habitat Seawater**	
Dredging and excavation from approved burrow site		Direct destruction of lagoon habitats, changes in seawater quality from sedimentation and changes in oceanography	Direct and indirect impacts to reef habitats and organisms due to sedimentation, turbid seawater	During construction
Excavation of lagoon material on the eastern side	May pose some threats to existing beach	Changes in nearshore currents	Short term changes in seawater quality	During construction
Construction of geobag revetment and groynes	Loss of existing beach areas and development may affect nearby beach areas	Minor changes in current flow pattern around project area	Minor sedimentation short term changes in seawater quality	During construction
Operation of construction vehicles	Exposure to noise and dust			During construction
Back filling works	Due to sudden change in the shoreline from backfilling, shoreline may be affected from natural shaping due to changes in nearshore dynamics	Minor sedimentation turbid water condition in the lagoon		During construction
Flood prevention	No major impacts to beaches	Some turbid conditions during rain due to over flow		Post construction

Table 7: Impact prediction table

The above table shows the main project activities and the environmental components upon which the environmental impacts will occur. As the Addendum only deals with revised coastal protection and other works proposed, impacts arising only from these activities has been predicted.

7.3 DESCRIPTION OF IMPACTS

7.3.1 Construction Phase Environmental Impacts

7.3.1.1 Impacts from Excavation of Fill Material from Approved Burrow Site

All required fill material will be obtained from the approved burrow site located on the southern side lagoon, which has been used during first phase of the project. It is estimated that around 4,000cbm of material will need to be obtained from the site.

The most significant direct cause of dredging is sedimentation and consequential turbidity, benthic destruction and changes in reef communities, dredge spoil as well as its impacts on the environment such as water quality deterioration, changes in light intensity, habitat destruction as well as species loss and reef damage. Some impacts to the shoreline are also anticipated.

Shoreline

The dredging area is located within the southern lagoon and will be dredged to a length of 222m and a width of 31m. The dredging in the area is believed to alter the oceanography of the lagoon, hence may have some implications on the existing shoreline on the southern side of the island. However, during first phase, excavation of material from the burrow site has made the shoreline more stable due to temporary sand beds placed which has given some protection to the southern shoreline and the wester tip.

Sedimentation

This is the most significant contributing factor to reef damage from dredging as it releases large amounts of sediments into the environment. Large volumes of sediment released into ambient environment including to the lagoon and reef, as a result of activities such as dredging is harmful to establishment, development and survival of many corals both in the lagoon and reef.

The ecological effects of sedimentation on coral reefs range from a temporary slow-down in coral growth to gradual dying and permanent changes in community structure and species diversity. This indicates that corals itself as well as coral communities are highly susceptible to changes that will occur from sedimentation. Concerning the settlement of sediment particles, a big quantity of different sized corals will bury them as well as will fill in all crevices and cavities together with numerous species and organisms that live there and which are indispensable to the structure and functioning of the whole ecosystem.

The capacity of corals to remove fine sediments falling on them depends on the type of coral. The ability of corals to reject sediments is limited by several factors such as excessive sediments and complete burial for more than several hours is lethal to most corals and coral colonies. Ciliary movements cause the rejection of sediment in corals. Branching species are more advantageous than other flat and massive growth forms in remaining viable in situations of prolonged sediment deposition.

Turbidity and Changes in Light Intensity

Light for organisms in seawater is a very complex problem as coral reefs are very sensitive to changes that occur within the environment in which they are found. Fine particles in suspension in the water column will contribute to a decrease in light intensity. Visibility in normal conditions in the Maldives range between 10-15m, however, it may drop to 2m during the operation of dredging, hence, drastically cuts down the light intensity, which will affect the growth of autotrophic organisms such as corals which depend on sunlight for its growth, reproduction and survival.

Seawater Quality Deterioration

As it is clear that abiotic and biotic reef conditions are modified by sedimentation, it also alters certain parameters of water. For instance, suspension of sediments, in addition to problems of turbidity and siltation, will produce dirtier water, noxious odours and significantly decrease the dissolved oxygen in water and the results can be severe for fish and other very active organisms. However, this will depend on the site itself and will reduce such problems in open areas where there is an adequate current flow. The proposed dredging site is quite open, hence, the impact on water quality is envisaged to be on an average scale.

Habitat Destruction and Changes in Reef Community Structure

As sedimentation causes adverse impacts on the general reef ecosystems, it is apprehensible that all levels of physical and biological content of a reef system will undergo drastic changes. In the vicinity of the dredged site, the main damage is caused by sand loading, sedimentation, silt deposition on coral colonies, other organisms, crevices and cavities, and such drastic modifications lead to very important changes in the biotic composition and sometimes lead to the death of the reef. Within the coral reef ecosystem, corals and coralline algae are first to suffer from sedimentation. Some corals and algae will immediately die because they cannot reject mass sedimentation episodes while molluscs and crustaceans as well as fish leave the

damaged reef or die, resulting total decrease in species richness and diversity as well as loses its renewable high productivity.

7.3.1.2 Impacts from Excavation of Lagoon Material on the Eastern Side

Due to lack of a proper swimming area on the island, it is proposed to remove some rock and rubble content found in the lagoon on the eastern side. The key environmental impacts from the activity are envisaged to be short-term in nature and mostly associated with sedimentation during removal of lagoon material. The existing beach on the eastern side may be affected due to sudden changes in the lagoon depths. Some sedimentation may run into the reef on the eastern side, however is not believed to have major environmental impacts due to strong currents in the area.

7.3.1.3 Impacts from Construction of Geobag Revetment and Groynes

Due to the sudden change in the shoreline as a result of placement of goe bag revetment and groynes, current patterns of the nearshore environment within the project area may be affected. This may divert some currents to other areas in the nearshore environment along the northern and southern as well as western shorelines of the island, hence, may cause further beach erosion. If beach erosion distributes to other areas along the shoreline, more coastal areas from the island will be affected. On the reverse side, there is also potential to supplement these areas with sand which may be transported during the site preparation process. Operation of construction vehicles during construction of the revetments within the lagoon, may also produce some sedimentation which may affect the lagoon habitats and seawater quality.

7.3.1.4 Operation of Construction Vehicles

As part of the proposed burrow site dredging works in Maaenboodhoo, some construction vehicles such as an excavator and a dump truck will be used in the operations. During the operation of these vehicles, impacts from noise and dust may be generated. Also, operation of these vehicles on the beach may affect the area, however, will be of short-term in nature. No Major environmental impacts are anticipated.

However, these impacts will be restricted to vehicle operation periods and specific project locations only.

7.3.1.5 Impacts from Backfilling Works

The portion of the area on the northern side of the island needs to be filled right up to the proposed geobag revetment as well as the proposed geo-bag areas need fill material for beach prifiling. These activities will be done from fill material obtained by dredging from the southern lagoons. This will no doubt have some implications in terms of environmental impacts on the area as well as on surrounding areas.

Following are the key impacts associated with land reclamation of the proposed project.

Loss of Lagoon Habitat

A major consequence of sand filling on the marine environment included permanent loss of lagoon including loss of some lagoon habitats as filling converts such habitats into land. For Maaenboodhoo island, the lagoon environment does not contain many varieties of lagoon habitats. The nearshore lagoon mostly consisted of sand, rocks, rubble and searass as well as few amounts of live corals.

