Environmental Impact Assessment



HDH. NEYKURENDHOO CHANNEL PROTECTION & DREDGING PROJECT

Proposed By:
Ministry of Housing & Infrastructure,
Male', Maldives

MEECO
Maldives Energy and Environmental Company

بسم الله الرحمن الرحيم

Ministry of Housing and Infrastructure
Male', Republic of Maldives.

މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންފްރާސްޓްރަކްޗަރ
މާލެ، ދިވެހިރާއްޖެ.

ނަންބަރު: 138-PIS2/203/2015/301

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Environmental Impact Assessment For:
Hdh. Neykurendhoo Channel Protection and Maintenance Dredging Project

December, 2015

Prepared for: Ministry of Housing and Infrastructure
Ameenee Magu, Maafannu, Republic of Maldives
Malé 20392, Republic of Maldives

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SYNOPSIS

Name of the Project:	EIA for Channel Protection and Maintenance Dredging in HDh. Neykurendhoo
Project Proponent:	Ministry of Housing and Infrastructure, Malé, Maldives
Project Value:	MVR 12 Million
Expected Duration:	150 days
EIA Consultant:	Ahmed Saleem (EIA License: EIA03/13)
EIA Date:	November 2015

MEASUREMENTS USED IN THIS REPORT

1 cubic meter (m^3)	=	1000 litre (L)
1 hectare (ha)	=	10,000 square meters (m^2)
1 hectare (ha)	=	2.471 acre (ac)
1 kilometre (km)	=	0.62 miles (mi)
1 meter (m)	=	3.28 feet (ft)
1 millimetre (mm)	=	0.039 inches (in)
1 foot (ft)	=	0.304 metre (m)
1 knot	=	0.514 metre per second (ms^{-1})

LIST OF ABBREVIATIONS

EIA	Environmental Impact Assessment
EPPA	Environmental Protection and Preservation Act (Law no.: 04/93)
MEE	Ministry of Environment and Energy
MHI	Ministry of Housing and Infrastructure
MMS	Maldives Meteorological Service
MSL	Mean Sea Level
NEAP III	National Environment Action Plan, 2009 – 2013
PPE	Personal Protective Equipment
RIAM	Rapid Impact Assessment Matrix
TOR	Terms of Reference

NON-TECHNICAL SUMMARY

a) This Environmental Impact Assessment (EIA) report was prepared by Maldives Energy and Environmental Company (MEECO) upon request by the Ministry of Housing and Infrastructure (MHI), the project proponent to fulfil the legal requirements of the Environment Protection and Preservation Act (Law no: 4/93) for the project entitled "HDh. Neykurendhoo channel protection and maintenance dredging".

b) The assessment was prepared addressing the key issues highlighted in the Terms of Reference (TOR) agreed between the proponent and EPA.

c) Neykurendhoo is an average sized island with a population of a little over 700, where basic services are available. The island has got an average sized harbour constructed in 2007 that is currently being used by boats owned locally as well as fishing and cargo vessels from other islands as a berthing location.

d) MHI proposed this project to address the requirement for providing safe access to Neykurendhoo. No maintenance dredging had been carried out since the construction of the harbour in 2007. The channel is reported to have become shallower over the years as a result of siltation in the area. In addition the breakwater at the entrance of the harbour was constructed too short to provide adequate protection from wind and waves.

e) The project is in line with government policies and legislation, and the proponent is committed to obtaining all the necessary permits and approvals prior to the commencement of the project.

f) The project proposes to construct a 116.2 m rock boulder extension to the existing breakwater at the entrance channel, and apply excavation techniques to conduct maintenance dredging. The dredge material is proposed to be used for levelling the access road from the residential areas of the island to the harbour. The proponent commits to put in place all the measures necessary to minimise the impacts of the development on the environment.

g) Assessment of the existing environment revealed that there were relatively few benthic communities to be directly affected as a result of the proposed activities. The channel has a sandy bottom characteristic of dredged locations. The only activity expected to cause damage to the benthic communities were the placement of the rock boulder extension to the breakwater. However, the coral communities in the area were in relatively sparse abundance and consisted only of small colonies. The impact on coral reefs is expected to revert back to its original state once the environment has stabilised upon completion of the project.

h) The major impact to the surrounding areas would be from sedimentation during dredging, especially since for much of the year the location will experience winds and the resulting wind-generated surface currents away from the island. Adequate silt netting would minimise the impacts to the surrounding areas during construction phase.

i) The proponent is fully committed to fulfilling the requirements of the monitoring plan developed, and undertake any mitigation measures necessary to minimise the negative impacts of this project

j) The benefits of this project outweigh the slight negative impacts caused by the project, and is encouraged to implement the project giving due considerations to the environmental issues.

ސާރާ ޚުލާސާ

(ހ) މިއީ ހދ. ނޭކުރެންދޫ ނެރުފަޅިކަރި ހަދައި ނެރު ފުންކުރުމުގެ ކުރިއަށް ގެންދިއުމަށްޓަކައި، މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާފުށް އަސަރު ދެނެގަތުމަށްޓަކައި، މަޝްރޫޢުގެ ފެންވަރާބެހޭގޮތުން މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންވަޔަރަންމަންޓަށް ގެ އެދިފައިވާގޮތުގެ މަތިން ހާއްޖު ވެސް އެނަރޖީ އެންޑް އެންވަޔަރަންމަންޓަލް ކޮންސަލްޓަންސީ (މީލާ) ގެ ފަރާތުން ތައްޔާރުކޮށްފައިވާ އެންވަޔަރަންމަންޓަލް އިމްޕެކްޓް އެސެސްމަންޓް (އީ.އައި.އޭ.) ރިޕޯޓެވެ.

(ށ) މި ރިޕޯޓް ތައްޔާރުކޮށްފައިވަނީ ޕްރޮޓެކްޝަންގެ ފެންވަރާއި އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ (އީ.ޕީ.އޭ.) އާއިދުގެ އެއްބަސްވުމާއި ޓާމްސް އޮފް ރިފަރެންސް (ޓީ.އޯ.އާރ.) ގައި ބަޔާންކުރާ ކަންތައްތަކާއި އެއްގޮތަށް ގޮތުގެ މަތިންނެވެ.

(ނ) ނޭކުރެންދޫއަކީ 700 ވަރަކަށް މީހުންގެ އާބާދީއެއް އުޅޭ އާދައިގެ ބޮޑުމިނެއްގެ ރަށެކެވެ. މިރަށުގައި 2007 ވަނަ އަހަރު ބަނދަރުހެދުމާ އާދައިގެ ސައިޒުގެ ބަނދަރެއް އެޅުއެވެ. މި ބަނދަރަކީ ރަށުގައި ފުރާ ދަތުރު ކުރާ އުޅަނދުފަހަރުގެ އިތުރުން ދޯނި ރަށްރަށުގެ މަސްވެރި އުޅަނދުފަހަރާއި ދޯނި އުޅާ އުޅަނދުފަހަރު ބޭނުންކުރާ ބަނދަރެކެވެ.

(ރ) މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންވަޔަރަންމަންޓްގެ އެހީ މި މަޝްރޫޢު ހުށަހެޅުއްވާފައިވަނީ ނޭކުރެންދޫއަށް ރައްކާތެރިކަމާއި ތަފާތު ކުރުމުގެ އިންތިޒާމު ހަމަޖެއްސުމުގެ ބޭނުންތެރިކަން ބޮޑުވެ، މިހައްސަލައަށް ހައްލެއް ހޯދައިދިނުމުގެ ގޮތުންނެވެ. ކިސާޔާއި ފެށި އަސަރުކޮށް، ނުހަމަ ތިރީވުމުގެ މައްސަލަ ތަރައްގީ ކުރަން ޖެހިފައިވާނަމަވެސް، 2007 ގައި ބަނދަރު ހެދުމުގެ މަޝްރޫޢު ފުރިހަމަވުމަށްފަހު ނޭކުރެންދޫ ބަނދަރުކަރަށް އެއްވެސް މެއިންޓެނެންސް މަސައްކަތެއް ކުރެވިފައި ނުވާކަން ފާހަގަ ކުރެވެއެވެ. އަދި ބަނދަރުގެ ނެރު ފައިބާ ދެކުނެޖީނުވާ ދިމާލުގައި ނުވުމުގެ ސަބަބުން އެބަނދަރަށް ވަދެނުކުމަށް ވާދަވެރި އުޅަނދުފަހަރު ނުވަދެވޭ މަސައްކަތް ހަރުދަނާ ކުރެވިފައި މަޝްރޫޢުގެ މަސައްކަތްތަކުގެ ތެރޭގައި ހިމެނެއެވެ.

(ބ) މި މަޝްރޫޢު ތަރުތީބުވާ ގޮތަށް ބަލައިފި، މިއީ ސަރުކާރުގެ ސިޔާސަތުތަކާއި، ފާއިތުވި އަހަރުތަކުގައި ފެނިގެން އައި މަސްލަހަތު ހުރި މަޝްރޫޢެއް ކަމަށް ބެލެވެއެވެ. މިގޮތުން މިކަމާއި ގުޅުންހުރި ފާއިދާތަކާއި ގެއްލުންތަކަށް ބަލާއިރު ބޭނުންކުރާ އުސޫލުގެ ދަށުން، މަޝްރޫޢު ފުރިހަމަ ކުރެވޭނެ ގޮތުގެ މަޝްރޫޢުގެ ތަފްޞީލުތައް އެންމެ ރަނގަޅަށް ދެކޭނެ ގޮތަށް އެކަށައަޅާފައެވެ.

(ޕ) މި މަޝްރޫޢުގެ ދަށުން ނެރުފަޅިކަރިބަން 116.2 މީޓަރު އިތުރުކުރުމަށް ރާވާފައިވަނީ ބޭރުކަށަ ބޭނުންކުރާގޮތަށެވެ. މީގެ އިތުރުން ނެރު ފުންކުރުމުގެ އޮކްސިޖަނަކީ ބޭނުންކުރުމަށް ރޯކުފައިވެއެވެ. އަދި މިހަރަކާތްތަކުން ނަގާ ވެލި ބޭނުންކުރުމަށް ހަމަޖެހިފައިވަނީ ބަނދަރަށް ދާނަ އޮންނަ މަގު އެއްވަރުކުރުމަށެވެ. މަސައްކަތްތަކާ ހިސާބުކުރުމުގައި، މަސައްކަތާއި ގުޅިގެން ތިމާވެށްޓަށް ކުރިމަތިވާނެ އެންމެހައި ނުރައްކާތަކާއި ދެކުނުގައި ގެއްލުން ހުރި ފާސްގަނޑުތައް އެއްގަމަކީ މަޝްރޫޢުގެ ފެންވަރާބެހޭ އެއްބަސްވުމެވެ.

(ހ) ރާއްޖޭގައި ވަޑު ކަނޑުތަކުގެ ހަރަކާތްތަކާއި ހިސާބުވަމުއް އެހެން ސަރަހައްދުތަކާއި އެއްފަދައިން، ނޭކުރެންދޫ ނެރު ހިމެނޭ ސަރަހައްދުގައި އެކިފާއް ދިރޭ މުޅި ރަށަށްގެ މަހުވެރި މަދުނުކަން ފާހަގަ ކުރެވެއެވެ. މި މަސައްކަތުގެ ސަބަބުން ސިޔާސީވެގެން ދިރޭ މުޅި ރަށަށްގެ އާބާދީއަށް އަސަރު ކުރާނީ ވަގުތީކޮށް ފަތުރާ ނެރުފަޅިކަރިއާއި ދިމާލުން އިތުރުކުރާ ރަށްތަކާއި ގުޅިގެން ދެރަވެގެންނެވެ. ނަމަވެސް މިސަރަހައްދުގައިވެސް ހުރި މުޅި ރަށަށްގެ އަދަދު މަދުވުމާއި ގުޅިގެން، މަޝްރޫޢުގެ އަމަލީ މަސައްކަތްތަކުގެ ސަބަބުން ސިޔާސީވެގެން

އަސަރުކުރާނޭކަމަށް ބެލެވޭ ދިރޫދުރަކައިގެ މިންވަރު ނިސްބަތުން ކުޑަވާނޭކަމަށް ލަފާކުރެވެއެވެ. އަދި މަލަދީ މަސައްކަތްތަކުން ނިމުމަށްފަހުގައި ކުރީގައި އޮތް ހާލަތަށް އިއާދަވާނެކަމަށް ބެލެވެއެވެ.

(ހ) ނުރައި، ނުރުގެ ކައިރީގައިވާ ސަރަހައްދުތަކަށް އެންމެ ބޮޑު އަސަރެއް ކުރާނެކަމަށް ބެލެވުނީ ކޮންމެ ހަރަކާތްތަކުގައި އަޑިން ނުވާ ފެއްސާއި ކިސަޑުގެ މިންވަރުން ދޮދުގެ ފެންގަނޑާއިއެކުވެ، އާއިވަރާއިއެކުވެ މި ސަރަހައްދުގައި ދެއްކުމާއި ގެދެވުން ކައިރި ސަރަހައްދުތަކުގައި ހުރި މުރަކައާއި މަހުގެ އާބާދީއަށް ކުރާ ނެގެޓިވް އަސަރުތަކެވެ. މި ސަރަހައްދުގައި އަހަރުގެ ބޮޑުބައެއްގައި ވައިގެ މިސްރާބަށް ބަލާއިރު، މިގޮތުން ދައްކުވާ ފެއްސާއި ކިސަޑު އާއިވަރާއިއެކު ރަށާއި ދުރަށް ގެންދިއުމުގެ ފުރުސަތު ބޮޑުކަމަށް ފާހަގަ ކުރެވިފައެވެ. މިކަމަށް ހައްލުގެ ގޮތުން "ސިލްޓް ސްކްރީން" ބޭނުންކުރުމަކީ އެދެވިގެންވާ ކަމެކެވެ.

(ށ) މިޕްރޮޖެކްޓްގައި ހިމަނާފައިވާ މޮނިޓަރިންގ ޕްރޮގްރާމްގައި ބަޔާންކުރާ އެންމެހާ ކަންތައްތައް ފުރިހަމަކުރުމުގެ ފުރިހަމަ ޒިންމާ އުފުލުމަށް މަޝްރޫޢުގެ ފަރާތުން އެއްބަސްވެއެވެ.

(ނ) ނޭކުރެންދޫ ނުރުވައިކަރި ހެދުމާއި، ނުރު ފުންކުރުމުގެ މަޝްރޫޢުގެ ސަރަހައްދު ތިމާވެއްޓަށް ކުރާ ނޭދެވޭ އަސަރަށްވުރެ މި މަޝްރޫޢުގެ ސަރަހައްދު ރަށު ރައްޔިތުންނާއި ރަށުގެ އިޤްތިޞާދަށް ކުރާ ބެލެވޭ ހެޔޮ އަސަރު ބޮޑުވާއި ގުޅިގެން، މި ރިޕޯޓްގައި ބަޔާންކުރާ ކަންތައްތައް ފުރިހަމަކުރުމާއިއެކު މި މަޝްރޫޢު ކުރިއަށް ގެންދިއުމުގެ ފައިދާ ބޮޑުކަން ފާހަގަ ކުރެވެއެވެ.

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CONSULTANT'S DECLARATION

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

Ahmed Saleem (EIA03/13)
December, 2015

Authors

Ahmed Saleem	Lead Consultant
Shafiya Naeem	Environmental Consultant

Surveys

Dinal Shalika	Surveyor
Farah Amjad	Research Assistant

PROPONENT'S DECLARATION

The proponent hereby certifies that this EIA was prepared for the project entitled "HDh. Neykurendhoo Channel Protection and Maintenance Dredging", in accordance with the Environmental Protection and Preservation Act (Act no. 4/93) and the EIA Regulation (2012).

Ministry of Housing and Infrastructure
Government of Maldives

1 INTRODUCTION

1.1 BACKGROUND

This Environmental Impact Assessment (EIA) has been prepared to fulfil the requirements of the Law No. 4/93, Environmental Protection and Preservation Act (EPPA), for the project entitled "HDh. Neykurendhoo channel protection and maintenance dredging". This report aims to provide a focused assessment of the proposed project including a description of the existing environmental and socioeconomic conditions of the proposed project area, an evaluation of the potential impacts of the proposed development on the existing conditions, an assessment of the possible mitigation and impact management measures and a proposed environmental monitoring plan.

1.2 PURPOSE OF THE EIA

The Ministry of Housing and Infrastructure (MHI) has proposed a project for the maintenance dredging and protection of the entrance channel to the harbour of Neykurendhoo Island, South Thiladhummathi Atoll, to address the issue of safe access to the island. This EIA was prepared to satisfy the requirements of the Environment Impact Assessment Regulation, 2012 (Regulation no: 2012/R-27) of the Ministry of Environment and Energy prior to the commencement of the proposed project.

The objectives of this EIA report are:

a) To seek environmental clearance for the project;
b) To identify the potential impacts of the proposed development and estimate the extent to which such impacts may extend;
c) To recommend environmentally sound development options to minimise and/or mitigate the level of impact arising from the proposed development; and
d) To promote, where relevant, the use of options to further enhance the environment around the site of development.

1.3 TERMS OF REFERENCE

This study has been conducted in accordance with the Terms of Reference (TOR) agreed upon following the scoping meeting held on October 4, 2015 for this project. The agreed Terms of Reference (TOR) for this EIA is included in **Annex 1**.

2 LEGISLATIVE AND REGULATORY CONSIDERATIONS

Due to the nature of the proposed development, as can be seen from the legal framework, a number of government agencies have a stake in the project. The project is planned and executed by the Ministry of Housing and Infrastructure (MHI) – the key government agency responsible for formulating and implementing policies on infrastructure development in the Maldives. In addition, MHI is also responsible for the construction of harbours, revetments, dredging and reclamation on behalf of the Government. This ensures that the proposed project is fully in line with the Government's development policies and plans. The environment sector of the Ministry of Environment and Energy is granted the broad responsibility to assess the development projects that may have significant impact to the natural environment during developmental as well as the operational phases.

2.1 ADMINISTRATIVE FRAMEWORK

2.1.1 Ministry of Housing and Infrastructure

MHI is the primary government authority responsible for formulating and implementing policies related to housing, land, land use planning, construction industry development and infrastructure development in the Maldives. In addition, the Ministry is responsible for regulating dredging and land reclamation, and planning and executing government projects of similar nature. Coastal protection and harbour development are also the responsibilities of the Ministry. The proposed project is planned and executed by MHI, on behalf of the Government of Maldives.

2.1.2 Ministry of Environment and Energy

The Ministry of Environment and Energy (MEE) is the key ministry mandated with the protection of the environment. Environmental responsibilities assigned to MEE includes formulating environmental policies, coordination, preservation and management of the environment throughout the country, and enforcing the Environmental Protection and Preservation Act (EPPA, 04/93).

2.1.3 Environmental Protection Agency (EPA)

EPA is an autonomous body formed under the umbrella of MEE, and is the key institution responsible for the regulation of the environment. It is mandated with the implementation of the EIA process in the Maldives, implementing the Environment Act and subsequent regulation MEE, regulating water and sanitation, biodiversity conservation, waste management and coastal zone management. It is also responsible for developing and implementing environmental standards and guidelines in the country. Under Article 5(a) of the EPPA, the submission and approval of an EIA is mandatory for any projects that may cause potential harm to the environment, prior to their commencement. EPA is vested with the responsibility of

evaluation and approval of EIA reports prior to project commencement. MEE has the right to terminate, without compensation, any projects with major undesirable impacts on the environment.

