ENVIRONMENT IMPACT ASSESSMENT

FOR THE PROPOSED

DESIGN AND BUILD BASIS FOR WATER SUPPLY NETWORK GROUND STORAGE TANKS AND REVERSE OSMOSIS PLANT, ALLIED WORKS BASED ON INTEGRATED WATER RESOURCE APPROACH IN R.MEEDHOO, MALDIVES

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Ministry of Environment and Energy

Consultant

CDE Consulting, Maldives

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List of Abbreviations

COADS	Comprehensive Ocean-Atmosphere Data Set
DO	Dissolved Oxygen
EIA	Envrionmental Impact Assessment
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
MEE	Ministry of Environment and Energy
MHI	Ministry of Housing and Infrastructure
MoTAC	Ministry of Tourism, Arts and Culture
MoTCA	Ministry of Tourism and Civil Aviation
MSL	Mean Sea Level
MWSC	Maldives Water and Sewerage Company
NAPA	National Adaptation Programme of Action
NE	North East
NEAP II	National Environmental Action Plan II
NW	North West
SAP	Strategic Action Plan
SE	South East
SW	South West
TDS	Total Suspended Solids
ToR	Term of Reference
UNFCCC	United Nations Framework Convention on Climate Change and the Kyoto Protocol

Acknowledgements

The lead author of this report is Dr. Ahmed Shaig.

Additional assessments were undertaken by the following team members.

Mr. Ahmed Faizan (Marine Environment Specialist)

Ms. Shahdha (Socioeconomic impact assessment)

Ms. Hana Saeed (Stakeholder consultations)

Mr. Ali Nishaman Nizar (Terrestrial Environment)

Field assistance was provided by the following members

Mr. Ali Moosa Didi (Marine Assessments and Social Assessments)

Mr. Mohamed Ali (Marine surveying Social Assessments)

Mr. Ahmed Haiman Rasheed (Field Assistance)

The curriculum vitae's of the EIA consultants are attached in Appendix H of this report.

Lead Consultant's Declaration

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

Dr Ahmed Shaig

Proponent's Declaration

As the proponent of the proposed project, I guarantee that I have read the report thoroughly and that to the best of my knowledge all information provided here is accurate and complete.

Please refer to Appendix H

Executive Summary

The purpose of this document is to fulfil the requirements to get necessary environmental clearance from the Environmental Protection Agency to install the proposed Water Production Supply System at Meedhoo, Raa Atoll. The proponent of this project is Ministry of Environment and Energy.

The main rationale for the project is to improve the health condition and quality of life of residents of Meedhoo Island by establishing a proper potable water supply system that will provide clean and safe water for the residents of Meedhoo. The project is intended at providing an integrated water supply system covering rainwater and desalinated water production and supply.

The proposed project involves installation and establishment of two 40 m^3 reverse osmosis plant systems that consists construction of a borehole to supply raw water for the RO plants, construction of elevated water storage tanks, construction of brine discharge outfall and house connections. An area of 9,557 sq ft has been approved and given to the proponent for this project. The project will also install the required water storage tanks including 500 m^3 storage tank for desalinated water and 1,000 m^3 storage tank for rainwater. The project aims at laying of separate pipe networks for water distribution, rainwater collection and rainwater treatment system. Duration of the project is approximately 11 months.

Currently the island population sources water from shallow wells constructed at individual households or in public areas. This is supplemented by collection of rainwater. These methods provide inadequate quantity and unacceptable quality due to the over abstraction and the unreliability of rainwater harvesting.

All project activities will be in conformance to the laws and regulations of the Maldives, and relevant international conventions that Maldives is party to. The key laws and regulations applicable to this project are: Environmental Protection and Preservation Act, Environmental Impact Assessment Regulation 2012, Desalination Systems Regulations, and Waste Management Regulation 2013.

The existing condition of the island and the proposed RO plant site was assessed for this report. Assessments conducted include marine assessments at the proposed brine outfall and alternative outfall locations. Groundwater quality and baseline noise level measurements were also taken. The assessments showed that there is a marine protected area within 11 km from the island. Marine assessments indicated that the proposed outfall location is mainly composed of dead coral.

The assessment shows that the RO systems can be developed on the island with limited implications on the environment. The assessment shows that the proposed developments involve significant impacts on the marine environment due to brine outfall construction, brine discharge, ground excavation and operation of vehicles and machinery. The project also involves moderately significant health and safety risks due to equipment handling and pollution. However, the predicted impacts can be minimized considerably with the proposed mitigation measures. Significant impacts of operation stage include marine degradation due to brine discharge, increased GHG emissions due to RO plant and operation of pumps stations, and increased cost of living due to additional cost in purchasing water. The assessment shows that the proposed project has many positive impacts including improved quality and accessibility to potable water, protection of groundwater aquifer, reduction of water related disaster risk, and increased employment and business opportunities

The alternatives evaluated for the project is the alternative brine outfall location. The "No Project" option has also been explored and this option is not deemed preferable, given the current condition of portable water. An alternative site for brine outfall was also explored, but given the advantages associated with the proposed outfall, it is the preferred option.

Monitoring plan is designed to assess any changes to the coral reef environment of the island, ground and marine water quality as these are the key areas that will be impacted from this project. Monitoring costs is estimated at Rf 75,000 per annum.

The management plan for this project is designed to produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions. In addition provide evidence of compliance to legislation, policies, guidelines and requirements of relevant authorities.

Stakeholder consultations were held with Meedhoo Island council, FENAKA, Meedhoo public, Health Protection Agency and Environmental Protection Agency. A willingness-to-pay survey was also conducted during field assessments. Both Meedhoo Island Council and public highlighted the need for a potable water supply system on the island and are in favour for the project. Majority of the people consulted wish to pay as per usage. HPA, currently does not have any regulations for quality of potable water, however they stressed the importance of disinfecting and treating water prior to releasing to the supply network. EPA advised on ways to implement the project and its components.

In conclusion, this project has been designed in conformance to the relevant laws and regulations of Maldives but requires final approval from EPA for the detailed drawings. The most significant impacts are expected to be short-term impacts for the construction phase. However,

mitigation measures have been proposed to adequately minimise these significant impacts. Overall, the project will have positive impacts to the island community of Meedhoo

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މި ދިރާސާ ރިޕޯޓަކީ ރ.މީދޫގައި ލޮނުފެން މިރުފެނަށް ބަދަލު ކުރާ ރިވާސްއޮސްމޯސިސް ޑީސެލިނޭޝަން ޕްލާންޓެއް ގާއިމް ކުރުމާއި ގޭގެއަށް ފެންފޯރު ކޮށްދިނުމަށް ފެންހޭލި އެޅުމުގެ މަޝްރޫއުއާއި ގުޅިގެން ތިމާވެށްޓަށް ކޮށްފާނެ އަސަރު ވަޒަންކުރުމުގެ ގޮތުން ކުރެވިފައިވާ ދިރާސާއެކެވެ. މި މަޝްރޫއުގެ އެދިވަރިޔާ މިނިސްޓްރީ އޮފް އެންވަޔަރަމަންޓް އެންޑް އެނަރޖީއެވެ. މި ރިޕޯޓުގެ މައިގަނޑު ބޭނުމަކީ މަޝްރޫއު ހިންގުމުގެ ތިމާވެށީގެ ހުއްދަ ހޯދުމަށް ބޭނުންވާ މައުލޫމާތުތަކާއި އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީއަށް ހުށަހެޅުމެވެ.

މި މަޝްރޫއުގެ ދަށުން ރ.މީދޫގައި 40 ކިއުބިކް މީޓަރުގެ ފެންއުފައްދާ ދެ ރިވާސްއޮސްމޯސިސް ޑީސެލިނޭޝަން ޕްލާންޓްބަހައްޓާނެއެވެ. އަދި މިޕްލާންޓްތަކުގައި މިރުފެން ބަދަލު ކުރުވާނީ ބިމުގެ 30 މީޓަރު އަޑީއަށް ބޯރުކޮށްގެން ނަގާ ފެނެވެ. މިޕްރޮޖެކްޓްގެ ދަށުން ޕްލާންޓްގައި ބަހައްޓާ ކަރަންޓް ބޭނުންކުރާ މިކްޑިޝަން ސިސްޓަމް ދަށުން ރައްޔިތުން، ގޭގެއަށް ފެން ފޯރުކޮށްދިނުމަށް ހޭލި ވެލްވުގައި، އަދި ވަލްވް ބޮކްސް ފުރުދު ބަޔަކުގެ ކޮށް ބޭއްވުމާއި ޕްލާންޓްގައި ކަރާ ވާނާއެވެ، ޕްލާންޓްގައި ހިސާބުކުރާ މީޓަރަކާއި ކަރަންޓް ބޭނުންކުރާ ސިސްޓަމް ވެސް އެޅުމުގެ ގޮތުގައި ހަމަޖެހިފައިވެއެވެ. އަދި ފެންއުފައްދާ ޕްލާންޓަށް ބަރަސްތު ކުރުމަށް މިޕްރޮޖެކްޓްގެ ދަށުން 500 ކިއުބިކް މީޓަރުގެ ފެން ރައްކާކުރާ ޓޭންކެއް އަދި 1،000 ކިއުބިކް މީޓަރުގެ ފެން ރައްކާކުރާ ޓޭންކެއް ގާއިމުކުރެވޭނެއެވެ. މި މަޝްރޫއުން 9،557 އާބާދީގެ ބޭފުޅުން ހިމެނޭ މީދޫ ރަށް ސަރަހައްދު ފުރިހަމަ ކޮށްދޭނެއެވެ.

މަޝްރޫއު ކުރުމުގެ ކުރިން ފިޔަވަޅު ކުރާ ދިރާސާ ހިނގާ ގޮތުގެ ތަފްސީލު. ވަގުތީ ގޮތެއް މިއުސިމުގެ ތަފާސްހިސާބު ގެނެސްދެވިފައިވެއެވެ. މަޝްރޫއުގެ ތަފުސީލުގައި ބޭނުންކުރާ ތަކެތި ހިމެނޭ ތަފާސްހިސާބެއް ތަކެތި ގެނައުމާއި، ބޭނުން ކުރާ ތަކެތީގެ ތަފުސީލު ކުރުމަށް ބޭނުންކުރެވޭ ތަފާސްހިސާބު ސާފުކުރެވިފައިވެއެވެ. ޝަރުތު އެނގޭ ދެކެވުނު މިނިސްޓްރީގެ ރިވާސްއޮސްމޯސިސް ޑީސެލިނޭޝަން ޕްލާންޓް ސިސްޓަމްގެ މައިގަނޑު ހިޔާލުތަކާއި ބަލާ ފާހަގަކުރެވިފައިވެއެވެ.

ތިމާވެށްޓަށް ކުރާ އަސަރު ދެނެގަތުމަށް ފަސްޓް ގްރޭޑް ސޯސްތަކުން ހޯދާފައިވާ މައުލޫމާތުތަކުގެ އިތުރުން ހަރުދަނާ ގޮތުން ކުރެވެ ޝަރުތު ކުރާ ދިރާސާތަކުން ފެނިފައިވާ ސާފު ފެނުގެ ކުރިއަރާ ގޮތުގެ ހިނގާން އޮތްކަމެވެ. މި މަޝްރޫއުގެ ހިސާބުން ދިމާވާ ތިމާވެށީގެ އަސަރު ހުރީ 11 ގަސްތަކަށެވެ.

މިދިރާސާގައި މިސަރަހައްދުގެ މިހާރުގެ ހާލަތު ބަލާފައިވާ މަޢުލޫމާތު އެއްކުރެވިފައިވެއެވެ. މިގޮތުން ރިވާސްއޮސްމޯސިސް ޕްލާންޓް ސިސްޓަމްގެ ބޭނުންކުރާ ތަކެތީގެ ފަރާތް ސަރަހައްދުގައި ސަރަހައްދު ހޯދާފައި ޕްލާންޓް ބަލާ ދިރާސާ ކުރެވިފައިވެއެވެ. މިގޮތުގެ މަތިން

ބޮޑުބުރުގައި ބަރުގެ ފެން ތަޣައްޔަރުވެފައިވާކަން ފާހަގަ ކުރެވުނެވެ. އަދި ދިރާސާކުރެވުނު ސަރަހައްދުގައިވާ މުރަކަތަކުގެ ބޮޑު ބައަކަށް ގެއްލުން ލިބި ބައެއް މަރުވެފައިވާކަން ފާހަގަކުރެވެއެވެ.

މިދިރާސާއިން ފާހަގަކުރެވުނުގޮތުގައި މިމަޝްރޫޢުގެ ސަރަހައްދު އަމަލީ މަސައްކަތްތަކުގެ ތެރެއިން ދުވަހާ އެއްގަމުގެ މާހައުލަށް އެންމެ ބޮޑު އަސަރުކޮށްފާނެ ކަމަށް ފާހަގަކުރެވުނީ ޕްރޮޖެކްޓް ބޯކޮށް ނަގާ އެއްގަމުގެ މަސައްކަތްތައް، މަގުކޮންމާއި، މަސައްކަތްކުރާ ބިންބިމާއި ވެޖިޓޭޝަނާއި އިކޮސިސްޓަމް ވެޖިޓޭޝަން ފާޅު ބިނާއެއް ބިމަށް މިދިން ތަކަށް ސާބިތު ބިރުވާނަމެ ސަރަހައްދު މަސައްކަތްތަކާ ވަޓަރޓޭބަލްގެ ހުރިހާ ގޮތްތަކަކީ ބޭނުމަކަށް ނޭރޭ ސްކޮޕެއް ޖެހިފައިވާ އެކަށީގެންވާގޮތަކެވެ. މަޝްރޫޢުގެ ހިސާބުން ޖެހުނުގޮތުން ކުރިން އެންމެ ބޮޑު އަސަރުކުރާކަމަށް ފާހަގަކުރެވުނީ ފެނާއި ބިމަށް ވެސް ކޮށްފާނެ ކަރުދާސްތަކުގެ ސަރަހައްދުން ދުރު ފެންގެ ކާލަޑްރަސްކުރުމާއި، ޕޮލިއުޝަން ޕްރޮޖެކްޓްގެ ޓްރާންސްޕޯޓް ހިންގުމުގެ ސަރަހައްދު ޒަމާނުގެ ދާއިރާ ތިލަކުރެވޭ ވަގުތުގެ އަސަރުތައް އިތުރުވުން، އަދި ފެނުގެ ނިޒާމަށް ފެނަށް ފެނުން ބަރުގެ އާންމު ދިރިއުޅުމުގެ އަޑުގަދަވުން ހިފެހެއްޓެވެ. ފާހަގަކުރެވިފައިވާ ނުލާފާ އަސަރުތަކަކީ މިފަދަ އަސަރުތައް ކުރިއަށް ކޮށްފާނެ ދެމެހެއްޓުމުގައި ހަމަޖެހިފައިވާ ކަންކަމެކަށް ކުޅިވަރުތަކުގެ ކަންކަން ކުރުމެވެ. މިދިރާސާއިން ފާހަގަ ކުރަނީ މަޝްރޫޢުގެ ސަރަހައްދުގައި ފަޅުގެ ކުޅިއެއް ބަރުގެ އާބާދީއާ ޖޯޑަރު ވެރިވިއިން ކުރާއަސަރު ކުރިއެރުމަށެވެ. އަސަރުން ބެލެނިވެރިން ޑިސްޕޯސަލް ބެލެނީ ކުރިއަށް ރަނގަޅުކުރުމުން، ބަރުގެ ފެންފަރާތް ހިމާޔަތްކުރުން، ބެލުން ނުލިބެންހުރި ކުރިޔާކަށް ކުރެކުރުން އަދި ވަޒީފާއާ ވިޔަފާރިގެ ފުރުސަތު ތަރައްގީވުން ހިމެނެއެވެ.

މި ދިރާސާގައި މަޝްރޫއަށް ގެނެވިދާނެ ބަދަލުތަކަށް ބަލާފައިވާނެއެވެ. މިގޮތުން މަޝްރޫޢު ނުހިންގުމާއި، ޕްލޭންޓެއް ޖާގަތްބެހުން ބަދަލުކުރުމާ ބަލައިގެން އެހެން ތަފާސްހިސާބު ގެއްލުމާ ބޭނުންކުރެވިދާނެ ގޮތްތައް ފާހަގަކުރެވިފައިވާނެއެވެ.

މިރިޕޯޓުގައި ބަޔާންކޮށްފައިވާ ތިމާވެއްޓަށް ކުރާނެ ނަތީޖާ އެސަސްމަންޓްގެ ބޭނުމަށް ކުރަނީ ހަމަ ދިރިއުޅުމާއި ފަރުދުން ޝާއިޢުކުރެވޭ ބަޔާން ގުޅިފައިވާ އެފެދަ ފަރާތްތަކުންނެވެ. އަދި މި ރިޕޯޓުގައި ބައްސަވިފައިވާ ފަރުދުންގެ ކުރިއެރުމަށް ބަލާ ކުރިކުރެވުނު ފައިދާއެއް އެކަންކަމުގެ ގުޅުންހުރި ވާހަކަ ދެއްކުމުގެ މަޝްރޫއާއި މަސައްކަތްތަކުގައި މިފަދަ ކަންކަމަށް ސަމާލުކަމެއް ރާއްޖޭގެ ހިދުމަތުގެ ބޭސިއްޔަތުގައި. މިގޮތުން ބެލުމަށް ރާއްޖޭގެ ހިދުމަތް މައިގަނޑު ކުއްލިއަމަލުތަކުގެ ވާރޭގައި މިކަމަށް ބާރުތަކުން ބަހަރު އަތޮޅު އަތިރިމަތި ބަހަރުވެރިން ފެށިގެން، ބަރުގެ ވަނަވަރު ބެލުމާއި، ދާދި ފަހުން ފެނުގެ 75000 ލީޓަރު ހަރުދަނާކުރަން އަރަރަށް ފެންވަރު ޓަންކީތަކުން ދިރާސާކުރަން ހަމަޖެހިފައިވާ ކަމަށް ފާހަގަކުރެއެވެ.

މިމަޝްރޫޢު ބޭރުގައި އަދި މަޝްރޫޢުގެ މައުލޫމާތު ފޯރުކޮށްދިނުމަށް، މީޓު ރަށު ކައުންސިލް، ފެނަކަ، މީޓު ރަށުއިދާރާ ހިމެނޭ ގޮތަށް ބަޔާން ކުރެވިފައި ހުރި އެއްބަސްވުމުގެ ބަޔާނެއް ބަލައިގަނެވިފައިވާނެއެވެ. ރަށު ކައުންސިލް އަދި މީޓު ރަށުވެރިން ހާމަކުރި ޚިޔާލުތަކަށް ބަލާފައި ފެނުގެ ޕްރޮޖެކްޓް ނިންމާލަން ވަރަށް މުހިއްމެވެ. އަދި އެއިން ބޭނުންތެރި ބޮޑު އަސަރުތަކެއް ކުރާކަމަށް ވަނީ ފާހަގަކުރެވިފައެވެ. މި ރަށަށް އިރުޝާދީ އެންޓިބެކްޓީރިއާ އެހެނިހެން ގެއްލުމެއް ނުވާކަމަށް ޕްރޮޖެކްޓަށް ފާހަގަ

އެޖެންސީއިން ހާމަކުރިގޮތުގައި ރަށްވެހިންނަށް ފެންފޯރުކޮށްދިނުމުގެ ނިޒާމު ރަނގަޅަށް ބޭނުންކުރުމަށްޓަކައި. އަދި އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީއިން މިމަޝްރޫއުގެ ހަރަކާތްތައް ހިންގަންވީ އުސޫލު އެކަށީގެންވާ ގޮތުގައި އަދިއަޅުވާލިއެވެ.

މި މަޝްރޫޢުގެ ސަބަބުން ރަށުގެ ވެއްޓަށްކޮށްދެވޭ ބަދަލުތަކެއް އައުން އެކަށީގެންވެއެވެ. އެހެންނަމަވެސް މިދެންނެވި އަސަރުތަކަށް ކުޑަކުރުމުގެ ގޮތުން ފާހަގަކުރެވިފައިވާ ކަންކަމަށް ސަމާލުވެ މަޝްރޫޢު ކުރިއަށް ގެންދެވޭނަމަ ދެންނެވުނުފަދަ ބަދަލުތަކުގެ ސަބަބުން ކުރާ ނުރައްކާ އަސަރުތަކަށް ވަރަށް މަދު ދަރަޖައަކަށް ކުޑަކުރެވިދާނެއެވެ. އެހެންކަމުން މަތީގައި ބަޔާންކުރިފަދަ ކަންކަމަށް ރިޢާޔަތްކޮށް ބަލާއިރު ޖުމުލަގޮތެއްގައި މިމަޝްރޫޢަކީ މީދޫ ރަށްވެހިންނަށް ނުހަނު ފައިދާ ހުރި މަޝްރޫޢެކެވެ.

1 INTRODUCTION

1.1 Purpose of the EIA

This Environment Impact Assessment (EIA) report is an evaluation of the potential environmental, socio-economic and natural impacts of the proposed EIA for the proposed installation and operation of RO Water Supply System, and water distribution network at Meedhoo, Raa Atoll.

This document is submitted by the proponent to EPA to fulfil the requirements for an EIA under Article 5 of the Environment Protection and Preservation Act (4/93). The EIA Regulations 2012 has been used as the basis for preparing this document.

This report provides the background to the proposed project components as well as an assessment of their likely environmental and social impacts, both beneficial and adverse. The proposed enhancement and mitigation measures are outlined where necessary together with an environment management plan and a monitoring programme.

1.2 Project Title

The project title is the “Design and build basis for water supply network, ground storage tanks and reverse osmosis plant, allied works based on integrated water resource approach in R.Meedhoo”.

1.3 Project Proponent

The proponent of this project is Ministry of Environment and Energy (MEE). MEE is the Government agency responsible for planning and implementing water and sanitation systems in islands of Maldives. The Ministry is currently implementing a number of water and sanitation projects across Maldives.

Contact details for the proponent are:
Ministry of Environment and Energy.
Green Building, Handhuvaree Hingun, Maafannu, Male', 20392,
Republic of Maldives.
Tel: +(960) 301 8300, Fax: +(960) 301 8301
Email: secretariat@environment.gov.mv

The main components of the project are:

- Construction of borehole to supply raw water for the RO plants
- Construction of RO plant building
- Installation of 2 reverse osmosis desalination plants of 40 m^3
- Construction of lifting stations for rainwater
- Construction of 1,000 m^3 rainwater storage tank
- Construction of 500 m^3 RO storage tank
- Installation of degasifier
- Construction of water storage tanks for 7-day requirement
- Preparation of catchment areas
- Laying of separate pipe networks for water distribution and rain water collection
- Connection to households

See next chapter for more details.

1.4 Project tasks completed

No physical developments have been undertaken. However an island survey has been conducted by MWSC prior to concept design works. During this survey, discussions were held with island council and site assessments were conducted to evaluate the feasibility of the project The concept design has been completed and approved and the project has been awarded to MWSC for implementation.

1.5 Project Location

The island of Meedhoo is located in Raa Atoll. The island is fully developed with few areas available for future development. A new sewerage system is being established at the island with house connection to all the houses.

Site location map and satellite image is presented in Figure 1.1 and Figure 1.2 respectively. The table below summarizes some key information about the island.

Table 1.1: Summary of key information about the proposed island

Island Name	*R. Meedhoo*
Location	*72°57'24.28"E; 5°27'41.86"N*
Land Area	*35 Ha*
Length	*About 636 m*
Width at the widest point	*About 727 m*
Distance to Male' City	*About 162 km*
Nearest airport	*Ifuru Domestic Airport (30 km)*
Nearest Inhabited Island	*Maduvvari (About 6.6 km)*
Nearest Resort	*Meedhupparu (About 2.1 km)*
Population	*2,034*
Households	*483*
Key facilities on island	*Health centre, School*

1.6 Legal status of Land

The Island Council has allocated Land for this project and the site has been approved by Ministry of Housing and Infrastructure (See Appendix B). The plot has been given on leasehold to the Ministry of Environment and Energy to establish public service. The authority to develop and use the plot may be handed over to the operator once construction is completed. The details of the land allocated is as follows:

Plot Size: 9,557.07 sq ft
Location: Southern side of the island.

Environmentally sensitive sites in the vicinity

There is one Marine Protected Area in Raa Atoll, 'Vilingilee Thila' located 11 km south to Meedhoo island. There are 3 Environmentally Sensitive Areas listed by EPA within 10 km radius to the project location; 'Dheburidheythere Vaadhoo' (7.2 km), 'Neyo' (9.5 km) and 'Muhlaafushi' (9km).