Sedimentation and Reef Damage

Sand filling on large areas release fine sediments into the environment causing impacts from sedimentation on physical and biological constituents of the reef environment in terms of degradation and damage to surrounding habitats which in turn leads to decreased or loss of diversity and abundance of certain species among corals, fish and other organisms. Most impacts from dredging-based sedimentation are discussed above. Sand filling and dredging in the proposed area will occur at the same period and the magnitude of impacts occurring on the marine environment from both operations will be largely felt simultaneously.

Changes in Current Flow

As a result of sand filling will alter natural wave and current patterns of the area thereby causing changes in the shoreline. Changes in the shoreline of the island are subject to changes in the beach dynamics due to altered equilibrium causing either beach erosion or accretion. In such cases sand is usually transported within the lagoon and beyond to the reef environment which is damaging to corals and coral colonies as well as will reduce fish populations. Fill material from the land will also be washed onto the lagoon and reefs due to changes in wave and current patterns.

7.3.2 Post Construction Environmental Impacts

7.3.2.1 Flood Prevention

Due to construction of the harbor on the northern side of the island and backfilling works undertaken from the material obtained from the basin was placed by the harbor at a level slightly higher than the existing island level, which makes flooding on the adjacent areas of the island during rain.

In order to prevent flooding in the adjacent areas, it is proposed to place two underground wells in the flood prone area to divert all storm water which will be connected to the sea. The excess water collected in the wells will directly flow into the sea whereby causing some sedimentation in the lagoon during over flow period. This may affect lagoon habitats to some extent and these impacts may be felt on a long-term basis.

However, more than environmental impacts associated with flood prevention, it is believed that the activity will bring more social benefits as the frequent flooding issue will be solved, which has been a social issue on the island for a long time.

7.4 IMPACT ANALYSIS AND EVALUATION

The following section analyses and evaluates the previously described environmental impacts in order to identify their significance.

	IMPACT MAGNITUDE					
ACTIVITY/IMPACT	**EXTENT**	**DURATION**	**INTENSITY**	**LIKELIHOOD**	**MAGNITUDE**	**COLOUR SCALE**
Excavation of fill material from burrow site	Local	Permanent	Medium	Likely	Moderate	
Excavation of lagoon material on eastern side	Local	Permanent	Medium	Likely	Moderate	
Coastal protection from geo-bag revetment and groynes	Onsite	Permanent	Medium	Likely	Moderate	
Backfilling works	Onsite	Short-term	Low	Likely	Minor	
Operation of contruction vehicles on land	Onsite	Short-term	Low	Likely	Minor	
Flood prevention	Onsite	Permanent	High	Likely	Major	

Table 8: Impact analysis table

It is clear dredging related impacts are felt within 1km radius having permanent changes and having medium intensity. Thus, the impact significant has been scaled as having moderate implications.

Construction of geo-bag revetments and groynes will also cause some permanent impacts such as alteration of the existing coastlines, changes in the oceanography, etc. Minor impacts can occur from operation of construction vehicles on land and damage to geo-bag revetment from excessive use.

Also, operation of construction vehicles in the adjacent beach areas have been identified have site-specific impacts which are of short-term in nature and have a low intensity. Thus, it has been scaled as having minor implications.

Flood prevention is believed bring a major beneficial impact as the flooding on the island will be to a great extent prevented. It is an important social issue that needs to be addressed.

8. MITIGATION MEASURES

The main purpose of the following section is to outline environmental management and mitigation measures that will be undertaken and followed with regards to minimizing and reducing environmental impacts from revised coastal protection works of Maaenboodhoo Island. Mitigation measures have been addressed for all environmental impacts identified in the previous section.

8.1 CONSTRUCTION PHASE

8.1.1 Mitigation Measures to Reduce Sedimentation

As can be seen from the previous section on environmental impacts from the proposed activities, sedimentation as a result of excavation to obtain necessary fill material, beach filling and placement of geobags have been identified as the major cause of environmental impacts from the project including seawater quality deterioration, impacts to corals and reef fish and other organisms as well as habitat destruction.

The following measures will be used to reduce impacts from sedimentation and reducing spread of sedimentation within and around the surrounding environment.

- In order to reduce effects of sedimentation, consideration has been given to undertake the dredging activity and beach filling as well as placement of geobags in the shortest possible time, thus sedimentation will be exposed only for a short period of time.
- It is proposed to undertake the activities mostly at low tide and on calm days, to ensure that the sedimentation does not reach far distances as well as for easy operation of the activity. It is believed that during low tides and calm days, transport of sedimentation will not reach far distances, hence its effects on the environment can be minimized.
- The turbid waters will be directed into the bottom in order to reduce the spread since bottom waters are less disturbed by winds; this combined with a shorter distance for sediments to settle may help to minimize the turbidity effects around the area. The burrow site itself can be made into the sedimentation sink location.

Key considerations;

Consideration	Detail
Reduce spread of sedimentation	Project implementation plan
Cost	0
Expected benefits	Reduced spread of sedimentation within the surrounding environment
Expertise	Sediment control
Required Manpower	3 - 5
Equipment/Technology	Excavator
Timing	During construction

8.1.2 Mitigation Measures to Reduce Impacts from Coastal Protection Works

In order to reduce impacts during construction of the revetment and grones, the operation will be coincided with low tide and calm days. Once, the revetment is constructed on the desired area, changes in the hydrography of the immediate area are believed to occur. In order to reduce the impacts, the construction of the revetment will be started on the toe of the revetment and gradually moved upwards. Regular monitoring of current movement will be undertaken during the operation.

Also, a geotextile layer will be placed under the rocks, and geo-bags hence, even if there are stronger currents after the development, no further erosion under the geo-bag revetment is expected to occur.

Key considerations;

Consideration	Detail
Reduce spread of sedimentation	Project implementation plan
Cost	US$7,500 material
Expected benefits	Reduced spread of sedimentation within the surrounding environment
Expertise	Sediment control
Required Manpower	3 - 5
Equipment/Technology	Excavator and geotextile layer
Timing	During construction

8.1.3 Mitigation Measures to Reduce Impacts from Landfilling Works

Practically, little can be done in order to prevent the impacts of sand filling as this activity will entirely replace the area by fill material placed directly on the required lagoon areas. Most of the impacts generated during sand filling are discussed earlier.

As sedimentation will cause the largest impact on the project and surrounding areas apart from the replacement and destruction of habitats by fill material and newly created land, effective measures to prevent, reduce and minimize sedimentation such as sediment nets, silt curtains, settling ponds, earthen and rock berms, placing rock boundary around reclamation area can be used.

Tidal current patterns of the proposed area have already been looked into during the baseline assessments and alignments to suit current movement has already been considered.

The following measures will be used to reduce impacts from sedimentation and reducing spread of sedimentation within and around the surrounding environment.

- Use a physical boundary around the proposed land filling area
- Operation will be undertaken on calm days at low tide to reduce potential for spread of sedimentation into far distances
- Immediately level and grade the area into desired heights
- Avoid stock piling of sand required for sand filling

Key considerations;

Consideration	Detail
Reduce fill area loss	Project implementation plan
Cost	0
Expected benefits	Reduced spread of sedimentation and protect fill areas
Expertise	Coastal protection
Required Manpower	3 - 5
Equipment/Technology	Project management
Timing	During construction

8.1.4 Mitigation Measures to Reduce Construction Vehicle Impacts

Vehicles such as excavator and dump trucks will be used during dredging and transport of dredged material to the island. Noise and dust are expected during the operations of these vehicles. However, these impacts will be minimal and is not expected to disturb the island community as the operations will be undertaken in the project area only.

Also, as an important measure, the operations will be undertaken during day time and in the designated area only.