2.1.4 Atoll Council

The Atoll Council is an elected independent legal entity entrusted with the responsibility of governing and planning, coordination and implementation of the developmental activities within the administrative division in accordance with the Constitution of the Republic of Maldives. According to the Act on Decentralisation of the Administrative Divisions of the Maldives (Law no.: 7/2010), the Atoll Councils should provide financial and technical assistance to the Island Councils in during the planning and implementation of social and economic activities within the administrative division. In addition, the Council is also responsible for monitoring the operation of the Island Councils

2.1.5 Island Council

The Island Council is an elected entity with the key responsibilities of the overall administration and development of the island. The council is responsible for the compilation and implementation of the island development plans, the management of public resources and funds allocated for the island, formulation of local developmental policies, and the implementation of social and economic plans of the government authorities.

2.2 POLICY FRAMEWORK

2.2.1 Strategic Economic Plan

The Strategic Economic Plan highlights the need for further public sector investments into the development of support infrastructure, such as harbours and jetties, in order to strengthen the linkages between different sectors as well as the inter-island linkages required for economic growth.

2.2.2 National Environment Action Plan 2009-2013 (NEAPIII)

The third National Environment Action Plan (NEAP III) set forth the agenda for environmental protection and management in the Maldives for the five year period 2009 – 2013. NEAP III is an instrument that seeks to achieve the stipulated goals and strategies through the coordinated effort of the responsible government departments and following the introduction of a decentralised system of governance, through the engagement of local level governance arrangements.

The underpinning theme of the policy instrument is protection of the natural environment and supporting resilience. NEAP III emphasises on promoting healthy communities by improving

solid waste management, hazardous waste management, safe use and disposal of chemicals and the cleanliness of air.

2.3 LEGAL FRAMEWORK

2.3.1 Environment Act (Law No.: 4/93)

The Environment Protection and Preservation Act of the Maldives was enacted in April 1993 as an umbrella law to protect and preserve the country's environment. As the Government authority responsible for the protection and preservation of environment, MEE has the responsibility of formulating policies, laws and regulations on the environmental protection and conservation. The provisions of the Act that are of relevance to the proposed project are outlined in the following paragraphs.

EPPA, the umbrella law concerning the environmental protection and preservation, obliges that, prior to the commencement of any such projects, an EIA be submitted to, and approval obtained from the relevant Government authority, for any development projects with potential negative environmental.

The relevant Government authority shall formulate guidelines for the assessment of environmental impact, and shall determine the nature of projects for which such assessments may be required. Where the assessments indicate significant negative impacts on the environment, the Government authority reserves the rights to terminate the projects without any compensation.

The disposal of wastes, oils and any poisonous substances or chemicals that may have a harmful effect on the environment shall not be disposed of within the territory of the Maldives.

The Government of Maldives reserves right to claim compensation for all damage caused by activities that are detrimental to the environment, and carried out in violation of the EPPA.

2.3.2 Environment Impact Assessment Regulation (2012/R-27)

The Government of Maldives, under the provisions of the EPPA, has formulated and published the Environmental Impact Assessment Regulations (2012), detailing the EIA process and guidelines on EIA preparation.

The Regulation outlines the environmental considerations during the planning stages of developmental projects as well as the process to be followed in the preparation, submission, and obtaining approvals for such projects. It also highlights the nature of projects that require an EIA submission, as well as the screening process in place for other developmental projects, the nature of which, does not fall within those that are included in the Regulation.

A submission shall be made to, and a decision statement be issued by EPA for any developmental projects with a potential negative impact on the environment, prior to the commencement of such projects.

The Government reserves the right to claim compensation for any activities in violation of the provisions of the EIA regulations.

2.3.3 Dredging and Reclamation Regulations (2013/R-15)

The Regulation on reclamation and dredging of island lagoons (Regulation 2013/R-15), effective as of April 2013, requires that a permit be obtained from EPA on projects involving alteration of the island, either by reclamation or dredging. The regulation specifically requires producing scaled maps of the island before and after the proposed intervention. Special provisions have been made on the protected and sensitive areas, restricting changes to the environment of the islands.

Any projects involving dredging and/or reclamation activities are required produce evidence of having obtained the necessary permits in accordance with the relevant regulations, for the EIA submission to be considered valid.

2.3.4 The Regulation on Environmental Liabilities (2011/R-9)

The objective of this regulation is to prevent actions violating the EPPA and to ensure compensations for all the damages that are caused by activities that are detrimental to the environment. The regulation sets mechanisms and standards for different types of environmental liabilities and equal standards that shall be followed by the implementing agency while implementing the regulation. According to this regulation the Government of Maldives reserves the right to claim compensation for all the activities which have breached the EPPA.

2.3.5 Regulation and Waste Management (2013/R-58)

Waste management Regulation (No. 2013/R-58) is more recent coming into effect on 6 February 2014. The regulation provides set of comprehensive guidelines on collecting, storing, transporting and managing waste. In the preamble its states the objective of the regulation is in line with the Article 22 of the Constitution, which requires that development activities designed for achieving socioeconomic targets should ensure that environment and its constituent living component is not compromised and that resources are utilized effectively.

The regulation outlines the responsibilities of collection, transport, treating and storage of waste. It also mentions management centres and landfill sites and managing hazardous waste. Various sectors and entities (including tourist resorts) encouraged having their own waste management plans consistent with the Regulation.

2.4 POLICY AND REGULATORY COMPLIANCE

In summary, the proposed project fully complies with relevant government policies, initiatives, all applicable environmental legislation, and regulatory statutes. The project has been planned and executed by the key government Ministry responsible for policies on developing infrastructures. The development of transport related infrastructure is fully in line with the government's economic development policies. The proponent will ensure that the mitigation measures stipulated in the report are effectively implemented and that the monitoring program is conducted to ensure perceived impacts of the project is kept within acceptable levels. Further, the proponent will ensure that all necessary permits and approvals will be obtained prior to project commencement. To this end, the proponent has obtained the dredging permit in accordance with the dredging and reclamation regulation (2013/R-15), and is attached in **Annex 2**.

3 STUDY AREA

3.1 SCOPE OF WORK

This EIA is prepared for the channel protection and maintenance dredging project in HDh. Neykurendhoo. The report will aim to assess impacts on the environment from the proposed development, taking into account the existing environmental conditions based on field observations as well as available historic data, methodologies applied during the construction phase and the projected impacts during the operational phase. It will also identify mitigation measures, explore alternatives to the proposed development and make recommendations based on findings of the study. The study will be carried out in consultation with relevant stakeholders.

3.2 PROJECT LOCATION

The island of Neykurendhoo belongs to the South Thiladhunmathi Atoll (Haa Dhaal), the second northernmost administrative atoll of the Maldives. Located approximately at 6°32’32”N, 7°58’49”E, Neykurendhoo sits some 270 km from the country’s capital, Malé, and approximately 32 km from Hanimaadhoo, the nearest airport. The island spans approximately 1.3 km in width and 1.7 km in length and covers an area of approximately 170 ha. Neykurendhoo sits on an isolated reef platform, with the island saturating most of the inner reef. Vaikaradhoo is the closest inhabited island located approximately 1.5 km from Neykurendhoo. The location of Neykurendhoo is shown in Figure 1.

3.3 THE PROJECT

The project entitled “HDh. Neykurendhoo channel protection and maintenance dredging” was planned to improve the existing harbour on the northern side of the island. The project involves the reconstruction of the entrance channel to the harbour using rock boulders, maintenance dredging to attain a depth of -3 m from Mean Sea Level (MSL) at the channel, and refilling the access road from the inner land to the harbour using dredge material obtained from the project. The location and dimensions of the proposed development are outlined in Figure 2 (and in annex 3).

3.4 THE PROPONENT

The protection of Neykurendhoo channel and maintenance dredging was proposed by the Ministry of Housing and Infrastructure (MHI), to address the requirement for long-term protection of the channel and deepening it to maintain navigable waterways at the channel.

MHI has over 25 years of experience in harbour development, reclamation and other infrastructure development in the country as the government authority mandated for infrastructure development in the country.

The contact details of the proponent is given below;

Ministry of Housing and Infrastructure
Ameenee Magu, Male', 20392, Republic of Maldives
Tel: + 960 300-4300, Fax: + 960 300-4301
Email: mohamed.muizzu@housing.gov.mv

3.5 PROJECT COSTS

The cost of the proposed channel protection and maintenance dredging project in HDh. Neykurendhoo is estimated at approximately MVR 12 million, which may be subjected to variations depending on the final scope of work. The project is fully financed by the government of Maldives.

3.6 PROJECT SCHEDULE

The main activities to achieve the proposed development include, site mobilisation, deployment of the rock boulder extension, deepening of the channel, disposal of the dredge material and finally demobilisation. The project is planned to be completed within 150 work days, including the time taken for the preparation of the EIA, obtaining all necessary approvals required, and the completion of the construction phase. A detailed outline of the proposed schedule for the project is provided in Table 1.

Table 1. Project schedule

Activity	Duration (days)					No. of days
	0-30	31-60	61-90	91-120	121-150	
Mobilisation						07
Demolition of existing seawall						30
Disposal of material from demolition						30
Re-construction of seawall						80
Dredging of harbour basin						70
Disposal of dredge material						50
Demobilisation						7

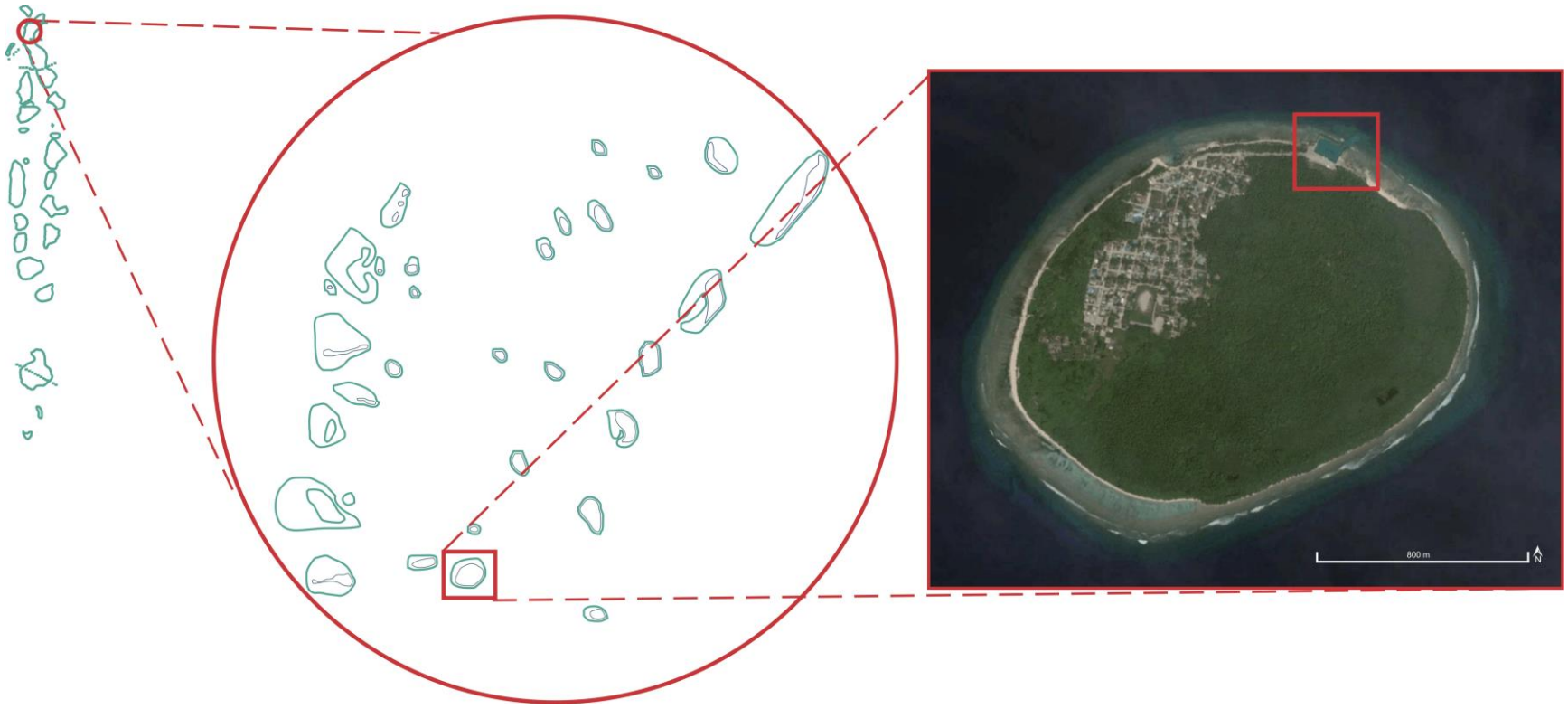

Figure 1. Project location – Island of Neykurendhoo situated at 6°32'32"N; 7°58'49"E, showing its position in reference to the country and the Haa Dhaalu Atoll. .

Figure 2. Project location showing the proposed development

3.7 NEED AND JUSTIFICATION OF THE PROJECT

The project has been planned under the government's policy on improving and developing the transport related infrastructure with the broad aim of achieving greater economic development in the outer atolls, thus contributing to the overall economic development of the nation. The project was proposed by MHI, the institution mandated with the responsibility of implementing the infrastructure development strategies of the Government, to address the increasing need for safe harbour development in the outer atolls. To this end, MHI has identified the need for the channel protection and maintenance dredging of HDh. Neykurendhoo channel.

The Neykurendhoo harbour has been known to be used by fishing vessels operating in the northern fishing grounds as well as some cargo vessels as a berthing location (Council members, pers.comm). However, the island is losing its attractiveness as a berthing location due to the state of the harbour facility in the island, and a lot of the vessels that used to harbour at Neykurendhoo have begun using alternative locations as a result. The channel to the Neykurendhoo harbour has been getting silted over time, due to sedimentation, making it too shallow for safe navigation. In addition to the siltation over time, the length of the existing breakwater at the entrance channel to the harbour further aggravates the issue of sedimentation and results in exposing the channel to strong wave action, making it unsafe to manoeuvre in and out of during rough weathers.

The current government has important plans for the northern regions of the country, targeted at bringing an "influx of money and job opportunities prompting great progress in the north of the country" (sun.mv, 2014). Ihavandhippolhu, the northernmost atoll of Maldives proposed to be developed under the I-Havan project sits some 40 km from Neykurendhoo. In order to facilitate islands within the region to gain maximum benefit from such economic developments targeting the region, it is important that adequate support facilities such as safe harbours are developed in the islands. Further, the development of safe harbour facilities in the outer atolls will facilitate regional development and indirectly contribute to the government's goal of decentralisation and relieving the pressure on the Malé region.

3.8 PROJECT COMPONENTS

The project has 3 main components as described below:

a) **Extension of the existing breakwater by 116.2 m** on the harbour constructed on the north of the island. The existing breakwater is deemed too short to provide adequate protection from wind and wave action to vessels entering and exiting the harbour. The breakwater extension will reduce wave energy at the entrance to the harbour and control infilling of the harbour due to sediments being carried into the channel.

b) **Deepening of the existing harbour channel and the channel extension.** The existing channel and the extension to the channel will be dredged to attain a depth of -3 m from MSL. The existing channel spans approximately 20 m in length and 25 m in width.
c) **Disposal of dredge material** to level the access road to the harbour. Approximately 629.3 m^3 of dredge material generated will be used to level an area 304.8 m in length and 15.42 m in width.

3.9 WASTE MANAGEMENT

During the construction phase, small quantities of solid waste and construction wastes are expected to be generated. These wastes can be disposed of at the waste disposal site on the island. Any large waste material can be temporarily stockpiled in the island's waste collection site, to be transported to Thilafushi upon completion of the project.

3.10 PROJECT INPUTS AND OUTPUTS

A brief overview of the inputs and outputs of the project are outlined in Table 2 and Table 3, respectively.

Table 2. Summary of project inputs

PROJECT INPUTS	Source/type	How to obtain the resources
Project staff	Skilled and semi-skilled labour; Manager (1), Supervisor (1), Excavator operator (1), Loader operator (1), Labourer (10) consisting of skilled, semi-skilled and unskilled labourers.	All workers will be sourced by the contractor. Contractor will ensure the workers hired for the project are capable and possess necessary skills and in case of foreign workers that they have necessary documents
Machinery	Excavator (1), Work barge (1), Dump truck (2)	To be obtained and operated by the contractor. Contractor will be required to bring to the site the machines in good working conditions to avoid loss of time due to faulty equipment
Construction material	Rock boulder, fuel	Imported material to be used for the project. Contractor will make the necessary arrangements for the material to be delivered to the work site.
Resources for the workers	All staff support services will be arranged on the island. No workers camp or temporary accommodation have been planned for the project.	Necessary arrangements to be made by the contractor, in consultation with the Neykurendhoo council.

Table 3. Summary of project outputs

PROJECT OUTPUTS	Details	Comments

Extension to the entrance channel	The existing entrance channel to be extended by 116.2 m, and dredged to obtain a depth of -3 m from MSL	
Breakwater extension	116.2 m in length from the existing breakwater	To be constructed from rock boulders
Levelled access road	Approx. 5800 m^2 of the access road from the harbour area to be filled to obtain a height of 1.2 m from MSL.	
Dredged material	629.3 m^3 of dredged material consisting mainly of sand and rubble.	The dredge material obtained will be used to level the access road to the south west of the harbour. The material will be transported from the dredge site to the fill site on trucks
Hazardous waste	Minor quantities	Hazardous wastes such as waste oil, lubricants, chemicals, etc. shall be stored and disposed of in Thilafushi at project completion, in full compliance with the waste management regulations
Solid waste	Minor amounts, mostly in the form of packaging wastes and empty containers	All solid waste shall be collected and disposed of at the waste disposal site on the island. The site manager will maintain record of the solid waste transferred during the project.
Noise and light	Construction of rock boulder breakwater can generate noise, in addition to the noise generated from the operation of vehicles and machinery	Work will be carried out at daytime to avoid disturbances to the locals as a result of the noise generated.

3.11 WORKERS' SAFETY

Worker safety shall be ensured by exercising the following safety measures during the construction phase. Appropriate personal protective equipment (PPE), including but not limited to hard hats, eye protection, protective trousers and gloves, shall be provided to the workers to be worn at all times when the works are being carried out. In addition, hearing protection, masks and wet weather clothing shall be made available to be used where necessary.

Further, the following safety measures will be put in place:

a) First aid kits shall be made available on site at all times;
b) All machinery shall be operated by competent certified operators;
c) All machinery and vehicles shall be serviced regularly;
d) Manual lifting operations will be kept to a minimum by use of mechanical means; and
e) Life buoys shall be provided close to the relevant work areas at all times.

3.12 PROJECT WORK METHODOLOGY

The general construction methodologies widely used in the Maldives for harbour deepening, breakwater construction and road levelling will be applied in this project. The construction of the proposed breakwater extension and the maintenance dredging activities will be carried out in a manner that would minimise the impacts during the construction phase. At project commencement, the existing breakwater will be removed by excavator, followed by the deployment of a new breakwater, with a 116.2 m extension. Dredging will commence at the mouth of the entrance channel and continued along the length of the channel. The dredge material will be collected onto trucks on a barge, which will transport the material to the designated fill site on land. Figure 3 illustrates the sequence of activities during the construction phase of the proposed development.

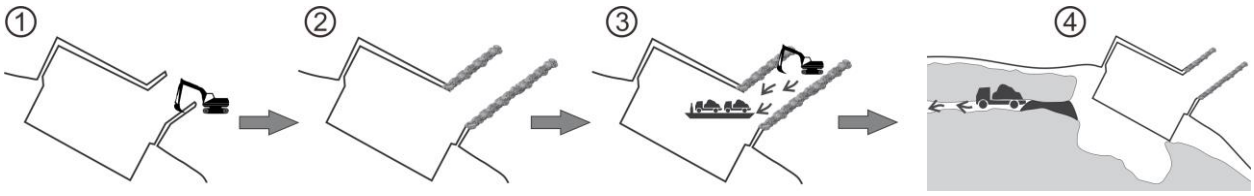

Figure 3. Sequence of activities during the construction phase of Neykurendhoo channel protection and maintenance dredging project. 1) demolition of existing breakwater; 2) deployment of new rock boulder breakwater with extension; 3) dredging to attain -3 m depth from MSL at the channel; 4) levelling of the access road to the harbour using dredge material.