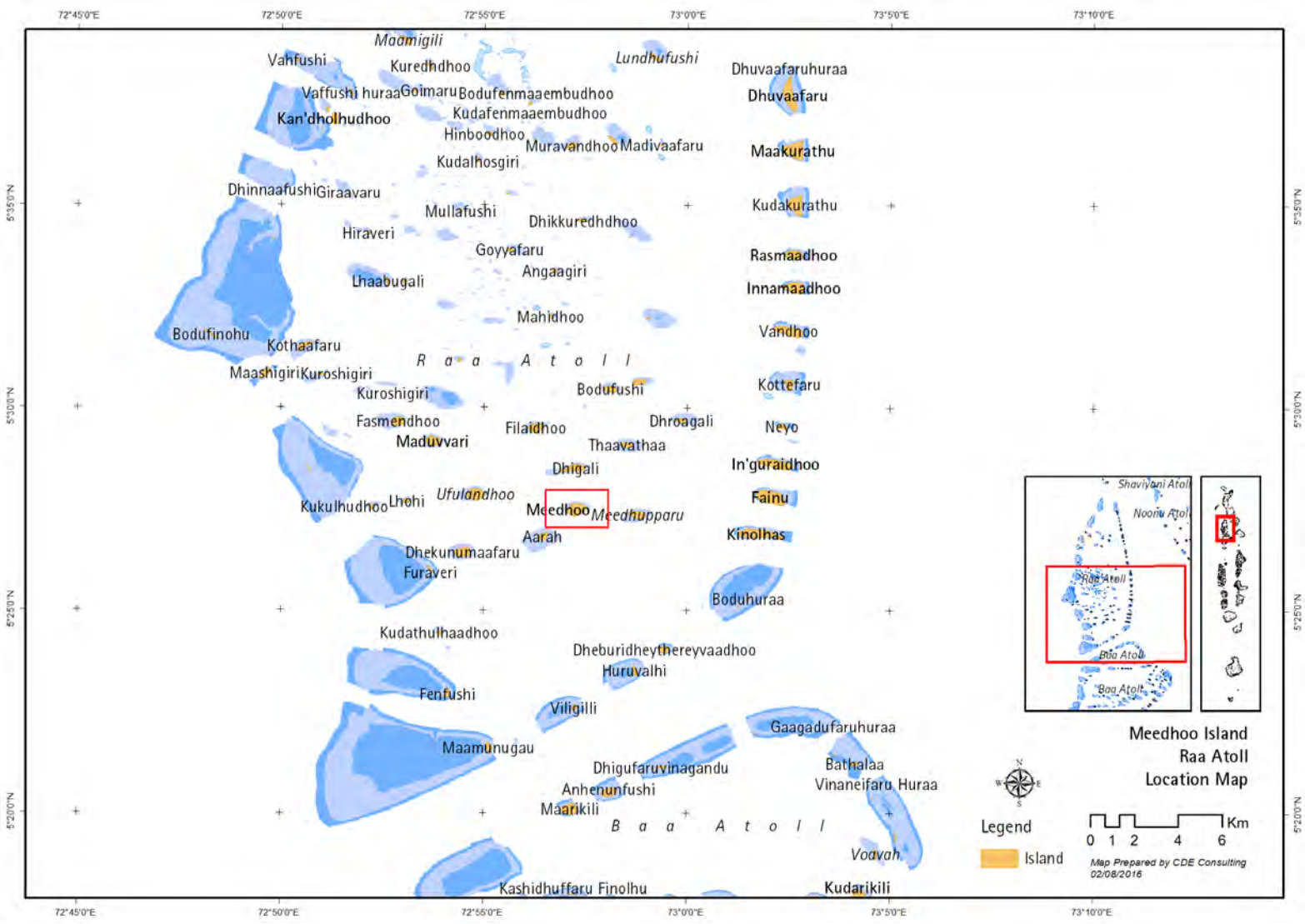


Figure 1.1: Location map of Meedhoo Island

Figure 1.2: Satellite image of Meedhoo Island

1.7 Project Rationale

Access to fresh water is a major issue in the Maldives. Except for a few wetlands or freshwater lakes there are no rivers or streams in any of the islands of Maldives. Freshwater resources occur only as groundwater in basal aquifers, mostly unconfined in nature and extending below sea level in the form of thin fresh water lenses that are vulnerable to saline intrusion owing to the freshwater- seawater interaction, making fresh water a scarce resource.

Fresh water scarcity is a serious concern in most of the inhabited islands of the Maldives. The unavailability of proper water not only cause inhibition to economic growth, social development and human health but also causes severe ecosystem damage due to water abstraction rates exceeding natural renewal rates. Furthermore, the lack of proper sewerage systems or sanitation, highly permeable soils, over extraction and high population densities in these communities cause contamination of the existing underground water lenses, making it foul smelling, undesirable and unhealthy for human consumption, limiting its usefulness as a resource.

To cope with this water paucity many islanders in the Maldives turn to rainwater harvesting. However the rain water harvested from the local roofs and the storage mechanism do not prove to be of the best practice as the catchment area are open for numerous types of contaminations causing rapid deterioration of the quality of water. These include addition of impurities from bird droppings, cats, rats other mobile organism's faecal matter. Moreover, there are no means of testing the quality of the harvested water or treating the water further. Hence it has become impossible to rely totally on natural resources and therefore it has become inevitable not to go for the alternative of desalination to supplement good quality water for human intake in the Maldives.

In the recent past government acquired a policy towards ensuring all inhabited islands have water supplies that meet basic requirements and supply safe water for drinking and cooking purposes. Efforts are being sorted out to improve the water supply in the atolls through the simultaneous enhancement of community rainwater collection and storage facilities and construction of desalinated water supply systems.

In a similar manner, to cater for the basic water requirement of the population of R. Meedhoo the Ministry of Environment & Energy have signed an agreement with MWSC for Design and Build basis for water supply network, ground storage tanks allied works based on integrated water resources approach.

The overall aim of this project is to enhance the quality of services and quality of life of residents of R. Meedhoo by establishing a proper potable water supply system.

The specific objectives are to:

1. Ensure attainment of safe portable water for the people of R.Meedhoo
2. Utilise harvested rainwater, save energy and reduce the operational cost of desalination.
3. Develop the facilities necessary to operate a potable water system based on reverse osmosis desalination technology.
4. Develop storage and pipe network to distribute water within R.Meedhoo

1.8 Consultants, Contractors and Government Institutions

All the EIA related work is undertaken by consultants from CDE Consulting. Design criteria and technical specifications have been developed by MWSC.

Project contractor is MWSC and project has been awarded as a design-and-build project.

No donor agencies are involved in this project. The project is financed by the government and executed by Ministry of Environment and Energy.

1.9 Project Financing

The project is financed by the government of the Maldives.

1.10 Scope and Terms of Reference of EIA

The scope of this EIA is broadly based on the Environmental Impact Assessment Regulations 2012. The assessment more specifically adheres to the Terms of Reference (ToR) issued by the Environmental Protection Agency on 27 June 2016. The ToR is based on scoping meetings held between the stakeholders at the EPA. A copy of the ToR is attached in Appendix A.

The EIA report contains the following main aspects.

A description of the project including the need for the project, how the project will be undertaken, full description of the relevant parts of the project, implementation schedules, site plans and summary of project inputs and outputs *(Chapter 1&2).*

A description of the pertinent national and international legislation, regulations and policies that are relevant and applicable to the project and a demonstration of how the project conforms to these aspects *(Chapter 3)*

Information on the baseline environmental condition of the project site; this includes information on marine flora and fauna, marine water quality, marine environment near the project site *(Chapter 4).*

An assessment of the potential impacts during both construction and operational stages of the project as well as identification and cost of the potential mitigation measures to prevent or reduce significant negative impacts during both construction and operation stages of the project *(Chapter 5, 6 & 7).*

Assessment of alternatives for the proposed project *(Chapter 8)*

Details of the environmental management and monitoring plan *(Chapter 9 and 10).*

Stakeholder Consultations (*Chapter 11)*

Potential gaps in information *(Chapter 12)*

Main conclusions *(Chapter 13)*

1.11 Summary of Assessment Methodology

The process followed in the preparation of this EIA report consists of five parts. These are: scoping consultations; literature review; field surveys; analysis of results; and compilation of the assessment in the form of a report.

The first step of the process covered consultations with client and government agencies to determine the scope of the impact assessment. During this stage the client clearly outlined their development needs and assessment was geared to match the development plan and environmental assessment needs. The environmental assessment needs was determined based on the EIA Regulations 2012 and the issues brought forward by the Environmental Protection Agency in the scoping meeting.

During the second stage, a literature review was conducted to acquire background information on the site and its environment as well as to identify possible environmental impacts of similar developments in island settings. In this context, the EIA Regulations 2012, best practices from similar development activities, scientific studies undertaken in similar settings around Maldives and previous documents/historical publications was considered.

The third stage involved field assessment on the island and areas covered by the EIA scope. Conditions of the existing environment were analysed using established scientific methods. The

fourth stage involved in house analysis using scientific analysis methods to identify, predict and assess the impacts and alternatives. These methods will be explained in detail in later sections.

The final stage involved compilation of individual consultants' findings.

The methods used in field assessments and impact prediction are summarised in their respective chapters.

1.11.1 The Study Area

The area impacted by projects like these can be quite wide particularly when the socio-economic impacts are considered. The study area of this project considers that the entire island and some areas of the reef system of the island will be affected by the development and that Meedhoo Island will experience the bulk of the socio-economic change.

Based on the results of the initial scoping of potential environmental impacts and the identification of sensitive aspects of the environment we have identified the following geographical areas likely to be affected at the various stages of the Project:

- During construction temporary and permanent impacts will occur primarily within a 100-200 m radius of the project site. The most direct physical impact will be on-site in the area of the actual physical interventions; particularly the borehole drilling and construction of RO plant facility.
- Secondary impacts are likely within a 100 m radius, particularly from noise, air quality reduction due to cement works.
- Secondary impacts during installation of pipes for water network
- During operation most impacts will be confined to the area that will be affected by construction impacts.
- There will also be induced development impacts due to the project, mainly in the form of positive socio-economic benefits to Meedhoo Island in general.

Study area boundary is presented in Figure 1.3 and survey locations map for the project is attached in Appendix D.

Figure 1.3: Study Area boundary

1.11.2 Field Observations

Field assessments were undertaken in Meedhoo between 18th and 20th July 2016. Field visits mainly covered water quality, noise measurements around project site, assessment of marine environment and lagoon condition of the proposed project sites. In addition, stakeholder consultations and public consultation were carried out in Meedhoo during the trip.

Marine Assessments

Fish Census

Fish and invertebrates species assemblages and abundance was surveyed using 50 m line transects, whereby the monitor swam along transect and recorded the number and the different species of fish and invertebrates observed within 2.5 m either side of the transect line.

A category-based methodology was adopted to estimate fish abundance and the mean number of fish per category and observation was extracted to estimate species and family abundance. The categories used to estimate abundance is displayed in table 1-1.

Table 1.2: Fish abundance categories

Category	Number of fish
1	1
2	2 - 4
3	5 - 16
4	17 - 64
5	65 - 256

Photo Quadrat Survey

The composition of the substrate was assessed by taking twenty high-resolution images every 5 m (pictures covering 0.5 m^2 of the seabed) along the same transect line used for the fish surveys. These were later analysed using CPCe. CPCe, or Coral Point Count with excel extension, developed by the National Coral Reef Institute, is software designed to determine coral community coverage and diversity using transect photographs. Underwater photographic frames are overlaid by a matrix of randomly generated points, and the fauna/flora of species or substrate type lying beneath each point is identified. 20 random points per picture were analysed to characterize the substrate composition (sample size: 200 points per transect).

Terrestrial Assessments

Terrestrial assessments were carried out on 19th – 20th July 2016, and the weather conditions during this period is shown in Table 1.3 below.

Table 1.3: Weather conditions during field survey period

Factors	19/07/2016, 12:00PM	20/07/2016, 12:00PM
General:	Sunny	Sunny
Temperature:	30.2 ^oC	30 ^oC
Wind (Direction):	NW	WNW
Wind (Speed):	12.0 mph	10.5 mph
Humidity:	74%	70%

Flora

The vegetation of the site was studied using ground observations. Vegetation types along the observation walks were recorded for their abundance, types of species and successional patterns.

Fauna

Terrestrial fauna was not surveyed in detail as the occurrence of fauna was found to be minimal during the brief survey period. However, based on similar conditions found elsewhere in the

Maldives, and local accounts on species found at the location, an approximate list of the faunal species have been compiled.

Water Quality

Water quality was assessed from MWSC laboratory. Marine water quality samples were taken at two locations (proposed and alternative outfall). Parameters measured include electrical conductivity, total dissolved solids (TDS), salinity, pH, temperature, dissolved oxygen (DO), Biological Oxygen Demand, Total Coliform and Faecal Coliform. Groundwater samples were taken from three locations. Parameters measured include temperature, pH, salinity, conductivity and Total Petroleum Hydrocarbon. Samples were collected in clean 1.5L PET bottles and sterile glass bottles.

1.11.3 Desk Study Review

A literature review was conducted to acquire background information on the site and its environment as well as to identify possible environmental impacts of similar developments in island settings. In this context, the EIA Regulations 2012, best practices from similar development activities, scientific studies undertaken in similar settings around Maldives and previous documents/historical publications was considered.

The literature review comprised of, but is not limited to, the following:

- EIA for Water Production and Supply System in M.Dhiggaru
- EIA for Water and Sewerage Project in Fuvahmulah
- EIA for Water and Sewerage Project at S.Hithadhoo
- Island development plans of R.Meedhoo
- Atoll Development Strategic Plan for Raa Atoll
- Relevant regulations, including Environmental Protection and Preservation Act, Environmental Impact Assessment Regulation and Desalination Regulation.

1.11.4 Public and Key Stakeholder Consultation

Stakeholder consultations were undertaken with the following stakeholders:

- Meedhoo Island Council
- Utility Providers of Meedhoo
- Meedhoo public

- Health Protection Agency
- Environmental Protection Agency

1.11.5 Data Analysis

The EIA experts used their experience and knowledge in their respective fields to analyse the data from the previous studies and field visits in order to determine the potential impacts of the proposed projects, the severity of effects arising from these impacts and how any adverse impacts can be best mitigated and positive impacts enhanced. This analysis provides the framework for the recommendations on corrective actions and remedial measures and provides the basis for the formulation of the environmental management plan which forms part of this EIA report.

1.11.6 Report Format

The report format and structure presented here follows the report formatting guidelines issued by EPA.

1.12 Study Team Members

The team members of this EIA are;

Dr.Ahmed Shaig (Lead Author and Coastal Environment Consultant)

Mr. Ahmed Faizan (Marine Environment Specialist)

Ms. Shahdha (Socioeconomic impact assessment)

Ms. Hana Saeed (Stakeholder consultations)

Mr. Ali Nishaman Nizar (Terrestrial Environment)

Mr. Ali Moosa Didi (Marine Assessments and Social Assessments)

Mr. Mohamed Ali (Marine surveying Social Assessments)

Mr. Ahmed Haiman Rasheed (Field Assistance)

The curriculum vitae's of the EIA consultants are attached in Appendix G of this report.

2 PROJECT DESCRIPTION

2.1 Project Outline and Project Site Plan

The proposed site plan and required land use permits are presented in Appendix B. A Reduced version of the site plan is provided in Figure 2.1 below.

There are 2 RO plants with a capacity of 10m^3 per day already installed in the island after tsunami in 2008. Since these plants are not in operational condition, this project involves the construction and operation of an integrated water resource management system

An area of 9,557.07 sq ft of land area is allocated to establish the necessary infrastructure for the project.

This project involves the following key activities;

1: Construction and installation of Reverse Osmosis water systems.

Key activities include:

- Construction of borehole to supply raw water for the RO plants
- Construction of plant building
- Installation of 2 x 40 m^3
- Installation of 500 m^3 RO tank
- Installation of Degasifier
- Construction of brine discharge outfall
- Connection to households

2: Rainwater harvesting and distribution

Key activities include:

- Preparation of catchment areas
- Establishment of rain water treatment system
- Installation of 1,000 m^3 rainwater holding tank
- Laying of separate pipe networks for water distribution and rain water collection

The main components of the project are:

1. Procurement of materials
2. Mobilization

3. Site preparation (equipment setup and storage facilities)
4. Civil works
5. Water pipeline networking for both desalination plant and harvested water
6. Construction works
7. Mechanical and electrical work
8. Finishing
9. Testing and commissioning
10. Demobilization

The next section provides the details of the project components

Figure 2.1: Project water network site plan summary

Figure 2.2: Project rainwater network site plan summary

2.2 Detailed Project Outline and Work Methodology

2.2.1 Scope of Works

This project is being undertaken on a Design and Build basis. As noted above, the project mainly involves installation of an integrated water production and supply system covering an RO plant and associated infrastructure, and rainwater harvesting facilities.

2.2.2 Site Preparation

Proposed sites for RO plant and distribution system is partially vegetated and is mainly covered with coastal bush vegetation. There is no dense vegetation or large trees at the site, which will need to be cleared apart from one '*Kaani tree'*. This tree will have to be removed if it impedes the development of the facility. .

All pipelines will be laid along the roads and roads where trees are planted in the middle of the road will need to be removed prior to pipeline installation.

2.2.3 Mobilization of equipment

No special equipment or materials are planned to be used for construction. Standard building and construction material will be used.

All site mobilisation and construction related activities will be undertaken in a planned manner. A temporary site office and the necessary facilities for preparatory works will be constructed at the initial phase of the project.

The materials used will include main line pipes and branch pipes made of PE, fittings and necessary valves, water storage tanks, interconnecting pipes, transfer pumps, power supply, wiring accessories and RO plant.

Construction Equipment

The likely equipment will consist of the following:

- Mini Excavator(s)
- Butt-welding machine
- Electro-fusion welding machine
- Mobile generator
- Pick-up truck

- Levelling equipment
- Dhoni

Heavy machinery is unlikely to be required for this component.

2.2.4 Design Considerations

After considering various options in the context of availability of source water, an integrated rainwater collection system and water desalination system through RO plant is considered as the best option for providing a sustainable source of freshwater in Meedhoo.

2.2.4.1 Existing Water Sources and Quality

Groundwater

Currently water is obtained from shallow wells constructed in the facilities or in public areas (e.g. a mosque). The ground water in the island seems to be contaminated and it has a foul smell For these reasons, rainwater has become the main source of drinking water in Meedhoo. This method provide inadequate quantity and unacceptable quality due to the over abstraction and the unreliability of rainwater harvesting.

Rainwater

Rainwater harvesting is traditionally practiced in the islands as a major source of water used for drinking with HDPE tanks installed in almost all houses. However, exceptional care in collection is needed to ensure that the surfaces from which the water is collected are kept clean and free from detritus which can pollute the water. Also, none of the households with private water tanks get adequate amount of rain during dry period.

2.2.4.2 Water Demand

Determination of design capacity is a prerequisite to begin the design of water supply facilities. Accordingly, the design period, estimated population, commercial and industrial growth, estimation of the unit water use, and estimation of the variability of the demand were taken into account when designing the capacity of the proposed water production and distribution project.

Approximately 15 Litres per capita per day is used as drinking water and in the future it is estimated that 20 Litres per capita per day will be used as drinking water (based on water usage in the existing water and sewer network laid islands).

The design consideration for the proposed water supply was based on the following:

- Current population
- Growth ratio
- Projected population for 5 years
- Per Capita Consumption (PCC)
- Daily Operation duration of RO plant
- Total water required

2.2.4.3 Plant Sizing Criteria

Factors taken into account in determining the size and layout of the plant are:

- Number and size of process units
- Number and size of ancillary structures include administration building, pumping facilities and storage
- Provision for expansion
- Connection to the water distribution system, and
- Residuals handling system.

2.2.4.4 Site Location Criteria

Criteria for site selection include:

- Land availability
- Potential for expansion
- Proximity to lagoon
- Proximity to rainwater catchment area

Other issues considered include:

- Waste disposal options
- Public acceptance
- Security

2.2.5 Concept of RO plant and Rainwater Harvesting System

2.2.5.1 Operation of RO Plant

Intake Design and Method

Water intake will be through borehole located in the vicinity of the RO plant building. The borehole will be drilled to 30 m depth and will pump out the required raw water for the RO plant. The feed water pumping capacity is designed such that one pump can supply required water for RO plant and the other will work as standby pump. The borehole conductivity will reach 50,000 µS/cm at 30 m depth.

Method of constructing tube well

- Temporary light post will be fixed to illuminating working area. The surrounding area will be barricaded to avoid unnecessary movement of workmen and also to restrict the entry of unauthorized persons into the drilling site for safety purposes. Land survey will be conducted with accuracy to find out the exact location of the borehole as per engineering drawing.
- Location of the bore hole will be worked out from the approved drawing and marked on the top of the existing ground profile. Drilling will be carried out at these marked locations. An area will be cleaned before set up of drilling machine.
- Two mud pits will be made by using shovel and spade in front of drilling location and connected to each other by a drain and canvas lining, to prevent fluid loss.
- Drilling mud will be prepared by mixing of bentonite with water with a proportion of 1:2 before 12 hours of starting of borehole. Thickness of the mud will be controlled as per the strata encountered during drilling. As far as possible the least amount of bentonite will be used to retain the natural condition of aquifer. If there is severe caving encountered during drilling through a particular stratum then 150 gm poly-anionic cellulosic polymer will be used by mixing with 50 Kg bentonite and 100 litre water.
- Drilling rig will be placed on the drilling spot with proper platform and verticality alignment of the machine is done by using spirit label. During the whole drilling process this is checked frequently to maintain the verticality and alignment of borehole.
- After attaching the mud pump and drilling machine with 50 mm hoses drilling will be started with reamer bit up to the loose formation or overburden and PVC casing will be

placed inside hole. The depth of outer casing will be decided as per geological strata encountered at site.

- After placing of outer casing up to required depth drilling will be continued with mud circulation, with the help of 200 mm drag and rock roller bit.
- Soil samples will be collected from return water from borehole at every 2 m interval or change of strata. Soil samples will be preserved in polythene bags marked with borehole number and depth and date of collection. Bore Log will be prepared as per the sample received during drilling from different depth. Soil samples will be sent to soil testing lab for grain size analysis.
- After drilling is completed up to 30 m depth hole shall be reamed again by using 200 mm diameter bit.
- Flushing of borehole will be carried out after completion and water sample will be collected in a sterilized 1 litre bottle from outgoing water of borehole and sample will be sent to chemical lab within a day for further testing as per specification. Parameters such as pH, EC, Temperature, Taste, Odour & Colour will be tested at site and that report will be submitted along with drill-log.
- After reaming of the hole, 6m length (3mX2) 152 mm diameter PVC screen pipe with bottom bail plug will be placed inside the hole and threaded solid PVC casing pipe (152mm) will be attached with the screen pipe & lowered one by one freely up to the depth of the entire borehole. At least 50 cm of PVC casing will be kept above the ground level of the borehole.
- Daily Progress Report (DPR) will be submitted at a regular basis. After completion of borehole drilling log along with stratification, ROP, casing details and water analysis at site will be submitted. Laboratory Water & Soil Testing reports will also be provided after completion of the relevant tests.

Method of construction of wells

- With the help of 38 mm gravel feeding PVC pipe, silica gravel will be placed through the annular space between outer and inner PVC casings and the gravel will make a layer surrounding inner PVC casing. Gravel feeding pipe will be raised slowly till the gravel will be filled up to 20 m from the bottom of the hole.

- Afterwards a 3 m thick sand layer will be placed above the gravel layer. Outer casing will be removed after placing the sand layer. Bentonite clay layer of 2 m will be placed over the sand layer. The bentonite clay layer will be described as a seal between cement, sand concrete layer and gravel pack. Above bentonite clay seal, M 25 grade concrete will be placed up to the ground level i.e. 5m. Fine aggregate for use in the production of concrete will be of river sand and for coarse aggregate will be composed of crushed gravel of 20mm size and it will be free from salt and other organic impurities. The mixture ratio of cement, sand & coarse aggregate is 1:2:3

Methods of development of bore well

Development of bore well is essential in order to obtain an efficient and long lasting well. The purposes of well development are as follows:

- To rectify the damage to the aquifer caused due to excavation of the borehole.
- To increase the porosity and permeability of screened formation adjacent to the borehole.
- To stabilize the formation/gravel pack around the screen so that the well will yield sand within permissible limits with water.

The methods of development of bore well are as follows:

- Surging with air compressor: with the help of 12kg/sq.cm capacity compressor bore well will be flushed. A 25 mm flexible hose will be attached with a 1m long hollow pipe and it will be lowered in the hole. By attaching the other end of hose with compressor air will be released to bore well and it will be flushed. After continuous flushing of 10 minutes air compressor will be stopped for 5 minutes and then again flushing will be carried out by the same process for 8 hours.
- Chemical Washing: After air flushing with compressor hole is washed with Sodium hexa-meta phosphate solution.
- Bailing: A bailer is a 1m length, 76mm diameter PVC pipe with a one way valve at the bottom. It will be lowered into the well by tripod arrangement, till it gets filled with water and sediment. It will then be pulled to the surface and emptied. This process will be continued for 12 hours or till the sand content in water is negligible.

- Back Washing: With the help of a pump, water lifting from bore well will be started and frequently switched off and switched on. The pumping will be carried out so the water in the rise pipe falls back through the screen openings with pressure, cleaning it.
- Over Pumping: In this method the well will be pumped at a much larger rate continuously for an hour or until sand become negligible.

Testing of the well

- By using the require capacity pump the yield will simply be measured with the help of a 200 lit empty barrel and stopwatch. Time taken to fill up the 200 lit drum in second can be converted in cubic meter per hour. For accuracy of the reading the same procedure will be conducted three times and then average of three stop watch reading will be taken for calculation. Water sample will also be collected before completion of the test for chemical and biological analysis.
- Step draw down test will be carried out with the help of required capacity pump or compressor, at least five steps of 60 minutes each. Discharge rates will be fixed on the basis of 25%, 70%, 100%, 125% & 150% of required yield and drawdown will be measured by lowering measuring tape after every 1 hour.
- Constant discharge pumping test will be carried out with the help of required capacity submersible pump or compressor at 150% of design discharge for 12 hours .Drawdown will be measured after every 1 hour by lowering a measuring tape.
- On completion of constant discharge taste, 12 hours recovery test will be conducted and water level would be measured for every one minute for the first hour and then every 5 minutes for the remaining 11 hours.
- All test reports will be submitted in a tabular format after completion of the tests.

Capping of bore well

After completion of yield test submersible pump will be removed from the bore well and the well will be capped with threaded 10” PVC cap to protect it from any unwanted material falling inside

Pre-treatment of Raw Water

The raw water from borehole will pass through primary filtration system, which consists of multimedia filter or screen filter of 50 microns and filter with 5 microns. The primary filtration removes dirt, dust and other sediments in raw water prior being pumped to RO membranes.

RO Plant Design

An area of 9,557.07 sq ft of land area has been approved to establish necessary infrastructure for the project. Necessary administration building including office space, laboratory, generator room, and equipment store and vehicle parking space will established on this land located at the southern side of the island.

The pre-treated water will be pumped into the RO plant, where high pressure pumps will pump in pressurized water through pressure vessels with spiral wound reverse osmosis membranes filtering the feed water. These membranes are made of synthetic materials that only allow water to pass through leaving salts and contaminants behind in a solution called brine. The RO plant will produce 30% to 33% fresh water and the rest as concentrated brine or reject water.

Post treatment and water storage

The product water or permeate from the RO process is passed through a Degasifier to remove the dissolved hydrogen sulphide. The product water is then pumped to the storage tanks by using transfer pumps. Storage tanks are designed for 7-day storage and a disinfectant solution (Calcium Hyper Chloride) will be dosed in to the inlet water pipeline of the storage tank. The proposed storage tank for product water from RO plant has a net capacity of 500 m^3.