Key considerations;

Consideration	Detail
Reduce impacts from construction vehicle operation	Mark and locate desired areas
Cost	0
Expected benefits	Reduced noise dust and shoreline impacts from vehicle operations
Expertise	Project management
Required Manpower	2
Equipment/Technology	Well maintained and serviced vehicles
Timing	During project implementation

8.2 POST CONSTRUCTION PHASE

8.2.1 Mitigation Measures for Flood Prevention

No major mitigation measures are required for flood prevention during operation phase of the project. The activity itself is an environmental mitigation measure to prevent flooding on the island as a result of rain.

8.3 COMMITMENT

The proponent fully recognizes the importance of protecting the environment and ensures that the proposed mitigation measures will be implemented throughout the project implementation.

Commitment letter from the proponent is attached in **Appendix 4.**

9. ALTERNATIVES

The following section outlines some alternative means to the project in terms of some alternative burrow sites that can otherwise be used as an alternative to the project. Also, a "No Development Option" has been considered as an alternative.

9.1 NO DEVELOPMENT OPTION

The no development option have been outlined here only to address the consequences if the proposed development did not go ahead as a result of environmental impacts that the implementation of the project will generate. If the development does not go ahead, there would be no environmental impacts, however, there will be more risks to the island in terms of spreading the erosion to further areas on the island, no swimming area for the island community as well as flooding issue will remain as it is.

In this regard, if the project does not go ahead due to the reason of environmental impacts, there is great potential for increasing the threat of erosion in the areas, which has great potential to impact more areas from the island, which will also highly risk some of the houses, and some infrastructure on the island. The environmental condition of the area will be further degraded and the whole area will have a diminished aesthetic quality.

The island currently lacks an adequate swimming area due to limited area currently available in the beaches due to major developments that have been undertaken (harbor) and are ongoing on the island (coastal protection). A recreational area opportunity will be lost as a result of no development option.

Flooding is another important environmental issue on the island that needs to be addressed immediately. The community is facing some nuisance due to frequent flooding on the island due to rain. The issue has been raised to the government on many occasions. The opportunity to properly address flood issue will be completely lost as a result of no development option.

Further environmental protection cost and social issues will be incurred if the problem is left unattended. Hence, the No Development Option is not considered as a favourable alternative for the project.

9.2 OTHER ALTERNATIVES

9.2.1 Beach Replenishment

The shorelines of the island affected by beach erosion can be replenished with sand as an alternative means to coastal protection proposed by the project. The beach replenishment can be undertaken all along the affected areas on the NW and SW shorelines of the island. In this regard, beach replenishment will be required for 1,215m of shoreline having 10m beach width and approximately 1.4m height from MSL. A total of 29,160cbm of sand will be required to carry out the beach replenishment work on all affected areas. Although it is possible to obtain the required beach replenishment material from the lagoon on the western side of the island, the coastal protection will be temporary.

Since beach erosion is an ongoing activity, only replenishing the affected beaches may not sustain these areas as the protection measure will be very temporary. Due to the above reasons, the alternative is less favorable.

9.2.2 Breakwater Alternative

In order to protect the areas affected by beach erosion, an offshore rock boulder breakwater has been looked as an alternative.

If an offshore breakwater is laid as an alternative to the geo-bag revetment and groynes, the length of the breakwater will need to be extended to cover the whole of the affected areas on the northern and western lagoons of the island. This option will be far more expensive than the proposed revetments and groynes. As the project budget has already been approved, consideration is only given for the proposed geo-bag revetment and groynes as the preferred alternative for coastal protection.

10. STAKEHOLDER CONSULTATION

With regards to implementing new coastal protection measures, development of swimming area and flood prevention measure on the island, extensive stakeholder consultations have been undertaken among all concerned parties.

10.1 MODE OF CONSULTATIONS

In order to under the proposed measures on the island, some extensive consultations among relevant parties have been undertaken through formal and informal meetings, telephone calls as well as conference calls.

The new measures have been largely proposed by Maaenboodhoo Island Council as well as Parliament Member of the Constituent, hence, this Addendum has been prepared for approval and environmental clearance for undertaking overall measures on the island.

10.2 KEY STAKEHOLDERS

Following are the key stakeholders that have been widely engaged throughout the process of stakeholder consultation for the purpose of this Addendum.

1. Dh. Maaenboodhoo Island Council
2. Dh. Kudahuvadhoo Constituency Member of Parliament
3. Ministry of Environment and Energy
4. Environment Protection Agency
5. Sas e Senok JV Private Limited
6. EIA Consultant

10.3 SUMMARY OF MAJOR DISCUSSIONS

1. The present environmental condition of the island in terms of erosion has been monitored by officials from Ministry of Environment, Environmental Protection Agency, Member of Parliament, Island Council and the Contractor.
2. The project proponent, Ministry of Environment and Energy agrees to the proposed revised coastal protection measures to be implemented on the island.
3. MP of the Constituent stressed for inclusion of the swimming area on the eastern side and flood prevention measures based on discussions with the Island Council and the island community.
4. Currently there is no recreational beach on the island and only a small area on the NE corner of the island is used by the islanders as a recreational area.
5. Island Council has issued a formal request to include swimming area and flood prevention measures to the project proponent as part of the revised project.
6. The Island Council desires to implement the project as soon as possible, and they regard the project as an important activity for the development of the island.
7. If the project schedule and budget permits, some requirements from the island council and the community can be accommodated
8. Great care will be taken to minimize environmental impacts from the project

10.4 LIST OF STAKEHOLDERS CONSULTED

NAME	DESIGNATION	CONTACT
Mohamed Naseem	President, Maaenboodhoo Island Council	7912787
Abdul Rasheed	VP, Maaenboodhoo Island Council	7758070
Ahmed Shahid	Maaenboodhoo Island Council	7502089
Afrah Adam	Maaenboodhoo Island Council	7766687
Yousuf Saeed	Maaenboodhoo Island Council	9910201
Ahmed Amir	Dh. Kudahuvadhoo Constituency MP	7782131
Abdulla Ziyad	Minister of State, Ministry of Environment and Energy	7781502
Yazeed Ahmed	Director, EPA	7903373
Mohamed Hamdhan Zuhair	Asst. Director, EPA	7633166
Saudulla Ahmed	SAS e Senok JV Pvt. Ltd.	7771682
Mohamed Zuhair	EIA Consultant	7776800

Table 9: List of stakeholders consulted

11. MONITORING PLAN

11.1 BACKGROUND

Environmental monitoring is important part of the whole EIA. It ensures that how the project has or is impacting the baseline environmental conditions that have been assessed as part of the EIA. It identifies the degrees and magnitudes of the predicted environmental impacts for the project are felt on the environment as a result of project implementation. Thus, it will help in implementing the mitigation measures that are already identified in this report or implement further measures if the impacts are identified to be bigger than anticipated.

The main EIA for the proposed project has already identified an environmental monitoring plan and following monitoring plan for the Addendum will be as part of the approved EIA monitoring programme.

11.1.1 Aim

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

11.1.2 Objective

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

- Coral reef health (main EIA baseline)
- Seawater quality (main EIA baseline)
- Beach Profiles (main EIA baseline)
- Currents (main EIA baseline)
- Bathymetry (main EIA baseline)

The monitoring will also ensure that these measurements are kept within the baseline limits and predicted impacts are accurate and mitigation measures taken are effective.