3.13 STUDY AREA AND IMPACT ZONE

The breakwater at the entrance channel to the existing harbour on the northern side of Neykurendhoo is proposed to be extended by 116.2 m, and the channel be dredged to attain a depth of -3 m from MSL. The dredge material is proposed to be used to level the access road from the harbour to the residential area of the island. The boundaries of the study area as well as the likely impact zone is shown in Figure 4. The study area has been decided based on the locations where direct actions of the project have been targeted and likely sediment movement may occur.

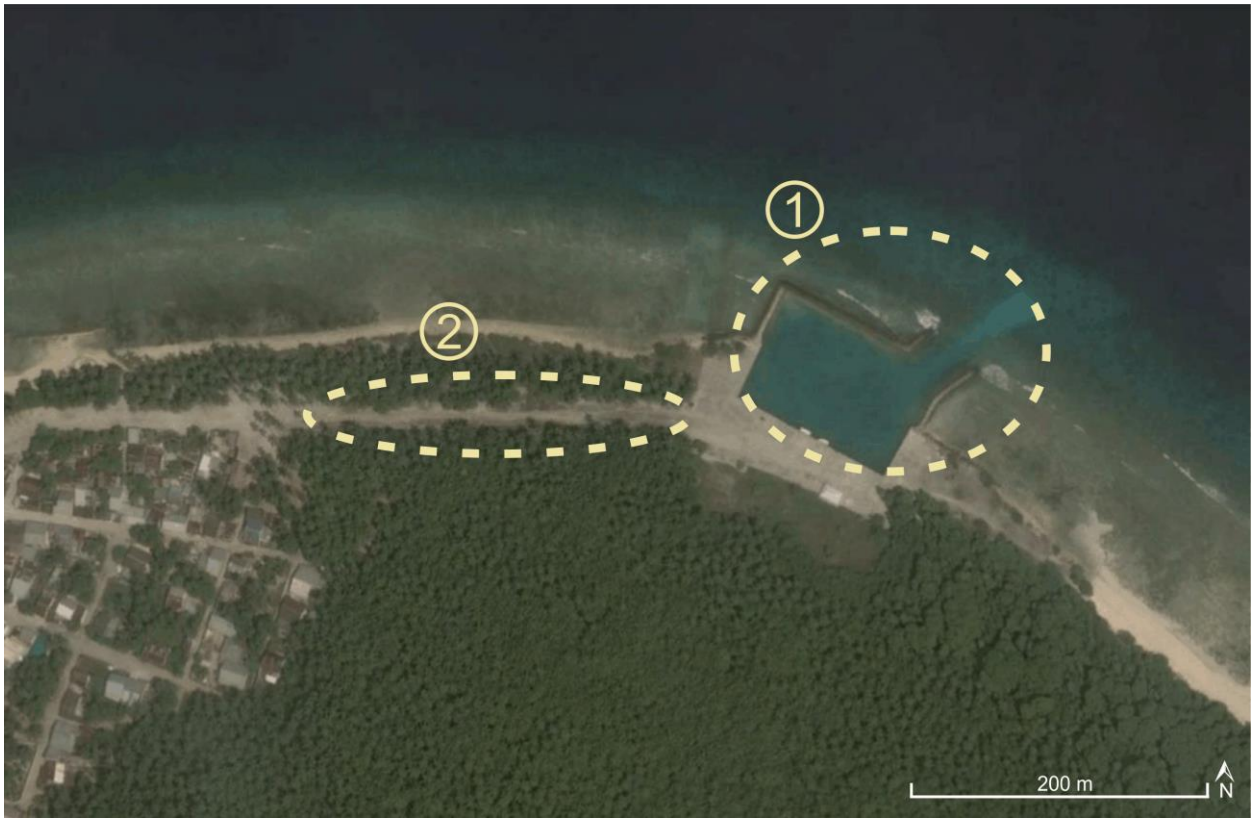

Figure 4. Study area and project impact areas. 1: Proposed extension of the breakwater of the channel by an additional 116.2 m, and deepening of the channel to obtain a depth of -3 m from MSL. 2: Proposed levelling of the access road to the harbour using dredge material obtained during construction phase.

4 METHODOLOGIES

This section describes the various methodologies adopted in assessing the existing environment of the proposed project site, surrounding environments and the environment impacts that may occur due to the development.

The data for the assessment of the environmental impact that may arise from the implementation of the proposed project were obtained using methods most appropriate for the specific environmental, social and economic conditions of the island and atoll environment. Quantitative, semi-quantitative and qualitative data were collected for this study. The assessment of the existing environment was conducted using standard, internationally adopted and locally practiced methodologies.

4.1 CLIMATE AND OCEANOGRAPHIC REGIEME

Meteorological data obtained from Maldives Meteorological Service (MMS) were used for the purposes of this study. Where possible, data for the MMS station at Hanimaadhoo were obtained, as it was the closest station, and were expected to provide a reasonable indication of the weather conditions at the project location. These data included those relating to the monsoons and winds, rainfall, waves, tidal information, temperature and sunshine.

4.2 MARINE ENVIRONMENT

4.2.1 Biological Environment

The marine environment was surveyed to assess and to determine the baseline of the existing environmental conditions. The reef flat of the affected area and the fish communities on the affected region of the reef flat, as well as the coastal vegetation were not quantitatively studied, but based on visual observation and expert judgement.

4.2.2 Bathymetry

Bathymetry of the existing entrance channel as well as the proposed extension was carried out using a hand-held depth meter, at positions marked using a hand-held GPS. The depth readings were corrected to the MSL.

4.2.3 Surface Currents

Surface currents outside of the channel, as well as inside the harbour basin were measured using a Garmin GPS tracker that was submerged on the surface of the water. The tracker was programmed to log position data every second to determine current direction and speed. The mean surface current velocity and direction were obtained using the tracker software.

4.2.4 Water Quality

Water quality at the project location was assessed using the Horiba multi-parameter water quality meter. The parameters measured included the ambient water temperature, salinity, dissolved oxygen (DO), pH, turbidity and total dissolved solids (TDS). The data obtained were analysed, tabulated and presented.

4.3 IMPACT ASSESSMENT METHODOLOGY

The Rapid Impact Assessment Matrix (RIAM) system developed for coastal development projects described by Jensen *et al* (1998) was used to derive an environmental score for the proposed development based on potential impacts categorised into four broad categories – Physical/Chemical environment (P/C); Biological/Ecological concerns (B/E), human issues defined as Social/Cultural (S/C) and issues relating to the Economic/Operational (E/O) aspects of the development. The RIAM system allows the direct comparison of different problems and allows a holistic and coherent anticipation of problems.

The potential issues were analysed according to five characteristic criteria, two of which relate to properties that are of singular importance to the condition, and three that are of value to the situation. Each issue was assigned a score based on the importance of the condition (I) and the magnitude of change or effect (M) according to the following scale criteria

Scale definition of the importance of condition (I):

4	=	important to national/international interests
3	=	important to regional/national interests
2	=	important to areas immediately outside the local condition
1	=	important only to local conditions
0	=	no importance

Scale definition of the magnitude of change or effect (M):

+3	=	major positive benefit
+2	=	significant improvement in status quo
+1	=	improvement in status quo
0	=	no change/status quo maintained
-1	=	negative change to status quo
-2	=	significant negative dis-benefit or change
-3	=	major dis-benefit or change

The issues were also assigned a score for the criteria based on the value to the situation. These criteria included permanence of impact, its reversibility, and the cumulative nature of the impacts. Table 4 defines the scale used for criteria that are of value to the situation.

Table 4. Scale definition for the criteria that are of importance to the situation

Score	Permanence (P)	Reversibility (R)	Cumulative nature (C)
1	No change/not applicable	No change/not applicable	No change/not applicable
2	Temporary	Reversible	Non-cumulative /single
3	Permanent	Irreversible	Cumulative / indirect effect / synergistic

The scores obtained for each of the criteria, for the different problems selected for evaluation, were computed into the equation below to calculate an environmental score (ES) for the components.

$$ES = I*M*(P+R+C)$$

To use the evaluation system described, a matrix of cells showing the criteria used, set against each defined component was produced for each project option, and ES values calculated and recorded. The ES values are banded together into ranges where they can be compared. The ES ranges and description of the magnitude of impact are outlined in Table 5.

Table 5. Range bands used for RIAM

Environmental Classification (ES)	Value of the class	Value of the class (numerical)	Description of the class
72 – 108	E	5	Extreme positive impact
36 – 71	D	4	Significant positive impact
19 – 35	C	3	Moderate positive impact
10 – 18	B	2	Minor positive impact
1 – 9	A	1	Slight positive impact
0	N	0	No alteration
-1 – -9	-A	-1	Slight negative impact
-10 – -18	-B	-2	Minor negative impact
-19 – -35	-C	-3	Moderate negative impact
-36 – -71	-D	-4	Significant negative impact
-72 – -108	-E	-5	Extreme negative impact

5 DESCRIPTION OF THE ENVIRONMENT

This section outlines the findings of the assessment of the status of the existing environment at the proposed project site at Neykurendhoo. The descriptions were produced based on historic records on the climate, field visits and interviews with the stakeholders. A field visit was conducted to the project location on November 7, 2015 to collect necessary field data and conduct consultations with the island council and some locals of the island.

5.1 CLIMATE AND OCEANOGRAPHIC REGIEME

Meteorological data for mean monthly temperatures, wind speeds and directions, and rainfall were obtained from the MMS weather station at Hanimaadhoo located approximately 32 km from the project site, as this was the nearest location from which weather data were available.

5.1.1 Monsoon and Winds

Generally, the Indian Ocean Monsoons govern the climatology of the Maldives hence monsoonal reversal plays a significant role in weather patterns. Two very distinct monsoon are observed in the Maldives: the Northeast (NE, locally known as *Iruvai*) monsoon characterised by predominant winds occurring in a north easterly direction and the southwest (SW, locally known as *Hulhan'gu)* monsoon characterised by south westerly winds. The NW monsoon is the dry season, which occurs from December to February, and SW monsoon is the rainy season, which lasts from May to September. The transition period of SW monsoon occurs from March to April, while that of the NE monsoon occurs between October and November (Wells, 1948).

Analysis of wind speed and direction data over 24 years for the Hanimaadhoo weather station indicated that the station experienced winds predominantly from a west-north-westerly direction between the months of April and October, and in an easterly direction between November and March, with a comparatively higher wind speed experienced during the former period (Figure 5). The highest wind speeds were observed in the months of June and July, where the mean maximum wind speeds exceeded 40 knots, and the lowest during February and March, reaching a mean maximum wind speed of 22 knots. Significant variation was observed between the mean maximum and minimum monthly wind speeds. The mean monthly wind speeds were observed to be higher than the annual mean of 19.2 knots between May and October.

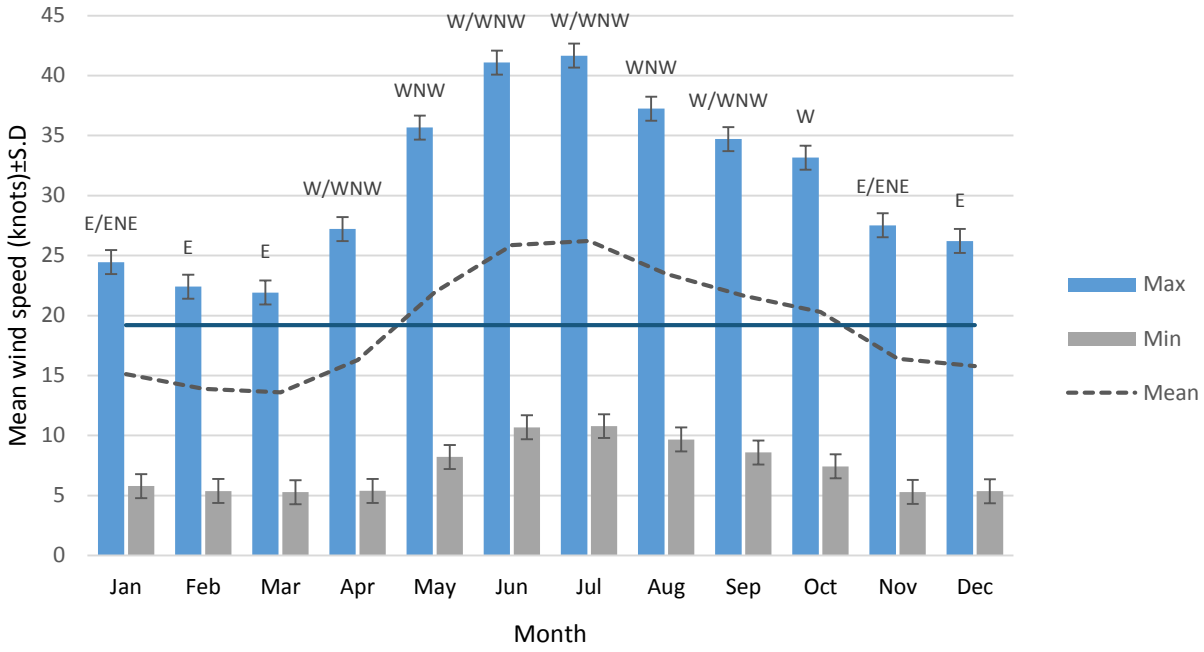

Figure 5. Mean monthly wind speeds (knots) ± S.D and direction from 24 years of data for the MMS weather station at Hanimaadhoo, showing maximum, minimum and average monthly figures. The horizontal solid line indicates the mean annual monthly wind speed based on 24 years of data. .

Considering the nearest location to the project site, from which weather data could be obtained was from Hanimaadhoo, the following predictions were made with the assumption that the wind directions and speeds will be relatively similar between the two sites:

a) Neykurendhoo will receive winds predominantly in a west to west-north-westerly direction during the months from April to October, and in an east to east-north-easterly direction between November and March.
b) The highest wind speeds will be experienced between May and September, in a west to west-north westerly direction.
c) The proposed development on the northern side of the island will be exposed to outward blowing winds for most of the year, which may have implications for planning the construction phase to minimise impacts from sedimentation.
d) Strong westerly and west-north-westerly winds will result in strong, wind-driven surface currents in that direction, which may explain why the channel is subjected to siltation, and may have implications for planning the construction period to minimise sedimentation during the dredging works.

5.1.2 Rainfall

Long-term rainfall data obtained from the Hanimaadhoo weather station showed that the station experienced the most amounts of rainfall between May and August, with a maximum of 266 mm of rain in the month of July, and the least amounts during January to April, with a minimum

rainfall of 27 mm in March (Figure 6). The mean total monthly rainfall experienced between May and November exceeded the annual average rainfall levels of 146.8 mm, and the rainfall during the January – April period was well below average. The drier period of the year (December – April) corresponded to the northeast monsoon, where the prevailing winds were also generally weaker. Subsequently, the wet period of the year corresponded to the southwest monsoon where, on average stronger winds were experienced.

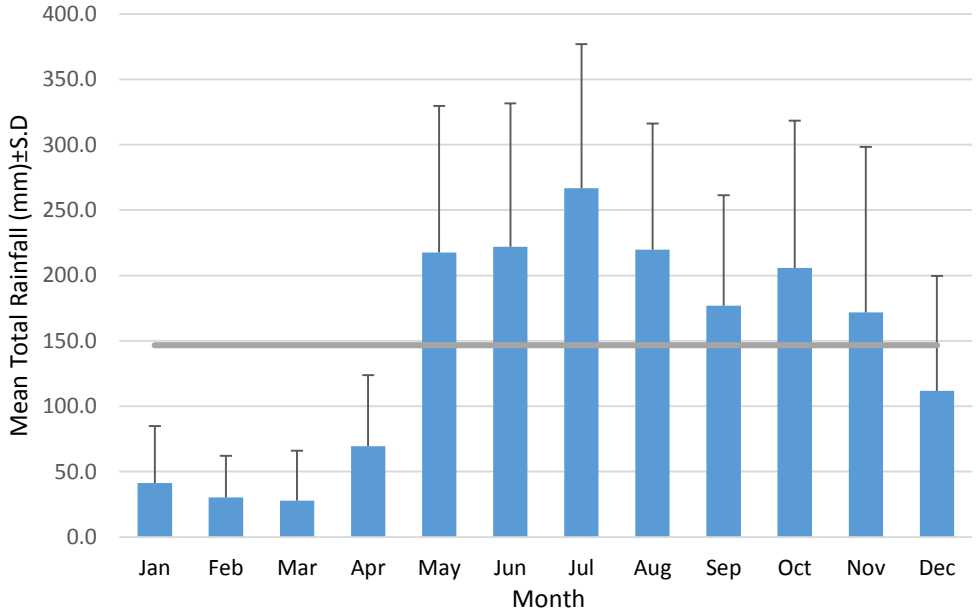

Figure 6. Mean total rainfall (mm) ± S.D. for Hanimaadhoo weather station based on 24 years of data. The horizontal solid line indicates mean annual rainfall level.

Assuming that average rainfall levels obtained for the Hanimaadhoo station is relatively representative of those across the northern region, the following predictions can be made about the project site:

a) Neykurendhoo will experience a higher rainfall between May and November, and on average will be drier during December – April.
b) The highest rainfall will be observed between the months of May and August, with above average levels throughout May – November.
c) The high rainfall periods will coincide with the strong westerly winds, which may not be the ideal timing to undertake activities of the construction phase.

5.1.3 Temperature

Analysis of 24 years of temperature data for the Hanimaadhoo weather station showed that the period between February and May corresponded to higher temperatures compared to the rest of the year, with a highest temperature of 32.4°C experienced in the month of April (Figure 7). The mean maximum annual temperature of 31.03°C was exceeded during these months. On average, a 5.7°C variation was observed between the monthly high and low temperatures. With

the exception of the period between February and May where the mean maximum temperatures were slightly variable, the temperatures during the rest of the year remained reasonably stable at approximately 30.6°C.

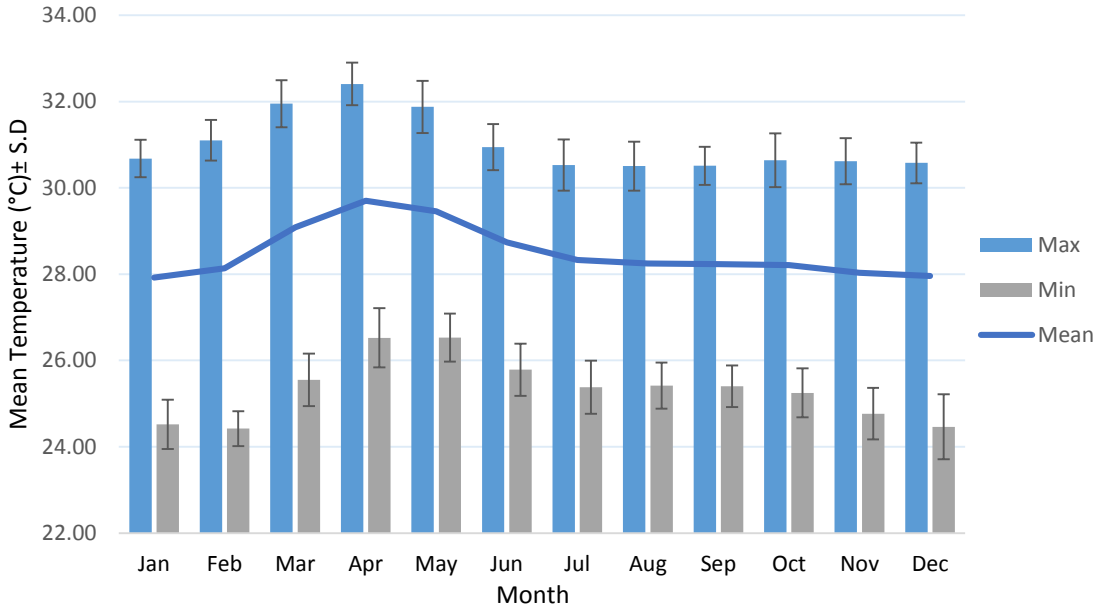

Figure 7. Mean monthly maximum and minimum temperatures based on 24 years of data from Hanimaadhoo.