Process flow diagram of water production system is illustrated in Figure 2.3

Brine Water Collection and Disposal

The RO plant will operate on an estimated 33% product water recovery; hence with 67% brine output. Proposed brine outfall will be located on the southern side of the island. It is proposed to lay a PE100 PN10 pipe with an Outer Diameter (OD) of 225 mm for the reject line (See Figure 2.1). The brine outfall outfall line will be deployed 10m from reef edge and it will be placed at a minimum depth of 1.5 m on the reef slope. The total length of the brine outfall line is 97m. The pipes will be butt welded offshore and then joined using flange connection in the sea. The pipes will be anchored to the bottom using concrete blocks and a diffuser will be placed at the end of the pipe. Levelling equipments will be used and divers will be laying the pipes. In addition, a butt machine, an EF machine and labourers will also be utilized.

Figure 2.3: Process flow diagram of water production system

2.2.5.2 Rainwater Harvesting System

Rainwater Collection and Processing

Rainwater collected from roofs of institutional and community facilities will be collected at interceptor tanks/ access chambers (pits) located at institutions. Manholes or inspections chambers are to be used as interceptor tanks to avoid blockages and also clear any debris or leaves passing through the rainwater network pipeline.

Rainwater from these interceptor tanks will then be passed to the main network system. Water from inspection chambers is passed to the lift station via UPVC pipelines of Outer Diameter 160 mm. The rainwater network is via a gravity pipeline, which is laid with little slope to pass the rainwater through gravity. Rainwater collected at the rainwater network pipes are collected at rainwater harvesting area. UPVC pipelines of 160 mm Outer Diameter (OD) will be used for rainwater harvesting and pipelines of 200 mm OD will be used for the network which pumps rainwater to lifting station in water production site. Table 2.1 shows the list of buildings where rainwater will be harvested for this project.

Table 2.1: List of buildings proposed for rainwater harvesting

No.	Location	Area / m^2
1	Health Center	412.4
2	Mosque	187.5
3	Masjidhul Falah	544.2
4	Magistrate Court	194.9
5	Island Council Office	198.0
6	School Site (Includes 7 blocks)	2,397.2

All of the rainwater will be collected at lift stations. Two rainwater lift stations are proposed for this project. The lift station acts to lift the collected rainwater collected through gravity via pumps installed inside the lift station. The lifted rainwater will then be passed to the rainwater holding tanks. The proposed rainwater-holding tank has a net capacity of 1,000 m^3.

The rainwater-holding tank is designed to cater 25% of total demand throughout the year into the distribution system. The rainwater stored during the raining event is then sent for processing through filtration mechanism and is filtered. The following will explain the filtration process in detail.

Micro Filtration

In the treatment process, rainwater is first pumped from holding tank to Micro Filtration process to remove suspended particles/debris. This Micro-Filtration removes particles up to 1-2 micron.

Ultra-Filtration

Ultra-filtration removes macromolecules from water and ideal for removing colloids, protein, parasites, bacteria and some viruses. Ultra-Filtration removes molecules up to 0.02 – 0.04 micron.

UV Disinfection

A UV disinfection system is proposed to be used prior to passing the treated rainwater to storage tanks. UV disinfection removes parasites and pathogens and unaffected by pH and temperature.

Chlorine Disinfection

Chlorine disinfection is more effective than UV disinfection. It takes pH and temperature into consideration for its effectiveness. The filtered processed water is then transferred to RO storage tanks. Treated from this storage tank will be again disinfected before sending to distribution water network.

Figure 2.4 illustrates the stages of rainwater harvesting system.

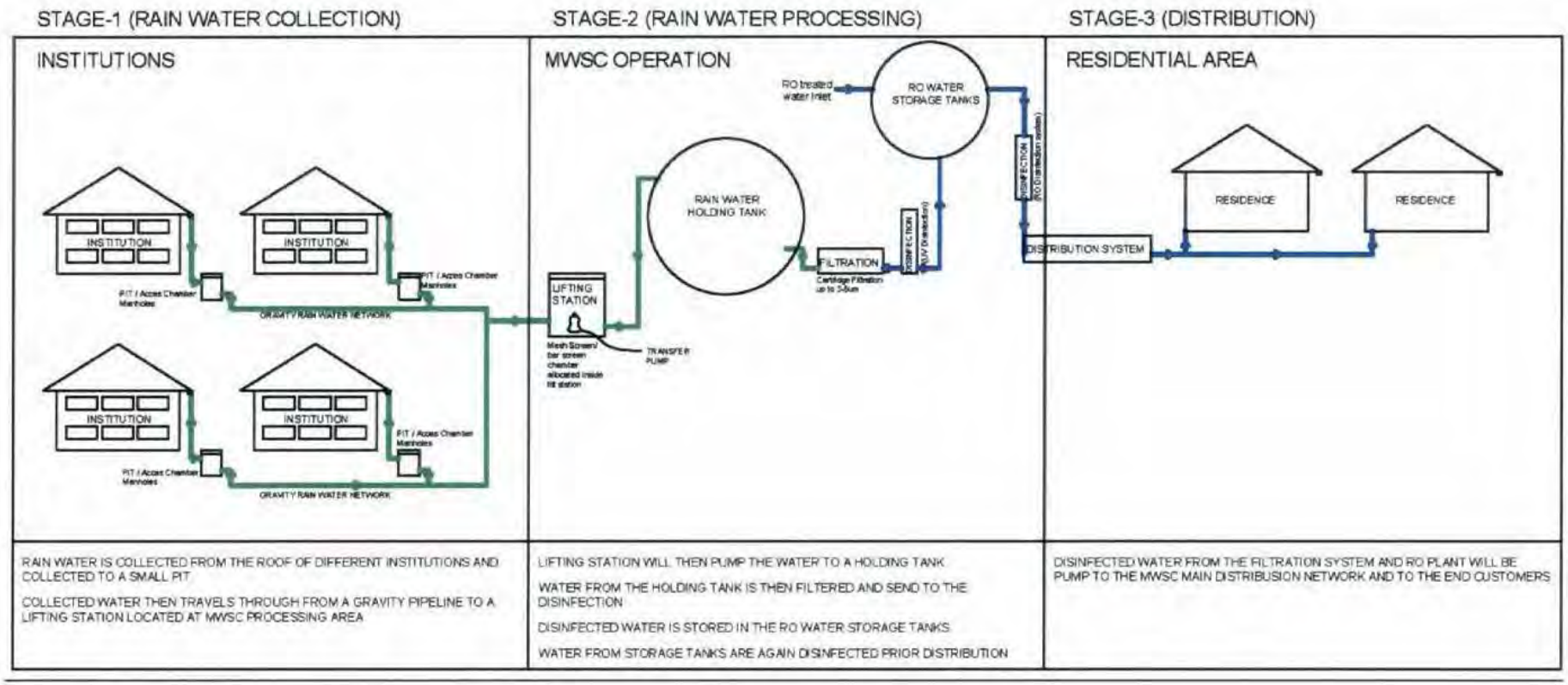


Figure 2.4: Stages of rainwater harvesting system

Water Network

Water network is designed to cater portable water for the island community, institutions and other uses. PE (polyethylene) pipes (PElOO PNlO) and fittings will be used in Water Network connections and butt welding or electro-fusion method would be used for jointing pipes and fittings.

All the water distribution pipes are to be laid underground at a depth of 600 mm below the ground level to safeguard the pipes from road traffic. Necessary Gate valves will be placed to control the water to prevent disruption of the whole network under events of water leakages or damages in any pipe. In the network design minimum of 63 mm PE pipes will be used. PE pipes from Outer Diameter 225mm to 63mm shall be used in network design. The network will also be designed including the undeveloped area in the island.

Water Cad simulation will be used to model the network and will be simulated to check pipe sizes, island zones and scenarios simulated for pipe damages.

Water Network will be divided into zones to avoid water disruption to the whole island under events of pipe damage or leakage. Necessary Distribution Sampling Points -DSP and Fire hydrants are allocated in the network. There are also six Flushing Points allocated to flush the water network for cleaning purposes.

Distribution System

Water distribution system will be designed with two pumps, one on operation and the other as a standby. The pump system will be provided with variable speed drives to maintain a constant pressure in the water distribution network. The standby pump will run at any instant if the set pressure of the system cannot be maintained by the operating pump.

Household Connections

Each house will be provided with a single connection with a water meter and tap. These house connections will draw from the water network through E/F saddles. Minimum sizes of 18 mm pipe are to be used for house connection. It is proposed to use "Kent" water meter or equivalent for the house connection.

2.2.5.3 Water Quality

The product water will be according to standards defined by EPA Maldives.

2.2.5.4 Excavation, Dewatering and Pipeline Installation

Pipeline for the proposed water supply distribution network will be installed at 600 mm from ground level. Dewatering depends on the water table levels. It is expected that only minor dewatering will be required in low areas during construction and installation of distribution pipe. The water tables lie on average between 0.5 m below ground levels.

All water removed during dewatering will be discharged back into the water table as outlined in the EPA guidelines.

Leakage test will be conducted on the whole network after installing the network prior to commission of water supply services.

2.2.5.5 Water Quality Management

The quality of product water will be monitored regularly on site and from the MWSC Laboratory according to the requirements of the Maldives Desalination Regulation. These are further elaborated in the Monitoring Programme given in this EIA.

2.3 Project Schedule and Life Span

Mobilisation for the project will begin after the EIA is approved. It is anticipated that the completion of the whole project will take approximately 11 months.

Preliminary schedule is given in Appendix E.

2.4 Labour Requirements

On average, 50 workers will be involved throughout the project including key staff members.

2.5 Waste Management, Logistics and Safety Measures

2.5.1 Construction Waste Management and Disposal

Waste will be generated from construction activities and from material consumption by construction workforce, green waste from site clearance, excavated material and construction debris. All excavated material will be used while laying out water connection pipe network. Dredge material will be used to fill the trenches once the pipeline is installed. Both unusable green waste and general domestic waste will be disposed at Meedhoo Waste Management Centre as designate by Meedhoo island Council. All substantial packaging and construction waste will be transferred to Vandhoo waste management centre by the contractor.

Small amounts of waste oil may be generated from the operation and maintenance of vehicles. All waste oil will be disposed as per the approved standards of the Environment Ministry.

2.5.2 Pollution and Emission Control Measures

The following measures will be taken to ensure minimal pollution during construction stage.

- Machinery will be properly tuned and maintained to reduce emissions and minimize risk of spills/leaks.
- All paints, lubricants, and other chemicals used on site will be stored in secure and bunded location to minimize risk of spill.

2.5.3 Sediment Containment and Turbidity Control Measures

The proponent is committed to prevent any sedimentation of the reef system from this proposed project. The following specific measures will be undertaken during the project.

- Undertake dredging work for brine discharge outfall during calm weather conditions.

2.5.4 Health and Safety Measures

- The contractor would ensure that Health and Safety procedures are complied with at all times.
- Construction activities would be carried out under the supervision of a suitably experienced person.
- All reasonable precautions will be taken for the safety of employees, and equipment will be operated by competent persons.
- Warning signs, barricades or warning devices will be provided and used. Necessary safety gear will be worn at all times.
- Fire extinguishing equipment would be readily available and employees will be trained in its use. In general, water-based fire extinguishers would be used.
- Oxygen, acetylene or LPG bottles will not be left free-standing. All welding and cutting will be done in accordance to high safety regulations by experienced personnel.

2.5.5 Utilities

Water, Electricity and sanitation facilities will be provided for construction workers from the existing facilities on the island. A generator is also installed in the RO plant house with capacity to run up to 8 hours will be used as a back-up.

Amount of power input required during construction phase has not been finalised by the contractor at the time of EIA report writing. This will be finalised during detailed design phase.

2.5.6 Labour Camps

Aaccommodations for the construction workforce will be provided on existing accommodation facilities on the island.

2.5.7 Equipment and Materials Storage

Equipment and materials will be stored either on-site or a site identified by the island council. Chemicals required for operation of RO plant will be stored in the Administrative building or RO building premises. Temporary work site and storage area will be located within the land allocated for the project.

2.6 Summary of Project Inputs and Outputs

The types of materials that will go into the development and from where and how this will be obtained are given in Table 2.2 and the type of outputs (products and waste streams) and what is expected to happen to the outputs are given in Table 2.3.

Table 2.2: Major project inputs

Input resource(s)	Source/Type	How to obtain resources
Construction workers	Local and foreign	Recruiting agencies, etc.
Engineers and Site supervisors	Local and foreign	Contractor's employees or by announcement
Construction material	Timber; electrical cables and wires, DBs and MCBs, PVC pipes, light weight concrete blocks, reinforcement steel bars, sand, cement, aggregates, telephone cable CAT 5, PVC conduits, floor and wall tiles, gypsum boards, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner...etc	Import and purchase where locally available at competitive prices – Main Contractor's responsibility.
Water supply (during construction)	Bottled water, ground water and rain water	Purchased from local businesses; contractor

Input resource(s)	**Source/Type**	**How to obtain resources**
		equipment
Machinery	Excavators, loaders, trucks, barges, cranes, concrete mixers, etc	Contractor's machinery or hire locally where available
Maintenance material	Maintenance parts and fluids required for the machinery and piping.	Import or purchase locally where available
Food and Accommodation	Existing houses or purpose built accommodation	Contractor's equipment or hire locally
Firefighting equipment	Fire Extinguishers...etc.	Contractor's equipment
Fuel	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers
Telecommunication	Mobile phones, fax machines and internet facilities	Contractor's equipment
Food and beverage bottles	PET bottles, glass bottles, packaging waste, plastic bags and various frozen, packaged and fresh food.	Contractor's equipment
Operation		
Electricity supply	Diesel	Local power supply system and generator set in the RO plant house
Operational staff	Local	Contractor's employees or by announcement
Raw water	Saline underground water and harvested rain water	From borehole and from local roofs

Table 2.3: Major project outputs

Products and waste materials	**Anticipated quantities**	**Method of disposal**
Excavated earth	Large quantity	Used while laying out water distribution pipe network.
Construction waste	Moderate quantity	Used as base material during water distribution pipe network
Waste oil	Small quantities	Barrelled and sent to Vandhoo waste management site during demobilisation.
Hazardous waste (diesel)	Small quantities	Barrelled and sent to Vandhoo waste management site during demobilisation.
Noise	Only localised	Excavator and truck operation will be noisy. No option available.
Food waste	Small quantities	Managed under existing waste management system of the island
Plastic and packaging wastes	Small quantities	Managed under existing waste management system of the island

Operation		
Brine	Large quantities	Discharged through the ocean outfall

2.7 Demobilization

The proponent advocates a phased demobilization plan to commence in the last week of the contract. Machinery transported from Male' will have to be demobilized on one specific date.

2.8 Maintenance during Operation Phase

During the first operational year, the facility and all contributing components will be maintained by the contractor. However, after the first year of operations, the facility will be handed over to Ministry of Environment and Energy. Then on the ministry would take the decisions on whom to run the facility. During the construction period and the first year of operations, the contractor would train locals from the island for various jobs associated with the facility.

2.9 Emergency Water Supply Plan

The proposed has been designed to cater 20L per day for drinking purpose. Water production and storage capacity has been calculated to cater for 7 days of storage. Detailed water demand for the island has been included in the detailed design report, which will be submitted to EPA after EIA submission.

3 POLICY AND LEGAL FRAMEWORK

These legal and policy provisions have to be fully respected in carrying out the proposed development. All contractors and sub-contractors will be informed of these requirements. This project conforms to all relevant laws and regulations of the Maldives.

3.1 Relevant Environment Legislation

3.1.1 Environment Protection and Preservation Act (Act no. 4/93)

The Environmental Protection and Preservation Act (*4/93*) enacted on 19 March 1993 is the framework law related to environment protection in the Maldives. The authority responsible for the Environment Act is the Ministry of Environment and Energy.

Articles 2, 4, 5, 6, 7, and 8 of the law are relevant to the Meedhoo water supply system Project.

Article 2 states that the concerned government authorities shall provide the necessary guidelines and advise on environmental protection in accordance with the prevailing conditions and needs of the country. All concerned parties shall take due considerations of the guidelines provided by the government authorities.

The project developers and contractors shall abide by any guidelines or advice given by the concerned Government authorities for the project.

Article 4 states that the Ministry of Environment shall be responsible for identifying protected areas and natural reserves and for drawing up the necessary rules and regulations for their protections and preservation.

The project developers and contractors shall ensure that there is no negative impact from the proposed project on sensitive environments in the vicinity or protected species.

According to Article 5 (a) of the Act, an Environmental Impact Assessment study shall be submitted to the Ministry of Environment before implementing any development project that may have a potential impact on the environment.

According to Article 5 (b), The Ministry of Environment shall formulate the guidelines for EIA and shall determine the projects that need such assessment as mentioned in paragraph (a) of this clause.

This report is prepared to fulfil this clause.

According to Article 6, the Ministry of Environment has the authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation.

All project developer and contractors shall be aware of this provision and contractors shall take all practical measures to ensure there is no irreversible and significant negative impact of the projects on the environment

Article 7 of the EPPA (4/93) states that any type of waste, oil, poisonous gases or any substances that may have harmful effects on the environment shall not be disposed within the territory of the Maldives. In cases where the disposal of the substances becomes absolutely necessary, they shall be disposed only within the areas designated for the purpose by the government. If such waste is to be incinerated, appropriate precaution should be taken to avoid any harm to the health of the population.

All project contractors shall comply with the Environmental Management Plan presented in this report, which specifies how the wastes, oil and gases generated by the project will be disposed.

Article 8 of the EPPA (4/93) states that Hazardous/ Toxic or Nuclear Wastes that is harmful to human health and the environment shall not be disposed anywhere within the territory of the country.

Any hazardous wastes that may be generated from this project shall be transferred to the designated waste site in Thilafushi or Vandhoo for disposal according to Government regulations and standards. It should not be disposed on the Island, as it does not have the necessary facility.

3.1.2 Maldivian Land Act (Law no. 1/2002)

The Act governs the allocation of Maldivian land for different purposes and uses and other issues regarding the issuing of land, issuing of state dwellings for residential purposes, conduct regarding state dwellings or private dwellings constructed for residential purposes and the sale, transfer and lease of Maldivian Land.

It states that:

- All transactions concerning the issuing, receiving, owning, selling, lease, utilizing and using Maldivian land shall be conducted in compliance with this Act.
- Policies concerning Maldivian land shall be decided by the President of the Maldives on the advice of the discussions in the Ministers Cabinet.

In accordance with section 3 of this Act, land shall be allocated for the following purposes and uses.

a. For the construction of households and buildings for residential purposes.
b. For commercial use.
c. For social use.
d. For environmental protection.
e. For government use.

Under the Maldivian Land Act several regulations had been formulated such regulations include:

- Issuing state dwellings regulation
- Regulation governing the transfer (of land) as a gift or by will
- Lease of buildings and dwellings regulation
- Mortgaging land, building and flats regulation
- Registration of state dwelling and building regulation
- Regulation on the Inheritance of Fixed Assets on State Dwelling / Intestate
- Transfer or transfer by will Regulations 2004
- Privatization of State Business Land Regulations 2006

The project complies with the provisions of this Act.

3.2 Relevant Regulations and Guidelines

3.2.1 Environmental Impact Assessment Regulations 2012

Environmental Impact Assessment regulations were issued by Environment Ministry on 8 May 2012. The first step in environmental assessment process involves screening of the project to be classified as one that requires an EIA or not. Based on this decision, the Ministry then decides the scope of the EIA, which is discussed with the proponent and the EIA consultants in a "scoping meeting". The consultants then undertake the EIA starting with baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring programme. This report follows the principles and procedures for EIA outlined in the EIA regulations.

The EIA report is reviewed by MEE following which an EIA Decision Note is given to the proponent who will have to implement the Decision Note accordingly. As a condition of approval, appropriate environmental monitoring may be required and the proponent shall have to

report monitoring data at required intervals to the Ministry. The project proponent is committed to implement all impact mitigation measures that are specified in this EIA report. Furthermore, the proponent is committed to environmental monitoring and shall fulfil environmental monitoring requirements that may be specified in the EIA decision note as a condition for project approval.

This report complies with the EIA regulations.

3.2.2 Desalination Systems Regulation

Desalination System regulation requires the registration of desalination systems that will be operated for use by a population exceeding 200 or for large-scale agricultural or tourism activities or for the purpose of implementing project(s) that involves economic or industrial operations. Prior to the establishment of desalination system, an Environment Impact Assessment (EIA) must be carried out in accordance with guidelines provided by Environment Ministry.

The desalination plants to be installed will have to be registered with EPA. For this, the Proponent will be required to submit the EIA Decision Note for this EIA report, completed application forms with all details of the plant to be registered. A copy of the relevant section of this EIA may be appended to the forms as justification for the desalination plants.

3.2.3 Maldives Building Code

The building code hand book of Maldives details the guidelines and standards that should be used for designing building in Maldives. All construction projects are required to meet the standards specified in the building code.

The proponent and contractor shall ensure that all construction activities of the project will follow the Building code.

3.2.4 Waste Management Regulation 2013

Waste Management Regulation (WMR) was published on August 2013 and came into effect in February 2014. It will be implemented by EPA. The aim of WMR is to implement the national waste policy, which contains specific provisions to:

- Implement measures to minimize impacts on human health
- Formulate and implement waste management standards
- Implement an integrated framework for sustainable waste management

- Encourage waste minimisation, reuse and recycling
- Implement Polluter-Pays Principle
- Introduce Extended Producer Responsibility

WMR contains four main sections:

- Waste management standards: Defines standards for waste collection, transfer, treatment, storage, waste site management, landfills and managing hazardous waste.
- Waste management Permits: Defines approval procedures for waste sites
- Waster transfer: Standards and permits required for waste transport on land and sea, including trans-boundary movements.
- Reporting requirements: Defines reporting and monitoring requirements and procedures.
- Enforcement: Defines procedures to implement WRM and penalties for non-compliance.

The proponent shall use registered vessels under this regulation for transporting waste to Thilafushi or Vandhoo.

The proponent should also ensure compliance from the subcontractors in handling and transport of waste from the island to the designated waste site.

3.2.5 The Environmental Liability Regulation (Regulation 2011/R-9)

This law is pursuant to Article 22 of national constitution that states that protection, preservation and maintenance of the Maldivian natural environment, the richness of the living species, the natural resources and the beauty of the Maldives for the present generations as well as for the future generations is a basic obligation of the Maldivian government. The government shall enforce that the activities conducted in order to gain economic and social development should be of sustainable nature that protect the environment and such activities shall not deteriorate the environment, endanger any species, damage the environment, and shall not waste any natural resources.

This regulation is also pursuant to Environment Protection and Preservation Act of Maldives (4/93). The regulation is aimed at maintaining equal standards for reprimanding and enforcing environmental liabilities, fines for those who violate the rules and regulations and give guidance to those who are involved in the implementation process of the regulations pursuant to Preservation Act of Maldives (4/93).

One of the key objectives of the environmental liability regulation is also to practice polluter-pay-principles in the Maldives.

All project developer and contractors shall be aware of this provision and contractors shall take all practical measures to ensure that all relevant laws and regulations, and the EMP proposed in this EIA is followed.

3.2.6 Guidelines and Manual for Rainwater Harvesting in the Maldives 2009

This guideline published by Ministry of Housing Transport and Environment in 2009 includes components for rainwater harvesting system that needs to be followed. Components included in the guideline are the following;

- Catchment Area
- Conveyance System
- Storage
- Filtering System
- Distribution
- Protecting Water Quality
- Rainwater Harvesting in Emergencies
- General Checklist

A detailed manual and standard guidelines are provided for each component.

All project developer and contractors shall be aware of this guideline and contractors must ensure that the procedures outlined in the guideline are followed.

3.2.7 Compliance

In general, the proposed developments are in compliance with the laws and regulations described above. Where there is a special requirement to comply, the EMP identifies measures and mechanisms required to comply.

3.3 Environmental Permits Required for the Project

3.3.1 Environmental Impact Assessment (EIA) Decision Note

The most important environmental permit to initiate project work would be a decision regarding this EIA. The EIA Decision Note, as it is referred to, shall govern the manner in which the project activities must be undertaken. This EIA report assists decision makers in understanding the existing environment and potential impacts of the project. Therefore, the Decision Note may only be given to the Proponent after a review of this document following which the Ministry may request for further information or provide a decision if further information is not required. In some cases, where there are no major environmental impacts associated with the project, the

Ministry may provide the Decision Note while at the same time requesting for further information.

3.3.2 Desalination plant registration permit

The desalination plant cannot be operated unless EPA processes the desalination plant registry. Hence, the plant needs to be registered at EPA before operations begins.

3.4 Responsible Institutions

The main government institutions that have roles and responsibilities relevant to this project are summarised below.

3.4.1 Ministry of Environment and Energy

The Ministry of Environment and Energy (formed in 2012) formerly the Ministry of Housing and Environment is mandated for the effective implementation of the Environmental Protection Act of the country and has the statutory power over issues related to the environment. It has the central control over the environment protection, management, conservation and environmental emergencies. The Ministry operates mainly at a policy level and the more regulatory and technical assessment activities are mandated to the Environmental Protection Agency (EPA). In this respect EPA has now been mandated to manage all issues relating to Environmental Impact Assessment of individual projects.

The Ministry of Environment also seeks the advice of National Commission for the Protection of Environment (NCPE) on all significant environmental matters. The commission is appointed by the president and is mandated to advice the Minister of Environment on environmental matters such as environment assessment, planning and management, and political decisions with regard to the protection of environment.

3.4.2 Ministry of Housing and Infrastructure

The Ministry of Housing and Infrastructure (MHI) is responsible for the construction of infrastructure and allocation of land in Maldives.

3.4.3 Atoll Council

The Maldives is grouped into 20 administrative areas under a new local governance system Raa Atoll has an elected Atoll Council located in Ungoofaaru. The Atoll Council Office is the main focal point of Government Ministries in Male' and they co-ordinate and liaise with government ministries and elected island councils on all issues relating to the Atoll.

A copy of this EIA will be submitted to the Atoll Council.

3.5 Guiding Policies and Documents

3.5.1 Guidelines and Manual for Rainwater Harvesting in the Maldives 2009

This guideline published by Ministry of Housing Transport and Environment in 2009 includes components for rainwater harvesting system that needs to be followed. Components included in the guideline are the following;

- Catchment Area
- Conveyance System
- Storage
- Filtering System
- Distribution
- Protecting Water Quality
- Rainwater Harvesting in Emergencies
- General Checklist

A detailed manual and standard guidelines are provided for each component.

All project developer and contractors shall be aware of this guideline and contractors must ensure that the procedures outlined in the guideline are followed.