11.2 MONITORING REPORT

A detailed environmental monitoring report will be compiled and submitted to all concerned agencies during construction and post-construction periods of the project based on the data collected for monitoring the parameters included in the monitoring plan outlined for the project. An Addendum Monitoring Report and an EIA Monitoring Report will be done simultaneously.

11.2.1 Report Format

The Environment Monitoring Report will be developed in accordance with the following format;

i) Introduction
ii) Aims and Objectives
iii) Environmental Conditions
    a. Coastal environment including shoreline, bathymetry, beach profiles, currents
    b. Marine environment including coral reef assessments, reef fish assessments and other benthos
iv) Comparison of data over different time periods
v) Conclusion and Recommendations

11.2.2 Reporting Frequency

It is important to ensure that monitoring of the environmental parameters mentioned above will be initiated during construction periods, which will be continued throughout the operation life cycle of the project. In this regard, the following measures will be followed.

- During Construction Phase – For 2 months
- During Operation Phase – Every 6 months for every operation year for 2 years

11.3 MONITORING PLAN AND COSTS

The following Addendum Monitoring Plan will be followed during and after the required dredging on the southern side of Maaenboodhoo.

Monitoring Requirements	Indicators	Baseline Reference Values	Technique	Frequency	Approx Cost (US$)
Coral cover	% live coral cover	EIA Baseline	Qualitative & Quantitative	Construction 1 and operation 4	100.00
Reef fish populations	Population structure	EIA Baseline	Qualitative & quantitative methods Fish census	Construction 1 and operation 4	100.00
Beach profiles	Sand movement	Baseline EIA	Standard leveling technique	6 months	400.00
Marine water quality	Turbidity, TSS, Salinity	EIA Baseline	Laboratory Analysis	Construction1 and operation 4	200.00
Current patterns	Seasonal directions and changes	EIA Baseline	Drought technique	Construction1 and operation 4	100.00
Bathymetry	Changes in depths	EIA Baseline	Echo sounder	Construction 1 And operation 4	500.00
			TOTAL COST PER MONITORING TRIP		**1,400.00**

Table 10: *Environmental monitoring and costs*

11.4 COMMITMENT

The proponent recognizes the important of environmental monitoring and commits to undertake the monitoring programme during construction and operation periods.

Commitment letter from the Project Proponent is attached in **Appendix 4.**

12. CONCLUSIONS

Following are the main conclusions of the proposed new burrow site based on the EIA Addendum undertaken for the project.

1. This is the Second Addendum to the EIA undertaken for coastal protection works to be carried out in Dh. Maaenboodhoo, etc, hence it shall be read in conjunction with the main EIA and the First Addendum.

2. The Addendum is submitted to EPA as per the Amended EIA Regulation 2012. Thus, it has to comply with the above Regulation. The Addendum is prepared based on approved Terms of Reference 6 February 2018.

3. This Addendum only looks at revised coastal protection measures, development of swimming area and flood prevention measures propose for the island.

4. During project implementation, it was noted that erosion previously identified on NW and SW shorelines of the island has been shifted along the northern sides of the island. Present condition of the island shows most parts of the shoreline on the northern side are severely affected by erosion and requires immediate action due to risks to some island infrastructure.

5. The Island Council requested to include development of a swimming area in the lagoon on the eastern side and flood prevention measures to be addressed within the scope of the second phase of the project.

6. No additional dredging permit is required as the required fill material sourcing is within the permit given by EPA.

7. The project involves excavation of fill material, land filling and development of geo-bag revetments and groynes to be constructed as part of the overall coastal protection works. The environmental impacts from sedimentation and direct destruction and loss of habitat from these activities have been identified to be the most significant

environmental impacts from the project. Especially in areas where dredging and land filling occur, irreparable damages in these areas of the environment have been identified. To some extent, the revetments itself is also an impact to the environment in terms of permanently replacing the habitats within the area.

8. Alternatives to some of the project components such as alternative coastal protection measures such as beach replenishment, alternative breakwaters have been identified and evaluated. The process of selecting preferred alternative has also been discussed.

9. Environmental monitoring during both construction and post construction stages has be given serious consideration in order to assess the degree and magnitude of environmental changes in the biophysical environment, severity of impacts as a result of the proposed development. An environmental monitoring programme will be implemented during construction and operation stages of the proposed development.

10. Although there are a number of environmental impacts from the proposed development, some of these can bring permanent changes to the environment of the island, other impacts can be reduced and mitigated by use of appropriate methodology. The effectiveness of these methodologies can be documented by implementing a comprehensive monitoring programme. Also, with positive social outlook of the project and considering the overall need for the project, it is concluded that the project should go ahead as planned.

13. REFERENCES

Regulations on Environmental Impact Assessment, 2012, MEE
Dredging and Reclamation Regulation, 2013, EPA

Environmental Resource Management, 2008, Solaire Direct Drennan Deir, Rev 2

EIA Regulation (Amended), 2015, EPA

Environmental Impact Assessment Report for Proposed Coastal Protection Works in Th. Veymandoo by Mohamed Zuhair in 2015.

Environmental Impact Assessment Report for Proposed Coastal Protection Works in Th, Kandoodhoo Island by Mohamed Zuhair, EIA01/15.

Handbook on Compilation of Laws and Regulations on Protecting the Environment of Maldives, 2006, MEEW