Based on the findings of the analysis of wind and rainfall data, the lower temperature periods coincide with stronger winds and heavy rains. This may be important when planning for the construction phase of the project. The temperatures during the construction phase may also have implications for the working conditions of the workers.

5.1.4 Tides

Astronomical tide levels recorded at the National Meteorological Centre at Hulhulé showed that the highest and lowest astronomical tide levels were +0.64 m and -0.56 m from MSL, respectively (Table 6). Assuming that the tide measurements at Hulhulé are comparable to those across the country, it was assumed that the tide levels for the project location would be similar. A tidal variation of 1.2 m between the lowest tide and the highest tide were recorded for the country. Tidal fluctuations cause changes in the current flow patterns around the islands and bring subsequent changes in the physical aspects of the shoreline. At low tide, water movement is generally very slow, compared to the movement of water at high tide. Considerations for the tidal patterns and the resulting changes in current movements are important while planning for dredging activities.

Table 6. Tide characteristics at Hulhulé. Data obtained from the weather station at Hulhulé Island.

Tide characteristic	Water levels with reference to MSL (m)
Highest Astronomical Tide (HAT)	+0.64

Mean Higher High Water (MHHW)	+0.34
Mean Lower High Water (MLHW)	+0.14
Mean Sea Level (MSL)	0.00
Mean Higher Low Water (MHLW)	-0.16
Mean Lower Low Water (MLLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

5.1.5 Sunshine

Annual sunshine data recorded over 38 years at Hulhulé revealed that on average 232.9 hours of sunshine was experienced annually. From the monthly averages, it was clear that Hulhulé received the maximum amounts of sunlight during the months between January and April (Figure 8). Assuming that the sunshine experienced in Neykurendhoo is reflective of the data obtained from Hulhulé, It can be established that the project site will receive longer hours of sunshine during the first four months of the year.

5.1.6 Waves

According to DHI (1991), the significant heights (H_s) in the southern regions of the Maldives exceeded 2.5 m in about 0.1 percent of the time. Figure 9 shows that the highest waves were from the west and south. Significant wave height exceeds 1 m less than about 1% of the time from N, NW, NE and E. The results are consistent with the satellite altimetry derived wave climate data over a 10 year period for the region (Kench & Brander, 2006), indicating that dominant swell approached from southerly directions, with some seasonal variations. Swells were predominantly from the south-southwest between April to November, with a significant peak in H_s of 1.8m observed in June, and from south to south eastern direction between November and March, with a minimum H_s of 0.75 m in March. The overall wave energy was greatest on all islands during the westerly monsoon (Kench & Brander, 2006).

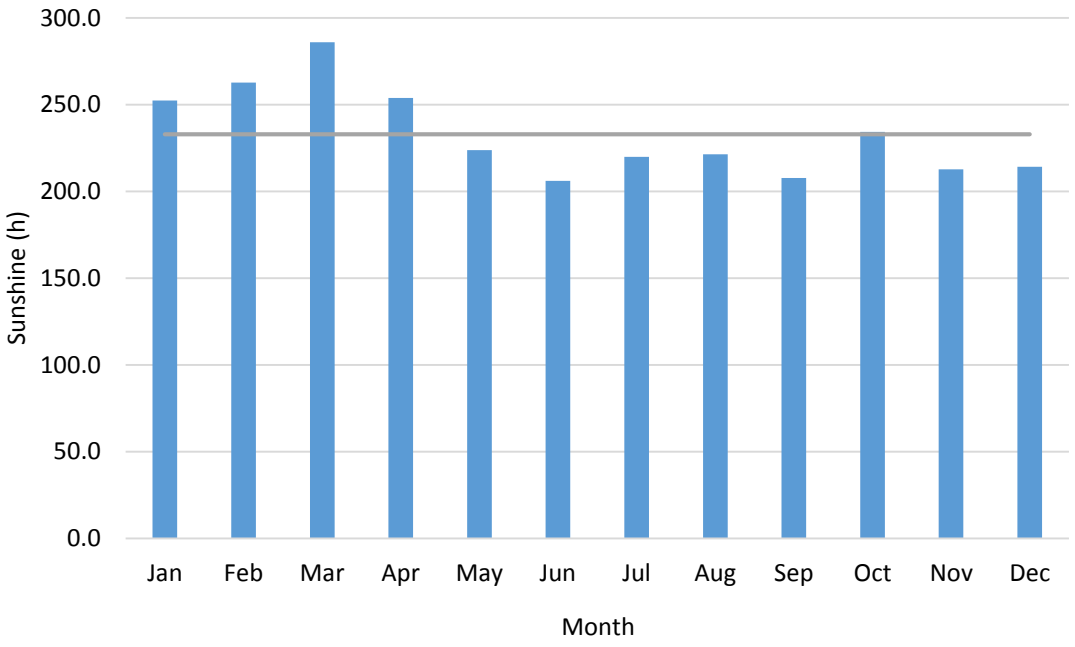

Figure 8. Mean monthly sunshine (h) recorded for Hulhulé based on 39 years of data. The solid line indicates the mean annual monthly sunshine

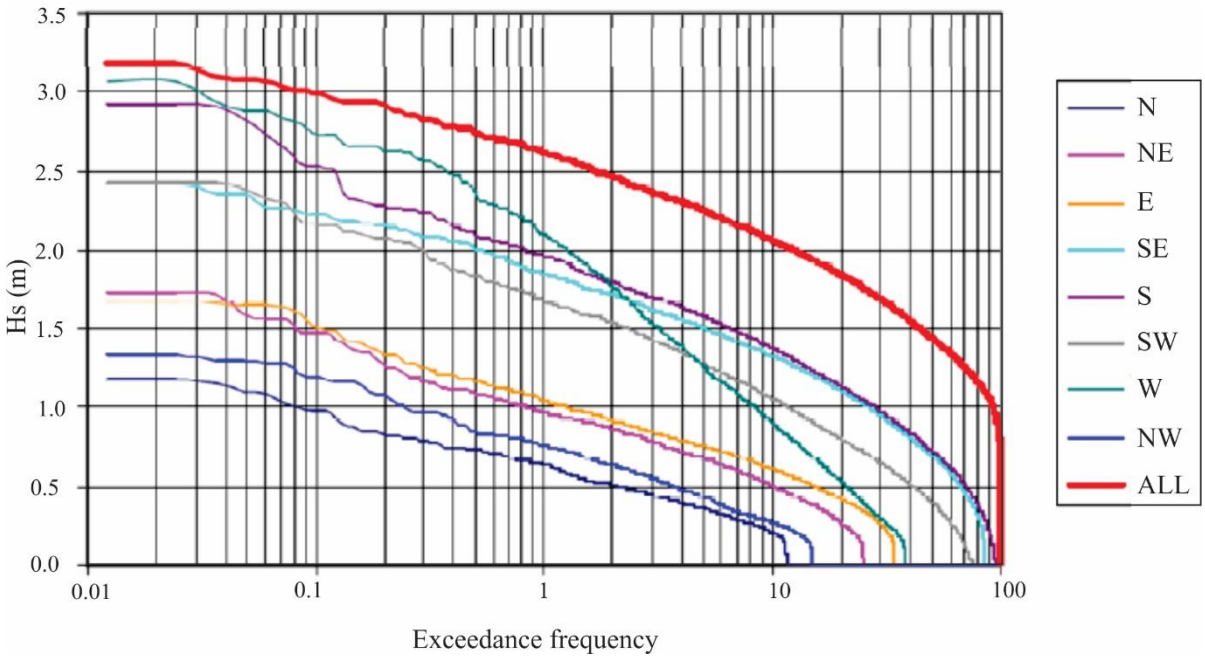

Figure 9. Wave height, H_s (m), exceedance curve for the southern region of the Maldives (source: DHI, 1999).

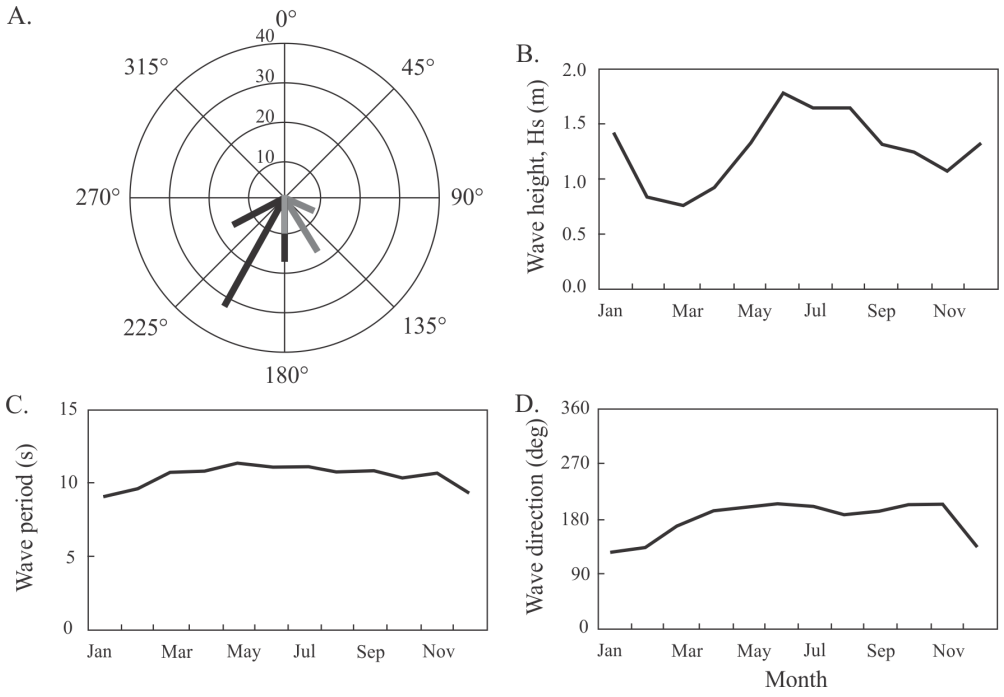

Figure 10. Mean monthly ocean swells for Maldives. (A) wave direction for April to November (black lines) and December - March (grey lines); (B) wave height; (C) wave period; (D) wave direction. Data from young (1999) adapted from Kench and Brander (2006).

The analyses of waves showed that for much of the year, stronger wind-driven waves will approach the project location from a westerly to west-north-westerly direction. During December to March, wind generated waves approach the project location mainly from the easterly to east-north-easterly direction. As is the case for the rest of the country, Neykurendhoo is exposed to swell waves approaching from a south westerly and south easterly direction. This implies that Neykurendhoo is exposed to swells that generate outside and enter the atoll through the channels formed between the islands. The intensity of waves generated is expected to be high due to the highly exposed nature of the atoll, however the waves are expected to lose their intensity to some extent as they reach Neykurendhoo, although possibly not by a considerable amount. Although located inside of the atoll, Neykurendhoo is reasonably exposed to both the westerly and west-north-westerly as well as the east and east-north-easterly wind-generated waves (Figure 11). Some level of protection from the westerly wind-generated waves is provided by the adjacent Vaikaradhoo Island.

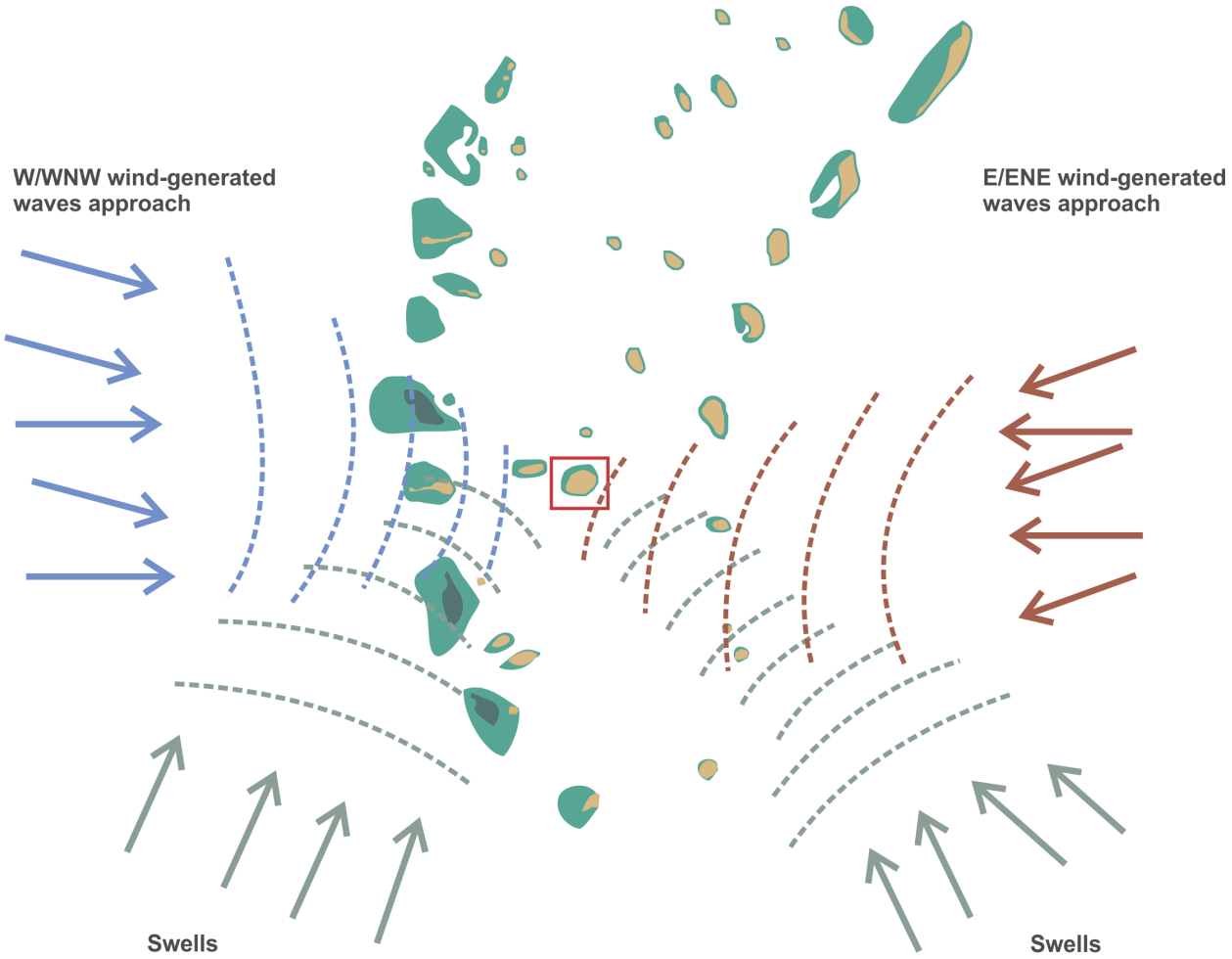

Figure 11. Estimated wave propagation patterns around the vicinity of HDh. Neykurendhoo.

5.1.7 Currents

The currents that the sea areas around the Maldives are exposed to are caused by one or more of the following systems:

a) Oceanic currents,
b) Tidal currents,
c) Wind-induced currents, and
d) Wave-induced currents

Because of its position in the vast Indian Ocean, Maldives is exposed to an immense body of water flowing constantly across the plateau on which the atolls are built. Approaching the equator, the effect of prevailing winds on the ocean surface currents become noticeably greater, in that the velocity and direction are driven, in a major way, by prevailing winds. The Maldives experience sea surface currents driven by two monsoonal winds – the westerly and easterly winds. The westerly currents tend to dominate from January to March, while the easterly currents dominate from May to November. Changes in current flow patterns are observed in April and December, at the interchange between the two monsoons. The average current

velocities are approximately 0.5 ms^{-1}, except in the month of May these values may increase to 0.8 ms^{-1}.

The surface currents measured at 2 locations just outside the existing breakwater at the entrance to the harbour indicated that the ocean surface currents of 0.13 ms^{-1} were observed on the day of sampling (Figure 12). The surface currents inside the basin was 0.08 ms^{-1} in a westerly direction.

Figure 12. Ocean surface current speeds (ms^{-1}) in the channel, outside the channel and inside the harbour basin, as were observed on November 7, 2015.

In making conclusions about the observed surface current velocities and directions, it is important to consider the weather conditions at the time the surveys were conducted. The field data were collected on November 7, 2015. The weather conditions for Hanimaadhoo on the day of sampling are summarized in Table 7 (Climate section, MMS). In general, it was a rainy day, with heavy rains in the morning and scattered showers and strong winds throughout the day.

Table 7. Weather conditions for the sampling date (data obtained for November 7, 2015 from the MMS station at Hanimaadhoo island)

Parameter	Recorded data
Maximum Temperature	30.0 °C

Minimum Temperature	23.9 °C
Maximum wind	E / 24 mph (08:09)
Mean wind	W / 06 mph
Rainfall	13.3 mm

Although surface current data collected on a single day will not provide a realistic picture of the annual and monthly current conditions, the following predictions can be made based on the fact that surface currents are, to a large extent, driven by the prevailing winds:

a) For a large part of the year, from March to October, surface currents around the Neykurendhoo area will be in a west to west-north-westerly direction, at generally higher current speeds in comparison to the rest of the year.
b) The strongest currents will be experienced between May – August as a result of strong westerly winds in that period.
c) Neykurendhoo area will experience generally weaker currents in the easterly and east-north-easterly direction during November – March.
d) The directions (E/ENE and W/WNW) of the currents may be used to explain why the channel gets silted over time.
e) Considering that for most of the year the surface currents will be away from Neykurendhoo and the proposed development site on its harbour, adequate protection against sediment transport away from the project site will need to be sought.

5.1.8 Coastal Dynamics

Neykurendhoo is an average-sized island that has remained relatively intact with respect to coastal modifications. The island consists of two harbours constructed on the northern side of the island, one that is used by larger passenger, cargo and fishing vessels, and the other, a shallower harbour that is currently being used by the locals to harbour small vessels. These developments comprise only a small proportion of the perimeter of the island. Apart from the construction of the harbours and beach nourishment using the dredge material from harbour construction, no other coastal developments have been carried out on the island. Figure 13 shows an outline of Neykurendhoo.

The island has two beaches, a smaller one on the north eastern side close to the harbour proposed for development, and a long stretch of beach that spans the entire north western to the south western side of the island.

Consultation with the Island Council revealed that the area to the south east of the island experienced seasonal erosion, but not at a concerning level.