3.5.2 National Environmental Action Plan II (NEAP II)

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

Accordingly, the key strategies of the NEAP II are:

- Continuous assessment of the state of the environment in the Maldives, including impacts of human activities on land, atmosphere, freshwater, lagoons, reefs and the ocean; and the effects of these activities on human well-being
- Development and implementation of management methods suitable for the natural and social environment of the Maldives and maintain or enhance environmental quality and protect human health, while at the same time using resources on a sustainable basis

- Ensure stakeholder participation in the decision making process by consultation and collaboration with all relevant sectors of society
- Preparation and implementation of comprehensive national environmental legislation in order to provide for responsible and effective management of the environment
- Adhering to international and regional environmental conventions and agreements and implementation of commitments embodied in such conventions.

Furthermore, NEAP II specifies priority actions in the following areas:

- Climate change and sea level rise; coastal zone management;
- Biological diversity conservation; integrated reef resources management;
- Integrated water resources management;
- Management of solid waste and sewerage;
- Pollution control and management of hazardous waste;
- Sustainable tourism development;
- Land resources management and sustainable agriculture
- Human settlement and urbanization.

3.5.3 National Waste Management Policy 2015

The aim of the waste management policy is to formulate and implement guidelines and means for solid waste management in order to maintain a healthy environment. Accordingly, the key elements of the policy include:

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

The proponents of this project must be aware of the policy and all solid and hazardous waste produced in this project should be disposed according to the Environmental Management Plan for the project, which reflects the principles of the Waste Management Policy.

4 EXISTING ENVIRONMENT

4.1 Physical Environment

4.1.1 Meteorology

4.1.1.1 Climate

The climate in Maldives is warm and humid, typical of the tropics. The average temperature ranges between 25°C to 30°C and relative humidity varies from 73 percent to 85 percent. The annual average rainfall is approximately 1,948 mm. As Maldives lies on the equator, Maldives receives plenty of sunshine throughout the year. Significant variation is observed in the climate between the northern and the southern atolls. The annual average rainfall in the southern atolls is higher than the northern atolls. In addition, greater extremes of temperature are also recorded in the southern atolls. On average southern atolls receive 2704 hours of sunshine each year. Table 4.1 provides a summary of key meteorological findings for Maldives.

Table 4.1: Key Meteorological Information of the Maldives

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

4.1.1.2 Monsoons

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

southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November.

4.1.1.3 Winds

The winds that occur across Maldives are mostly determined by the monsoon seasons. The two monsoons are considered mild given that Maldives is located close to the equator. As a result, strong winds and gales are infrequent although storms and line squalls can occur, usually in the period May to July. During stormy conditions gusts of up to 60 knots have been recorded at Male'.

Wind has been uniform in speed and direction over the past twenty-plus monsoon seasons in the Maldives (Naseer, 2003). Wind speed is usually higher in central region of Maldives during both monsoons, with a maximum wind speed recorded at 18 ms-1 for the period 1975 to 2001. Mean wind speed as highest during the months May and October in the central region. Wind analysis indicates that the monsoon is considerably stronger in central and northern region of Maldives compared to the south (Naseer, 2003).

Besides the annual monsoonal wind variations there are occasional tropical climatic disturbances (tropical storms or low intensity tropical cyclones) in the central region which increases wind speeds up to 110 km/h, precipitation to 30 to 40 cm over a 24 hour period and storm surges up to 3 m in open ocean (UNDP, 2006).

Table 4.2 summarises the wind conditions in central Maldives throughout a year. Medium term meteorological data from Hulhule meteorological centre (see Figure 4.1, Figure 4.2 and Figure 4.3) and findings from long-term Comprehensive Ocean-Atmosphere Data Set (COADS) are used in this analysis.

Table 4.2: Summary of General Wind Conditions from National Meteorological Centre

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

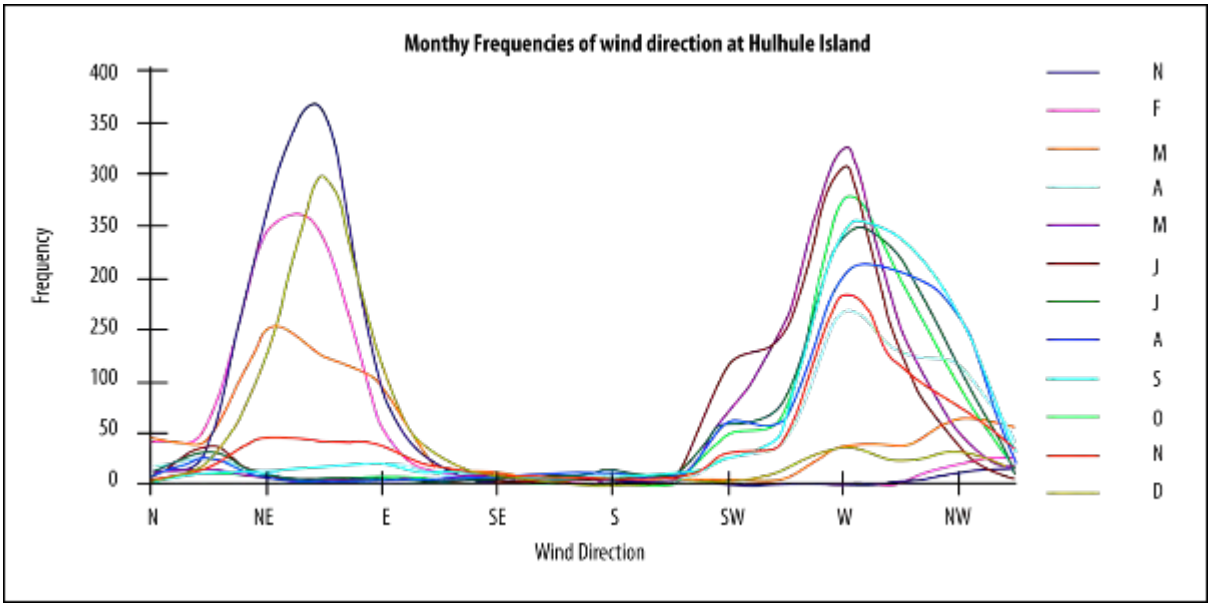


Figure 4.1: Monthly Frequencies of Wind Direction in Central Maldives based on National Meteorological Center 10 year Data (adapted from Naseer, 2003).

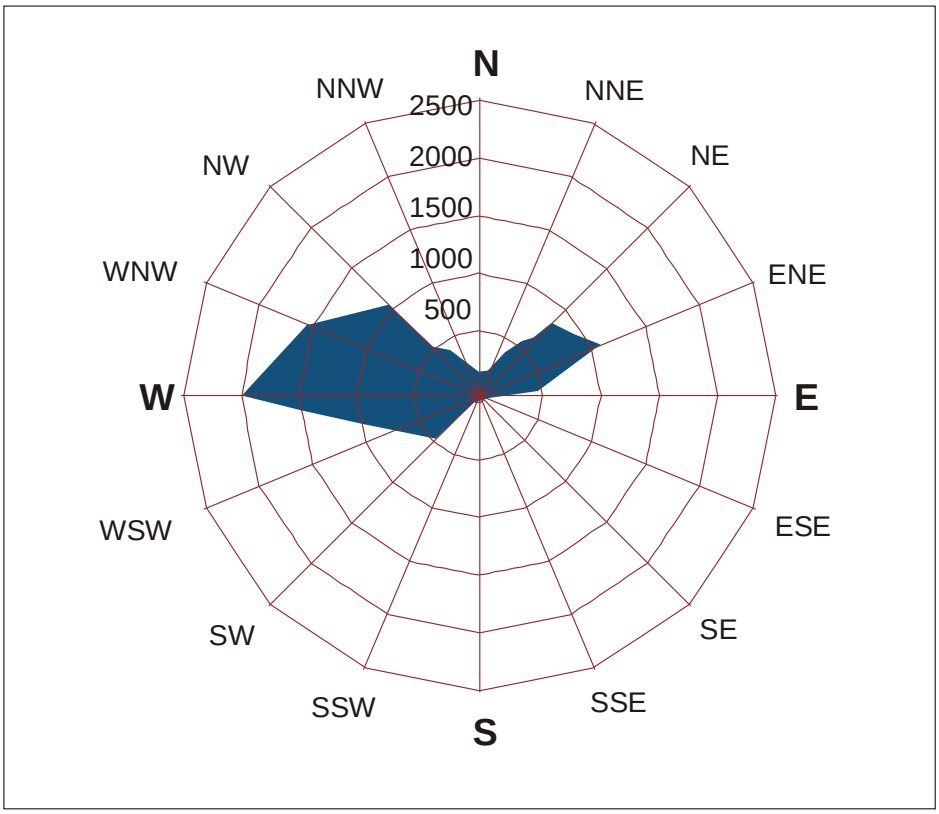


Figure 4.2: 24 Year Wind Frequency Recorded at National Meteorological Center.

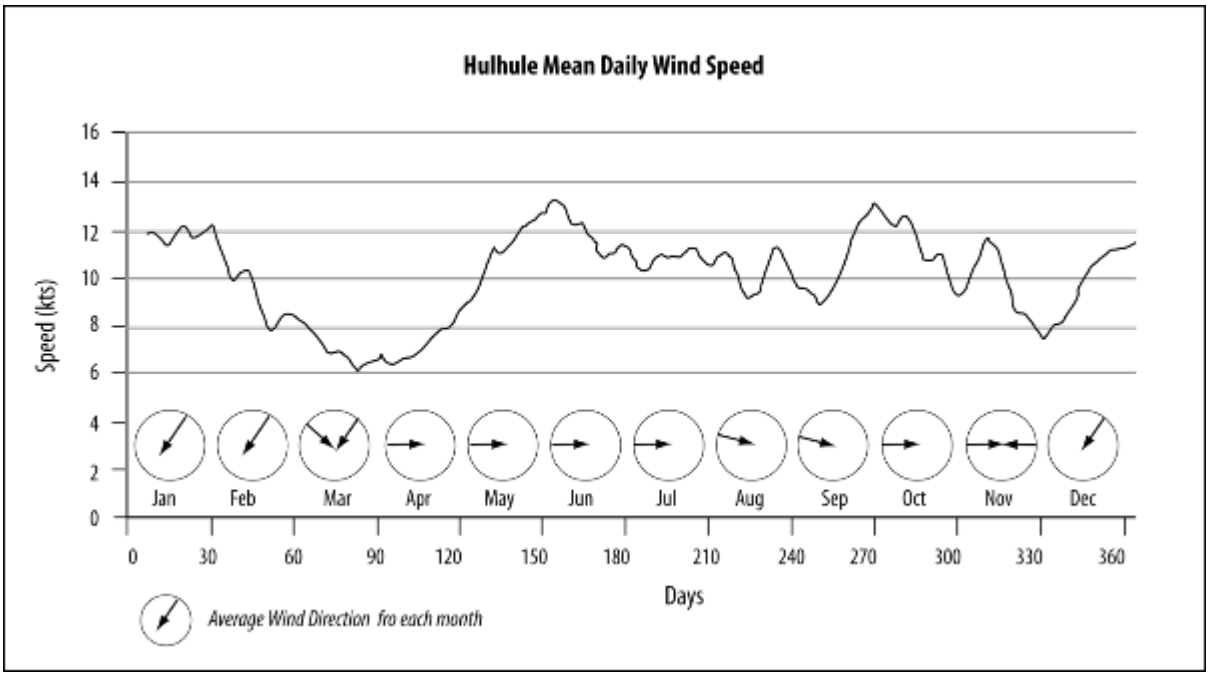


Figure 4.3: Mean Daily Wind Speed and Direction Recorded at National Meteorological Centre (1978 – 2004)

The Disaster Risk Profile of Maldives (UNDP, 1006) reports 11 cyclonic events over the Maldives in the last 128 years and only one event over the central Maldives. All of these events were of category 1 cyclones. There have been no cyclonic events since 1993.

Meedhoo Island is located in a high risk cyclonic hazard zone which has the potential for a maximum probable cyclonic wind speed of 84.2 kts (UNDP, 2006).

The project site is expected to receive regular annual strong winds during the peak SW monsoon.

4.1.1.4 Rainfall

The average annual rainfall for the archipelago is 2,124 mm. There are regional variations in average annual rainfall: southern atolls receive approximately 2,280 mm, and northern atolls receive approximately 1,790 mm annually (MEC, 2004). Mean monthly rainfall also varies substantially throughout the year with the dry season getting considerably less rainfall. This pattern is less prominent in the southern half, however. The proportions of flood and drought years are relatively small throughout the archipelago, and the southern half is less prone to drought (UNDP, 2006).

The nearest meteorological station to Meedhoo is the National Meteorological Centre in Hulhule' Island. The mean annual rainfall in Hulhule' is 1991.5 mm with a Standard Deviation of 316.4 mm and the mean monthly rainfall is 191.6 mm. Rainfall varies throughout the year with mean highest rainfall during October, December and May and lowest between February and April (See Figure 4.4).

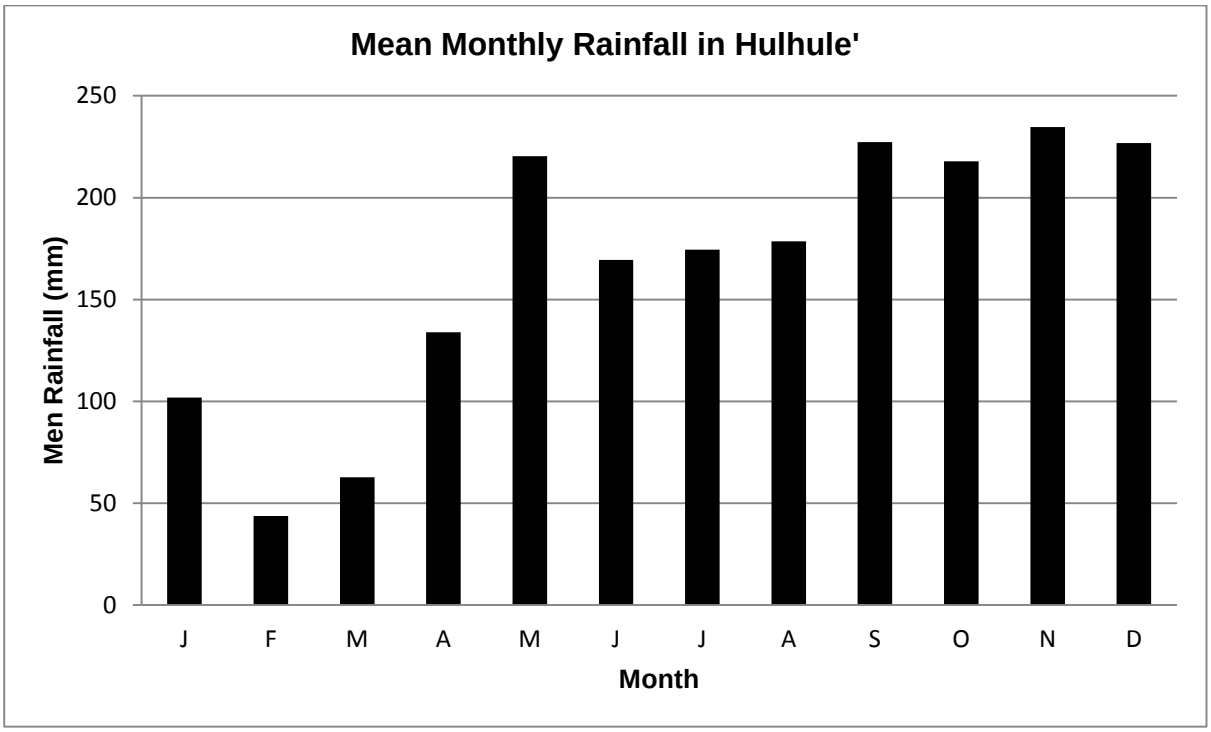


Figure 4.4: Mean Monthly Rainfall in Hulhule' (1975-2004)

Analysis of daily maximum annual rainfall data shows high variability, including extremes (see Figure 4.5 below). However, no significant long term trends are evident in the Hulhule data.

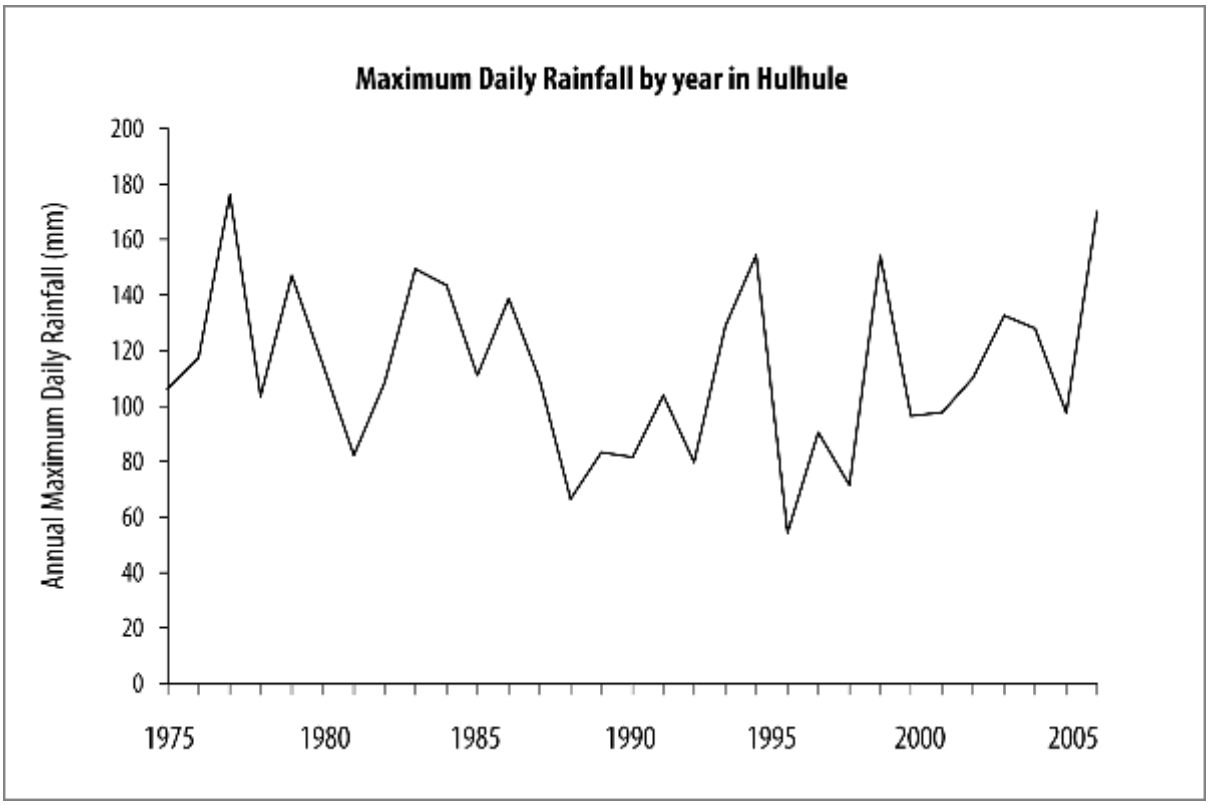


Figure 4.5: Maximum daily rainfall by year in Hulhule' (1975-2005) - (Source: Hay, 2006)

The probable maximum precipitations predicted for Hulhule' by UNDP (2006) are shown in Table 4.3.

Table 4.3 Probable Maximum Precipitation for various Return periods in Hulhule'

Station	Return Period			
	50 year	100 year	200 year	500 year
Hulhule'	187.4	203.6	219.8	241.1

Source (UNDP, 2006)

It would be possible to identify threshold levels for heavy rainfall for a 24 hour period in Meedhoo, which could cause flooding or disruptions to operations. However, it does require observation of historic, daily rainfall data, which at present is unavailable.

4.1.1.5 Temperature

Daily temperatures of Maldives vary little throughout the year with a mean annual temperature of 28°C. The annual mean maximum temperature recorded for Male' during the period 1967-1995 was 30.4°C and the annual mean minimum temperature for the same period was 25.7°C. The highest recorded temperature for Male' was 34.1°C on 16th and 28th of April 1973. The hottest month recorded was April 1975 with a maximum monthly average temperature of 32.7°C, the next highest being 32.6°C in April 1998. The lowest minimum average temperature of 23.7°C was recorded in July 1992.

There is considerable inter annual variability in extreme temperatures for Hulhule as shown in Figure 4.6. A maximum temperature of at least 33.5^{o}C is rare at Hulhule and has a return period of 20 years (Hay, 2006).

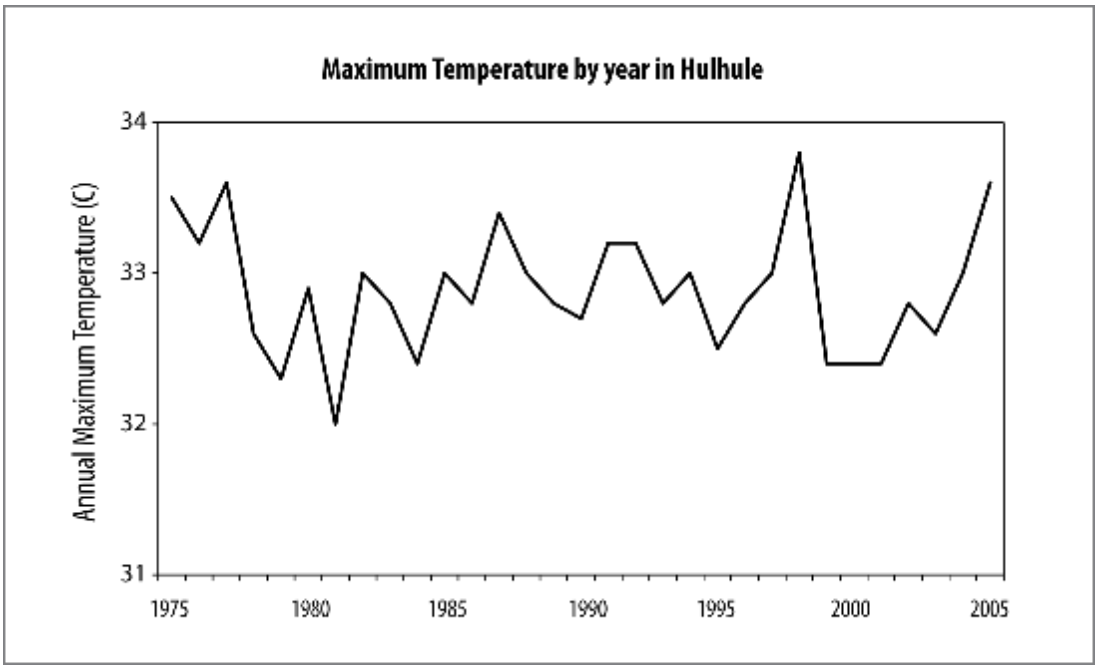


Figure 4.6: Maximum Temperature by year in Hulhule'- 1975-2005 (Source: Hay, 2006)

4.1.2 Hydrology

4.1.2.1 Tidal Pattern

Water levels at the site vary mainly in response to tides, storm surge or tsunamis. Tides in the Maldives are mixed and semi-diurnal/diurnal.

Tidal variations are referred to the standard station in at Hulhulé Island located approximately 163 km from the Meedhoo Island. Typical spring and neap tidal ranges are approximately 1.0m and 0.3m, respectively (MEC, 2004). Maximum spring tidal range in Hulhulé is approximately 1.1m. There is also a 0.2 m seasonal fluctuation in regional mean sea level, with an increase of about 0.1m during February to April and a decrease of 0.1m during September to November. Table 4.4 summarizes the tidal elevations reported at Hulhulé, which is representative of tidal conditions at the project site.

Table 4.4: Tidal Variations at Hulhule International Airport

Tide Level	Referred to Mean Sea level
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 (MHLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

4.1.2.2 Waves

There are two major types of waves observed along the islands of Maldives. The first type is wave generated by local monsoon wind with a period of 3-8 seconds and the second type is swells generated by distance storms with a period of 14-20 seconds [Kench et. al (2006), DHI (1999), Binnie Black & Veatch (2000), Lanka Hydraulics (1988a & 1998b)]. The local monsoon predominantly generates wind waves, which are typically strongest during April-July in the southwest monsoon period. Wave data for Male and Hulhulé' between June 1988 and January 1990 (Lanka Hydraulics 1988a & 1998b) shows that the maximum significant wave height (Hs) recorded for June was 1.23 m with a mean period (Tm) of 7.53s. The maximum recorded Hs for July was 1.51 m with a Tm of 7.74s. The mean wave periods were 5.0 – 9.0s and the peak wave periods were within 8.0 – 13.0s.

Maldives experiences occasional flooding caused by long distance swell waves that are generated by South Indian Ocean storms (Goda 1988). The swell waves of height 3 meters that flooded Male' and Hulhulé' in 1987 are said to have originated from a low pressure system off west coast of Australia (refer the next section for more detail). In addition, Maldives has recently been subject to an earthquake-generated tsunami reaching heights of 4.0m on land (UNEP, 2005). Historical wave data from Indian Ocean countries show that tsunamis have occurred in more than 1 occasion, most notable has been the 1883 tsunami resulting from the volcanic explosion of Karakatoa (Choi et al., 2003).

Meedhoo Island is exposed to wind generated waves during both monsoons and during transition periods. The eastern and northern side receives the strongest waves during the peak NE monsoon (see figure 4.7) and during transition periods when wind blow from a northerly to north-easterly direction.

The southern and western side receives the strongest waves during the SW monsoon.

4.1.2.3 Swell Waves and Storm Surges

Waves studies around Maldives have identified the presence of swell waves approaching predominantly from a southwest to a southerly direction Kench et. al (2006), Young (1999), DHI(1999), Binnie Black & Veatch (2000) and Naseer (2003).

Being located inside the atoll lagoon, the reef system is generally protected from predominant Indian Ocean swells approaching from the SW and the SE. However the atoll passes on both western and eastern rim allows swell waves to refract through them reach Meeadhoo reef system albeit with reduced energy. The strongest swells occur between May and July.

Waves generated from abnormal events could also travel against the predominant swell propagation patterns (Goda, 1998), causing flooding on the eastern and southern islands of Maldives (UNDP, 2009).

As noted in the previous section, Meedhoo Island is located in a moderately high risk cyclonic hazard zone. It has the potential for a 2.30 m storm tide in a 500 year return period (UNDP, 2006, p45).