14. APPENDICES

APPENDIX 1: **Dredging and Reclamation Permit**

APPENDIX 2: **EIA Addendum TOR**

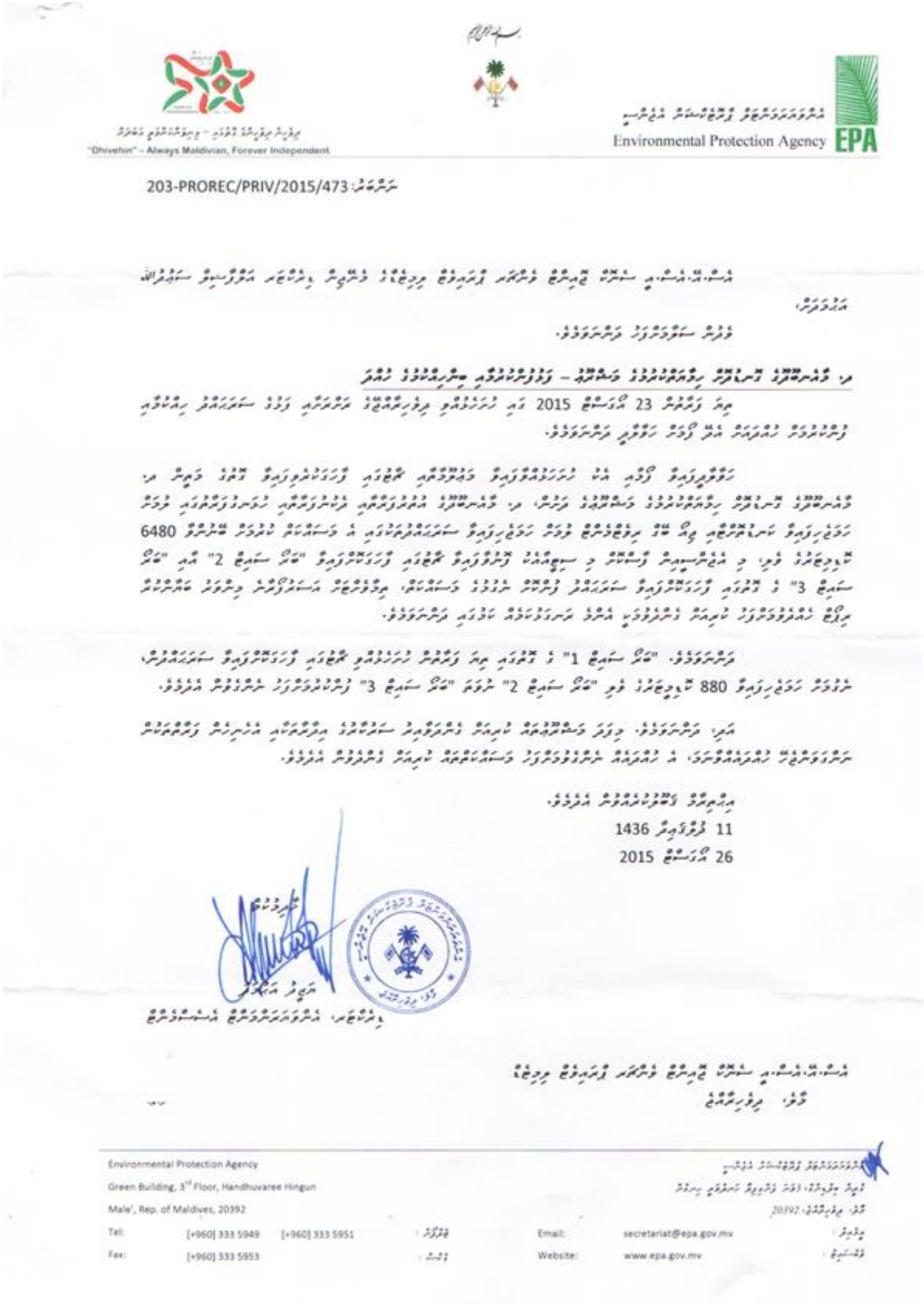
APPENDIX 3: **Water Test Results**

APPENDIX 4: **Commitment Letter**

APPENDIX 5: **Letter from Island Council**

APPENDIX 6: **CVs of Consultants**

APPENDIX 1: Dredging and Reclamation Permit



"Dhivehin" – Always Maldivian, Forever Independent

Environmental Protection Agency EPA

203-PROREC/PRIV/2015/473

11 1436

26 2015

Environmental Protection Agency
Green Building, 3rd Floor, Handhuvaree Hingun
Male', Rep. of Maldives, 20392

Tel: [+960] 333 5949 [+960] 333 5951
Fax: [+960] 333 5953
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

Project Concept - Design and Build of Coastal Protection Structures in Dh. Maaenboodhoo (AFTER MAP)
Rock Revetment 220m
Core Fill Material Required 880cbm
Burrow Site 1 Revetment Core Fill Material Burrow Site Length = 40m Width = 22m Depth = 1m Volume = 880cbm
Rock Revetment 550m
Core Fill Material Required 2,200cbm
Revetment Core Fill Material Burrow Site Length = 100m Width = 22m Depth = 1m Volume = 2,200cbm
Backfill and Beach Profiling Material Required 1,912cbm
Geo Bag Revetment 255m
Backfill and Beach Profiling Material Required 1,425cbm
Geo Bag Revetment 190m
Geo Bag Revetment Backfill and Beach Profiling Material Burrow Site Length = 100m Width = 34m Depth = 1m Volume = 3,400cbm
N
APPROVED
203 - PROREC/PRIV/2015/979

APPENDIX 2: EIA Addendum TOR

بسم الله الرحمن الرحيم

Environmental Protection Agency EPA

No: 203-EIARES/438/2018/37

Terms of Reference for Second Addendum to the Environmental Impact Assessment for Coastal Protection Works in Maaenboodhoo, Dhaalu Atoll

The following is the Terms of Reference (ToR) for Second Addendum to the EIA for Coastal Protection Works in Dh. Maaendoodhoo Island. The Second Addendum deals with revised new design of coastal protection works. The proponent of the project is Ministry of Environment and Energy.

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 First Addendum 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.

2. **Study area** – Submit a minimumA3 size scaled plan of the proposed new burrow site

3. **Scope of work** – The report should be categorised into the following components:

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

Coastal structure construction

- Details and justification of location, number, size and materials of coastal protection structures e.g. groins, seawall or breakwaters;
- Construction methods, materials, equipment, man power, expertise and scheduling.

Dredging:

- Location and size of sand burrow areas on a map;
- Justification for the selection of this location;
- 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;
- Emergency plan in case of spills (diesel, grease, oil).

Drain System

- Details of the drain system
- Justification
- Details of equipment and machinery used

Public Swimming Area

- Method of removal of rocks and sand
- Details of the swimming area including extent and details of machinery used
- Justification

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:

Baseline Environmental Condition (main EIA report and First Addendum)

- Marine environment including coral reef health
- Seawater quality
- Bathymetry
- Currents
- Other relevant data

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. Legal requirements:

- Approval for dredging from Environment Protection Agency

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:

Impacts on the natural environment

- Changes in flow velocities/directions, resulting in changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Loss of marine bottom habitat, both in the borrow area as well as due to enlargement of the islands, resulting in (temporary) loss of bottom life, which may impact fish stocks and species diversity and density of crabs, shellfish etc.;
- Sediment dispersal in water column (turbidity at the dredging site (overflow) 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 of noise, vibration and disturbance;
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.), and

Impacts on the socio-economic environment

- Impacts of the dredging and construction works on the public, stakeholders and tourism ventures (nearby resorts and dive sites);
- Impacts on employment and income, potential for local people to have (temporary) job opportunities (and what kind) in the execution of the works;
- Level of protection against hazards like sea level rise, storm surges, etc.
- Social destabilization of the island community, and
- Monitoring of socioeconomic and demographic development.

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". This should include alternative locations. 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 with particular attention paid to sedimentation control and future changes in coastal processes. Mitigation measures to avoid or compensate habitat destruction caused by dredging will have to be considered, e.g. temporal sediment control structures, coral reconstruction and MPA replacement areas. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources 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.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan relevant for marine

environment. 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.

- Coastal erosion and accretion changes around the island;
- Water quality, especially turbidity;
- Impacts from sedimentation on nearby coral reefs, benthic system, seagrass beds and fish and invertebrate communities;
- Condition of the sensitive ecosystems and marine resources;
- Re-colonization of the benthic organisms in the borrow areas;
- Environmentally sound site clearance;

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 [redacted], Ministry of Housing and Infrastructure, Island Council, NGOs, engineers/designers, development managers, staff and members of the general public. 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 f or 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 and relevant amendments.

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

……

06th February 2018

ENVIRONMENTAL PROTECTION AGENCY Male', Rep of Maldives

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
FEN Building 5th Floor, Machangoalhi, Ameeneemagu, Male', Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

MWSC

WATER QUALITY TEST REPORT

Test Report No: 301220/2015/01

Customer Informations : *Mr. Mohamed Zuhair*
H. Eforniumge,
Moonlight Hingun,
Male'
Rep.of Maldives

Date: 15/10/2015

Sample Description / Location~	Dh. Maaenboodhoo	TEST METHOD	UNIT
	SW1		
Sample Type~	Sea water		
Sampled Date~	06/10/2015		
Sample Received Date	07/10/2015		
Test Requisition Form No.	900161290		
Sample No.	818622		
Date of Analysis	7/10/2015 - 12/10/2015		
PARAMETER	ANALYSIS RESULT		
Physical Appearance	Clear	Visual	-
Conductivity	52300	Method 2510 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	µS/cm
Nitrate	0.4	Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
pH	8.10	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Sulphate	2980	Method 8051 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Salinity	34.20	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Total Suspended Solids (TSS)	26500	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	0.635	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys:
mg/L: Milligram Per Liter, **µS/cm:** Micro Siemens per centimeter, **‰:** Parts Per Thousand, **NTU:** Nephelometric Turbidity Unit
LoQ: Limit of Quantification

Checked by:	Approved by:
Afnan Farooq Laboratory Executive	Mohamed Eyman Senior Technical Officer

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory
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**********END OF THE REPORT**********

APPENDIX 4: Commitment Letter

بسم الله الرحمن الرحيم

Ministry of Environment and Energy
Male', Republic of Maldives.