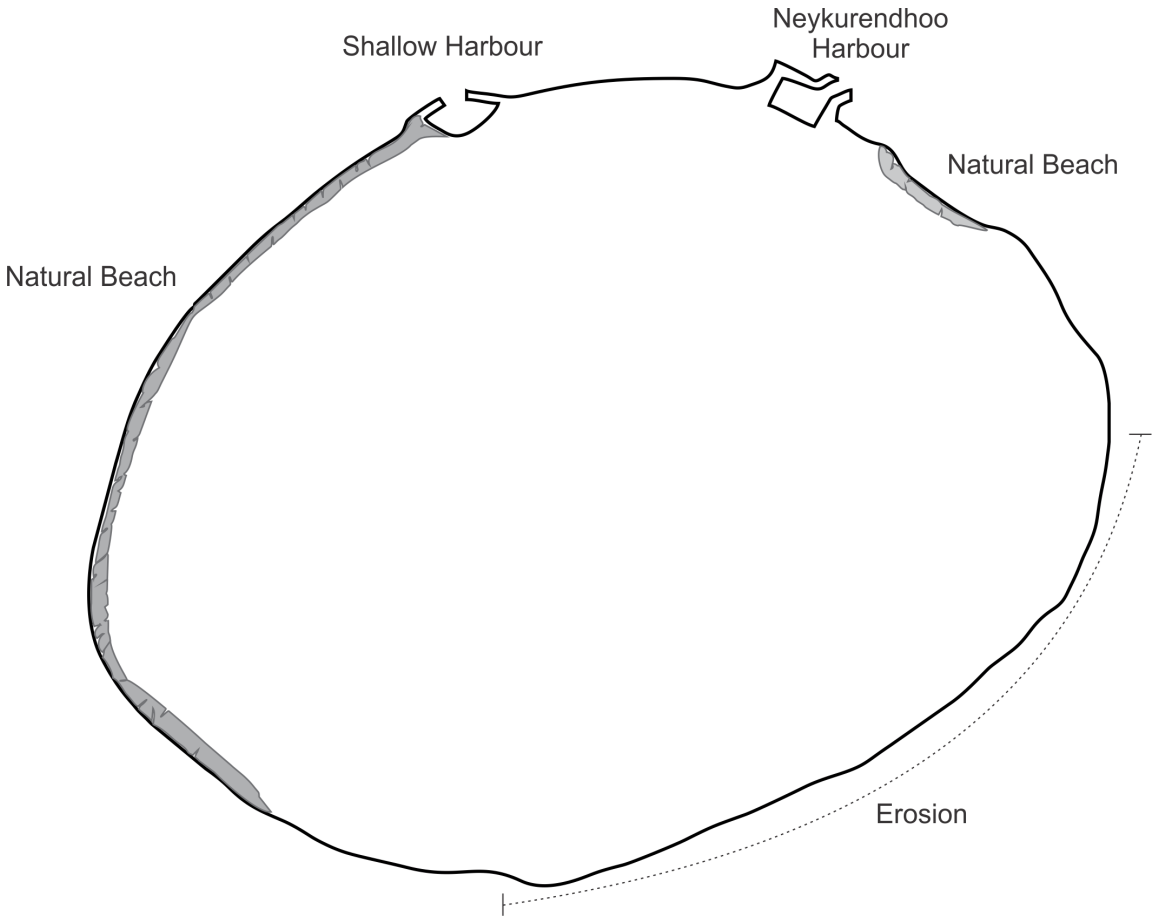

Figure 13. Profile of Neykurendhoo, showing the existing coastal developments, the natural beaches and the area subjected to seasonal erosion

5.1.9 Bathymetry

The depths within the existing entrance channel ranged between -0.61 m and -5.91 m, with an average of -2.97 m from MSL. A detailed depth profile of the area proposed for development is given in **Annex 3**. An estimated volume of approximately 623.9 m^3 of dredge material will be generated from the deepening of the channel.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Marine Environment

The sides of the channel, constructed of big boulder rocks in the previous harbour development project, hosted colonies of relatively small sizes of varieties of digitate and columnar coral forms, which were widely dispersed over the area with minimum live coral coverage. Aside of the sandy bottom of the channel, the rock boulder walls that were pre-constructed as the channel wall, dominated as a substrate in the area. The sandy bottom was uniform throughout the channel length, with moderately high levels of siltation and sedimentation (Figure 14). The

siltation could potentially be a result of the dynamic movement of the sub-water currents as the surf break coincides with the entrance of the channel.

Observations of the fish and invertebrate population both presented relatively low diversity and abundance. The previous alterations and development of the site could be a contributing factor for this observation. Fishes in the families of Butterflyfishes, Damsels, Trevallies and Parrot fishes were sighted in this area.

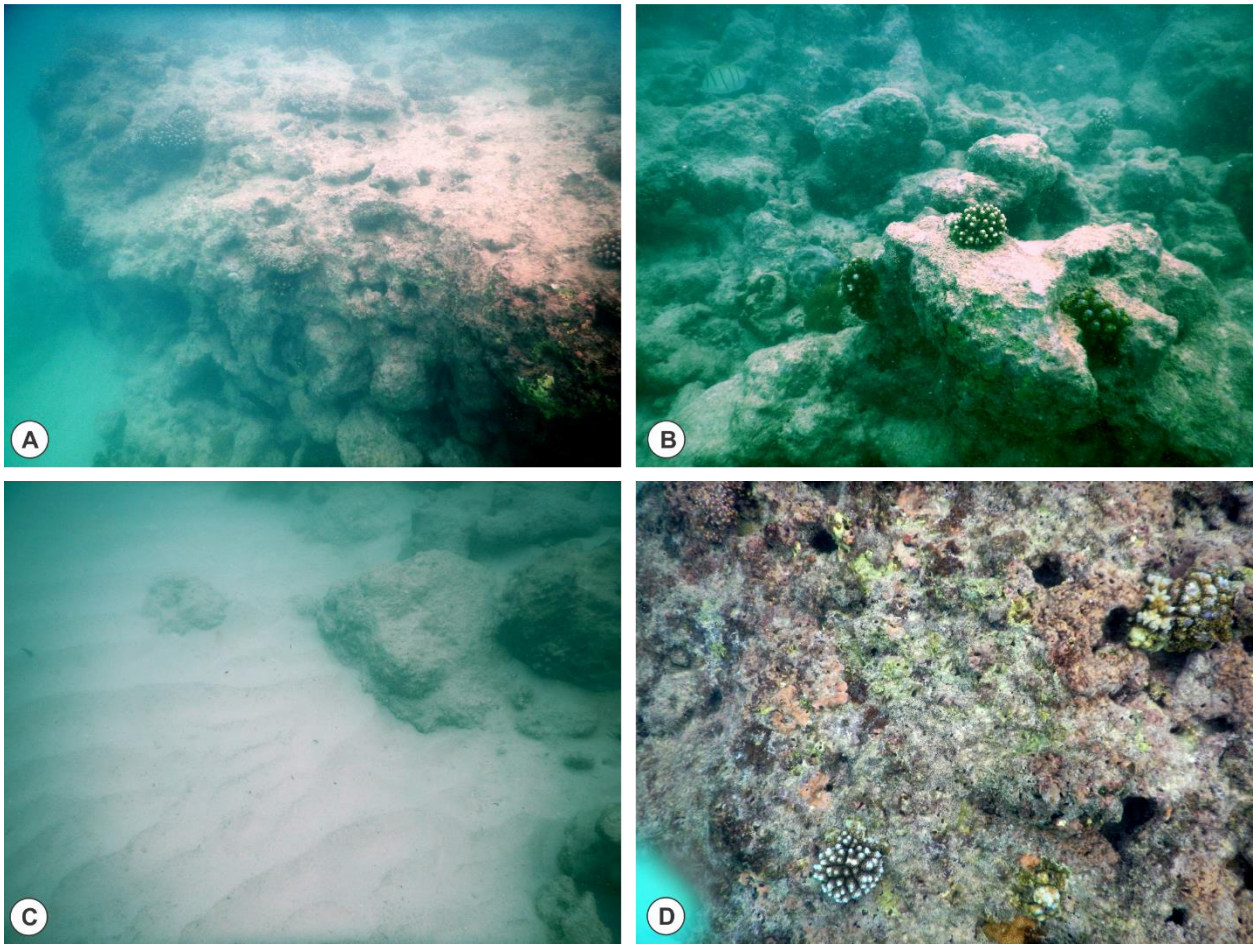

Figure 14. Benthic cover at project location. A & B: the foot of the existing breakwater; C: the bottom of the existing channel and C: Cover at the proposed extension location

Observations at the location of the proposed extension to the break water showed slightly higher coral cover, with the same morphological coral forms present. This location also hosted a relatively higher population of fish species compared to the entrance channel. Visual observations concludes fish varieties to range in the families of Butterfly fishes, Damsels, Parrotfishes, Surgeon fishes and Sergeant fishes.

The findings of this survey study shows that no significant amount of coral communities or marine animal population will be lost or damaged, as a direct result of the project activities.

5.2.2 Terrestrial environment

The outpost zone vegetation close to the proposed project location generally had a dominance of coastal species (Table 8, Figure 15), namely *Tournefortia argentea* (Boashi), *Cocos nucifera* (coconut palm) and *Scaevola taccada* (Sea lettuce shrubs).

The material generated from the dredging activities is proposed to be used to level an existing access road to the harbour. The road has already been cleared in the past and in use at the moment, therefore no additional clearing is required. The vegetation on the sides of the access road were all relatively salinity tolerant species.

Table 8. Coastal vegetation near the proposed fill site.

Local Name	Common Name	Scientific Name
Magoo	Sea Lettuce	*Scaevola taccada*
Dhivehi Ruh	Coconut palm	*Cocos nucifera*
Boashi	Velvet soldierbush	*Tournefortia argentea*

Figure 15. Coastal vegetation around the project location, showing a representation of the different species present

5.3 WATER QUALITY

The water quality test results revealed that the quality of water at the site of the proposed development, at the time the measurements were taken, were well within the acceptable ranges for all parameters measured (Table 9). The average water temperature 28.62 °C, which is within the characteristic range for the Maldives. An average pH of 8.35 was recorded, which was within the range for normal seawater. A mean turbidity level of 0.50 NTU was recorded, with the maximum turbidity level being measured inside the harbour basin, just at the exit to the channel. Mean dissolved oxygen (D.O) was recorded at 14.63 mgL^{-1}, which is well above the threshold D.O. level required to sustain life in aquatic environments. The total dissolved solids (TDS) load recorded was 31.12 gL^{-1}), and an average salinity of 34.1 ppt was recorded for the site at the time the measurements were taken.

Table 9. Water quality test results for Neykurendhoo. The tests were carried out on November 7, 2015 using a Horiba U-52 multiparameter water meter

Sampling point	Temperature (°C)	pH	Turbidity (NTU)	D.O (mgL^{-1})	TDS ($g\ L^{-1}$)	Salinity (ppt)
1	28.21	8.23	1.7	13.13	31.0	33.9
2	28.70	8.36	0.3	14.88	31.2	34.2
3	28.54	8.39	0.4	15.5	30.8	33.7
4	28.64	8.34	0.5	13.97	31.4	34.4
5	28.68	8.35	0.1	14.62	31.1	34.1
6	28.94	8.44	0.0	15.68	31.2	34.2
Mean	28.62	8.35	0.50	14.63	31.12	34.1
S.D	0.24	0.07	0.62	0.96	0.20	0.25

5.4 PROTECTED AREAS AND ENDANGERED SPECIES

No rare endangered species were encountered during the field investigation. Neykurendhoo beach is not known for turtle nesting. No designated protected areas or environmentally sensitive areas are situated in close proximity to the project site.

5.5 HAZARD VULNERABILITY

Site-specific data on historical natural hazards for Neykurendhoo were very limited. However, certain generalisations could be made with regards to the potential natural hazards vulnerability of Neykurendhoo Island based on the Detailed Island Risk Assessment in the Maldives (DIRAM) published by UNDP (2006). Historic records have shown that swell surges, gravity waves (locally known as '*udha*'), wind storms and flooding due to heavy rainfall were the most common natural disasters affecting the islands of the Maldives. The frequency and intensity of a given hazard may vary from island to island depending on the geomorphic and geographic setting of the island. The DIRAM study indicated that the impact of swell waves and udha events were expected to be the highest at the western rim island due to the strong south westerly and westerly approach of these events. Factors such as location of the islands within the atolls, their shapes, formation and orientation, the degree of protection offered to the islands by surrounding reefs and islands, and the wetlands at the coasts contribute to the resilience of the islands to withstand natural events.

The exposure and vulnerability of Neykurendhoo to hazards can be deduced from Figure 16. Neykurendhoo, being located in the middle of the northernmost natural atoll makes it vulnerable to udha and rainfall flooding events. The periods May – August have a higher risk of these events, as the period coincides with heavy rainfall and strong winds. Although in the middle of the atoll, Neykurendhoo is highly exposed, as there are very few islands in the immediate vicinity of the island to offer protection, and are exposed to waves approaching the island through channels that open up to the open ocean.

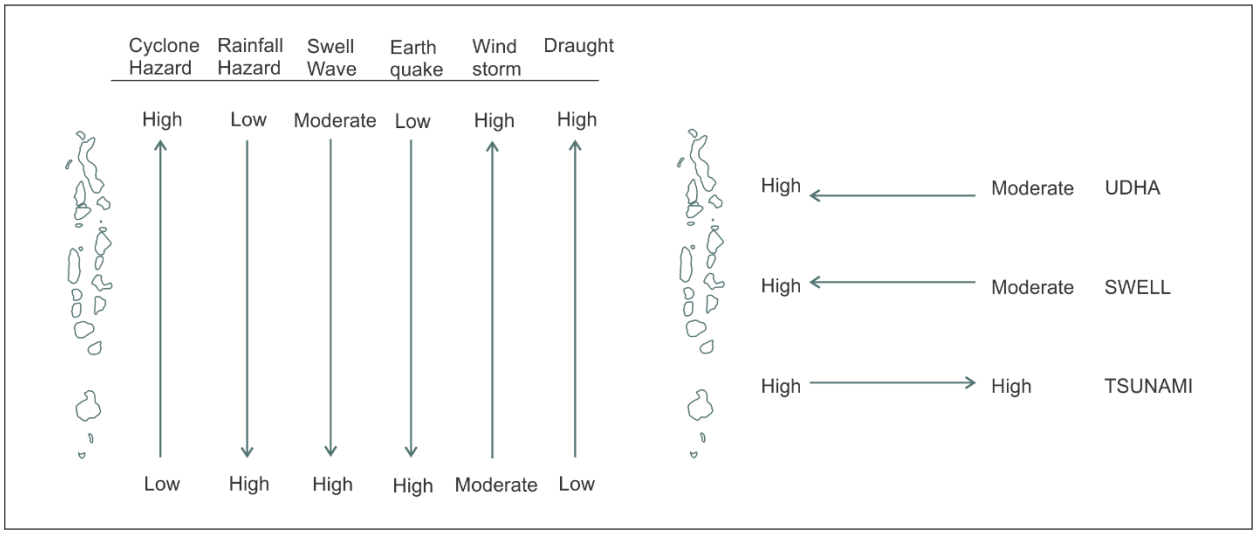

Figure 16. Hazard vulnerability of the Maldives (Source: DIRAM, 2006)

6 SOCIOECONOMIC SETTING

6.1 POPULATION

The island of Neykurendhoo is one of the inhabited islands in South Thiladhunmathi Atoll, the second northernmost administrative atoll of the country. The total population of the island as of the population census of 2014 was 750, which contributes to about 4% of the total population of the atoll (Table 10). A slight decrease in population (growth rate of -1.93%)) was evident between the 2006 and 2014 censuses. The population utilises less than 50% of the island's land area for residential use.

Table 10. Population breakdown in Neykurendhoo, Haa Dhaalu Atoll. (Source: population census, NBS, 2014)

	Male	Female	Total
Local	308	407	715
Foreign	29	6	35
Total	337	413	750

6.2 SOCIOECONOMIC ENVIRONMENT

The main economic activities of the Neykurendhoo population include agriculture, fisheries, thatch work, carpentry and construction work. According to the information provided by the island council, Neykurendhoo currently has a total of 26 vessels, with an average length of 15 m.

As part of the then Ministry of Housing and Environment's "outer island electrification project", power generation the electrification of Neykurendhoo was completed in 2009 and the island now has the capacity to generate 24 hours electricity. Neykurendhoo has a Health Centre that provides for the basic health care needs of the island community. The Neykurendhoo School has the capacity to each up to the 10th standard.

Neykurendhoo Island Council has been exploring the possibilities of expanding the island's economy as well as to enhance the socioeconomic status of the island community. To this end, the Council, in association with the relevant Government organisations as well as other interested parties, have conceptualised several development ideas, and are at present in the process of implementing some (Figure 17). To this end, Neykurendhoo Council is at present working toward the expansion of the existing thatch making and agriculture sectors to enhance opportunities for income and employment within the island (PSM, 2015), in addition to a proposed ice plant to facilitate fishermen operating in the area. The Government of Maldives has also planned a correction facility with a 300-inmate capacity on the south western side of the island. The Island Council has also taken an initiative to enhance the support services such as the provision of better electricity and the establishment of waste management capacity required for these developments. With such ongoing and planned developments, the need for better access to the island becomes evident. Especially with the expansion of the agriculture

and thatch making sectors in the island, where the produce from the sectors are exclusively traded out of the island, the requirement of proper maintenance of the harbour thus providing safer access to the island becomes necessary.

In general, the island seemed to be a well-connected community, where information regarding the major developments were shared with the public, and the public concerns are heard and acted on as much as possible.

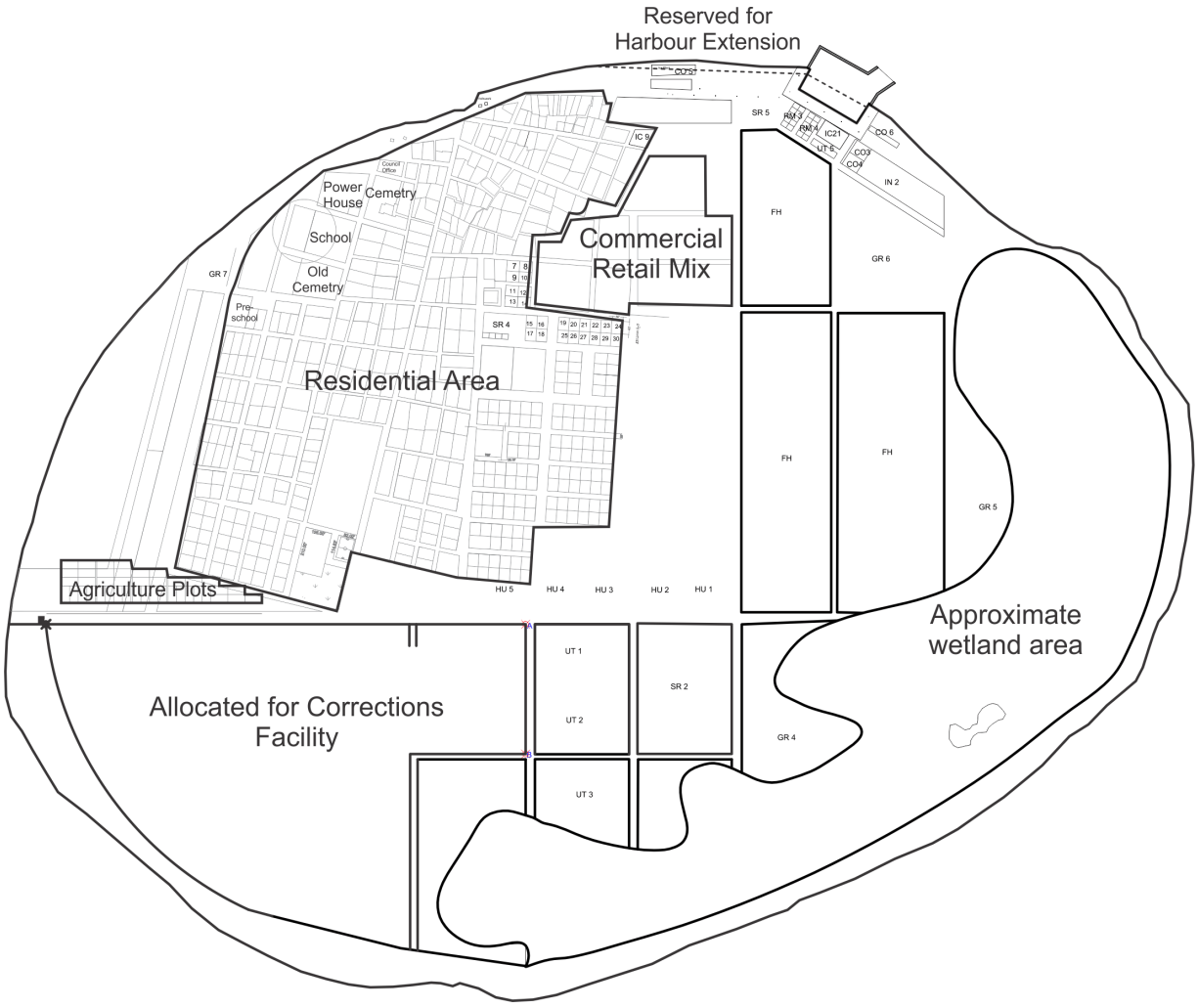

Figure 17. Neykurendhoo land use plan (Source: Neykurendhoo Council)

7 STAKEHOLDER CONSULTATION

Stakeholder consultations aimed at understanding the views and concerns of the parties who have a stake in the project, were conducted as part of the study. The main stakeholders identified were the Ministry of Housing and Infrastructure (MHI, the project proponent), Ministry of Environment and Energy (MEE), Environment Protection Agency (EPA) and the atoll and island Councils.