4.1.2.4 Currents

Currents that affect the reef system of Meedhoo Island can be caused by tidal currents, wind-induced currents and wave-induced currents. It is presumed that generally current flow through the country is defined by the two-monsoon season winds. Westward flowing currents are dominant from January to March with the change in current flow pattern taking place in April and December (Kench et. al, 2006). In April the westward currents become weak while the eastward currents start to take over. In December the eastward currents are weak with the westward currents becoming more prominent. Hence, currents within the site are very likely to be heavily influenced by the monsoons.

Current measurements were undertaken on the island during field visits (SW monsoon) during day time high tide. Generally, long term studies are required to establish the prevailing site specific current patterns. However, due to time limitations of the present study a snapshot assessment was undertaken using drogue technique. The findings of the tide measurements are presented in Figure 4.8. Current measurements varied based on location. Current flow was generally in an easterly direction. Flow rate was generally high at the time of the survey, between 0.3 and 0.4 m/s.

The proposed outfall site has good year round tidal flushing.

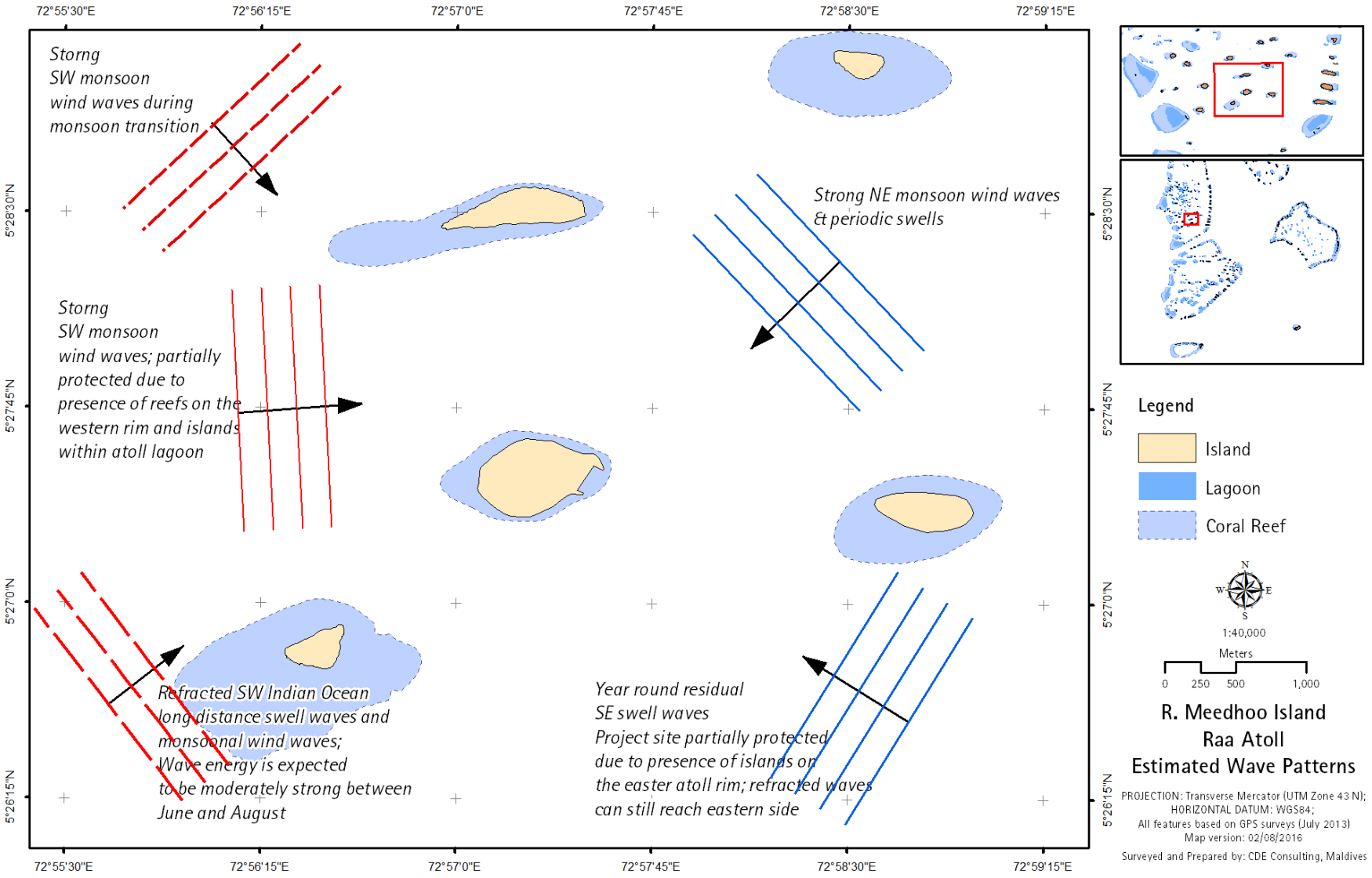


Figure 4.7: Estimated wave patterns aorund Meedhoo Island

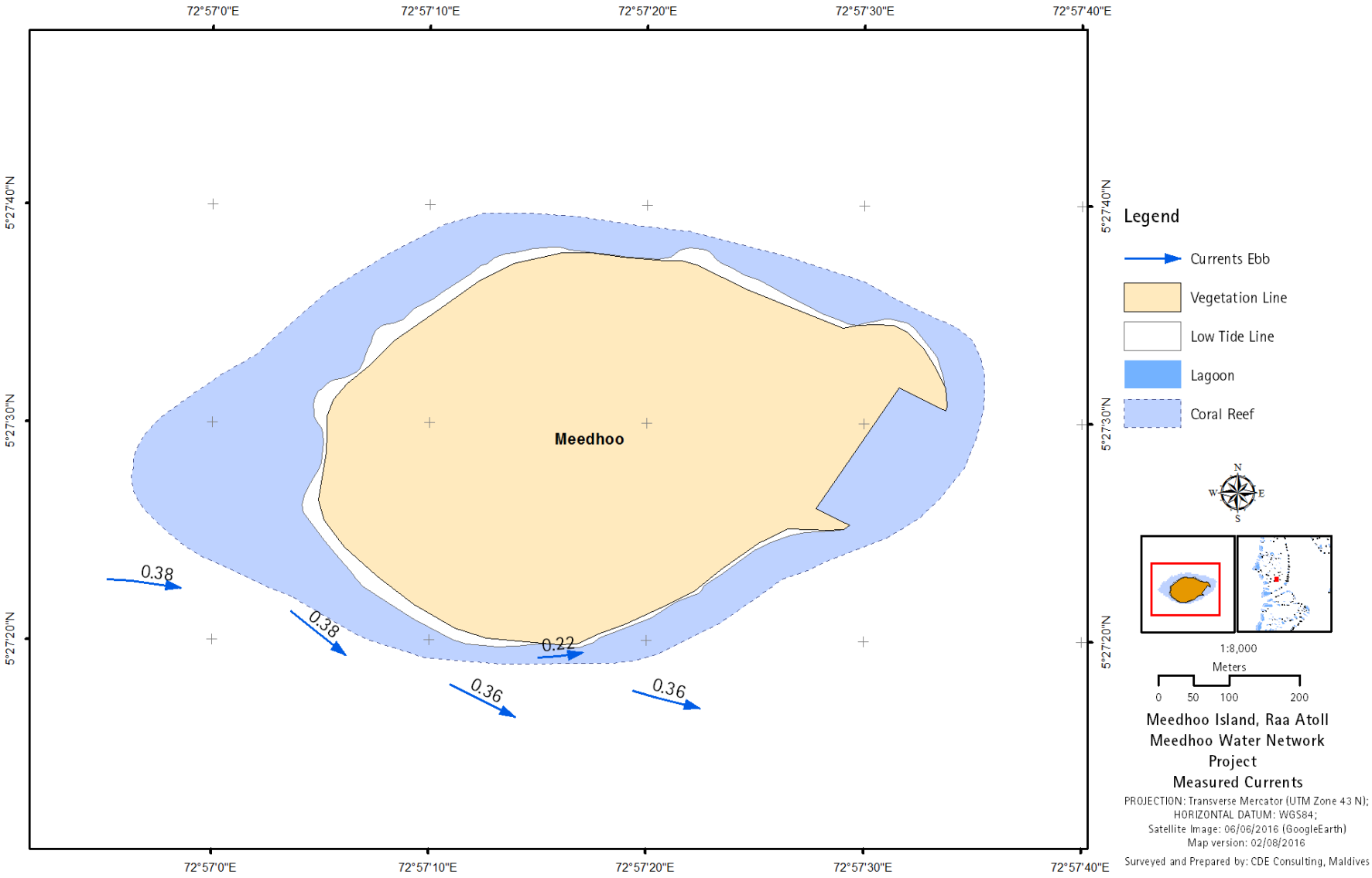


Figure 4.8: Results of current study

4.1.3 Ground Water Quality Assessment

The primary objective of the ground water quality sampling was to determine the baseline conditions of the ground water in Meedhoo, especially at the proposed project site. All water quality tests were done at the Male' Water & Sewerage Company laboratory.

The following table shows the test results of the ground water samples collected on 19th July 2016. Laboratory results are attached in Appendix C.

Table 4.5: Results of water quality testing for groundwater

Parameter	Optimal Range by EPA for product water	GW1	GW2	GW3
Physical appearance	Clear	Pale yellow with particles	Clear with particles	Clear with particles
Temperature ^{0}C	18 - 32	27.4	26.4	26.8
Conductivity	NE	19480	674	14100
pH	6.5 – 8.5	7.24	7.79	7.24
Total Petroleum Hydrocarbon	NE	**23.4**	0.27	0.14
Salinity ‰	NE	**11.57**	0.33	**8.15**

(NE – not established, TNTC- too numerous to count)

At present there are no established reference quality parameters for ground water in the Maldives. Nonetheless, EPA provides a standard that needs to be maintained by the desalination plants for product water, which is described in the above table. However, the standards may not be applicable to groundwater as the inherent characteristics of groundwater are different from desalinated seawater.

The investigations of groundwater quality revealed that most of the parameters are within the limits specified by EPA for sites GW2 and GW3. Sample taken from GW1 appears to be contaminated by oil and saltwater intrusion. The site has a high count of salinity (11.57%) and

Total Petroleum Hydrocarbon (23.4 mg/L). This must be taken into note as GW1 is the site next to the proposed site for RO plant house. Site 3 is also contaminated by high salt content with a salinity count of 8.15%.

4.1.4 Marine Water Quality Assessment

The primary objective of the marine water quality sampling was to determine the baseline conditions of the marine water in Meedhoo, especially at the proposed project site. Two sites were selected for marine water quality assessment, proposed outfall location and alternative outfall location. All water quality tests were done at the Male' Water & Sewerage Company laboratory.

The following table shows the test results of the ground water samples collected on 19th July 2016. Laboratory results are attached in Appendix C.

Table 4.6 Marine water quality assessment results from MWSC laboratory

Parameter	Optimal Range (EPA)	Results	
		SW1 (Proposed outfall)	SW2 (Alternative outfall)
Physical appearance	Clear	Clear with particles	Clear with particles
pH	8.0 – 8.3	8.06	8.12
Temperature (°C)	18 - 32	21.7	26.1
Salinity (°/₀₀)		35.2	32.24
Total Dissolved Solids (mg/l)	-	26700	26000
Conductivity		53300	52000
Dissolved Oxygen		7.98	7.99
Total Coliforms (mg/L)	0	0	0
Faecal Coliforms (mg/L)	0	0	0

The investigations of marine water quality revealed that most of the parameters are within limits specified in the EPA guideline. Parameters, temperature, pH are well within acceptable limits. Total coliform count and faecal count is also within the limit specified in the EPA guidelines. This indicates that marine water quality around the island is in good condition.

4.1.5 Soil

In order to analyse the soil profile of the area, a borehole (5ft x 5ft) was made (See Appendix D for survey location map) on the island. The soil conditions of the site were similar to soil

conditions of other islands across the Maldives, consisting considerable quantities of un-weathered corals as parent materials, coral rocks and sand.

The top layer is a layer of peat and black soil (5cm) followed by layer of black soil (20cm) and a transition layer (25cm) from black to white sand. The layer of white sand (15cm) is followed by a shallow hard pan layer (5cm) of limestone before finding an additional deep layer of fine white sand (40cm) underneath. The water table is reached at a depth of 1.1m (See Figure 4.12).

The pH of the water sample taken at the site was 7.24. The soil is generally poor and deficient in nitrogenous nutrients, potassium and several other micronutrients; particularly iron, manganese and zinc.

Figure 4.9: R. Meedhoo RO Plant Site Soil Profile

4.1.6 Noise

Baseline noise measurements at the proposed project site was recorded on 19th July 2016. In general, much of the noise during daytime is associated with background noise level of the settlement, including vehicle movements and other natural noises. On average the maximum noise level is at 81 dBA and minimum noise level is 66 dBA. It should be noted that powerhouse was located approximately within 20 m radius from the proposed project which explains the high noise level at this site. Table 4.7 below displays the results of the noise measurements.

Table 4.7 Baseline noise measurements

Location	Noise level (dBA)
10 m radius from proposed site	73
20 m radius from proposed site	81
30 m radius from proposed site	66

4.2 Biological Environment

4.2.1 Marine Environment

The aim of this assessment is to establish the baseline condition at the proposed project location. Marine assessments were carried out from 19th July 2016, the sea was rough and the sky was partially cloudy during the survey. The main objectives of this assessment were:

1. To determine the general status of the reef associated with the island
2. To assess the condition of the marine environment which will be directly impacted by the project
3. To determine the fish species abundance and composition of the reef system

The following sub-sections provide details site, the methodology adapted for this assessment and the results.

4.2.1.1 Photo Quadrat Survey and Fish Census

Photo Quadrat survey and fish census were carried out at two sites near the project location.

Proposed Brine Outfall

This transect was deployed at 3m depth, along the reef edge on the south side of the island. Visibility was poor during the assessments. This site was assessed as it is the proposed site for brine disposal.

Reef system at this site is almost completely dead with only a few live corals and magnificent sea anemones, leaving more surfaces for the vigorous expansionist carpet Corallimorph. Analysis of the photos shows that the dominant benthic substrates at this site are Corallimorphs belonging to the class Zoantharia (39%) and coral rubble (26%). The carpet Corallimorph observed at this site is an invasive species which reproduce very quickly and dominate entire habitats. Coral coverage at this site was very poor making up 0.5% of the

surveyed area. Only a few massive type *Porites* were recorded from this site. Rest of the area was covered in dead rocks and coral rubble. Ascidians were also observed at this site.

A total of 29 fish species belonging to 10 fish families were recorded during the fish census. Highest numbers of fish species were recorded from families *Pomacentridae* (10 species) and *Chaetodontidae* (4 species). The most abundant fish species recorded was Maldivian Anemonefish. This species is associated with the magnificent sea anemone.

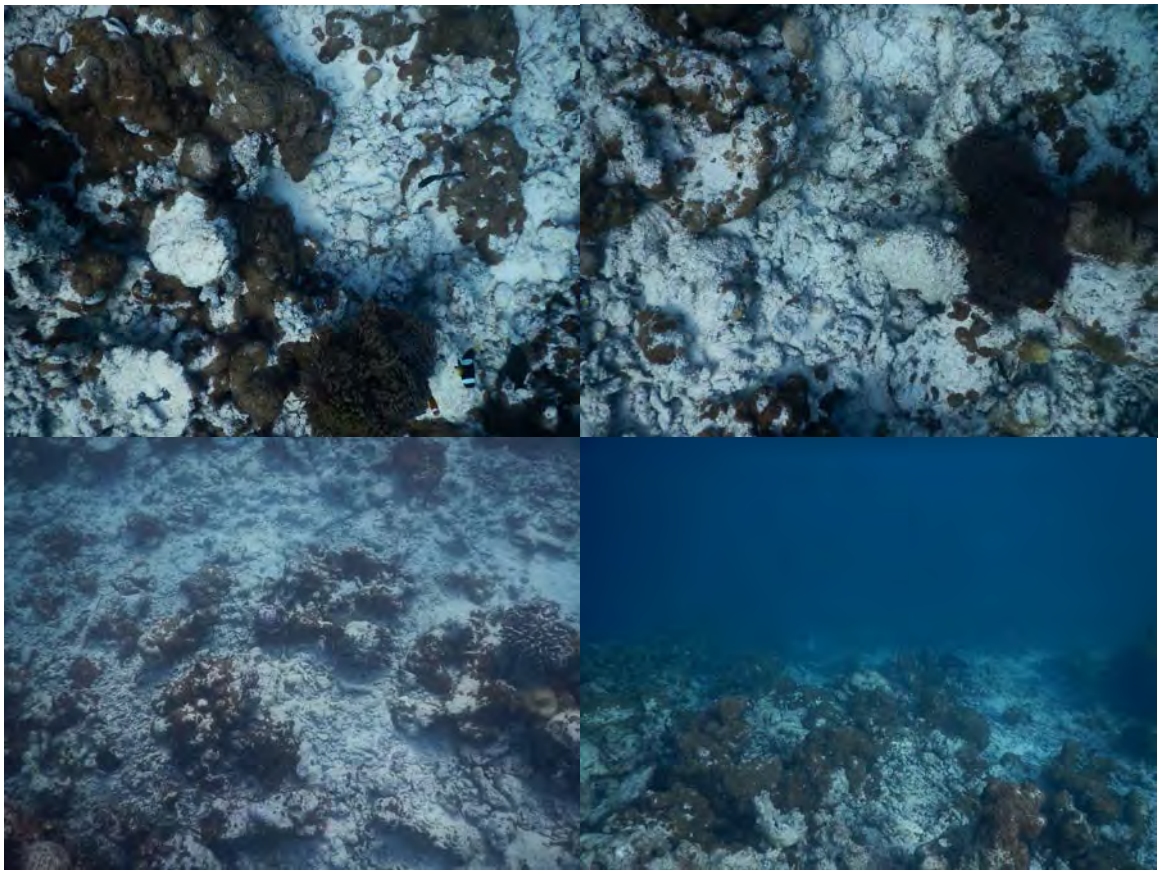


Figure 4.10: Selected images showing benthic composition along proposed brine outfall

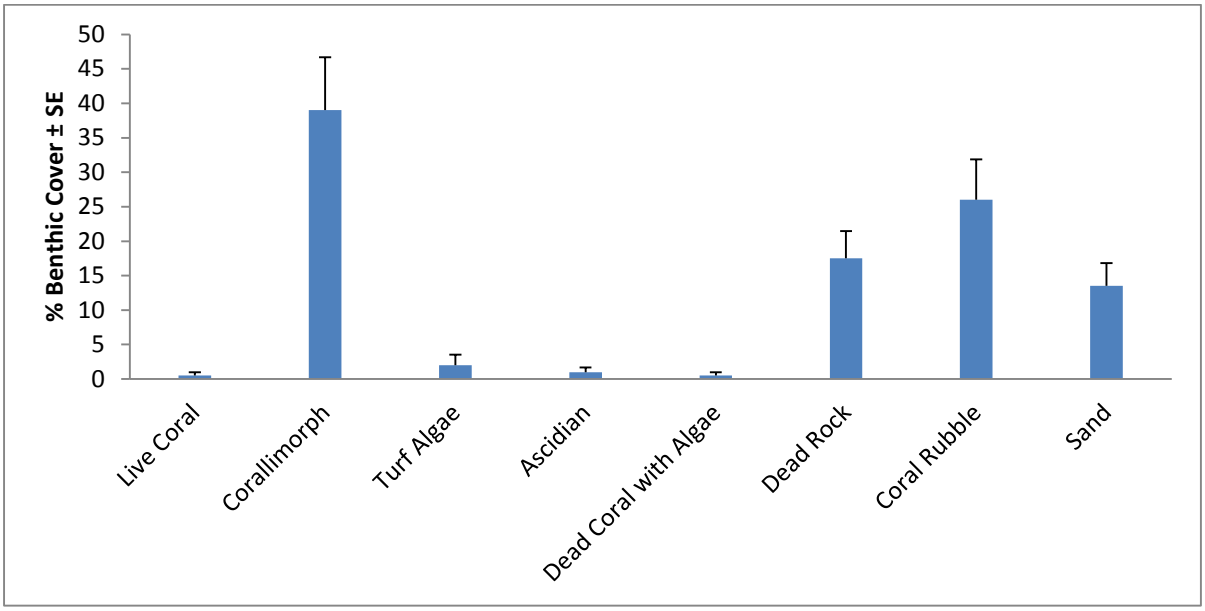


Figure 4.11: Benthic substrate composition and coral genera composition along proposed brine outfall

Table 4.8: Summary of fish census data along transect 1

Family	***Species***	**Common Name**	**Abundance**
Serranidae (Groupers)	*Cephalopholis argus*	Peacock Rock Cod	2
Serranidae (Basslets)	*Pseudanthias squamipinnis*	Orange Basslet	4
Mullidae	*Parupeneus barberinus*	Dash-and-Dot Goatfish	2
Chaetodontidae	*Hemitaurichthys zoster*	Black Pyramid Butterflyfish	3
	Chaetodon kleinii	Brown Butterflyfish	2
	Chaetodon auriga	Threadfin Butterflyfish	2
	Heniochus diphreutes	Schooling Bannerfish	4
Pomacentridae	*Amphiprion clarkii*	Clark's Anemonefish	2
	Amphiprion nigripes	Maldivian Anemonefish	6
	Dascyllus aruanus	Humbug Damsel	3
	Dascyllus trimaculatus	Three-spot Humbug	4
	Chromis virdis	Green Puller	5
	Chromis dimidiata	Two-tone Puller	3
	Chromis weberi	Weber's Puller	5
	Pomacentrus caeruleus	Blue-yellow Damsel	3
	Plectroglyphidodon dickii	Narrowbar Damsel	2
	Stegastes nigricans	Dusky Gregory	2
Labridae	*Labroides dimidiatus*	Blue-streak Cleaner Wrasse	2
	Gomphosus caeruleus	Bird Wrasse	3
	Thalassoma amblycephalum	Two-tone Wrasse	4
	Thalassoma hardwicke	Six-bar Wrasse	2
Scaridae	*Cetoscarus bicolor*	Two-colour Parrotfish	2
	Scarus sordidus	Shabby Parrotfish	2

Zanclidae	*Zanclus cornutus*	Moorish Idol	2
Acanthuridae	*Acanthurus leucosternon*	Powder-blue Surgeonfish	2
	Ctenochaetus striatus	Fine-lined Bristletooth	4
Balistidae	*Melichthys indicus*	Indian Triggerfish	2
	Pseudobalistes flavimarginatus	Yellow-margin Triggerfish	2
	Odonus niger	Blue Triggerfish	1

Southwest site

This transect was deployed at 3 m depth, along the reef edge to the south western side of the island.

Live coral cover at this site is very poor making up 1 % of the area. Only a few massive type *Porites* corals were recorded. Most dominant benthic substrate at this site is dead coral rubble (45.5 %) and large dead rocks (25.5%). The carpet corallimorph which was recorded from the previous transect was densely covered on the large dead rocks at this site, making up 14 % of the area. Few magnificent sea anemones were also observed with some of them partially or completely bleached.

A total 33 fish species belonging to 11 fish families were recorded during the fish census at this site. Highest number of fish species was recorded from families' *Pomacentridae* (8 species) and *Chaetodontidae* (6 species). The most abundant fish species recorded was Two Tone Puller (*Thalassoma amblycephalum*).

Figure 4.12: Select images showing benthic substrate cover along alternative brine outfall

Figure 4.13: Benthic substrate composition and coral genera composition along proposed brine outfall

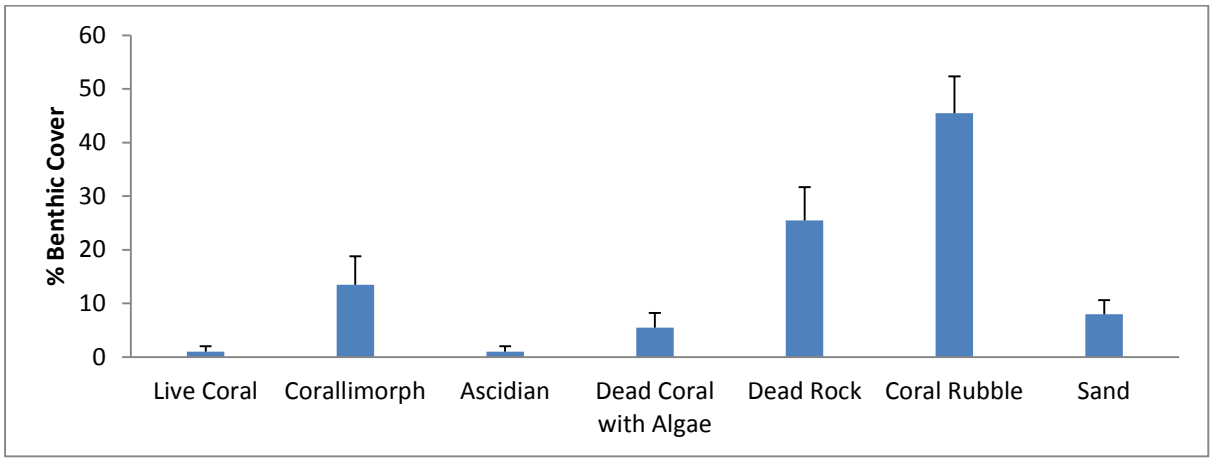


Table 4.9: Summary of fish census data along transect 2

Family	***Species***	**Common Name**	**Abundance**
Holocentridae	*Sargocentron caudimaculatum*	White-tail Squirrelfish	2
	Myripristis pralinia	Big-eyed Soldierfish	2
Serranidae (Groupers)	*Cephalopholis argus*	Peacock Rock Cod	2
Nemipteridae	*Scolopsis bilineata*	Monacle Bream	2
Mullidae	*Parupeneus barberinus*	Dash-and-Dot Goatfish	2

Chaetodontidae	*Hemitaurichthys zoster*	Black Pyramid Butterflyfish	3
	Chaetodon trifasciatus	Pinstriped Butterflyfish	2
	Chaetodon kleinii	Brown Butterflyfish	2
	Forcipiger flavissimus	Long-nose Butterflyfish	2
	Heniochus pleurotaenia	Phantom Bannerfish	3
	Heniochus diphreutes	Schooling Bannerfish	3
Pomacentridae	*Amphiprion clarkii*	Clark's Anemonefish	4
	Amphiprion nigripes	Maldivian Anemonefish	5
	Dascyllus aruanus	Humbug Damsel	3
	Chromis virdis	Green Puller	5
	Abudefduf vaigiensis	Sergeant Major	3
	Plectroglyphidodon lacrymatus	Jewel Damsel	2
	Plectroglyphidodon dickii	Narrowbar Damsel	3
	Stegastes nigricans	Dusky Gregory	3
Labridae	*Halichoeres hortulanus*	Checkerboard Wrasse	3
	Thalassoma amblycephalum	Two-tone Wrasse	5
	Thalassoma hardwicke	Six-bar Wrasse	3
	Thalassoma janseni	Jansen's Wrasse	2
Scaridae	*Cetoscarus bicolor*	Two-colour Parrotfish	2
	Scarus sordidus	Shabby Parrotfish	2
Zanclidae	*Zanclus cornutus*	Moorish Idol	2
Acanthuridae	*Acanthurus leucosternon*	Powder-blue Surgeonfish	2
	Ctenochaetus striatus	Fine-lined Bristletooth	4
	Zebrasoma scopas	Brown Tang	2
	Naso hexacanthus	Sleek Unicornfish	3
Balistidae	*Melichthys indicus*	Indian Triggerfish	2
	Pseudobalistes flavimarginatus	Yellow-margin Triggerfish	2
	Sufflamen bursa	Boomerang Triggerfish	2

4.2.1.2 Marine Protected Areas and Environmentally Sensitive Sites

There is one Marine Protected Area (MPA) in Raa atoll; Vilingilee Thila located 11 kilometres south to Meedhoo Island.