ފަރާތްތަކާ ގުޅުއްވުމަށް - ތިލަދުންމަތީ ކަނޑުއޮޅި

ފ.ގާ، ދިވެހިރާއްޖެ.

Date: 28th February 2018

No: 438-ENV/203/2018/37

Mr. Ibrahim Naeem

Director General

Environmental Protection Agency

3rd Floor, Green Building

Male' , Maldives

Dear Mr. Naeem,

Sub: Commitment to Undertake the Mitigation and Environmental Monitoring Proposed in the EIA Addendum for the coastal protection Project, Maaenboodhoo Island in Dhaalu Atoll

The EIA Addendum prepared for the proposed coastal protection project at Dh. Maaenboodhoo has been prepared in accordance with the EIA Regulations 2012 and its amendments, issued by the Ministry of Environment and Energy.

We would like to confirm our commitment to the proposed mitigation measures and the monitoring programme that has been highlighted in the EIA Addendum report that has been specifically prepared for the above referred project.

Sincerely,

Abdulla Ziyad,
Minister of State

Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
+(960) 301 8300
+(960) 301 8301
www.environment.gov.mv
ފ.ގާ، ދ.ވ.ހ. 20392
secretariat@environment.gov.mv
www.twitter.com/ENVgovMV
www.facebook.com/environment.gov.mv

APPENDIX 5: Letter from Island Council

[illegible]

بسم الله الرحمن الرحيم

Secretariat of Dh. Maa'enboodhoo Counci
Dh.Maa'enboodhoo, Maldives

ސިކުރެޓޭރިއޭޓް ދެކުނުބުރީ މާއެނބޫދޫ ކައުންސިލް އިދާރާ
ދ.މާއެނބޫދޫ، ދިވެހިރާއްޖެ

ނަންބަރު: 380/438/2018/2

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ފޯން: 6760043 ފެކްސް: 6760666 އީމެއިލް: maaenboo.office@gmail.com

APPENDIX 6: CVs of Consultants

Mr. Mohamed Zuhair

Personal Details

Full Name:	Mohamed Zuhair
ID Card:	A-045870
Date of Birth:	18 December 1971
Address (Home):	H. Eforniumge (South), 4th Floor, Moonlight Hingun/Lonuziyaarai Hingun, Male' 20023, Rep of Maldives Mobile: (960) 777 6800 EMail: moh.zuhair@gmail.com
Marital Status:	Married with 3 children
Languages:	English (Professional) Dhivehi (Native)

Education and Training

- **Master of Applied Science (Protected Area Management), 2003**
  James Cook University, Townsville, Queensland 4811
  Australia

- **Certificate in Integrated Management of Coastal and Marine Protected Areas, 1998**
  South Asia Cooperative Environment Program (SACEP) in collaboration with Great Barrier Reef Marine Mark Authority, Male'
  Maldives

- **Certificate in Coral Reef Survey Methods, 1998**
  IOCUNESCO/UNEP/IUCN, Global Coral Reef Monitoring Network (GCRMN) in collaboration with Ministry of Fisheries and Agriculture, Male', Maldives

- **B.Sc (Hons) Combined Studies (Major: Environmental Biology), 1994**
  Bath College of Higher Education, Newton Park, Bath BA2 9BN
  United Kingdom

- **Certificate in Coral Reef Ecology, Theory and Practice, 1990**
  International Center for Ocean Development and Ministry of Fisheries and Agriculture, Male', Maldives

Employment

- **Freelance Environmental Consultant (2011 - Present)**

Provide technical consultancy on environment-related work including development of environmental management plans, preparation of Environmental Impact Assessments (EIA) and environmental monitoring plans, field assessment and environmental analysis of potential development sites, technical input for proposed development projects, as well as assist in project development, etc

Recent Clients: Hotel and Resorts Construction, Leisure Horizons, Amin Construction, Malahini Holdings, Cocoon Investments, Akirifushi Investments, Hanimaadhoo City Hotel Investments, Mr. Ali Zahir, Mr. Hassan Moosa, Mr. Ali Moosa, ABN, CPM Consultants, Cowrie Investments, Oliva Efficient, Island Channels, Sandcays, Beachrock, SAS e Senok JV, Group X, Coastline Investments, Sanken Overseas

- **Director General (2009 – 2011)**

Environmental Protection Agency (EPA), 4th Floor, Jamaaluddin Complex, Nikagas Magu, Male', Rep. of Maldives

Duties: Overall in charge of the Environmental Protection Agency directly reports to Minister and Deputy Minister. Direct, supervise and technical input to the work of the Sections including Environmental Impact Assessment, Biodiversity Conservation, Coastal Zone Management, Waste Management, Water and Sanitation, Physical Oceanography, Resource Valuation and support to implementation of Environmental Protection Act and subsequent Regulations and develop national Environmental Standards, etc.

Recent Consultancies Undertaken

- **Project Proposal**
  Establishment of a Seaweed Mariculture Farm on Funagaadhoo Island, Laamu Atoll, Maldives, 2011

- **Project Proposal**
  Community Development in Thaa Atoll and Establishing a Tourist Resort on Thaa. Fushifaru Island, Maldives, 2011

- **Environmental Impact Assessment**
  Proposed Harbour Development in Noonu Magoodhoo Island, Maldives, 2011

- **Project Proposal**
  Establishment of a Jetty on the Eastern Side of Noonu Henbadhoo Island, Maldives, 2011
- **Marine Environmental Assessment for the Environmental Impact Assessment**
  Coastal Developments at Thulhaagiri Island Resort and Spa, Maldives, 2011

- **Environmental Impact Assessment**
  Proposed Water Supply and Sewerage System in Haa Dhaalu Vaikaradhoo, Maldives, 2012

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Banana Island, Qatar, 2012

- **Environmental Impact Assessment**
  Proposed Airstrip Development on Maavarulla Island, G.Dh. Atoll, Maldives, 2012

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Kodhipparu Island, K. Atoll, Maldives, 2014

- **Environmental Impact Assessment**
  Proposed City Hotel Development on Hanimaadhoo, H. Dh Atoll, Maldives, 2014

- **Environmental Impact Assessment**
  Proposed Proposed Tourist Resort Development on Maamunagau Island, Raa Atoll, Maldives, 2014

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Akirifushi Island, K. Atoll, Maldives. 2014

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Kuda Bandos, K. Atoll, Maldives, 2014

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Kudafushi Island, Raa Atoll, Maldives, 2014

- **Project Proposal**
  Establishment of Marine Finfish Aquaculture Farm on Fonagaadhoo Island, Laamu Atoll, Maldives, 2014

- **Project Concept**
  Development of Aquaculture, Aquarium Fish Culture, Hydroponics, and Organic Farming in Huruvalhi Island, Raa Atoll, Maldives, 2014

- **Project Proposal**
  Development of Agriculture, Hydroponics, Organic Farming, and Fish Drying in Maarehaa Island, GA Atoll, Maldives, 2014