7.1 SCOPING MEETING

A scoping meeting was held on October 4, 2015, to identify the scope of the project proposed for the channel protection and maintenance dredging in Neykurendhoo, and to finalise the terms of reference (TOR), on which the scope and design of this report was based. The meeting was attended by representatives from MEE, MHI and MEECO (Table 11).

Table 11. List of attendees at the scoping meeting

Name	Designation	Organisation	Contact
Nafha Aujaz	Environmental Analyst	Min. of Housing & Infrastructure	772 1554
Ahmed Niyaz	Asst. Director		794 9720
Safa Ahmed	Asst. Director	Environmental Protection Agency	964 5680
Asra Ahmed	Asst. Director	Maldives Energy & Environmental Company	796 5626
Ali Nisham	Asst. Env. Officer	Environmental Protection Agency	
Mohamed Hamdhaan	Asst. Director	Environmental Protection Agency	766 8606
Aminath Shahula		Environmental Protection Agency	

MHI, as the project proponent is fully committed to the completion of the project as a priority of the Government and the financing for the project has been allocated in the Government's budget for the current fiscal year. No specific requirements beyond what was mentioned in the project brief were put forward, and no objections to the proposed development were voiced.

7.2 COMMUNITY CONSULTATION

The opinions of the locals of Neykurendhoo were sought during field investigations. Meetings were held with the Island Council (list of council members consulted is provided in Table 12) as the representatives of the island community revealed that this project was one that the community has looked forward to for a few years. The council indicated that the Neykurendhoo harbour used to be one that was regularly used by fishing boats travelling from other atolls as a berthing location, and that since its construction in 2007, no maintenance work had been carried out on the harbour. The council also indicated that they receive constant complaints from tuna vessels about the difficulties they have when navigating through the channel that has, over the years, become too shallow to facilitate safe navigation in and out of the harbour. The council is of the view that, since the harbour at the neighbouring Vaikaradhoo Island was developed recently, and the fact that basic facilities like ice and water supply is now available

in nearby islands where the harbours are in a better state, Neykurendhoo is losing its attractiveness as a berthing locations for passing by vessels. The council also mentioned that a project for the provision of water supply at the harbour is in the pipeline, and that the maintenance of the channel is necessary in order to bring the maximum benefits from other development efforts on the island. Some elderly folk believe that the design of the existing entrance channel is responsible for the siltation resulting in shallowing of the channel.

Table 12. Attendees at the meeting with the Neykurendhoo Council

Name	Designation	Organisation	Contact
Mohamed Shizan	Council President	Neykurendhoo Council	762 3671
Ibrahim Mauz	Vice President	Neykurendhoo Council	746 4677
Ali Adam	Member	Neykurendhoo Council	965 1918
Mohamed Ibrahim	Member	Neykurendhoo Council	778 2943
Mohamed Shaneez	Member	Neykurendhoo Council	795 2923

8 POTENTIAL IMPACTS

8.1 INTRODUCTION

Developmental projects involving coastal development and coastal modification in island environments are considered to generate a various level of environmental impacts, some of which can be felt on the immediate environment and some can be cumulative. Marine environment is directly affected from changes in hydrodynamics due to coastal modification from dredging and reclamation projects, as the coral reefs are very vulnerable to immediate changes that will be sustained from most of the development activities. Therefore, during the scoping, designing of the project activities and field surveys, considerations must be given to minimise the impacts felt on the environment. This chapter aims at describing in detail, the potential environmental impacts and measures proposed to mitigate the impacts arising from the proposed development in Neykurendhoo.

8.2 UNCERTAINTY

Environmental impact prediction itself involves a certain degree of uncertainty, as the predicted impacts may vary depending on weather, ecological conditions and social conditions in the atoll or island. Further, limited time allocated for conducting the EIA studies does not permit collecting adequate primary data on the existing environment of the project location. In addition the limitation in the availability of key site-specific historic data meant that the baseline obtained was based on data collected over a single field visit to the site. Efforts to collect more data over a longer period of time were hindered by budget and time constraints. Data on environmental aspects such as currents, waves and sediment transport regimes may require at least a full year of data collection to make an informed judgement. The level of uncertainty in the proposed project is considered to be low, as the project scope is small and experience from harbour construction work carried out in many islands and resorts in the Maldives are readily available.

8.3 POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT

As is the case with any coastal development projects, majority of the impact of the project are expected during the construction phase, which will include mobilisation of machinery and vehicles, workforce, demolition of the existing breakwater and deployment of a new one, maintenance dredging of the channel and the disposal of the dredge material to the proposed fill area on land. This section identifies the potential impacts and possible issues that could arise during the construction and operational phase. The identification of potential impacts does not mean they would necessarily occur or that they could not be successfully mitigated.

The results of the assessment of the environmental impacts, both positive and negative, during the construction phase are outlined in Table 13, and those during the operational phase in Table 14.

Table 13. Results of the RIAM matrix for the construction phase, showing the different impact components (I = importance; M = magnitude; P = permanence; R = reversibility and C = cumulative nature) and the impact scores (ES = environmental score and RS = alphabetical range values). RS values indicate the levels of positive and negative impacts, where N = no impact; A = slight impact; B = minor impact; C = moderate impact; D = significant impact and E = extreme impact.

		ES	RS	I	M	P	R	C
PC1	Coastal morphology	**0**	**N**	0	0	1	1	1
PC2	Hydrological conditions	**-9**	**-A**	1	-1	3	3	3
PC3	Water quality	**-12**	**-B**	1	-2	2	2	2
PC4	Natural disasters	**0**	**N**	0	0	1	1	1
PC5	Pollutants	**-7**	**-A**	1	-1	2	2	3
BE1	Coral reefs	**-6**	**-A**	1	-1	2	2	2
BE2	Endangered species	**0**	**N**	0	0	1	1	1
BE3	Sedimentation/eutrophication	**-7**	**-A**	1	-1	2	2	3
BE4	Terrestrial ecosystem	**0**	**N**	0	0	1	1	1
SC1	Aesthetic and cultural value	**-9**	**-A**	1	-1	3	3	3
SC2	Income	**6**	**A**	1	1	2	2	2
SC3	Fishery	**-6**	**-A**	1	-1	2	2	2
SC4	Recreational value	**0**	**N**	0	0	1	1	1
SC5	Employment	**6**	**A**	1	1	2	2	2
SC6	Public health and safety	**-7**	**-A**	1	-1	2	2	3
EO1	Infrastructure	**5**	**A**	1	1	2	2	1
EO2	Navigation	**-6**	**-A**	1	-1	2	2	2
EO3	Regional economy	**0**	**N**	1	0	1	0	1

Class	**-E**	**-D**	**-C**	**-B**	**-A**	**N**	**A**	**B**	**C**	**D**	**E**
PC	0	0	0	1	2	2	0	0	0	0	0
BE	0	0	0	0	2	2	0	0	0	0	0
SC	1	0	0	0	3	1	1	0	0	0	0
EO	0	0	0	0	1	1	1	0	0	0	0
Total	**1**	**0**	**0**	**1**	**8**	**6**	**2**	**0**	**0**	**0**	**0**

Table 14. Results of the RIAM matrix for the operational phase, showing the different impact components (I = importance; M = magnitude; P = permanence; R = reversibility and C = cumulative nature) and the impact scores (ES = environmental score and RS = alphabetical range values). RS values indicate the levels of positive and negative impacts, where N = no impact; A = slight impact; B = minor impact; C = moderate impact; D = significant impact and E = extreme impact.

		ES	RS	I	M	P	R	C
PC1	Coastal morphology	**0**	**N**	0	0	1	1	1
PC2	Hydrological conditions	**-9**	**-A**	1	-1	3	3	3
PC3	Water quality	**-12**	**-B**	1	-2	1	2	3
PC4	Natural disasters	**0**	**N**	0	0	1	1	1
PC5	Pollutants	**-6**	**-A**	1	-1	1	2	3
BE1	Coral reefs	**-5**	**-A**	1	-1	1	1	3
BE2	Endangered species	**0**	**N**	0	0	1	1	1
BE3	Sedimentation/eutrophication	**-7**	**-A**	1	-1	2	2	3
BE4	Terrestrial ecosystem	**0**	**N**	0	0	1	1	1
SC1	Aesthetic and cultural value	**9**	**A**	1	1	3	3	3
SC2	Income	**18**	**B**	1	2	3	3	3
SC3	Fishery	**24**	**C**	2	2	2	2	2
SC4	Recreational value	**6**	**A**	1	2	1	1	1
SC5	Employment	**10**	**B**	1	2	1	1	3
SC6	Public health and safety	**0**	**N**	0	0	1	1	1
EO1	Infrastructure	**18**	**B**	1	2	3	3	3
EO2	Navigation	**18**	**B**	1	2	3	3	3
EO3	Regional economy	**36**	**D**	2	2	3	3	3

Class	**-E**	**-D**	**-C**	**-B**	**-A**	**N**	**A**	**B**	**C**	**D**	**E**
PC	0	0	0	1	2	2	0	0	0	0	0
BE	0	0	0	0	2	2	0	0	0	0	0
SC	0	0	0	0	0	1	2	2	1	0	0
EO	0	0	0	0	0	0	0	2	0	1	0
Total	**0**	**0**	**0**	**1**	**4**	**5**	**2**	**4**	**1**	**1**	**0**

Table 15. Class summaries for the two phases of the project

Class	**-E**	**-D**	**-C**	**-B**	**-A**	**N**	**A**	**B**	**C**	**D**	**E**
PC	0	0	0	2	4	4	0	0	0	0	0
BE	0	0	0	0	4	4	0	0	0	0	0
SC	0	0	0	0	3	2	4	2	1	0	0
EO	0	0	0	0	1	1	1	2	0	1	0
Total	**0**	**0**	**0**	**2**	**12**	**11**	**5**	**4**	**1**	**1**	**0**

The analyses of the impacts revealed that the proposed development does not carry any major impact based on their significance, magnitude, permanence, reversibility and the cumulative nature. The only negative impacts recorded were only minor (-B range value) or slight (-A) impacts, of which there were 2 and 12 records, respectively (Table 15). Eleven categories showed no impact (N), while 4 categories showed slight positive impact (A). Four categories showed minor positive impacts (B) and only one category showed moderately positive impacts (C).

8.3.1 Impacts on coastal morphology

As the scope of the proposed development is very small, and does not involve any major dredging activities, the impacts on the coastal morphology are expected to be negligible. Although the project proposes to use the dredge material generated, which is expected to have salt content, to level the access road to the harbour, this activity is also expected to have negligible impact on the coastal vegetation, as the vegetation observed along the site to be levelled were relatively tolerant of salinity.

8.3.2 Impacts on hydrological conditions

Slight alterations to the hydrological conditions are expected from the proposed maintenance dredging and the extension of the existing breakwater. As the maintenance dredging is planned on a relatively small stretch along a channel that has already been dredged in the past, the magnitude of impacts on the hydrological conditions are expected to be minimal. However, as all dredging activities, the proposed dredging activity can cause some changes to the hydrodynamic flow around Neykurendhoo. In the case of the Neykurendhoo channel protection and maintenance dredging project, the magnitude of dredging related hydrodynamic alterations may fall within the range of naturally occurring changes and will likely impose only slight disturbances to the marine features.

8.3.3 Water quality

As evident from the RIAM analyses, the release of suspended sediments into the water column, both during the dredging activity as well as the transport of dredge material to the fill site, thus increasing the turbidity levels, is a concern when carrying out the proposed project. The issue of suspended solids is a particular issue with dredging activities, especially because they have a tendency to form sediment plumes that may be trailing behind the dredgers. In the case of Neykurendhoo, as was evident from the wind, waves and current analyses, the prevailing winds, and the resulting wind driven waves and current are away from the project site for much of the year during both monsoons. This increases the possibility of the solids suspended in the water column during dredging activities to move away from the island. Sediment resuspension presents a potential problem when it is moved out of the immediate project location by the tidal processes (Bray *et al*, 1997). However, the impact of sediment suspension on nearby reef systems is considered minimal as there are no such environments in a close enough proximity in the directions of wind and the associated wind-driven currents, with the exception of the uninhabited island of Kattalafushi about 1.8 m to the north of Neykurendhoo. The only other island that may be affected from the activities on Neykurendhoo is Vaikaradhoo. However, the chances of sediments affecting Vaikaradhoo is very small based on historic climatic data. Figure 18 shows the direction of wind and the wind driven current and waves around the project location for visualising the possible directions of sediment movement during the construction phase.

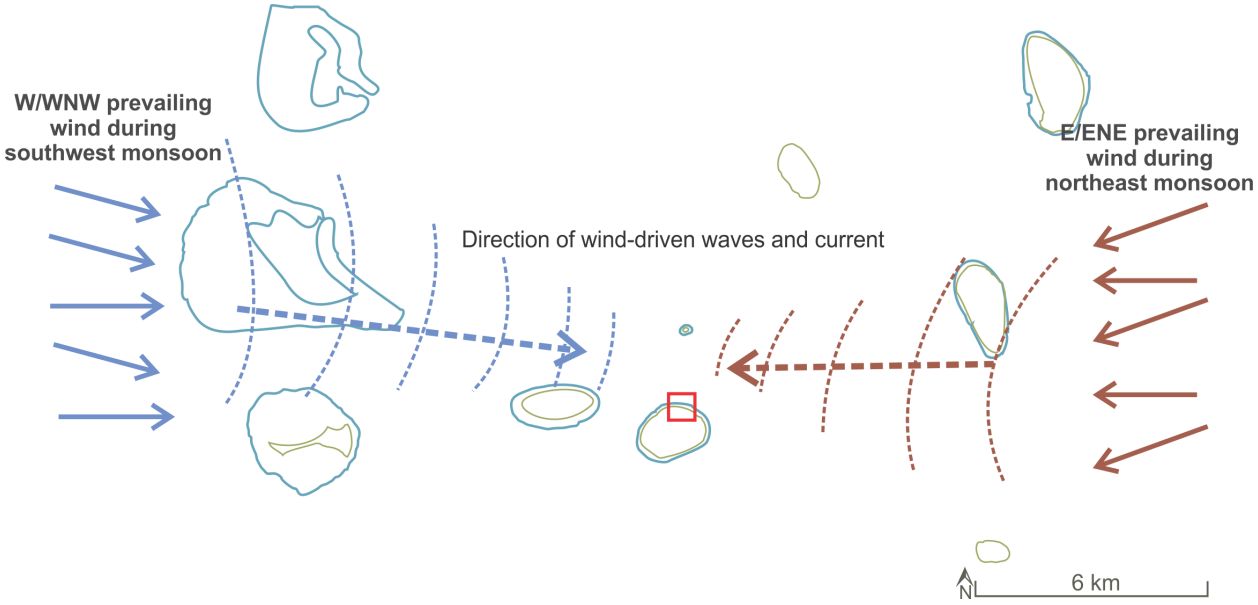

Figure 18. Wind directions and the direction of wind driven waves and currents at the project location

A reduction in water quality is also expected when the harbour becomes operational upon completion of the dredging and channel protection works as a result of boats approaching and exiting the channel.

Increased suspended sediments load can affect filter feeding organisms through affecting their feeding and breathing mechanisms (Brehmer 1965, Parr *et al*, 1998) as well as small fish through trapping sediments in their gills (Wilbur, 1971). Further, resuspension of sediments rich in their organic content may result in localised removal of oxygen from the water, which may result in affecting living organisms in the surrounding water.

8.3.4 Impacts on coral reef

The surveys to assess the coral reef environment and the abundance of live fish indicated that the site contained virtually no live corals, and the abundance and diversity of fish species were very low (refer to section 5.2). This is characteristic of locations that have undergone dredging activities in the past, as is the case with Neykurendhoo channel. The dredging activities are expected to have only slight impacts on the coral cover in and around the channel proposed for dredging.

The area between extensions to the breakwater was also dredged to provide better entrance to the existing channel, and consists of very little live coral cover as a result. The deployment of breakwater is expected to have only slight impacts on the coral reef environment. The loss of bottom habitats as a direct result of the dredging and placement of breakwaters are expected to be minimal.

The reef fish present in the area were in scarce in abundance, and are expected to migrate to more suitable locations during the construction phase. The fish communities are expected to return back once the construction phase is complete and the environments stabilise.

8.3.5 Impacts on aesthetic and cultural value

The aesthetic and cultural values are expected to be slightly impacted during the construction phase. These include the visual impact caused due to the presence of construction equipment and machinery, in addition to those arising from increased sedimentation levels is expected during the construction phase. The noise generated during the deployment of rock boulders as well as waste generated during the construction phase may also cause slightly negative impacts. However, these impacts are expected to be short-lived.

Another potential social impact during the construction phase could be those arising from the temporary migration of foreign labour force into the island. The increase in number of foreign labourers in an island like Neykurendhoo could potentially cause a lot of unwanted social problems.

The operational phase is expected to have a slight positive impact on the aesthetic and cultural values of Neykurendhoo.

8.3.6 Impacts on income and employment

The project is expected to bring slight improvements in the income opportunities to the island community during the construction phase. Some improvements in the small local businesses are expected, as the workers on site are expected to use local facilities, contributing to increased revenue as a result.

Once the construction phase is complete, and the harbour becomes operational, it is expected that more vessels will use the Neykurendhoo harbour, bringing with it, an increase in trade for the small businesses operating locally.

The employment opportunities as a direct result of the construction activities are expected to be only very small. However, improved transportation facilities as a result of the development is expected to improve the employment opportunities for the Neykurendhoo community during the operational phase.

8.3.7 Public health and safety concerns

The impacts on the public health and safety during the construction phase are expected to be slightly negative, as a result of the operation of the dredging equipment and machinery. The sound generated during the operation of the machinery may pose health-risks, however this impact to the local community is expected to be only slightly negative or even negligible, as

the harbour is located away from the residential areas of the island. The health risk during the construction phase are more of a concern for the labourers on site while the operations are ongoing. The risks on public health and safety are only short-lived during the construction phase of the project.

8.3.8 Impact on navigation

Temporary hindrance to navigation are expected during the construction phase, due to the placement of silt-screens during dredging activities and the operation of construction equipment and machinery on site. The situation is expected to be reversed upon project completion. The navigation situation is expected to be moderately improved during the operational stage, as a result of better structures providing more protection to vessels entering and exiting the Neykurendhoo channel, as well as increased safety from the channel being deepened.