There are 3 Environmentally Sensitive Areas listed by the EPA within 10 kilometres radius to the project location; Dheburidheythere Vaadhoo (7.2 km), Neyo (9.5 km) and Muhlaafushi (9km). The proposed project is not expected to have any significant impact on the Marine Protected Area (MPA) and Environmentally Sensitive Areas (ESA) listed above.

4.2.2 Terrestrial Environment

The aim of this assessment was to establish the baseline condition of the terrestrial environment at the proposed project location in Meedhoo Island, Kaafu Atoll.

The sub-objectives of the assessments include determination of the present terrestrial fauna, flora, vegetation groups and soil conditions at the proposed location.

4.2.2.1 Flora

General Characteristics

The proposed site is located on the southern side of Meedhoo Island, on a junction diagonally opposite to the existing FENAKA site. The area is partially vegetated and can be best described as an area of coastal bush vegetation.

No dense pockets of vegetation were observed at the site. A single tree was observed on site, an 18m~ Kaani tree (*Cordia subcordata*). No other trees were observed on the site, however there were some Midhili (*Terminalia catappa*), Dhigga (*Hibiscus tiliaceus*) and Kaani (*Cordia subcordata*) trees in the surrounding area outside the proposed site. A large number of small (<3m) Ipil ipil trees (*Leucaena leucocephala*) were also observed on site, with the rest of the site covered in various grass/ ground cover species.

The site has multiple access pathways and urban sites adjacent to the proposed site. The site is easily accessible and no unique trees or groups of vegetation were observed during the field visit.

Vegetation Types

Since the area of assessment is relatively small (compared to the size of an average island) and as there are relatively few species on the site, there are no specific vegetation groups that can be classified at this location. Generally the site can be classified as an area of coastal bush vegetation.

Figure 4.14: A large number of small Ipil ipil (Leucaena leucocephala) trees were observed on site

Figure 4.15: The site is partially covered in grass/ ground cover species

Figure 4.16: The existing FENAKA site opposite to the proposed RO plant site

4.2.2.2 Fauna

General Characteristics

The site is located in an urban area close to shore with limited vegetation. The only species recorded during the field visit was the common crow (*Corvus linnaeus*), and the common garden lizard (*Calotes versicolor*).

However, based on local accounts and experiences from similar conditions found in the Maldives, it can be said that some other common species such as the Rat (*Rattus sp.*), Fruit bats (*Pteropus giganteus ariel*) and other small fauna will be found in this area.

No bird species or other faunal species of significant importance was identified for the proposed RO plant site.

4.3 Natural Hazard Assessment for the Site

According to the UNDP Disaster Risk Assessment Report of Maldives in 2006, proposed site is located in an area exposed to tsunami, wind storms, storm surges and flooding. According to Disaster Risk Profile, Meedhoo has a multi hazard social risk index of 1The following parameters can be deduced for the Meedhoo Region based on Disaster Assessment Report and the Detailed Island Risk Assessment Reports (UNDP, 2009).

Tsunami: Maximum probable wave height range 0.3 m

Cyclone or storm (wind): Probable maximum wind speed 84.2 knots

Storm surge: predicted storm surge height – 0.99 m; predicted storm tide height 1.97 m

Rainfall: probable maximum daily rainfall for Hulhule' for a 500 year return period 284.4 mm

Based on these parameters, field surveys and planned design parameters of the island, the methodology for risk assessment identified in the Detailed Island Risk Assessment Reports (UNDP, 2009) and findings from Ali (2005) was used to assess the hazard risks on the site. However, the results should be treated with caution as this is a preliminary risk assessment. A more comprehensive assessment will require a longer timeframe and more data, which is beyond the scope of this study.

4.4 Island Social Socio-Economic Setting

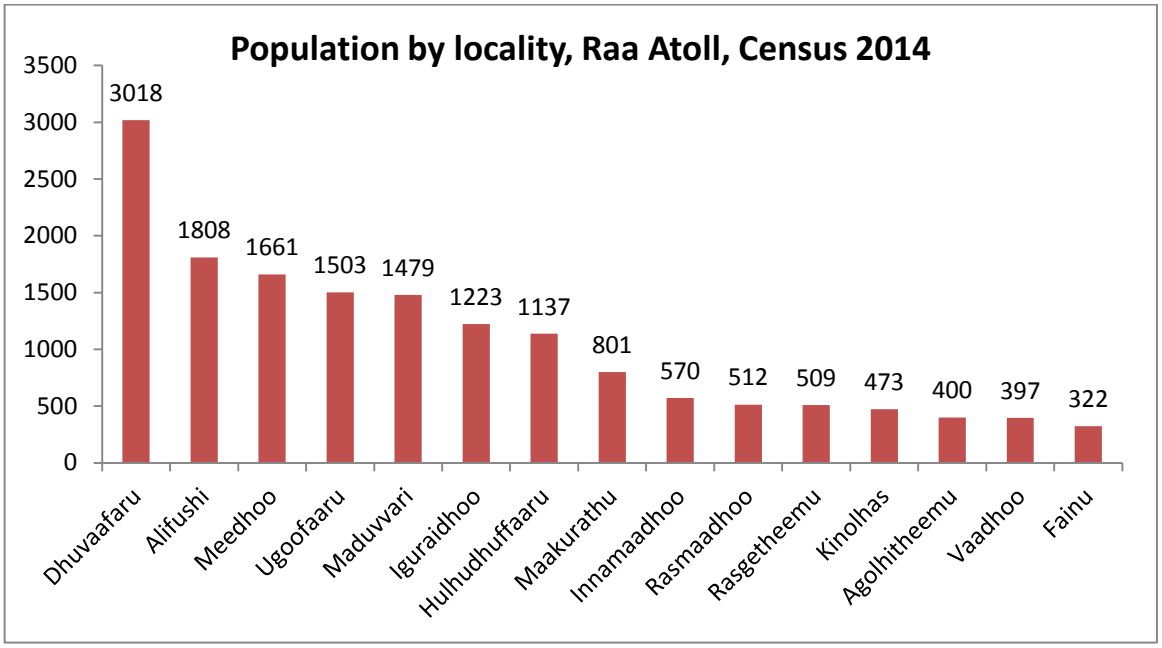
4.4.1 R. Meedhoo

4.4.1.1 Population Characteristics

Total Population

According to Preliminary results of Census 2014, Meedhoo had a total population of 1,661. Out of the total enumerated population in 2014, 828 were males and 833 were females. The population in 2014 was comprised of 1,607 Maldivians (781 males and 826 females) and 54 foreigners (47 males and 7 females). Meedhoo has the third highest population in North Maalhosmadulu Atoll and makes up 10.50 per cent of the atoll population. Figure 4.17 below represents population sizes for the all administered islands in the atoll.

Figure 4.17: Population Size by locality, R Atoll, Census 2014



Source: National Bureau of Statistics, 2014

Sex Ratio

According to census 2006, there were more females than males in *Meedhoo* with a sex ratio of 93 males per 100 females. The current population of *Meedhoo* also shows that there are more females than males in *Meedhoo*, however, the difference in the number of males and females have increased. The current sex ratio of Meedhoo, according to the census 2014, is 95 males per 100 females.

Annual Growth Rate

According to census 2006 and 2014, the population of Raa atoll experienced a positive population growth with an average annual growth rate of 0.18. A similar trend is observed in Meedhoo for the period between 2006 and 2014, with an average annual growth of 0.91. Table 4.10 below shows the population figures for Meedhoo during census 2000 and 2006.

Table 4.10: Population figures for Census 2006 and 2014 for R. Meedhoo

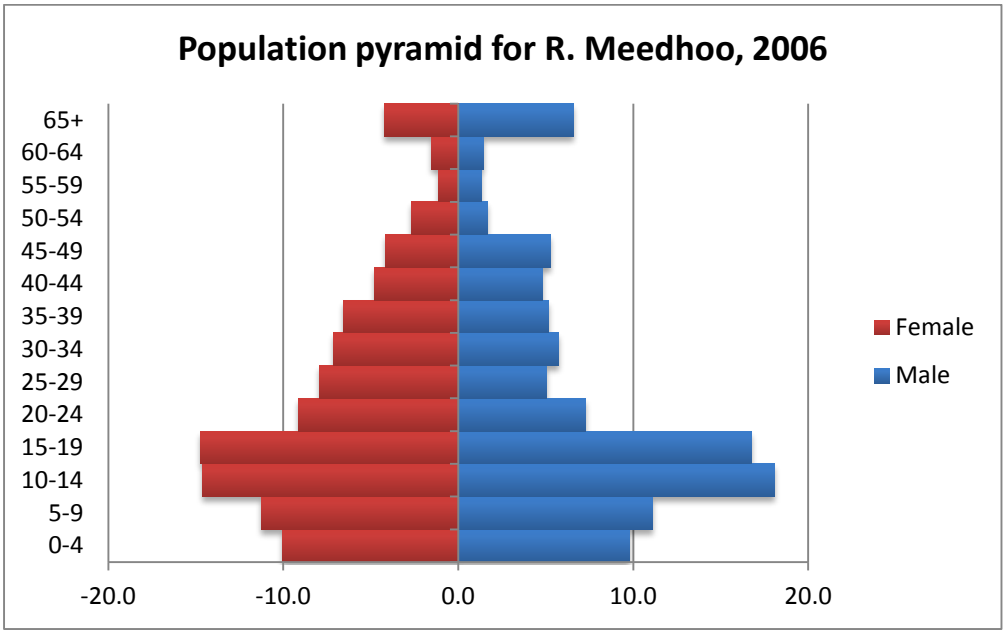
	Census 2006	**Census 2014**
Total Population	1736	1661
Male	838	828
Female	898	833

Source: Ministry of Planning and National Development, 2008 and National Bureau of Statistics, 2014

Population Structure

The general structure of Meedhoo population is shown in Figure 4.18 below. The dependent population is 42.8%, which comprises of 37.4% children and 5.4% elderly. The working age population comprises 57.2% of the total population of the island. According to this pyramid, the most dominant age group for R. Meedhoo is age group 15-19.

Figure 4.18: Population Pyramid for R. Meedhoo, Census 2006



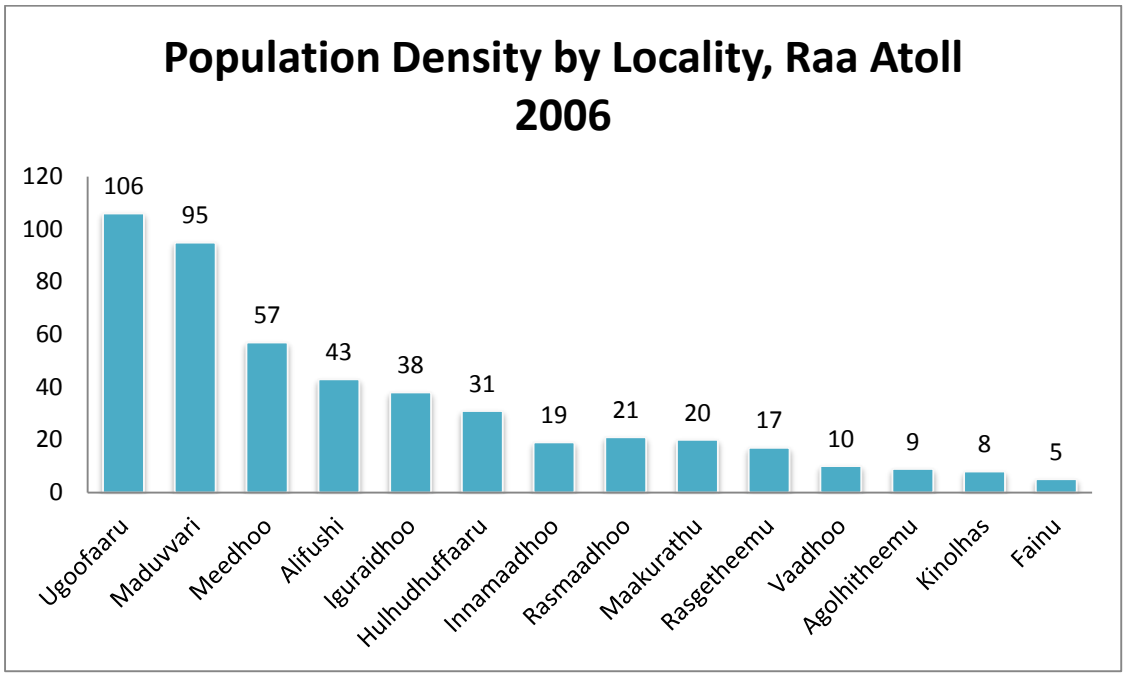
Source: Ministry of Planning and National Development, 2008

Island Sizes and Population density

According to Maldives Population and Housing Census 2006, Hulhudhuffaaru is the biggest administered island in Raa atoll with an area of 48.6 hectares. The smallest administered island in the atoll is Maduvvari with an area of 16.4 hectares. Meedhoo has an area of 30.6 hectares according to census 2006.

Ugoofaaru is the most densely populated island in the atoll with a population density of 106 persons per hectare. The least populous island is Fainu with a population density of 5 persons per hectare. Figure 4.19 below shows population densities for all administered islands in the atoll. The density is given in persons per Hectare.

Figure 4.19: Population density for R Atoll, Census 2006

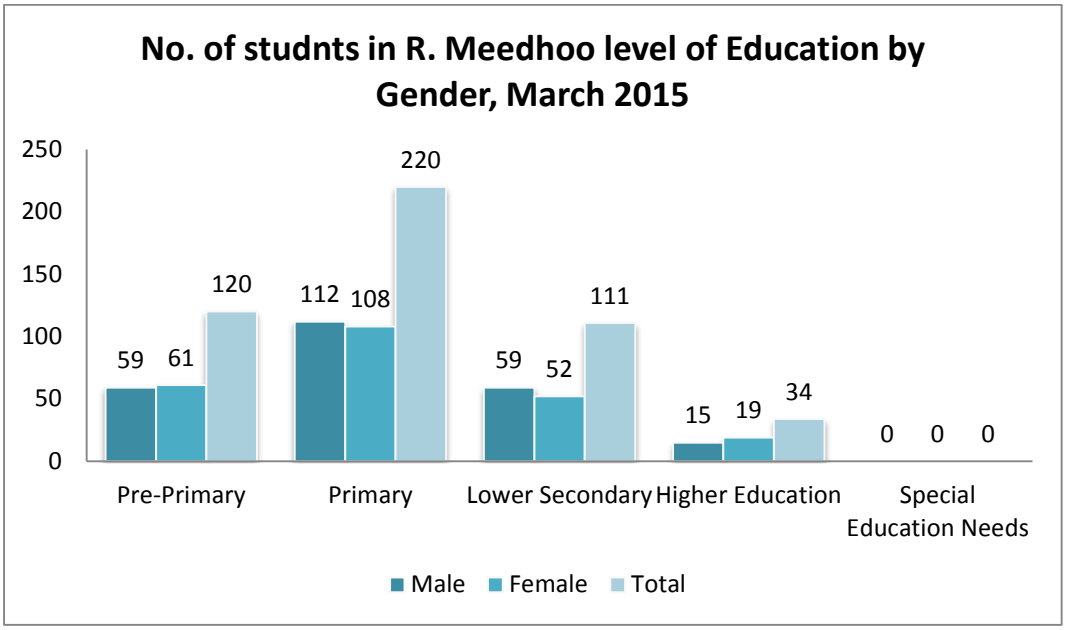


Source: Ministry of Planning and National Development, 2008

4.4.1.2 Education

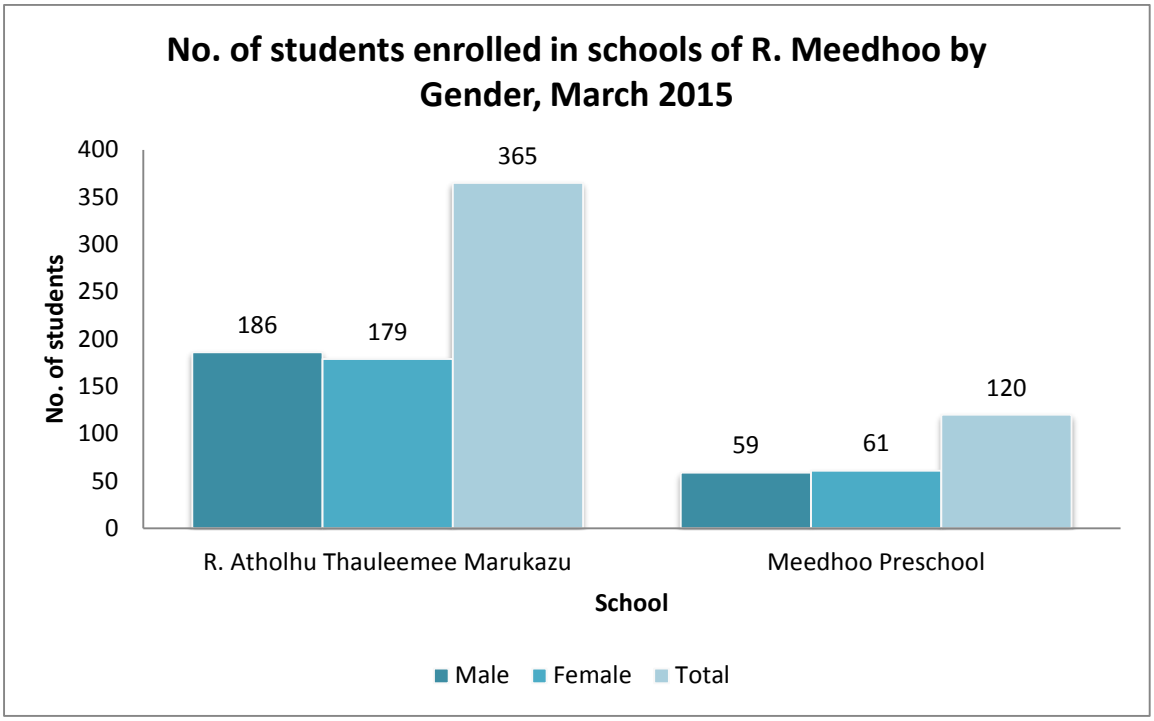
According to School Statistics report published by the Ministry of Education in 2015, there were a total of 485 students in Meedhoo enrolled in different levels of studies. Out of the total student population, 245 were males and 240 were female students. Figure 4.20 below shows the number of students enrolled in different levels of education by gender in March 2015 in Meedhoo.

Figure 4.20: Number of students in Meedhoo by level of education and by gender in March 2015



There is 1 Government school in Meedhoo; R. Atholhu Thauleemee Marukazu, that teaches from grade 1 to 12. Additionally there is one pre-school in the island, Meedhoo Preschool that is run by the community. Figure 4.21 shows the number of students enrolled in each school of Meedhoo by gender in March 2015.

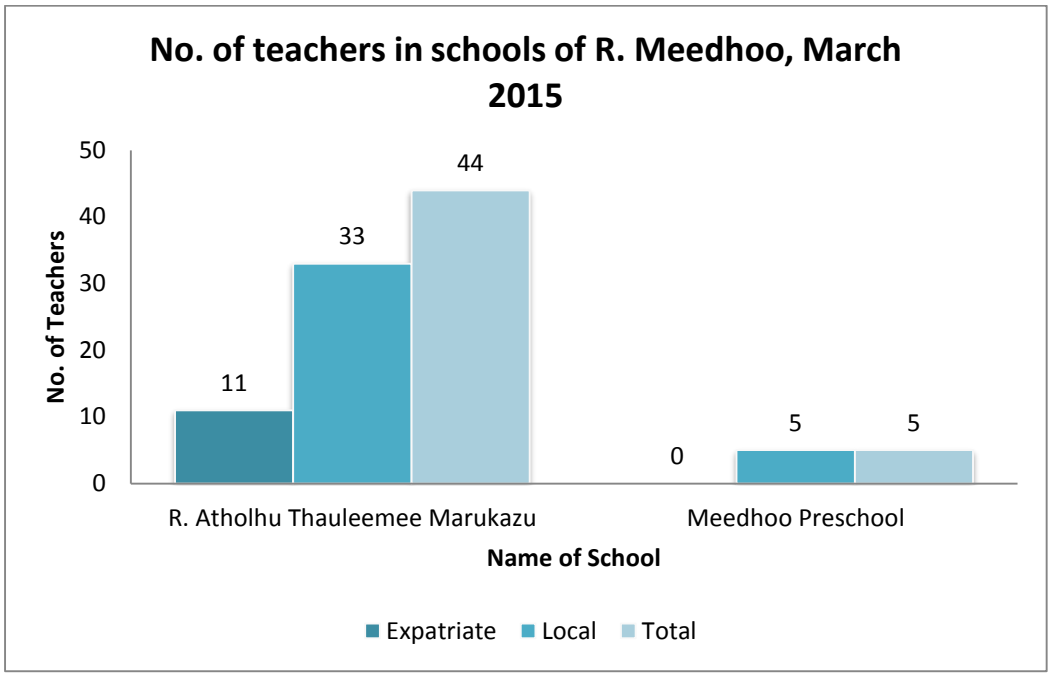
Figure 4.21: Number of students enrolled in schools of Meedhoo by gender in March 2015



Source: Ministry of Education, 2015

Meedhoo School had only local teachers in March 2015 while the number of local teachers outnumbers the expatriate teachers in R. Atholhu Thauleemee Marukazu. Figure 4.22 displays the number of teacher in the two schools of Meedhoo in March 2015.

Figure 4.22: Number of teachers in the schools of Meedhoo in March 2015



Source: Ministry of Education, 2015

4.4.1.3 Employment

Employment and Unemployment Rates

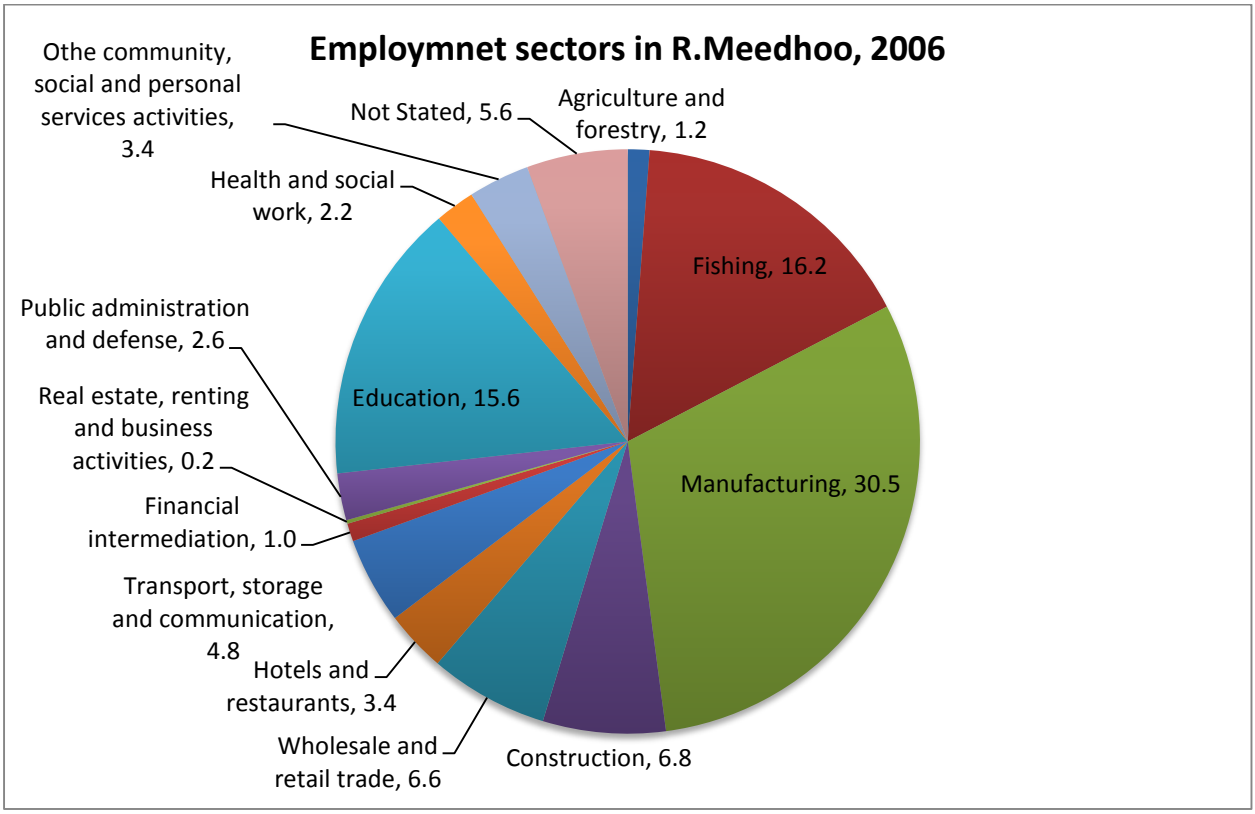
According to census 2006, the total number of economically active population in Meedhoo was 627. Amongst them 501 are employed and 126 are unemployed. The economically not active population is reported as 445 people. Labour force participation rate is 57.6% and unemployment rate is reported as 20.1%. Much of the unemployment is among the female population, with 32.1% of females unemployed compare to 10.4% males.