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development on Ookolhu Finolhu Island, Lhaviyani Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Proposed Harbour Development in Himandhoo Island, AA Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Kottafaru Island, Raa Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Proposed Harbour Rehabilitation in Thoddoo Island, AA Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Aarah Island, Raa Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Proposed Coastal Protection Measures in Plam Beach Resort and Spa, Lh. Atoll, Maldives, 2015

- **Hazard Analysis and Risk Assessment**
  Sunken Excavator near Havodda Island, GDh. Atoll, Maldives, 2015

- **Environmental Impact Assessment**
  Coastal Modifications at LUX Maldives, South Ari Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Agriculture Product Development in Hulhudhoo Island, Baa Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Coastal Protection Works in Ukulhas Island, AA Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Mariculture, Hydroponics, Aquaponics and Boatyard Development in Vihamaafaru, AA Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Coastal Protection Works in Maaenboodhoo, Dhaalu Atoll, Maldives, 2015

- **Situation Analysis Report**
  EIA for Proposed Coastal Modification and Partial Renovation Project, LUX South Ari, ADh. Atoll, Maldives, 2015

- **Technical Study of Erosion and Coastal Protection Measures**
  Northern side of Dharavandhoo Island, B. Dharavandhoo, Malrives, 2015

- **First Addendum:**
  EIA for Coastal Protection Works in Maaenboodhoo, Dhaalu Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Tourist Resort Development in R. Filaidhoo Island, Raa Atoll, Maldives, 2015

- **Environment Impact Assessment**
  Proposed Agriculture, Water Sports and Training Facility Development in Faadhoo Island, Maldives, 2016

- **Environment Impact Assessment**
  Proposed Tourist Resort Development in Vashugiri Island, Vaavu Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Sunny Lagoon in South Male' Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Access Channel and Mooring Area Deepening in B. Fehendhoo Island, Baa Atoll, Maldives 2016

- **Environmental Analysis Report**
  For Tourist Resort Development in Ethigili Island, Raa Atoll, Maldives, 2016

- **First Addendum to Environmental Impact Assessment**
  Proposed Coastal Protection Works in Ukulhas Island, AA Atoll, Maldives 2016

- **Environment Monitoring**
  Land Reclamation Works at Bodufinolhu, ADh Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Uthuruboduveli, Uthurugasveli, Hurasveli, Meemu Atoll, Maldives 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Maniyafaru Lagoon, South Male' Atoll, Maldives 2016

- **Environmental Impact Assessment**
  Proposed Beach Nourishment Works at Ayada Maldives, GDh. Mugudhuvaa Island, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Beach and Swimming Area Development in K. Himmafushi Island, Male' Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed 11 Storey Building Development at H. Finimaage Aage, Male', Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Land Reclamation and Tourist Resort Development in Maavaru Lagoon, North Male' Atoll, Maldives, 2016

- **Environmental Monitoring**
  Land Reclamation Works at Akirifushi Island, North Male' Atoll, Maldives, 2016

- **Third Addendum to the Environmental Impact Assessment**
  Proposed Tourist Resort Development in Akirifushi Island, North Male' Atoll, Maldives. 2016

- **Second Addendum to the Environmental Impact Assessment**
  Proposed Resort Development in Kodhipparu Island, North Male' Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Aerodrome and Access Channel in the Lagoon near St. Regis Vommuli Resort, Dhaalu Atoll, Maldives, 2016
- **Environmental Impact Assessment**
  Proposed 20-Storey Rehendhi 5 Building, Male', Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Hanimaadhoo, HDh. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Hoarafushi, HA Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Farming Development Project at Aidhoo Island, Baa Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Villingili, GA. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Ungoofaaru, Raa. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Milandhoo, Sh. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Guraidhoo, Th. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Kudahuvadhoo, Dh. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Naifaru, Lh. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Water Production and Distribution Facility at Villingili, GA. Atoll, Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in the Lagoon Plot 4.155882 / 73.251890, North Male Atoll, 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Amingiri Lagoon, Kodhipparu Falhu, North Male' Atoll, 2016

- **Environmental Impact Assessment**
  Proposed 10-Storey Mixed Use Residential Complex in Block D10-4C, Hulhumale', Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Mixed Use Residential Complex in Block C4-3, Hulhumale', Maldives, 2016

- **Environmental Impact Assessment**
  Proposed 10-Storey Building with Basement at H. Loveside, Male', Maldives, 2016

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Dhidhoofinolhu Lagoon, Kodhipparu Falhu, North Male' Atoll, 2017

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Dhigudhefaru Island, Baa Atoll, Maldives, 2017

- **Environmental Impact Assessment**
  Proposed Tourist Resort Development in Maarandhoo Island, GA Atoll, Maldives, 2017

- **Environmental Impact Assessment**
  Proposed Coastal Protection Project at Hulhudhoo Island, Addu City, Maldives, 2017

- **First Addendum to the Environment Impact Assessment Report**
  Proposed Tourist Resort Development in Uthuruboduveli, Uthurugasveli and Hurasveli Islands in Meemu Atoll, Maldives, 2017

- **Environmental Audit Report**
  Powerhouse Registration at Malahini Kuda Bandos, North Male Atoll, Maldives, 2017

- **Environmental Impact Assessment Report**
  Proposed Tourist Resort Development in Aanugandufalhu, North Male' Atoll, Maldives, 2017

- **Fourth Addendum to the Environmental Impact Assessment Report**
  Proposed Tourist Resort Development in Akirifushi Island, North Male' Atoll, Maldives. 2017

Professional Certifications

- **Registered EIA Consultant (2015)**
  Registration (EIA01/15) at Environmental Protection Agency
  3rd Floor,
  Green Building
  Male'
  Republic of Maldives

- **PADI Research Diver (1998-Present)**
  Sea Explorers Dive School,
  2nd Floor, Ma. Thuniveli,
  Male' 2001
  Republic of Maldives

Ibrahim Shakir (Shark)

Date of Birth: *18 July 1967*

Contact Address: *Ma Sharky Shark*

Koarukendi Magu

Male' 20-30

Maldives

E-mail: *Sharkydives@gmail.com*

Nationality: *Maldivian*

Contact no: *+9607759695*

Qualifications

Associate Diploma of Land information Management Systems

(Surveying) South Australian Institute of vocational Education (1994), Australia

Certificate from the Group Training Course in Hydrographic Survey (international accredited Category B Course) *–*

Conducted by the Japan International Cooperation Agency under the International Cooperation Programme of the Government of Japan, Tokyo, Japan (1996)

Certificate of participation in Environment Management at Singapore Environmental Management and Engineering Services Pte Ltd (January 2000)

Relevant Experience

Surveying projects

*Current*_____

AA.Fesdhoo *2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*

Completed _____

K.Fulmoon *2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*

K.Velassaru *2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*

K.Kurumba *2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*

K.Baros	*2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*
M.Hakuraa Huraa	*2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*
K.Dhonveli	*2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*
AA.Ehlidhoo	*2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*
N.fushivellavaru	*2012 Control and as built survey, after establishing PSM to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.*
Gdh.Dhigulaabadhoo	*Topographic survey and Hydrograhic Survey.*
K.Kaashidhoo	*set-out survey for tourist hotel*
B.Vakkaru	*Topographic survey and Hydrograhic Survey including set-out survey for Back of the house*

Laguna Maldives (Male' Atoll) managed by Universal Enterprises

Topographic Survey, Hydrographic Survey, Tree Survey, Set out Survey & Environment impact assessment study.