9 MITIGATION AND IMPACT MANAGEMENT

The processes incorporated in the Neykurendhoo channel protection and maintenance project, their potential impact and possible mitigation and impact management measures are highlighted in Table 16. Impacts due to sedimentation and the resulting increase in turbidity levels was identified as a major concern, especially for most of the year, the wind directions and the resulting ocean surface currents were found to be away from the project site. The construction methodology does not include any means of controlling the sedimentation levels. The use of adequate methods for silt/sediment trapping to ensure their dispersion is controlled should be implemented to mitigate the impacts due to sedimentation.

Table 16. Potential impacts and proposed impact mitigation measures for the key components of the project

Component	Potential impact	Considerations	Mitigation measures
Removal of existing breakwater and the placement of the new breakwater with a 116.2 m extension	Permanent removal of benthic communities	The site is already dredged and the abundance of benthic communities were low	• The use of the existing foot of the existing breakwater as much as possible
	Health & safety issue	The site is located at a reasonable distance from the residential community, hence the risk is mostly for the workers on site	• Provision of safety equipment and gear for workers • Availability of workers' safety instructions on site • Ensuring that workers operating equipment and machinery are qualified for the work
	Materials generated	The removal of the existing rock-boulder breakwater is expected to generate reusable material	• Reuse of as much material from the existing breakwater to minimize additional material requirements as well as the amounts of waste generated
	Reduced water quality	This activity is expected to produce some level of disturbance to the water column, resulting in sedimentation	• Selection of appropriate methods that minimize the level of disturbance • Timing of activity to a favourable point with respect to weather conditions and tidal cycles

Component	Potential impact	Considerations	Mitigation measures
Maintenance dredging to achieve a depth of -3 m from MSL	Removal of benthic species and animals at dredge site	Communities within the existing, previously dredged site were already degraded, and are likely to show relatively rapid recovery to existing condition	• Timing of dredging to avoid sensitive periods
	Reduced water quality at dredge site	The dredging activity will cause temporary increases in suspended sediment level giving rise to turbidity, possible reduction in oxygen levels and an increase in nutrient content	• Selection of appropriate dredge equipment • Completion of the breakwater prior to commencement of dredge activities • Placement of silt screens at channel entrance to avoid sediment spread • Timing of dredging activities to the most favourable points with respect to tidal cycles and weather conditions • Adequate monitoring of water quality to ensure sedimentation does not exceed threshold levels. • Completion of dredging activities in the shortest duration
	Health & safety issue	The site is located at a reasonable distance from the residential community, hence the risk is mostly for the workers on site	• Provision of safety equipment and gear for workers • Availability of workers' safety instructions on site • Ensuring that workers operating equipment and machinery are qualified for the work • Ensure all marine-based machineries are equipped with fire extinguishers • Discourage smoking at the work site, to reduce fire hazards

Component	Potential impact	Considerations	Mitigation measures
Maintenance dredging to achieve a depth of -3 m from MSL (cont…)	Generation of waste	Waste is expected to be generated during construction phase; no large construction wastes are expected	• Provision of adequate land-based facilities for disposal of general wastes, to be disposed of at local waste disposal sites • Waste oils and fuels generated to be collected on site and transported to appropriate disposal sites at project completion
Levelling the access road to the Neykurendhoo harbour	Saltation of the levelling site causing impacts on terrestrial vegetation	The levelling site is one that has already been cleared and in use, and the vegetation around the levelling site are relatively salt-tolerant	•
	Rubble in the fill material resulting negative aesthetic impacts	The dredge material obtained will likely consist of a large proportion of rubble, which, when used to fill the access road may not be very appealing	• The dredge material should be sieved to eliminate any large-sized rubble to make the road more even.
Operation of the harbour with the new development	Reduced water quality	The increase in number of vessels operating is expected to disturb the channel bottom and may result in sediment resuspension	•
	Generation of waste	The operation of increased numbers of boats is expected to generate more waste. In addition it increases the chances of spillage of waste oils in the harbour	• Vessels operating in this area should adhere to best practices to avoid dumping of wastes into the marine environments as well as to avoid the intentional or accidental spillage of oils • Regular harbour cleaning activities • Provision of adequate land-based facilities like bins for the disposal of waste at the harbour

10 ALTERNATIVES

10.1 BACKGROUND

The project for the Neykurendhoo channel protection and maintenance dredging explored all the development options during the planning process. The possible alternatives taking into account engineering feasibility, cost aspects, regulatory considerations, financial and environmental aspects were analysed to assess the environmental acceptability of the different options.

10.2 NO DEVELOPMENT OPTION

Not carrying out the proposed channel protection and maintenance dredging would result in avoiding the impacts highlighted in section 8. This option would also mean that the Neykurendhoo channel will remain in its existing state, with a diversion of the vessels that use the harbour to more attractive, and safer locations nearby. Although the channel has known to become shallower over the years, it is worthy to mention here that since its construction in 2007, neither the harbour nor the entrance channel has needed to undergo any maintenance dredging activity until recently. The no development option will mean that the channel in need of maintenance dredging will remain unattended. There can be significant beneficial improvements from the use of properly monitored maintenance dredging to enhance the environment, as opposed to leaving it unmaintained.

10.3 DEVELOPMENT OPTIONS

10.3.1 Optional dredging methods

The project proposes to use excavators for the planned maintenance dredging. The methodology an equipment have been determined by the proponent based on their extensive experience in the field. A possible alternative to excavators would be the use of cutter suction dredgers, which might be effective in controlling sedimentation levels. However, due to the additional cost of using a cutter section dredger compared to the magnitude of the impact it would resolve, the proposed method of dredging is preferred. Neykurendhoo maintenance dredging project is a relatively small project with limited dredging requirements, and the amount of sedimentation expected to arise from dredging activities is considered relatively small.

Further, the use of cutter suction dredgers may, due to the small working space available, cause logistical and operational difficulties.

Based on these assessments, the proposed option of using excavators for the maintenance dredging works is preferred.

10.3.2 Alternative breakwater material

In addition to the proposed rock boulders, coral rubble, tetrapod and geotextile tubes can be used to construct the breakwater. Considering that coral mining is banned in the Maldives, coral rubble as an alternative material is not considered. As for the other options, in addition to the cost factor each option would incur, the aesthetics are considered. Further, the material requirements are further reduced with the use of rock boulders, as the materials from the existing breakwater can also be reused to construct the new breakwater, hence the use of rock boulders as proposed is considered the preferred option. The rock boulder will provide adequate dissipation of wave energy in the entrance channel.

10.3.3 Options for dredge material

The project proposes to use the dredge material generated to level the access road to from the residential areas of the island to the harbour covering an area of 5806 m^2. Two alternative fill sites were proposed by the Neykurendhoo Council, one of which was a road already in use on the western side of the island (with an area of 3716 m^2), and the other, a section of cleared land just adjacent to the harbour on the southern side (with an area of 7432 m^2). Another alternative to this fill location would be a section between the south and the west of the island that has undergone erosion over the years (Figure 19). However the exposed nature of the island, in addition to the ENE and WNW approaching wind generated waves may mean that any fill material on that site will not be effective, and may contribute to increased sediment levels in the water.

The proposed fill locations (1-3 on Figure 19) causes the least damage to the environment, as the site proposed is in land, well away from any wave and current action, in an area that has already been cleared of any vegetation, and the vegetation along the sides area relatively salinity tolerant varieties. As the amount of dredge material is very small, it will only be possible to fill one of the proposed locations, which should be decided by the council.

An alternative to using the dredge material for road levelling would be stockpiling the material for local construction use. This option would mean that the locals engaged in construction work on the island will not be required to source the sand required from elsewhere. The council should decide between the two options based on the need of the island.

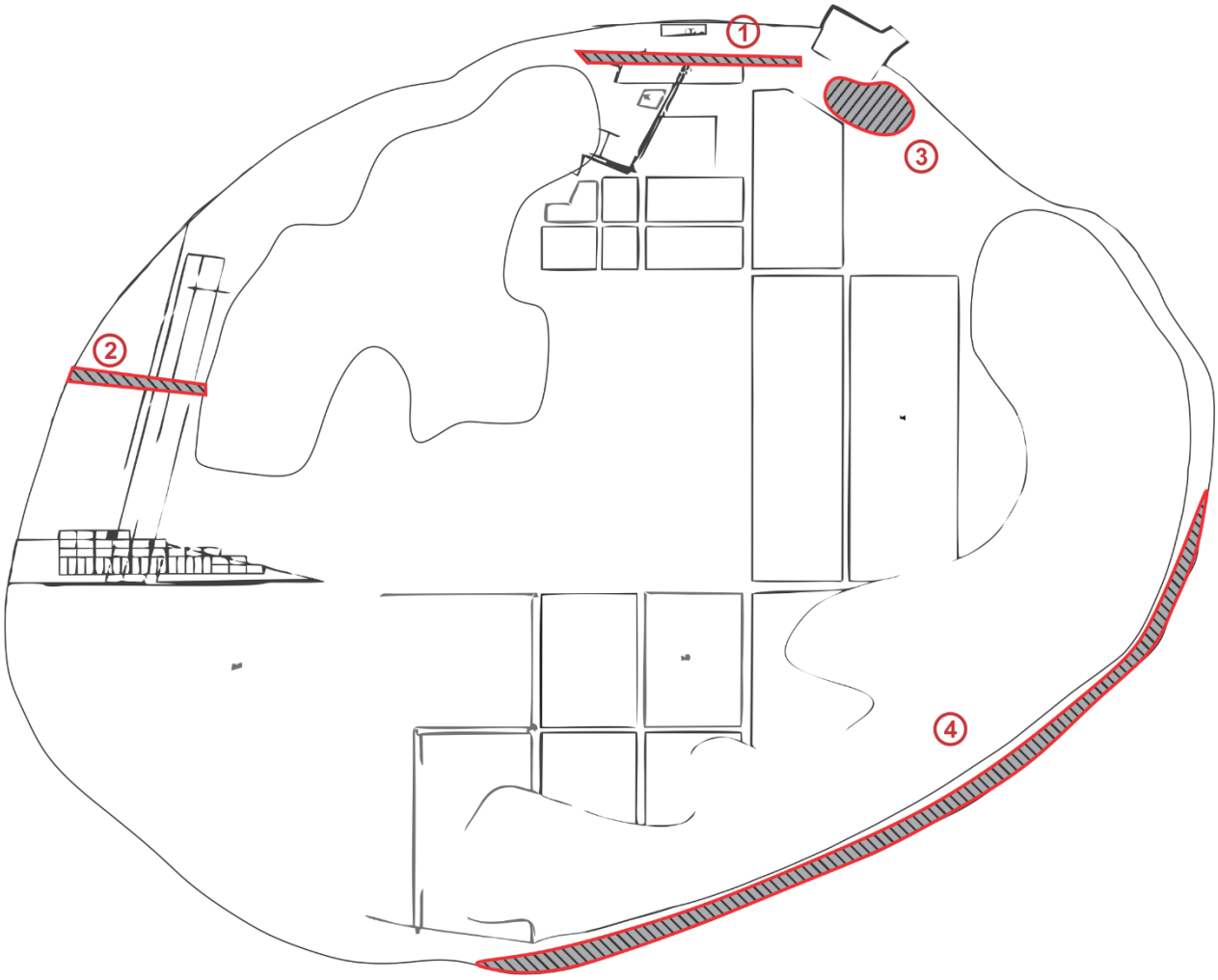

Figure 19. Neykurendhoo, showing the proposed (1) and alternatives (2-4) locations where the dredge material may be used

11 ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

11.1 AIMS AND OBJECTIVES

This section aims to present in detail the management and monitoring measures put in place by the proponent and the contractor in order to manage and monitor the environmental impacts that could arise as a result of the project activities. The main focus area of the monitoring plan would be the marine environment that would directly be affected by the coastal protection and dredging activity. The scope of the plan are as follows:

a) Monitor and manage any major impact on the project environment to avoid any unmanaged and unmitigated impact that may have major impacts on the species and ecosystem
b) Produce a framework for anticipated impacts, including practical and achievable systems for monitoring reporting and implementing corrective measures at all stages of the project
c) Provide information that will help eliminate any major impacts in a timely manner
d) Comparison of data collected against the baseline figures to assess the effectiveness of the implemented mitigation measures
e) Provide evidence of compliance to laws and regulations

The parameters that will be of particular importance include the changes to the marine ecosystems, amount of sedimentation on the reef and the pollution levels in the harbour and surrounding environment.

11.2 ENVIRONMENT MONITORING PLAN

Monitoring activities should begin prior to the commencement of construction phase of the project, and continue into the operational phase. The regular monitoring of water quality and the marine ecosystem should be carried out. The monitoring schedule, indicating the frequency of monitoring each component are provided in Table 17. The proponent is committed to undertake the monitoring programme for a year after project completion. Evidence of proponent's commitment are provided in Annex 4.

11.3 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan, and will cover details of site conditions, operations, and environmental monitoring data. Reporting will be carried out by the environmental consultant assigned by the proponent. A detailed environmental monitoring report will be submitted to EPA to fulfil requirements of EPA as the enforcement authority upon project completion and the completion of the monitoring period.

In addition, regular site monitoring will be carried out by the contractor and site supervisor during construction. Enforcement officers from the MEE will also visit the site for routine inspections.

11.4 PROJECT MONITORING COST

The monitoring should commence prior to the commencement of project activities, and be continued for a year after project completion. In addition, visual inspections of the marine areas around the project location should be carried out. Monitoring costs of approximately USD 7,000 will be incurred for the project, and will be borne by the proponent. Details of project monitoring are provided in Table 17.

Table 17. Monitoring plan showing the aspects, parameters and methods, reporting frequency and estimated costs

Environmental aspect	**Parameters and monitoring methods**	**Monitoring and reporting frequency**	**Cost (USD)**
Water quality	Sediment levels – to be measured in the project location, and based on the wind direction and speed, upwind from the project area. Other water quality parameters such as pH, DO, nitrates, phosphate levels, and total dissolved solids tested using an approved laboratory or reliable equipment, the details of which, should be mentioned in the report.	Daily during construction phase and monthly for a year after project completion. Quarterly reporting Once at project commencement, and quarterly thereafter until a year after project completion. Quarterly reporting	6,000 –including travel costs and testing
Coral reef	Visual inspection of benthic fauna as well as fish abundance in addition to photographic records of impacts.	Once at project commencement and biannually for a year post project completion.	200 per trip – consultant charges. Travel costs are not included here as the surveys can be carried out simultaneously
Aesthetic and cultural values	The pollution levels within the harbour and marine environments monitored by visual inspection	Information to be included in the monitoring report	No additional charges for this component.

12 CONCLUSION AND RECOMMENDATIONS

This EIA has been undertaken to evaluate the proposed project for the protection and maintenance dredging of the Neykurendhoo channel, in terms of assessing the potential impacts from the development based on baseline data obtained during field surveys, exploring the alternatives that would reduce major impacts, and possible mitigation measures to ensure the impacts that do occur are minimised and managed.

The project will result in bringing improvements in the socioeconomic status of the island community, especially with large plans for the island in the pipeline.

This study did not find any evidence of any major negative impacts that were of importance at the regional and/or national level. Although the scope of the project is very small, the nature of the development is expected to have some potential negative impacts, mostly localised to the immediate vicinity of the project location, the magnitude of which, can be minimised through proper management of the critical activities of the project. The following recommendations are proposed to ensure the planned activities are carried out in an environmentally and socially acceptable manner:

a) Given the limited scope of the project, and the relative magnitude of the expected negative impacts as found in this study, the project should be encouraged, with the necessary management measures in place to minimise impacts.
b) Place adequate silt screening at the channel entrance so as to minimise sedimentation
c) Ensure all the mitigation measures suggested in this report are in place and fully implemented.
d) Make waste collection facilities available at the harbour to minimise pollution at the harbour and surrounding areas.
e) Place sign boards at project site to inform the community of the development
f) Sieving out larger pieces of rubble from the dredge material prior to using it for road levelling
g) Removing waste from island when empty barges carrying project waste

The proposed project was found to be an environmentally acceptable one that will result in improvements to the socioeconomic condition of the island community. Further the project is also fully in compliance with the rules and regulations relevant to this project. The effective implementation of the mitigation measures proposed should eliminate any unacceptable adverse effects on the environment. The proponent is committed to complying with the comprehensive monitoring programme to check the effectiveness of the mitigation measures and to take any necessary actions to mitigate any unforeseen negative effects.

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14 APPENDICES

Annex 1: TOR

Annex 2: Dredging Permit

Annex 3: Location Map

Annex 4: Bathymetry

Annex 5: Commitment Letter

Annex 6: Atoll Council Confirmation letter

Annex 7: Curriculum Vitae

ANNEX 1. TERMS OF REFERENCE

EPA/ToR/2015/144

Terms of Reference for Environmental Impact Assessment

The following is the Terms of Reference (ToR) following the scoping meeting held on *4th October 2015* for undertaking the EIA for extension of the harbor entrance channel.

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

1. **Introduction and rationale** –Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Identify the donors and the institutional arrangements relevant to this project. Provide an executive summary of the EIA report highlighting important findings from the EIA study

2. **Study area** – Submit a minimumA3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds).Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites

3. **Scope of work**

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

The main activities of the project are:

- Maintenance dredging;
- Construction of entrance channel with boulder rock;
- Refilling of the access road from the inner land to harbour;
- Measures to protect environmental values during construction and operation phase;
- Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills)

The EIA report should investigate possibilities for alternatives:

- Operation and positioning options;
- Location, routing and design of pipelines;

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

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

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

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

Climate

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

Geology and geomorphology

- Offshore/coastal geology and geomorphology (use maps);
- Bathymetry (bottom morphology) (use maps);
- (Seasonal) patterns of coastal erosion and accretion;
- Shoreline (high tide line, low tide line) and vegetation line

Hydrography/hydrodynamics (use maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Sea water quality measuring these parameters: temperature, pH, salinity, turbidity and Total Suspended Solids (TSS). Sea water quality should be tested from the project location and from at least one control site for monitoring purposes.

Socio-economic environment

- Land use planning, natural resource use and zoning of activities;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);

Task 3. Legislative and regulatory considerations – Identify 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. The report should clearly identify the different articles and clauses that apply to the said project and should state how the project meets these requirements.

Task 4. Potential impacts – 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

- Loss of terrestrial vegetation flora and fauna from land preparation works if any;
- Impacts on marine habitats including damages to coral reefs and sea grass communities, fish stocks, protected areas and protected species;
- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Temporary sediment dispersal in water column (turbidity at the dredging site, reclamation areas and related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

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

Construction related hazards and risks

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

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and professional judgment. Justification must be provided

to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

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

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Mitigation measures to avoid or compensate habitat destruction, e.g. temporal sediment control structures, coastal protection structures to reduce erosion, coral reconstruction and MPA replacement areas. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for coastal modification, beach morphology, sediment movement around the island. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

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

Task 8. Stakeholder consultation – The EIA report shall include documentary evidence that stakeholder consultation was carried out with the immediate beneficiary of the project HDh. Neykurendhoo council and the community. Provide a list of persons consulted, information on how, when and where the consultation were conducted and a summary of the outcome of the consultations including the main concerns identified.

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 for any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2012.