Main Employment Sectors

The four main employment sectors in Meedhoo according to census 2006 are Manufacturing (30.5%), Fishing (16.2%), Education (15.6%) and Construction (6.8%). Other economic activities practiced in the atoll include construction, public administration and defence,

wholesale and retail trade and other community, social and personal service activities. Figure 4.23 below shows the main employment sectors in Meedhoo based on census 2006.

Figure 4.23: Employment sectors in Meedhoo in 2006



Source: Ministry of Planning and National Development, 2008

4.4.1.4 Infrastructure and Utility Services

Households

There are a total of 483 households in the island where approximately 270 are residing households.

Healthcare

There is only on healthcare facility in the island; Meedhoo Health Centre

Utility Services

Power, water and sewerage system in the island is managed by FENAKA Corporation Limited. The island has a total power generating capacity of 700 KW.

4.4.1.5 Ongoing Projects

Currently there is an ongoing sewerage project in the island. The project is implemented by Ministry of Housing and Infrastructure.

5 IMPACT IDENTIFICATION

5.1 Introduction

Potential adverse and beneficial impacts of construction and operation stage of the proposed water supply system are identified and evaluated in this section. Significant impacts are identified and evaluated in two stages. The first stage identifies the environmental and socio-economic components that may be impacted from key project activities. The second stage determines the significance of impacts of each component. The following sections provide details of the evaluation of impacts.

Nature of potential impacts is defined here as No Impact, Adverse Impact or Beneficial Impact. Table 5.1 below provides the nature of potential impacts from the proposed project on environmental and socio-economic aspects by the project components. Where impacts are not applicable to different components, this is indicated as 'X'. Some aspects may be affected both adversely (indicated as [-]) and beneficially (indicated as [+]) from the project.

5.2 Impact Identification and Evaluation

Environmental and socio-economic aspects that may be impacted by the project as identified in Table 5.1 are further evaluated to identify significant impacts. Assessments of the impacts are conducted using the four criteria of Magnitude, Reversibility, Duration and Distribution as described below. Evaluation of key impacts is provided in Table 5.2.

1. **Magnitude**: Refers to the quantum of change that will be experienced as a consequence of the impact.
2. **Reversibility:** Refers to the degree of reversibility of an impact (i.e. ease of reversing the conditions).
3. **Duration:** Refers to the temporal scale (i.e. duration, frequency) of the impact. It does not take into account the duration of the impact's effects.
4. **Distribution:** Refers to the spatial scale of the area impacted (e.g. a small portion of a reef or an entire lagoon)

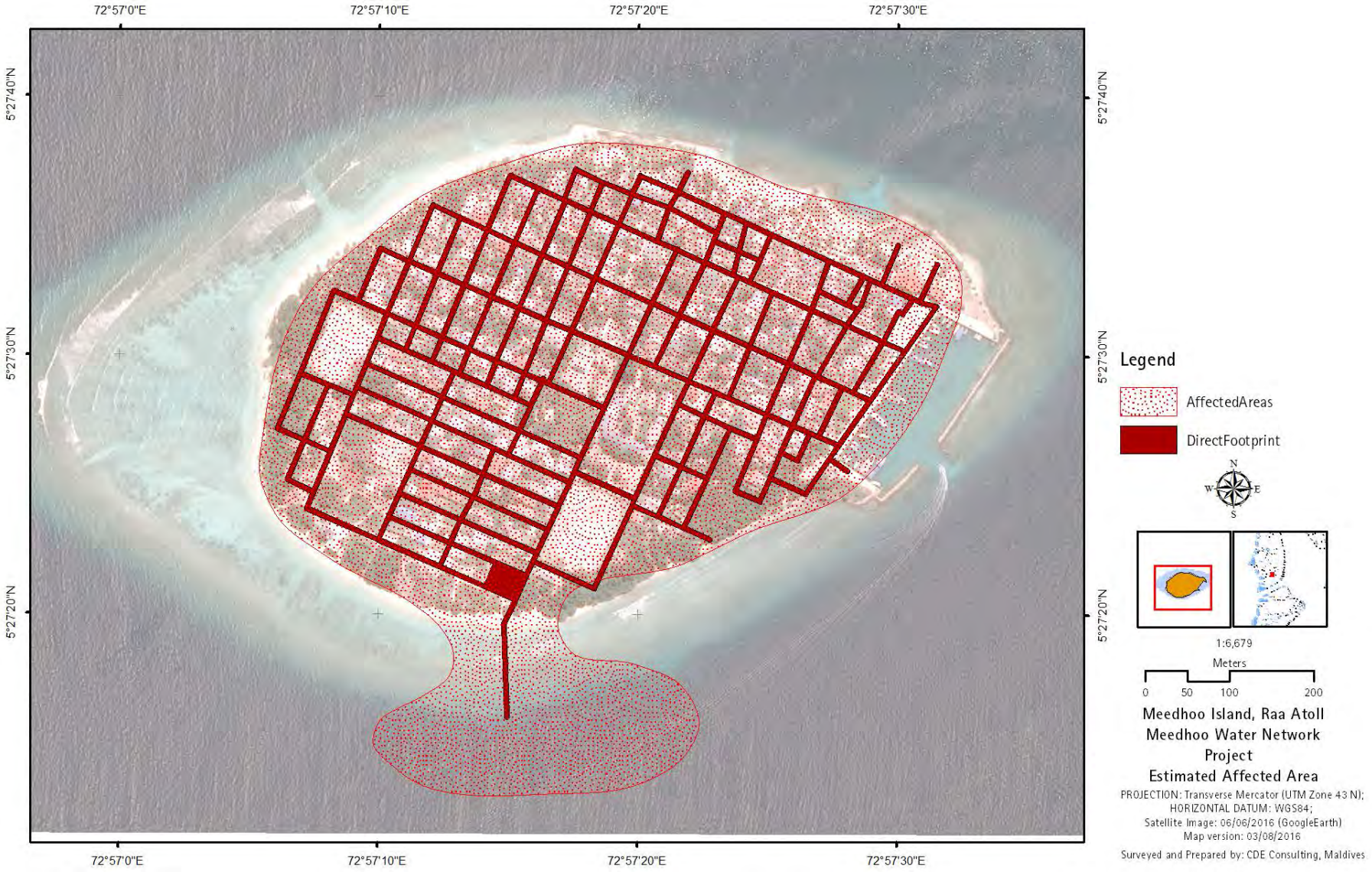
Estimates for negative impacts represent a 'worst case scenario' based on the assumption that the project will undergo full-scale development with no consideration for its environmental and social consequences, i.e. significance is assessed prior to implementation of mitigation measures. Values are attributed by the EIA team on the basis of direct observation of surveyed sites, professional judgment and pre-existing experience in development projects of similar nature.

5.3 Evaluation of Cumulative Impacts

While direct primary impacts are relatively easy to identify and evaluate, special consideration needs to be afforded to evaluating cumulative impacts. While it is relatively simple to identify and evaluate direct primary impacts, the complex nature of natural systems makes it difficult to accurately predict synergistic and interactive impacts of a particular development project. On the other hand, it is relatively simple to identify potential additive impacts.

The following sources of cumulative impacts were considered in evaluating the potential impacts of the proposed water supply system.

- Time crowding: overall impacts of many similar concurrent developments. E.g. While many marine species and birds are relatively versatile and can relocate to other similar habitats following disturbances, concurrent developments in nearby habitats will reduce their chances of relocation and survival.
- Space crowding: high density of impacts on a single environmental medium. E.g. release of effluent from different sources into the same area.
- Indirect impacts: secondary and tertiary impacts resulting from an activity. E.g. groundwater contamination can affect the growth of terrestrial plants, which result in loss of habitat for terrestrial fauna.
- Triggers and thresholds: ecological systems can undergo fundamental changes beyond certain thresholds. Standards and guidelines have been developed based on anticipated threshold levels, for instance, in determining water quality. Such standards have been considered, where available.


72°57'0"E
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5°27'30"N
5°27'20"N
Legend
AffectedAreas
DirectFootprint
N
W
E
S
1:6,679
Meters
0
50
100
200
Meedhoo Island, Raa Atoll
Meedhoo Water Network Project
Estimated Affected Area
PROJECTION: Transverse Mercator (UTM Zone 43 N);
HORIZONTAL DATUM: WGS84;
Satellite Image: 06/06/2016 (GoogleEarth)
Map version: 03/08/2016
Surveyed and Prepared by: CDE Consulting, Maldives

Figure 5.1: Project footprint and potential affected are

Table 5.1: Impact Identification Matrix

Project Activity	Ambient noise level	Ambient air quality	GHG emissions	Groundwater	Coastal Processes	Marine water	Terrestrial Flora and Fauna	Soil Condition	Marine Flora and Fauna	Landscape Integrity/ Scenery	Natural Hazard Risk	Health and Safety	Demand for Resources and Services	Local Economy	Social Cohesion
Construction Phase															
Mobilization and site setup	-	-	-	X	X	X	X	X	X	-	X	-	X	+	+/-
Worker accommodation and activities	X	X	X	X	X	X	X	X	X	X	X	X	+	+	+/-
Equipment and material storage	X	X	X	X	X	X	X	X	X	-	X	X	+/-	+/-	+/-
Site clearance	-	-	-	-	X	X	-	-	X	-	X	-	X	X	+/-
Construction of RO plant building and storage tanks	-	-	-	-	X	X	-	-	X	-	X	X	+/-	X	+/-
Installation of RO plants	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Installation of brine outfall pipe	-	-	-	-	-	-	X	X	-	X	X	-	X	X	X
Excavation and dewatering	-	-	-	-	X	X	-	-	X	-	X	-	X	X	X
Installation of water network	-	X	-	-	X	X	X	X	X	-	X	-	X	-	-
Demobilization	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Operation Phase															
Operation of water supply system	-	-	-	X	X	X	X	X	X	X	+	-	+/-	+	+
Disposal of Brine	X	X	X	-	X	-	X	X	-	-	X	X	X	X	X
Maintenance works	X	X	X	-	X	-	X	X	-	X	X	X	+/-	+	X

X (no impact), - (negative impact), + (positive impact)

Table 5.2: Evaluation of key impacts on the natural and socio-economic environment

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Ambient noise level	***Noise Pollution:*** Operation of vehicles, machineries during mobilization, site clearance, construction activities (e.g. building construction, excavation), and demobilization is expected to generate noise. However these will not be operated continuously for a long period of time.	Loud noise generated during construction works may be a nuisance to residents of the island. Impacts cumulative overtime.	Minor negative	Easily reversible	Short term	Vicinity of project sites	Insignificant (*Limited hours of operation*)
	Noise Pollution: Operation of RO plants and pump stations is expected to generate noise. However these will not be operated continuously for long periods of time.	Noise generated during operation of RO plants and pump-stations may be a nuisance to the residents of the island. Impacts cumulative overtime.	Minor negative	Reversible (with costly implications)	Long term	Vicinity of RO plant building and pump stations	Insignificant (*Limited hours of operation*)

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Ambient air quality	**Air quality degradation**: Negligible level of dust and air emissions during transport of labour force and equipment's to the project site. In addition small amounts of emission are anticipated during operation of machineries and vehicles.	Cumulative from different project activities	Minor negative	Easily Reversible	Short term	Island level	Insignificant (*Negligible levels of dust and air emission*)
GHG emissions	**Increase in GHG in atmosphere** due to construction equipment, power generation for equipment	Cumulative from different project activities and over time	Minor negative	Reversible in the long term	Short term	Regional level	Insignificant (*Negligible amount of GHG emissions over short period*)
	Increase in GHG in atmosphere due to operation of RO plants and pump stations.	Cumulative from different project activities and over time	Minor negative	Reversible in the long term	Long term	Regional level	Insignificant (*Negligible amount GHGs is anticipated to be released*)

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Groundwater	Accidental spillage of fuel or other hazardous substances could pollute the groundwater.	Cumulative from different project activities Indirect impact on terrestrial flora, fauna, and soil condition Excavation can expose deeper soil layer and groundwater to increased risk of contamination by accidental spillages	Moderate negative	Irreversible	Long term	Island level	Major
	Leakage of brine via cracks in the disposal pipeline into the groundwater, lead to salinization of the groundwater.	Indirect impact on terrestrial flora, fauna and soil condition in the affected area.	Moderate negative	Reversible over time	Short-term	Island level	Moderate

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Marine water	Increased turbidity and suspended solids during installation of brine outfall reduce the quality of seawater.	Reduced water quality adversely effect marine life in the area, especially if the condition persists for a long period of time. Cumulative from different activities undertaken near this site (e.g. maintenance dredging of harbour)	Minor negative	Reversible over time	Long term	Site level	Moderate
	Increased level of salinity and chemicals (e.g. those used for cleaning the system, corrosion of system) in the area	Cumulative from different activities undertaken near this site (e.g. maintenance dredging of harbour)	Minor negative	Reversible over time	Long term	Site level	Insignificant (*High flushing action is expected to dilute brine*)
Terrestrial Flora and Fauna	Loss of terrestrial flora and fauna due to vegetation clearance and worker actions	Cumulative from different project activities and over time	Minor negative	Reversible in the long run	Short term	Site level	Insignificant (*No major flora and fauna occurs within the*

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
							project footprint
Soil Condition	Accidental spillage/ leakage of fuel, lubricants, etc. during construction	Cumulative from different project activities and over time	Moderate negative	Reversible in the long term	Long term	Site level	Moderate negative
Marine Flora and Fauna	The marine biota and habitat of in the direct footprint of the brine outfall pipeline will be lost.	Cumulative from different activities undertaken near this site (e.g. maintenance dredging of harbour)	Moderate negative	Irreversible	Long term	Site level	Minor negative (total footprint of the pipeline is small)
	Brine disposal may adversely affect sea grass, plankton communities, change in-faunal community composition and other marine life.	Cumulative from different activities undertaken near this site (e.g. maintenance dredging of harbour)	Moderate negative	Reversible in long term if brine disposal is stopped	Long term	Site level	Insignificant (*High flushing action is expected to dilute brine*)
Landscape Integrity/ Scenery	Loss of visual amenity due to built structures	Cumulative from other building and development works in	Minor	Reversible with costly implications	Short term	Site level	Minor negative

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
		the area					
Natural Hazard Risk	Operation of RO Plants will ensure water security in the island, even during drought periods	-	Major positive	Reversible with costly implications	Long term	Island level	Major positive
Health and Safety	Accidents related to equipment handling and pollution	Indirect impacts from contamination of water, air and soil	Moderate	Possibly irreversible	Long term	Island level	Moderate negative
Demand for Resources and Services	Demand for freshwater, energy and waste disposal will increase during construction and operation	Cumulative impact on waste management facilities at Vandhoo	Negligible	Reversible	Short term	Island level	Insignificant
Local Economy	Increase in employment opportunities: workers will be employed for operation of RO plant	-	Minor positive	Reversible	Long term	Island level	Minor positive

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Social Cohesion	The choice of work methodology, construction workers or contractors for the project, may lead to dissatisfaction amongst island population.	-	Minor negative	NA	Short term	Island level	Minor negative

6 SIGNIFICANT IMPACTS AND MITIGATION MEASURES

6.1 Impacts on Natural & Socio-Economic Environment during Construction and proposed Mitigation Measures

This section describes potential negative impacts during construction stage of the activities involved in the establishment of water system. Figure 6.1 presents project footprint and potentially affected area.

6.1.1 Noise and Vibration

Noise pollution and vibrations are likely to be caused by:

- Operation of machinery such as small excavators, dump trucks and concrete machines during construction, excavation and dewatering.
- Construction works related to buildings and structures.

Increased noise levels from operation of machinery including construction works may cause some nuisance to people in the area at the time of undertaking work. In addition, higher noise levels could affect nocturnal fauna that use auditory communication such as bats. Nonetheless, any unfavourable disturbance to public and fauna in the island would be short term and limited to duration of construction.

Mitigation measures to manage Noise and Vibrations

- Vehicles and machinery will be tuned and well maintained to reduce unnecessary noise emissions.
- All construction work will be carried out during daytime to minimise nuisance to the local community and disturbances caused to nocturnal fauna that uses auditory communication.
- Construction works will be completed in the shortest duration possible.
- Nearby communities will be notified of construction.

No additional cost are involved in undertaking these mitigation measures.

6.1.2 Air Quality Degradation

Air quality may be deteriorated due to:

- Operation of machinery such as small excavators, dump trucks and concrete machines during construction, excavation and dewatering.
- Construction works related to buildings and structures.

Dust and emissions from vehicle and machinery exhausts may degrade the air quality leading to long term health risks to the community. Due to relatively small size of islands that allow rapid turnover and flushing of harmful emissions, impacts from air pollution due to operation of machinery and construction works is considered insignificant.

With proper mitigation measures, it is unlikely that air pollution impacts will cause long term effects such as human health risks that lead to increased public and private health costs.

Mitigation Measures for degradation of Air Quality

- Vehicles and machinery will be tuned and well maintained to minimise air emissions.
- Construction work will be carried out in as short duration as possible.
- Ground/soil will be kept damp to minimise dust from construction works.

6.1.3 Groundwater Depletion, Salinization and Contamination

Project activities that may lead to groundwater depletion, salinization, contamination of water resources are:

- Installation of pipes for water distribution network.
- Waste management and disposal including construction waste and domestic waste.
- Construction of buildings, and structures related to storage tanks, and desalination plant house.

Groundwater aquifer may be exposed during excavation and dewatering to lay pipes and, during other construction activities such as building of structures. Any accidental spill of oil and toxic substances has the potential to contaminate groundwater especially if the aquifer is exposed due to excavation. Likewise, during construction, significant quantities of waste will be generated where any mishandling of solid and hazardous waste could also pollute the aquifer. Waste disposal also has the potential to cause contamination of groundwater from leachate while waste is stockpiled.

In the Maldives, groundwater contamination is an irreversible impact due to the absence of impermeable layers to separate the freshwater lens in independent reservoirs. Accordingly, any point sources of pollution would cause the contamination of the entire island groundwater resources. For this reason, contamination of groundwater is considered a significant impact.

It is anticipated that only small quantities of fuel and chemicals will be used during construction. Power will be sourced from existing power supply therefore fuel for power will not be handled at the site. However, special care should be taken when handling oil, solid waste and hazardous waste to entirely avoid any accidental spills and leakage.

The pipelines of the water distribution network are proposed to be buried to a depth of 600 mm requiring a maximum excavation depth of 1 m approximately.

Construction of buildings and structures will require excavation and dewatering for foundation purposes. Excavation depth desalinated water tanks structures and desalination plant house is estimated at 0.3 m.

Impacts from dewatering will be felt on the groundwater aquifer primarily salinization and reduction in volume of water in the aquifer. Salinization and depletion of groundwater aquifer is predicted to be short term and expected to be recharged during rainfall. Therefore, salinization and depletion of groundwater aquifer is considered insignificant.

Mitigation measures to reduce depletion, salinization and contamination of groundwater

- Dewatering will be carried out only if and where necessary after on the spot assessments by construction supervisor.
- Dewatering will be carried out during low tide in order to reduce the amount of dewatering required.
- All water extracted from ground during construction will be drained back into the system.
- All paints, lubricants, and other chemicals used on site should be stored in secure and bunded location.
- Littering and accidental disposal of construction wastes should be avoided by preplanning.
- General refuse should be stockpiled in one central area of the development site for easier management and monitoring.
- Construction activities should be carried out under the supervision of an experienced person.

- Cost for this component is already embedded in the project contract to be signed with the successful contractor.

Cost for this component is already embedded in the project contract to be signed with the successful contractor.

6.1.4 Marine Water Degradation

Installation of brine disposal pipeline is expected to impact the lagoonal area of the island. The lagoon bottom at the proposed reject water disposal pipeline is mainly made up of sand and a thick sea grass bed. Hence, it is likely that the lagoon water to become slightly turbid, when the brine disposal pipeline is placed on the lagoon bottom. But it is expected to subside shortly, without any significant damage and disturbance to biodiversity in this area. To reduce turbidity and sedimentation that might be incurred during this process, the following measures are proposed.

Mitigation measures to reduce marine water degradation

- Complete works in the shortest time period possible.
- Carryout work in low tide hours in calm sea condition.
- The project manager and workforce involved during construction will be briefed of environmentally practices.
- The pipe deployment site should be demarcated to ensure no work is carried out outside this boundary.

No additional cost are involved in undertaking these mitigation measures.

6.1.5 Loss of terrestrial flora and fauna

No significant terrestrial flora and fauna occur within the land allocated for the desalination plant house.

6.1.6 Disruption to Road Traffic

Pipe installation works will require blockage of roads to some extent and diversion of traffic.

Mitigation measures to reduce disruption to road traffic

- Work schedule will be effectively communicated with Island Council for traffic diversion and re-routing.
- Appropriate signboards will be put up in working areas.

- Public will be informed through Island Council on road blockages and traffic diversion.
- Work will be organised to complete work in shortest period possible.

Cost for this component is already embedded in the project contract to be signed with the successful contractor.

6.1.7 Changes to Road Conditions

Pipe installation will require roadsides to be excavated. Excavation will lead to changes in road condition such as levelling and compaction where roads are unpaved. Changes to road condition can lead to increased risk of flooding during heavy rainfall. In addition, poor levelling can lead to wear and tear in vehicles requiring more maintenance.

Mitigation measures to reduce changes to road conditioning

- Excavation will be coordinated with road construction work where possible.
- Filling activities at the end of pipe installation will be properly supervised.

No additional cost are involved in undertaking these mitigation measures.

6.1.8 Pressure on Existing Resources

If workers arrive from other areas there will be extra pressure on existing resources including natural environment as well as infrastructure and services. Groundwater will be used for non-potable purposes of the workforce. Domestic waste will be generated that will be disposed at islands waste disposal area. Sewage will be disposed in the existing sewerage system. Furthermore, there will be more demand for healthcare services as well as transportation services.

Mitigation measures to reduce pressure on existing resources

- Utilise locally available workforce as much as possible.

This mitigation measure does not incur any additional cost.

6.1.9 Impact on Visual Amenity

Construction stage of the project will have a visual impact on the island, specifically at the project site, including obstruction or alteration of scenic views. This might give rise to complaints from locals. However, it is considered that any adverse effects of the proposed

development on natural character and visual amenity of the area are likely to be minor and short-term.

Mitigation measures to reduce visual impact on the island

- Complete the works in the shortest time possible.
- Fence off the construction site to shield off noise and unsightly views.

Cost for this component is already embedded in the project contract to be signed with the successful contractor.

6.1.10 Risks to health and safety of construction workers

Health and safety risks arising from construction work is high. Thus, it is important to take measures to reduce these risks as some of these accidents can be devastating impacts on lives of individual workers.

Mitigation measures to reduce health and safety risk

- Health checks prior to start of work
- Maintain on-site first aid kit
- Have qualified person to properly instruct and supervise the work
- Keep evacuation facility in place all the time during construction
- The construction site should be properly closed so access to any unauthorized person.

Main cost will be initial investment in first aid kits, and health checks (cost estimate range for these (MRF 7500 - MRF 10,000).

6.2 Impacts on the Natural & Socio-Economic Environment during Operational Phase and proposed Mitigation Measures

This section will provide a brief description of each of the potential impacts and suggest appropriate mitigation measures for all potential adverse impacts.

Negative impacts during operation stage of the desalination plant are envisaged to be minor. Potential impacts anticipated during the operation stage of the RO include:

- Impact of brine discharge on marine environment.
- Possible occupational health risks to employees due to noise inside the plant (85 dBA at 1m).

- Possible contamination of ground/marine water due to handling, consumption, storage and disposal of chemicals used in the RO plant.
- Air pollution due to emission from power generation.

6.2.1 Degradation of Marine Environment

RO plants generate concentrated brine solution as the effluent from the desalination process. Brine solution has the potential to kill marine organisms where it is discharged into the marine environment. The brine discharged might contain all or some of the following constituents:

- High salt concentration.
- Chemical used during pre-treatment stage.
- High total alkalinity as a consequence of increasing the calcium carbonate.
- Change of pH due to calcium sulphate and other elements in the seawater.
- Higher temperature of the discharge brine due to the high temperature is used in the desalination facility.
- Toxic metals, which might be produced if the discharge brine has contact with metallic materials used in the plant facilities.

It is noted that biocides such as chlorine is used for pre-treatment and periodical membrane and pipe cleaning. Such chemicals in brine may harm the marine environment if they are discharged into the marine environment without treatment. Marine assessment of the proposed brine outfall location shows that the area is pre-dominantly covered in dead coral and rubble and there is very low level of live coral. Land and Marine Environmental Resources Group Pvt Ltd (2010) notes that the chloride level of reject water from Male' water supply system is approximately 30 % higher than feed water.

It is also noted that temperature of the brine from RO plants are near ambient temperature since RO plants do not heat feed water unlike distillation plants. Therefore, impact to marine environment from RO reject temperature will not be significant.

The de-chlorination process of the RO plants may marginally reduce the pH of the waste brine compared to the feed water. However, the change in pH in brine and hence its effect on the receiving environment will not be significant.

Similarly, heavy metal concentration of the brine generated from RO plants is relatively low. RO facilities are less likely to release heavy metals as they are usually constructed largely of corrosion resistance stainless steel. The RO process also adds treated and cleaning chemicals that can include metals such as iron. However, Land and Marine Environmental Resources Group

Pvt Ltd (2010) reports that Iron and Manganese levels tested in reject water by MWSC for Male' water supply system shows that the levels are lower than WHO and EPA guidelines. Based on this observation, it is considered that impact of heavy metal in brine on marine environment will be minor.

Further, given that the brine is discharged into the open sea, it is anticipated that adequate flushing and dilution of the effluents will bring the effluent to the background salinity of seawater quickly.

Due to absence of live coral colonies and moderately strong currents in the area, adverse impact on marine environment from discharge of brine is considered insignificant. The area will be monitored for significant adverse changes during the lifetime of the project as outline in the monitoring plan given in this EIA report.

6.2.2 Local Noise Pollution

Operation of desalination plants generate noise that may pose a potential health risk to the people who are working in the plant and may cause nuisance to those living nearby the site. For SWRO plants, noise levels of over 90 dB (A) have been reported (UNEP 2008). Major sources of noise during operation include the intake pumps, the RO high pressure pumps and other pumps and equipment such as the different pumps and equipment of the pre-treatment and cleaning systems. The facilities would normally be installed in buildings which may include additional noise attenuation measures, thereby reducing the noise emissions to surrounding areas.