Konnota Island (Gaafu Dhaal atoll) managed by PCH

Topographic Survey, Hydrographic Survey, Tree Survey and Setout Survey.

Maavelavaru Island (Noonu atoll) managed by Athama Marine

Topographic Survey, Hydrographic Survey and Setout Survey.

Halaveli Tourist Resort (Ari Atoll) / Waterfront Pvt Ltd.

Topographic Survey, Hydrographic Survey, Tree Survey and Setout Survey.

HANDHUFUSHI (Herathere) ADDU Atoll / managed by Yatch tours

Hydrographic Survey of the proposed water villa site

Madoogali Island (Ari atoll)

Topographic survey includes buildings, structures and water villas.

Ariyadhoo Island (North Male' atoll) / managed by VB

Topographic survey and Hydrographic survey, includes buildings, structures and water villas.

Full Moon Maldives / Universal Enterprises

Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.

Baros island Resort / Universal Enterprises

Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.

Dhigufinolhu island Resort / Universal Enterprises

Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.

Palm Beach Resort, Lhaviyani Atoll, Maldives

Provided all consultancy work including equipment layout design and procurement analysis for all F&B areas and laundry

Ari Beach Resort, Ari Atoll, Maldives

Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.

Coco Palm Resort, / Sunland Travels, Baa Atoll, Maldives

Provided all consultancy work including equipment layout design and procurement analysis for all F&B areas, Environment design, Water & Waste Management, Project Management and Laundry Design and Layout in addition, the project included the supervision of the installation of the designed system, surveying and instructing the contractors on construction methodology.

Veligandu Huraa, Maafushivaru (Twin island)

Tree survey, including identification of species and their respective locations through out the island, set-out survey for all structures.

Fesdu Fun island / Universal Enterprises

Reef survey, identification of coral species and condition of the reef with regard to coral bleaching, Tree survey including detailed layout of vegetation line and shoreline, set-out survey.

NakatchaaFushi / Huvafenfushi

Topographic survey, Hydrographic Survey, Tree survey, set-out survey for water bungalows and land villas.

Hilton on Rangali / Crown company

Topographic Survey, Hydrographic survey and set-out survey for water villas, land bungalows, current and wave action surveys, tide measurements for the under water restaurant.

Reethi Rah Resort / One & Only

Environment impact assessment study.

Moofushi island Resort

Topographic survey, including vegetation, shore line, High tide and Low tide line and all structures.

Villivaru & Biyadhoo / Ministry of Tourism

Environment impact assessment study for the bidding project includes Plant identification survey, soil contamination survey, Ground water monitoring, coral diversity and abundance survey, coastal erosion survey, sediment movement and setting studies, beach profiles and land topography survey.

Mushimas Migilli / Dhoani Migilli

Environment impact assessment study including Harbour development.

Keekimini / Fisheries Project

Environment impact assessment study including, Harbour development and set-out survey for infrastructure development.

Hudhufushi island Resort / Abdul Rauf

Topographic survey and Hydrograhic Survey including set-out survey for all buildings and villas.

Ministry of Health, Malé Maldives

Development of a master plan for the provision of safe, adequate and affordable freshwater for Malé (Maldives) including the designing of processes to harness and distribute water on a commercial basis. Includes study on sustainability of utilizing the freshwater aquifer of Malé as well as utilizing airport runway and a loating collector (shallow lagoon) for rainwater catchments vis-à-vis desalination of seawater.

Hinnavaru island, Lhaviyani Atoll, Maldives

Provision of a wastewater collection and disposal systems for a densely populated island.. Design to overcome the problems associated with a high water table and flat low lying island with limitations for proper gradients.

Maadhoo island, Maldives

Environmental impact study on Harbour Development and Recreational Boating Activity for the Management Kandooma island Resort, Republic of Maldives.

Fuah Mulaku

Hydrographic study and Environment impact study on harbour development and commercial boating activity.

Mirihi island Resort

Hydrographic Study, Land survey / and Environmental impact assessment on harbour Development.

Hebadhoo island Resort

Hydrographic Study and Environmental impact assessment on harbour Development.

Embudhoo Finolhu island Resort / Taj

Hydrographic Study and Environmental impact assessment on harbour Development.

Shaviyani Atoll (all inhabited islands)

Hydrographic Study and Environmental impact assessment on Harbour Development.

Hulhumeedu island

Hydrographic Study and Environmental impact assessment on Harbour Development.

Kulhuduffushi island Harbour

Hydrographic Study and Environmental impact assessment on Harbour Development.

Vangaaru(shaviyani atoll)

Dh.Eboodhoo/Olhuveli

Topographic survey and Hydrograhic Survey including set-out survey for all buildings and villas.

Gdh.Gazeera

Topographic survey for resort construction

ADh.Athurugaa

Topographic survey and Hydrograhic Survey

AA.Thundufushi

Topographic survey and Hydrograhic Survey

Ha.Uligamu

Topographic survey and Hydrograhic Survey including set-out survey for buildings.

STO Building

Set-out survey in Male',Maldives.

Velaanaage office Building

Set-out survey in Male',Maldives.

K.Giraavaru

Topographic survey for Resort Construction

Ga.Handahaa

Topographic survey and Hydrograhic Survey including set-out survey for all buildings, Beach Villa and Water Villa.

N.Huivani

Topographic survey and Hydrograhic Survey.

N.Minaavaru

Topographic survey and Hydrograhic Survey.

Gdh.Baulhagilaa

Topographic survey and Hydrograhic Survey.

Rendheli Island (Noonu atoll) managed by INT Management Pvt Ltd.

Setout Survey of Rendheli Island, Noonu Atoll.

Finolhas Island (Baa atoll) managed by Coastline Maldives

Topographic & Hydrographic Survey of Finolhas Island, Baa Atoll.

Kuramathi Maldives (Ari Atoll) managed by Universal Resorts, Maldives.

Topographic Survey (update the site plan) of Kuramathi Maldives, Ari Atoll.

EIA Projects Participated

Environmental Impact Assessment for Tourist Resort Development in Kudafushi Island, Raa Atoll, Maldives, Mr. Ali Zahir

Environmental Impact Assessment for Tourist Resort Development in Kottafaru island, Raa Atoll, Maldives, ABN Pvt Ltd

Environmental Impact Assessment for Tourist Resort Development in Ookolhu Finolhu Island, Lhaviyani Atoll, Maldives, Cocoon Investments, Pvt. Ltd.

Environmental Impact Assessment for Resort Development in K. Kuda Bandos, North Male Atoll, Maldives, Malahini Holdings Pvt. Ltd.

Environmental Impact Assessment for Resort Development in K.Akirifushi, North Male Atoll, Maldives, Akirifushi Investment Pvt. Ltd.

Environmental Impact Assessment for Development of a CityHotel Hanimaadhoo, H.Dh. Atoll, Maldives, Island Expert Pvt. Ltd.

Environmental Impact Assessment for Resort Development in K. Kodhipparu, North Male Atoll, Maldives, Kodhipparu Investment Pvt.Ltd.

Environmental Impact Assessment for Proposed Tourist Resort Development on Raa. Maamanagau Island, Maldives, Bir Hotel Management Pvt. Ltd.

Employment

Managing Director of Beach Rock Investment Pvt Ltd. Ma Sharky Shark, Male', Maldives.

Managing Director of Beach Marine Pvt Ltd. Ma Sharky Shark, Male' , Maldives.

Managing Partner of Sharkventures LLP, Ma Sharky Shark, Male', Maldivesharkventures LLP, Ma Sharky Shark, Male', Maldives