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

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6th October 2015

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ANNEX 2. DREDGING PERMIT

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"Dhivehin" - Always Maldivian, Forever Independent

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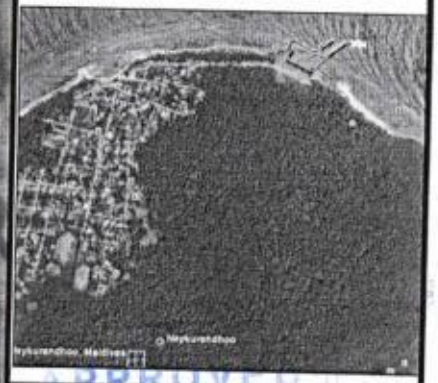
މާލެ، ދިވެހިރާއްޖެ، 20392
ފޯނު:
ފެކްސް:
އީމެއިލް:
ވެބްސައިޓް:

HARBOUR LOCATION:

N



DRAWN BY: HAMRAAU

APPROVED BY: ABDULLA MUTHTHALIB

PROJECT:

EXTENSION OF
H.DH NEYKURENDHOO
BREAKWATER

CONTENTS:

HARBOUR LAYOUT

DATE:

10 MAY 2015

ENGINEERING DIVISION
MINISTRY OF HOUSING AND INFRASTRUCTURE
AMEENEE MAGU MALE' 20392
REPUBLIC OF MALDIVES
TEL: 300 4300, FAX: 300 4301

203 - PROREC / 138 / 2015 / 169

ANNEX 3. LOCATION MAP

HARBOUR LOCATION:

N

DRAWN BY: AMIR

APPROVED BY: ABDULLA MUTHTHALIB

PROJECT:

EXTENSION OF
H.DH NEYKURENDHOO
BREAKWATER

CONTENTS:

HARBOUR LAYOUT

DATE:

10 NOV 2015

ENGINEERING DIVISION
MINISTRY OF HOUSING AND INFRASTRUCTURE
AMEENEE MAGU MALE' 20392
REPUBLIC OF MALDIVES
TEL: 300 4300, FAX: 300 4301

ANNEX 4. BATHYMETRY

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

_UNITS IN METERS

_ELAVATION ARE REFERRED TO MSL

_DREDGE VOLUME
629.3 CU.M

_FILL VOLUME
617.53 CU.M

LEGEND

———	EXSISTING WALL

SCALE :	1:750
SURVEYED BY :	NAME (SURVEYOR)
DATE OF SURVEY :	DATE
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	HASHIKA (SENIOR SURVEYOR / ENGINEER)
DATE OF SUBMIT :	02/12/2015

LOCATION
HDH NEYKURENDHOO
HAA DHAALU ATOLL

PROJECT : H.D.H NEYKURENDHOO CHANNEL PROTECTION & MAINTENANCE DREDGING PROJECT

DRAWING TITLE :

DRAWING No : 2015/019

SHEET No :001

REV	DESCRICTION	BY	DATE

ANNEX 5. COMMITMENT LETTER

Ministry of Housing and Infrastructure
Male', Republic of Maldives.

Date: 14th December 2015

No: 138-PIS2/203/2016/302

Yazeedh Ahmed
Director
Environmental Protection Agency
Ministry of Environment and Energy
Ameenee Magu, Maafannu, Male', 20392
Maldives.

Dear Sir,

Sub: EIA to the Proposed Construction of Channel Protection in HDh.Neykurendhoo:

As the proponent of the project, we confirm our commitment to finance and implement all construction mitigation and the monitoring program as specified in the report.

Thanking you.

Sincerely,

Fathimath Shaana Farooq
Director General

Ameenee Magu, Maafannu, Male', 20392, Republic of Maldives.
+(960) 300 4 300 +(960) 300 4 301
www.housing.gov.mv www.facebook.com/housing.gov.mv

ANNEX 6. ATOLL COUNCIL CONFIRMATION LETTER

haa dhaalu neykurendhoo to "Farah Amjad"

Images are not displayed - Display images below

އީއައިއޭ ރިޕޯޓާމެދު މިއުލާގެ ކޮމެންޓެއް ނެތްކަމުގައި ދަންނަވަމެވެ.
ޝުކުރިއްޔާ!

On Mon, Dec 14, 2015 at 3:17 PM, Farah Amjad <farah.amjad@meeco.com.mv> wrote:

Dear Sir,

Attached herewith please find the final documentation of the EIA for the proposed channel protection project at your island. Please have a look and share your feedback, where and if applicable.

Also, please issue us an official letter from the island council, stating that we, the consultant, has sent the document for your viewing and comments.

We would appreciate you sending the requested letter soon, as we need it for application and processing purposes.

Thank you and regards,

Farah Amjad
Research Assistant

MEECO

Aakakaage, Galolhu, Alikilegefaanu Magu, Male', 20129, Maldives.
Mobile: +(960) 768 8861 | Tel: +(960) 301 0855 | Fax: +(960) 301 0844 | http://www.meeco.com.mv/

http://thinkbeforeprinting.org/struct/signature-1.gif

ANNEX 7. CURRICULUM VITAE

Shafiya Naeem
Neutrino; Sikka Goalhi; Malè 20082; Maldives
Phone: +(960) 771-1586 (M); +(960) 332-2242 (W); Fax: +(960) 332-2509
Email: shafiyanaeem@gmail.com; snaeem@mrc.gov.mv

Education

University of Tasmania, Launceston, Tasmania (2002 – 2005)
Bachelor of Aquaculture with upper second class Honours

Science Education Centre, Malè, Maldives. (1998 – 2000)
London GCE A Level Examinations

Aminiya School, Malè, Maldives (1993 – 1997)
London GCE O Level Examinations

Employment

Marine Research Centre; Ministry of Fisheries, Agriculture and Marine Resources
H. White Waves, Malè, Maldives
Senior Research Officer (February 2008 –)
Aquaculture Research Officer (February 2006 – February 2008)

- OIE focal point for aquatic animal health monitoring
- Management of mariculture research projects undertaken by Marine Research Centre
- Community mobilisation and sensitisation activities to promote commercial aquaculture in the country
- Administration of the Pearl Culture Project undertaken by the Marine Research Centre in collaboration with the United Nations Development Programme
- Provide technical advice on aquaculture and on the import of aquatic animals into the country to policy makers in order to facilitate the development/refinement of guidelines

Project Officer Trainee (September 2001 – February 2002)

- Assisted in the Pearl Culture Project undertaken by the Marine Research Centre in collaboration with the United Nations Development Programme
- Participated in all other mariculture activities undertaken by the Research Centre
- Organised workshops on the use of pearl oysters, and the importance of mariculture of pearl oysters in the Maldives
- Participated in the annual fishermen's day celebrations as a member of the Fishermen's day Advanced Team.

Ministry of Fisheries, Agriculture and Marine Resources; Ghazee Building, Ameer Ahmed Magu, Malè, Maldives
Fisheries Extension Officer Trainee (August 2000 – September 2001)

- Assisted in surveys, studies and research undertaken by the Fisheries Development and Extension Section of the Ministry of Fisheries, Agriculture and Marine Resources
- Developed training materials, manuals and modules for fisher folk, on fish processing and Seafood Technology, as well as Fisheries Economics and Financial Management
- Conducted quality control checks on yellow fin tuna fishing vessels to ensure quality export products
- Coordinated training/extension courses on Fisheries Economics and Financial Management of Small Fishing businesses as well as on fish product quality management in fishing communities
- Worked with the Fishermen's day Advanced team in organising the hosting of the annual Fishermen's day events

Conferences, Training Programmes and Seminars Attended

Regional consultative workshop on "Best practices to supporting and improving livelihoods of small-scale fisheries and aquaculture households"
Asia Pacific Fisheries Commission, Manila, Philippines (October 2009)

Training course on fish disease diagnostics
UNESCO-MIRCEN for Marine Biotechnology, Karnataka Veterinary, Animal and Fisheries Sciences University, College of Fisheries, Mangalore, India (July-August 2009)

The 10th International symposium on Genetics in Aquaculture "Roles of Aquaculture Genetics in Addressing Global Food Crisis"
Faculty of Fisheries, Kasetsart University; Bangkok, Thailand (June 2009)

Second Regional Workshop on Lessons Learned in Post-tsunami Sustainable Livelihoods and Coastal Ecosystem Management
Asian Institute of Technology; Bangkok, Thailand (February 2008)

Regional Study Tour Exchange Programme on Grouper and Seaweed Farming Techniques as Post-Tsunami Relief and Reconstruction for Sustainable Coastal Development
USAID; Bali, Indonesia (June 2007)

UNEP Environmental Impact Assessment Training
United Nations Environment Programme in collaboration with Ministry of Environment, Energy and Water; Male', Maldives (September 2006)

Aquafin CRC Conference
Cooperate Research Centre; Tasmania, Australia (July 2005)

Bioinformatics Course
The Australian National Genomic Information Service; University of Tasmania, Australia (June 2005)

International Training Course for Fisheries Extension Officers in Extension Methodology and Coastal Fisheries Management
Training Department, SEAFDEC; Bangkok, Thailand (June – July 2001)

Socioeconomic Coral Reef Monitoring Training Programme
Global Coral Reef Monitoring Network in Collaboration with IOC-UNESCO/UNEP/IUCN; Vaavu Atoll, Maldives (January 2001)

Experience

- Conducted interviews with victims of 2004 tsunami in the Maldives, in association with the Pacific Tsunami Museum and the University of New South Wales (April 2009)
- PADI Open Water Divers (November 2008)
- Led the investigation team during the mass fish mortality to determine the cause of the mass fish kill that occurred in the Maldives (September 2007 – January 2008)
- Practical experience in the aquaculture of groupers, pearl oysters and anemone fish, seahorses, live feeds for aquaculture, etc (2003 – current)
- Molecular identification of some groups of bacteria colonising the southern bluefin tuna (2005)
- Biochemical identification of bacterial flora of southern bluefin tuna (2005)
- Practical demonstrator for third year Aquatic Animal Health, and Physiology of Aquatic Organisms practical courses at the University of Tasmania (2005)
- Casual employment at the University of Tasmania as a research assistant working on amoeba, a parasite causing losses in salmon aquaculture in Tasmania (January – March 2005)
- Volunteered in research on the aquaculture of seahorses and salmonids, including general husbandry and maintenance of the fish stock as well as immunology of salmonids. (2003 – 2005).
- Volunteered in the TasSTAR peer-tutoring programme organised by the University of Tasmania at the Newstead College (March – November 2004).

Referees

PROFESSIONAL

Mohamed Shiham Adam, PhD

Executive Director,
Marine Research Centre
H. White Waves
Male', Republic of Maldives
Phone: + (960) 332-2242
Fax: + (960) 332-2509
Email: msadam@mrc.gov.mv

Hassan Shakeel, MSc

Senior Biologist,
Marine Research Centre
H. White Waves
Male', Republic of Maldives
Phone: + (960) 332-2242
Fax: + (960) 332-2509
Email: hshakeel@mrc.gov.mv

ACADEMIC

Assoc. Prof. John Purser

Head of Department of Seafood Quality and Safety,
National Centre for Marine Conservation and Resource Sustainability
AMC, University of Tasmania
Launceston, Tasmania, Australia 7250
Phone: + (61) 3-6324-3820
Email: John.Purser@utas.edu.au

Dr. Chris Burke

Degree Coordinator,

National Centre for Marine Conservation and Resource Sustainability
AMC, University of Tasmania
Launceston, Tasmania, Australia 7250
Phone: + (61) 3-6324-3804
Email: C.Burke@utas.edu.au

MP DinalShalika priyaruwan,
Parana Alupothagama,
Badalkumbura,
Monaragala,
Srilanka.
dinalshalika@gmail.com
+94773764203 /
+94555682479/+967685313

PERSONAL INFORMATIONS

- **Full Name :** ManamendraPatambandige DinalShalika Priyaruwan.
- **Birthday :** 11th June 1987
- **Gender :** Male
- **Current Position :** Surveyor.
- **Nationality:** Sinhalese
- **Country:** Sri Lanka
- **National Identity Card No.:** 871633592V
- **Passport No.**: N 5548430
- **Marital Status:** Married

Objective:

To provide the best to the employer from my abilities, while updating the knowledge and the quality of the carrier within the profession.

ACADEMIC QUALIFICATIONS

*Now following Civil HND.

***NCT Civil at technical college, Bandarawela**
(2008-2011)

- *Which included following theory subjects:*

*Land surveying.
*Construction surveying.
*Mathematics.
*Drawing.
*Geology.
*Building servicers.
*Construction Management.
*Irrigation Construction.
*Highway Construction.
*Structure.
*Quantity surveying.

Nishshanka Central College.Badalkumbura.
(1993 – 2007)

*General certificate of education Advanced Level – 2007
Biology – S Physics – S Chemistry – S

*General certificate of education Ordinary Level – 2003
A - 2 (Including Science) B -2 C – 6

TECHNICAL SKILLS

*Platform : Drawing
*Subjects : 3d max(max 6,max 7,max 9)\Maya/Auto Cad,civil 3d/Computer -hardware/Ulead studio.

WORKING EXPERIENC E

1). OCT 2015-UP to now :Working as a Land surveyor at MEECO.

***** Preliminary hydrographic survey for EIA study of **Th-Guraidhoo**

***** Tree & TOPO graphical survey for a construction requirement of **Hibalhidhoo** island.

2).May 2015- Up to now :Worked As a Land Surveyor At SAMMANEE ASSOCIATE.
& March 2014 –2015 Sep :As a Land Surveyor. Worked At SGCC (Southern Group Civil Construction) pvt ltd.

3). April 2012 – February 2014: As a Technical Surveyor. Worked in CML-MTD

*Thoppuwa-Dankotuwa- Naththandiya-Madampe.

5). JAN 2011 – April 2012 : As a Technical officer. Worked in CML-MTD Construction Ltd**.**

(Widening, Improving and Asphalt Overlaying)

*Dayatakirula Project(Helagama to Okkampitiya).

* Galle fort access Road (Southern expressway).

* RDA Project (Urapola – Wathuragama and Yakkala – Radawana Road).

* A-32 Road Project,(Mannar)

* Uva 5 Project Badulla.

PERSONAL REFEREES

G.T.J Pathirana,
Passara Road,
Uva pelwatta.
(Syrveyor CML-MTD).
+94773381046

H.H.H. Gunarathna,
19/21 5th lane Ambagaha
landa watta, Gampaha
Road, Yakkala.
+94773762925
+94332237108
+9607949301.
Surveyor MEECO
(Surveyor & propertied SAMMANEE ASSOCIATE)

I declare that the information furnished here are true and correct to the best of my knowledge.

Shalika M.P.D. 18/11/2015

FATHIMATH FARAH AMJAD

G.Male' Hiya 2 (11-04) | Male', Rep. of Maldives | (960)7688861 | fara.a@outlook.com

PERSONAL DATA

Date of Birth:	April 30th, 1990
Nationality:	Maldivian
Marital Status:	Single

OBJECTIVES

To gain knowledge in the fields of environmental conservation and research, marine sciences and oceanography which will help me actively contribute to improving the livelihoods of marine ecosystems and the natural environment.

To take part in a professional team, get hands on experience in the field and understand the practical methods and approaches.

EDUCATIONAL BACKGROUND

2015 - Present — **Bachelor of Environmental Management**
Maldives National University, Male'

2013 — **ABE Diploma in Marketing Management - Level 4**
Maps College, Male'

2010 - 2011 — **Foundation in Built Environment**
UCSI University, Kuala Lumpur, Malaysia

2007 — **Advanced Certificate in Residential Drafting**
Male' Centre of Technology, Male'

2007 — **Certificate in AutoCad 3D**
Male' Centre of Technology, Male'

2003-2005 — **Cambridge O' Levels**
Aminiya School, Male'

TRAININGS AND SKILLS

- Year 2014 – PADI Open Water Diver Certification
- Year 2014 – PADI Advanced Open Water Diver Certification
- Year 2015 – Reefcheck.org Eco-Diver Certification
- Year 2015 – Certified Assessor at Greenfins.org
- Year 2015 – PADI emergency first response Certification (Pending)

FATHIMATH FARAH AMJAD

G.Male' Hiya 2 (11-04) | Male', Rep. of Maldives | (960)7688861 | fara.a@outlook.com

EMPLOYMENT RECORD

2015 October - Present

Research Assistant
Maldives Energy and Environmental Company (MEECO)

- *Data collection and analysis: Coral reef transects, fish census, description of existing environments, etc.*
- *Assist in drafting Environmental Assessment Reports.*
- *Organize and coordinate site visits.*
- *Communicate with government authorities, island councils and other parties regarding ongoing work at the company.*

2014 March – 2015 September

Project Assistant/ Draftsperson
Renewable Energy Maldives Pvt Ltd, Male'

- *Data management and monitoring of the installed PV solar systems at sites in Male' and several islands.*
- *Designing and drafting technical and electrical layouts. I.e. Roof layouts, Waste to energy Incinerator design, etc.*
- *Regular communication with suppliers about equipment for PV installations and a variety of other DC products.*
- *Communication with customers, government authorities and other parties regarding various matters for PV systems, equipment clearance and site installations.*
- *Drafting proposals and bid documentations.*
- *Assisting the engineer in the preparation of energy audit reports, data collection and site surveying.*

2012

Freelancer designing and drafting work (Refer to Referee Ahmed Ashfam)

2009 January- 2009 April

Draftsperson
Arcade Pvt Ltd, Male'

- *Designing exterior and interior layouts of buildings.*
- *Drafting all finalized architectural, structural, plumbing and electrical drawings sets for various residential and commercial buildings with the assistance of the civil engineer.*

2008 August - 2008 November

Customer Services and Data collection Officer (3 month contract)
Estate Department, Hulhumale' Development Co-operation, Male'

- *Collecting and processing data, communicating with customers.*

FATHIMATH FARAH AMJAD

G.Male' Hiya 2 (11-04) | Male', Rep. of Maldives | (960)7688861 | fara.a@outlook.com

2008 Jan-July **Draftsperson**

Gedor Consultancy Pvt Ltd, Male'

- *Drafting architectural and structural drawings with the guidance of the head architect and engineer.*
- *Worked in the designing and drafting phase of a number of resort projects, residential, commercial and government buildings.*

2007 Jun- Sep **Draftsperson Trainee**

Design House Pvt Ltd, Male'

- *Draftsman Trainee during residential drafting course at Male' Centre of Technology.*

COMPUTER SKILLS

- Extensive knowledge in use of Autocad 2D.
- Proficient in use of Microsoft Office, Autocad 3D, Adobe, Coraldraw.

COMMUNICATIONAL SKILLS

- English.
- Dhivehi (Mother tongue).

AFFILIATIONS

- Assessor at **Greenfins**, a non-profit initiative by Reef World Foundation and UNEP aimed to protect and conserve coral reefs by establishing and implementing environmentally friendly guidelines to promote a sustainable diving and snorkeling tourism industry.

- Certified surveyor of **Reefcheck.org**, an international non-governmental organization dedicated to the conservation reefs by collecting data from volunteer scuba diver teams in over 80 countries. This is the United Nations' official coral reef monitoring program.

- Volunteer at NGO **Save the Beach**, working at clean up events at Villimale' beach and in Villimale' house reef, awareness programs and reef monitoring programs.

- Volunteer at **'Project Damage Control'**, a collective like-minded group of volunteers, working at cleanups in the greater Male' area.

- Researcher/Writer at '**Backpack in Maldives'** blog.

FATHIMATH FARAH AMJAD

G.Male' Hiya 2 (11-04) | Male', Rep. of Maldives | (960)7688861 | fara.a@outlook.com

PROFESSIONAL REFEREES:

- Aishath Hudha Ahmed
  Director
  Renewable Energy Maldives Pvt Ltd
  Contact No: (960) 7788010, (960) 3337734

- Ismail Rasheed (Bobby)
  Managing Director
  Arcade Pvt Ltd.
  Contact No: (960) 7773283

- Ahmed Ashfam
  Human Resources Manager
  ADK.Akarsu Developments Pvt. Ltd.
  Contact No: (960) 7661988