It is reported that continuous exposure to noise levels exceeding 85dBA for more than 8 hours a day is considered hazardous and it is recommended that workers should not be exposed at any time to sound levels exceeding 115dBA, without the use of hearing protectors. Hence, the following mitigation measures are recommended to minimise the impact of noise pollution.

Mitigation measures to reduce local noise pollution

- Provide personal protective equipment such as earmuffs to all staff working in the RO plant.
- Working shifts must be no longer than 8 hours.
- Make the desalination plant building soundproof as appropriate to anticipated noise levels.
- Enclose the desalination building with a boundary wall.
- Cost for this component is already embedded in the project contract.

Estimated cost of mitigation measure is MVR 1,000 – 2,000

6.2.3 Groundwater Salinization and Depletion

Pumping groundwater for desalination has the potential to cause draw down of groundwater which may lead to salinization and depletion of groundwater lens.

For desalination, water will be pumped at a depth of 30 metres. Due to the unconfined nature of the freshwater lens, the proposed pumping may have some drawdown effect. Considering the depth at which water is withdrawn, the pumping rate and the location of the borehole on the edge of the freshwater lens, it is considered that the drawdown effect on groundwater lens will be minimal.

Based on the above factors, it is considered that salinization and depletion of groundwater aquifer due to the proposed water intake for desalination will be minor in the short to medium term.

6.2.4 Pollution due to Handling and Storage of Hazardous Materials

The operation of a desalination plant requires the routine transport, storage and handling of hazardous materials. These may include chemicals used for:

- Pre-treatment of the intake water against biofouling, scaling, corrosion, etc.;
- Cleaning of the plant to remove biofilms, scales, etc.;
- Membrane preservation during transport and shutdown;
- Product water disinfection and stabilization.

In handling and storage of such chemicals, precautionary measures are generally taken to minimize hazards. Under reasonably foreseeable accident conditions, the risk of fire, explosion or release of hazardous materials into the environment is therefore low. However, despite all precautionary measures, a small risk remains that workers, the public or the environment is unexpectedly exposed to hazardous materials. The likelihood of an accident is low; however, in the unforeseen event that hazardous material is released, impacts may be severe (UNEP 2008).

The release of cleaning chemicals in larger quantities by accidental spills during routine transport, handling and storage may cause localized soil contamination. Chemicals may affect water quality if spilled on the ground or surface waters by rain and runoff after a spill. For example, high and low pH values of strongly alkaline or acidic cleaning solutions could affect the natural pH of the water body. Chemicals may also affect seawater quality if chemicals are

accidentally spilled into the sea or washed into the sea by surface runoff. Accidental spills into the ground or surface water bodies may affect the local fauna and flora.

To avoid any pollution or contamination of the natural resources, the following measures will be undertaken for better storage and handling of hazardous chemicals.

Mitigation measures to reduce pollution due to hazardous waste

- All chemical will be stored in a separate storage section of the RO plant building.
- In transportation, the danger of spilling chemicals into the sea or the coral environment as well as on the island will be reduced by tight fittings and appropriate material.
- Precautions to avoid spilling of chemicals will also be given by instructions to the staff.
- Cost for this component is already embedded in the project contract to be signed with the successful contractor.

Cost for this component is already embedded in the project contract to be signed with the successful contractor.

6.2.5 Air Quality Degradation and GHG Emissions

Energy use is a major factor in the environmental assessment of desalination projects. Energy use associated with the operation of a desalination plant includes the electrical or thermal energy produced on site or taken from the electricity grid and used to operate the facility. The total energy demand of the facility comprises the energy for the desalination process, for air conditioning, for lighting and office supplies, as well as the fuel energy used for maintenance visits and employee vehicles. The specific energy demand refers to the energy demand of the desalination process only.

Power requirement for the proposed RO plant will be met by the existing power available from the island. Meedhoo has a power generating capacity of 700 KW. Hence, additional generators may be required to cater for the future power demand and emergency power failure at the RO plant. Since power is generated using diesel generators, air quality will mainly be affected by emissions of greenhouse gases (mainly CO2), acid rain gases (NOx, SOx) or fine particulate matter (PM10).

There is no air quality standards followed in the Maldives. Generally air quality is regarded as good. It is anticipated that emissions from the proposed project will contribute considerably to other existing or projected air emissions (cumulative impacts) due to the additional power requirement. However, pollutant concentration is not expected to be significant enough to create objectionable odours or pose a health risk to the community.

Although quantity of GHG emissions is considered low for the operation of desalination plant, contribution to national GHG emission levels is in contradiction to the national goal of carbon neutrality by 2020 and meeting Maldives Intended Nationally Determined Contribution (INDC) by 2030. On this note, GHG emissions are considered a significant impact of the project.

Mitigation measures to reduce air quality degradation

- Desalination plant and water pumps will be regularly services.
- Low-emission energy technology or renewable energy options will be explored for feasibility in desalination.
- Cost for this component is already embedded in the project design.

Main cost will be servicing desalination plants and water pumps. Cost of servicing RO plant systems is estimated to be 10% of the total cost of the system.

6.2.6 Increased Cost of Living

When the water supply system is operationalized, a user fee will be introduced based on the usage. Given the current economic situation of the country and the high inflation rate, levying a charge on the user will increase the cost of living. This may be an additional burden on the community.

6.3 Description of Positive Impacts from the Construction and Operation of the RO Water System

6.3.1 Improved Quality of and Accessibility to Potable Water

The most significant positive impact from the proposed water system will be the availability of quality piped water to the community. This will in turn improve the public health of the community. Such improvements to the public health can only be assessed through systematic recording and monitoring on the health of the community. Hospital reports can be used to monitor the number of water borne diseases such as diarrhoea.

6.3.2 Protection of Groundwater Aquifer

Over extraction of groundwater has led to groundwater contamination and quality deterioration of groundwater. An additional source of water will contribute to protection of groundwater.

6.3.3 Increased Employment Opportunities

The proposed development will create employment opportunities during both construction and operation stage. Construction stage is likely to create skilled and semi-skilled job opportunities. Staff will be hired for the operation and maintenance of the plant, administrative support and other areas of work.

6.3.4 Increased Business Opportunities

Business opportunities will be opened up particularly as maintenance contracts and supply of office materials, chemicals and some spare parts. There will also be business opportunities for retail shops, restaurants and café especially during construction stage with the influx of staff for construction works. There will also be a demand for renting houses to accommodate some of the staff

7 ALTERNATIVES

This section looks at alternative ways of undertaking the proposed project. Firstly, at the broad level there are two main options: (1) undertake the project or (2) not undertake the project. The environmental assessment above has been conducted in view of the former and this section will explore the no project option.

7.1 "No-Project" Alternative

The option of a no project alternative has been considered for the installation of RO desalination plant. The no project option takes the following into account.

- Harvested rainwater will continue to be the source of drinking water for the people and whenever there is a drought spell, shortage of potable water will continue.
- Current health risks associated with an unreliable supply of water will continue.
- Social discontent over poor quality of water and associated health risks will continue and worsen.
- Mandate to provide water and sanitation facilities will remain unfulfilled.

Table 7.1: Summary of "No Project" option

Options	Advantages	Disadvantages
No installation of RO desalination System	No development costs to the government. Community avoids increased living costs from the water services Adverse environmental impacts associated with the project are prevented.	Burden of diseases particularly water-borne diseases may increase. Socio-political issues may arise from the lack of access to clean water. Loss of employment opportunities to the island and atoll population. Loss of opportunity to the people in accessing proper water supply system.

Given the disadvantages of the existing water situation, the preferred option is to go ahead with the project.

7.2 Alternative Brine Outfall Location

The following table provides a comparison of possible alternative sites for brine outfall against the proposed site.

Table 7.2: Evaluation of alternative for RO plant brine outfall pipe

Aspect	**Proposed site**	**Alternative 1**	**Alternative 2**
Impact on terrestrial environment	• No Vegetation clearance required along the pipeline length on land	• No Vegetation clearance required along the pipeline length on land	• No Vegetation clearance required along the pipeline length on land
Impact on marine environment	• Impacts are predicted to be moderate as no live corals occur within this site • Better flushing	• Construction impacts are predicted to be lower as no live corals will be affected during construction; • Concentration of brine in the lagoon due to occasionally slow currents • Sand movement in this zone is high as seen by the island moat. It would be a risk to leave it here. Any further out and reaches coral cover zone which is not	• Construction impacts are predicted to be moderate as live corals may be affected during construction; • Better flushing • Better positioning at the tip of southern rim.

Aspect	**Proposed site**	**Alternative 1**	**Alternative 2**
		allowed by EPA.	
Impacts on coastal environment	• Requires excavating along the beach.	• Requires excavating along the beach.	• Same as the proposed site.
Cost implications	• Slightly shorter pipe compared to the alternative site 2	• Lowest due to shorter pipe	• Slightly longer pipe compared to proposed site

Based on the advantages and disadvantages in the alternative described above, the preferred option is to go ahead with the proposed outfall location.


72°57'10"E
72°57'20"E
72°57'30"E
5°27'30"N
5°27'20"N
RO Plant Facility
Alternative Outfall 1
Length: 60 m
Alternative Outfall 2
Length: 145 m
Legend
Alternative Brine Outfall
Desalination Plant Facility
N
W
E
S
1:4,529
Meters
0 25 50 100
Meedhoo Island, Raa Atoll
Meedhoo Water Network
Project - Alternative outfall locations
PROJECTION: Transverse Mercator (UTM Zone 43 N);
HORIZONTAL DATUM: WGS84;
Satellite Image: 06/06/2016 (GoogleEarth)
Map version: 03/08/2016
Surveyed and Prepared by: CDE Consulting, Maldives

Figure 7.1: Alternative outfall options

8 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is an important component of the EIA process, needed to determine the accuracy of impact prediction, the adequacy of mitigation measures, and level of compliance with commitments regarding implementation of mitigation measures and monitoring of relevant environmental aspects.

The main objectives of the environmental management plan are to:

- Produce a framework for managing anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions.
- Provide evidence of compliance to legislation, policies, guidelines and requirements of relevant authorities.

8.1 Environmental Management System

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives.

- **Environmental Management Planning and establishment of key performance indicators:** The EMP specifies environmental management measures and required performance standards
- **Monitoring and corrective action**: The implementation of EMP measures will be monitored. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions
- **Auditing, reviews and improvement**: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

The environmental management strategy is demonstrated in the following figure.

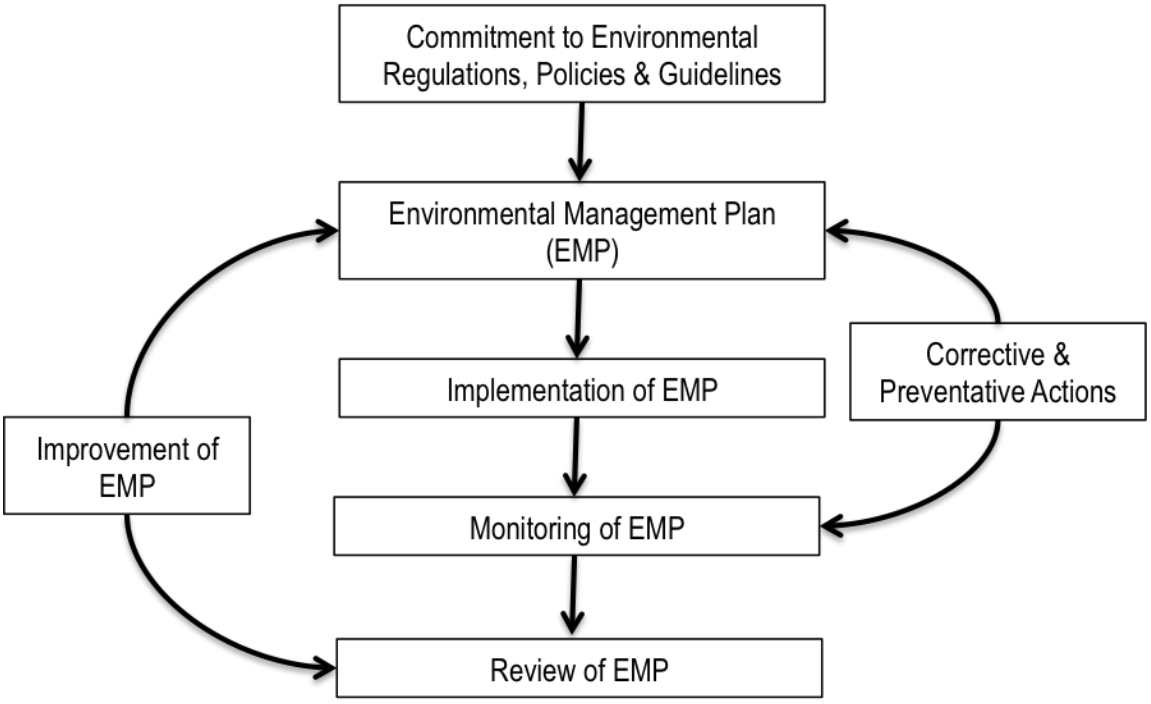


Figure 8.1: Environmental Management Strategy flow diagram

8.2 Management Structure and Responsibilities

The following parties are involved in the EMP of this project:

- Project proponent
- Environmental consultant
- Environmental Protection Agency (EPA)

The roles and responsibilities of the parties involved are as follows.

8.2.1 Project proponent

- Execution of all project activities
- Preparation of EMP
- Detailed designs of proposed water supply system
- Monitoring of the project activities
- Submission of annual environmental monitoring reports as required by the EPA

8.2.2 Ministry of Environment and Energy

- Approval of detailed drawings

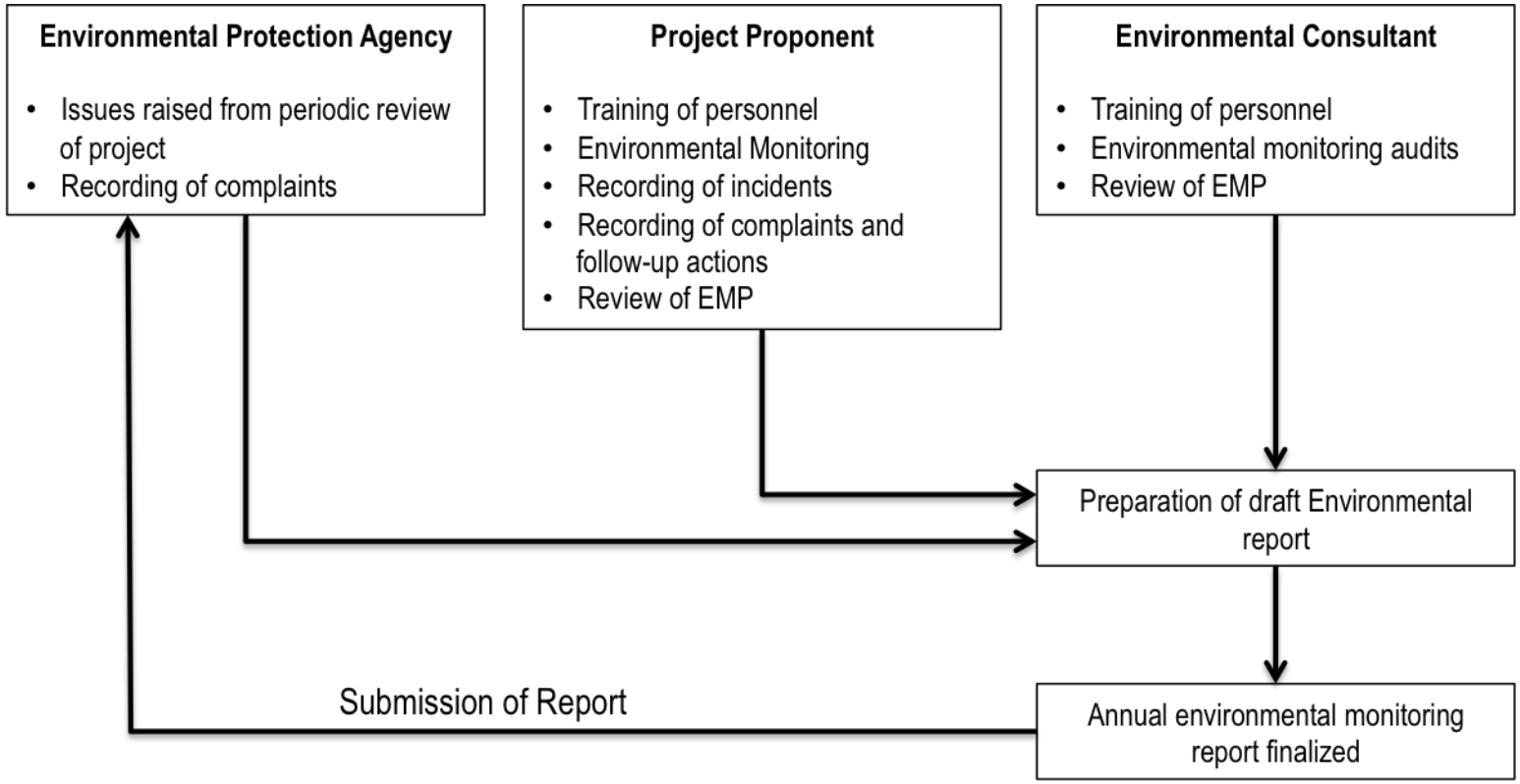
8.2.3 Environmental Consultant

- Preparation of EMP
- Monitoring of performance of project activities according to the EMP
- Auditing the EMP to ensure desired outcomes are achieved
- Making amendments to the EMP according to the results of the audits
- Preparation of environmental monitoring report as required by the EPA (detailed in Chapter 9 of this report)

8.2.4 Environmental Protection Agency

- Review environmental monitoring report
- Intervention in the event of a breach in environmental permit conditions
- Site visit and inspection before commissioning of water supply system

Figure 8.2: Environmental Management Plan for construction and operation phase



8.3 Management Strategies and Actions

8.3.1 Environmental Education

Environmental education and awareness is the key to the success of an environmental management system and thus will be an integral part of the total environmental management system. The education and awareness programme will be addressed to labour force undertaking construction works, and staff that will be operating the water supply system.

8.3.2 Environmental Monitoring, Reporting and Audit

A regular environment monitoring programme will be conducted to observe any changes taking place and this programme would be mainly directed at continuously understanding and reporting the reef health, lagoon water quality, ground water quality, and the product water quality.

An independent environmental audit will be conducted every year. The purpose of this audit is to check whether all the operations of the water supply system conform to the standards set by the government authorities and to evaluate the success of the policies and programmes implemented by the water supply system operator and identify where improvements can be made.

Table 8.1 Environmental Management Plan for Construction and Operation Phase

Activity	**Management measures**	**Responsible party**	**Timing**
Training of staff and contractors	All construction workers and project management staff will be provided information on general environmental issues, compliance with environmental permits and EMP. All staff involved with environmental monitoring will be provided training in environmental monitoring procedures.	Project proponent & Environmental Consultant	Before commencement of construction activities
Documenting non-conformances and corrective actions	All non-conformances to the environmental permit conditions, observed during monitoring will be documented. Necessary corrective actions and preventative actions will be identified Corrective actions will be implemented, with systematic follow ups to ensure effectiveness of these measures	Project proponent & Environmental consultant	Continuous during construction phase

Activity	**Management measures**	**Responsible party**	**Timing**
Control of water contamination	Oil, solid waste and hazardous waste handled carefully and transported in sealed containers. All paints, lubricants, and other chemicals used on site stored in a secure and bunded location. Littering and accidental disposal of construction wastes avoided by preplanning. All raw materials stored away from the vicinity of the coastal areas. General refuse stockpiled in one central area. Construction activities carried out under the supervision of an experienced person. Regular visual inspection of surrounding marine environment for waste	Project proponent	Continuous during construction phase
Waste management (Waste generated from construction activities, the construction workforce will generate domestic and sewage waste)	The island waste management system will be integrated to accommodate waste disposal from project activities and project workforce.	Project proponent	Continuous, during construction phase
Supervision of project activities	Assign suitably experienced and qualified personnel to supervise the entire project and ensure that all activities are carried out with minimal adverse impact on the environment	Project proponent	Before commencement of the project

8.4 Non-conformances and Corrective Action

All non-conformances to the environmental permit conditions, observed during monitoring will be documented.

Necessary corrective actions and preventative actions will be identified

Corrective actions will be implemented, with systematic follow-ups to ensure effectiveness of these measures.

8.5 Reporting

Reporting shall be undertaken to provide evidence of the ongoing implementation of the EMP and will cover any training activities, site conditions and operations, monitoring data, details of non-conformances, incidents, complaints and follow up action, results of audits and reviews. Reporting shall be undertaken by the project proponent and the Environmental Consultant.

The environmental reporting process is summarized in the figure 8.2. All non-compliances and complaints during the execution of the project are to be reported to the EPA.

9 ENVIRONMENTAL MONITORING PLAN

9.1 Introduction

This chapter will outline the monitoring plan for the proposed project. Environmental monitoring is essential because, although with proper mitigation measures, the overall environmental damage can be significantly minimized, an unforeseen impact may still occur. Furthermore, some of the impacts predicted may turn out to be far greater than predicted, making mitigation measures ineffective. Therefore, in order to avoid or reduce the chances of such events, regular and frequent environmental monitoring is vital.

9.2 Objectives of the Monitoring Plan

The main objectives of the monitoring plan are:

1. To identify whether the predicted impacts are accurate and mitigation measures taken are effective
2. To identify any unforeseen impacts so that appropriate mitigation measures can be taken at the earliest
3. To identify and resolve any issues of social unrest at the earliest
4. To eliminate or reduce environmental costs

9.3 Before Construction

The monitoring assessments prescribed in Table 9.1 are required before construction, if the construction activities begin 12 months after this EIA.

9.4 Monitoring during Construction Phase

Table 9.2 shows the details of the different monitoring attributes and parameters must be monitored during the construction stage.

Additionally, the following aspects will be monitored during the construction stage to ensure that environmental impacts are minimized.

1) Daily monitoring to ensure that the cleared areas and other construction processes are not creating any significant dust nuisance for the local environment.

2) Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands and to ensure that they are done properly. This is to reduce the potential of soil contamination from spills. The site supervisor will conduct spot checks.

3) Daily inspection of site clearance activities to ensure that the proposed building plans are followed.

Table 9.1: Monitoring Schedule for Before Construction

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency and responsible agency	Applicable standard	Est. Total Costs RF*	Responsible Agency
Marine Water Quality (Marine)	To determine the baseline condition of marine water at proposed outfall site and alternative outfall site	The following parameters will be tested: Temperature, pH, Salinity, Total Dissolved Solids, Conductivity, Dissolved Oxygen, BOD, Total Coliform, and Faecal Coliform	Laboratory analysis	Two Locations SW1 – proposed outfall SW2 One sample for each site taken at 1 m depth	Once prior to commencement of construction activities and	WHO marine water quality standards	3,000	Proponent
Ground Water Quality (ground water)	To determine the baseline condition of groundwater at project site	The following parameters will be tested: pH, Salinity, Conductivity, and Total Hydrocarbon.	Laboratory analysis	Three Locations (sites G1 , G2 and G3)	Once prior to commencement of construction activities	Maldivian (EPA) ground water monitoring standards	2,500	Proponent
Coral Reef Health	To assess the status of reef of the island and to determine fish species and abundance	Fish species composition and population size	Visual Fish Census	Proposed brine outfall location (T1) and	Once prior to commencement of construction	Maldives EPA standards	10,000	Proponent

				T2	activities			
		Coral genera composition and coverage	Photo Quadrat Method	Proposed brine outfall location (T1) and T2	Once prior to commencement of construction activities	Maldives EPA standards	10,000	Proponent
Noise	To determine the baseline noise level at project site	Noise levels	Measurement using sound meter	Proposed location for RO plant house	Once prior to commencement of construction activities	Ambient noise standard in most OECD countries	10,000	Proponent

** Does not include logistic and consultant fees*

Table 9.2: Monitoring Schedule for Construction Stage

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency	Applicable standard	Est. Total Costs RF*	Responsible Agency
Marine Water Quality (Marine)	To determine the impact of marine water during construction stage	The following parameters will be tested: Temperature, pH, Salinity, Total Dissolved Solids, Conductivity, Dissolved Oxygen, BOD, Total Coliform, and Faecal Coliform	Laboratory analysis	Two Locations SW1 – proposed outfall SW2 One sample for each site taken at 1 m depth	On every six months during construction	WHO marine water quality standards	6,000	Proponent
Ground Water Quality (ground water)	To determine the impact of groundwater water during construction stage	The following parameters will be tested: pH, Salinity, Conductivity, and Total Hydrocarbon.	Laboratory analysis	Three Locations (sites G1, G2 and G3)	On every six months during construction	Maldivian (EPA) ground water monitoring standards	5,000	Proponent
Water Contamination	To determine the impact of oil spillage and leakage on	Oil spills (Surface layer of groundwater)	Visual observation	All area where oil is handled	Daily for the duration of the project	NA	Included in contract or fees	Contractor
		Oil leakage from machinery or vessels	Maintenance and tuning of all machinery & vessels	All area where oil is handled	Weekly during the construction phase	NA	Included in contract or fees	Contractor

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency	Applicable standard	Est. Total Costs RF*	Responsible Agency
Noise	To determine the impact of noise during construction	Noise levels Noise complaints received from neighboring residents	Noise meter Logs	Around project site	Weekly during construction	Ambient noise standard in most OECD countries	Included in contract or fees	Contractor

- *Does not include logistic and consultant fees*

Table 9.3: Monitoring Schedule for Operation Stage

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency	Applicable standard	Est. Total Costs RF*	Responsible Agency
Marine Water Quality	To determine the impact on marine water quality	The following parameters will be tested: Temperature, pH, Salinity, Total Dissolved Solids, Conductivity, Dissolved Oxygen, BOD, Total Coliform, and Faecal Coliform	Laboratory analysis	Two Locations SW1 – proposed outfall SW2 One sample for each site taken at 1 m depth	Bi-annually during operation phase for 5 years	Maldives EPA marine water monitoring standards	30,000	Proponent
Ground Water Quality	To determine the impact on ground water quality	The following parameters will be tested: pH, Salinity, Conductivity, and Total Hydrocarbon	Laboratory analysis	One Location (GW1)	Bi-annually during operation for 5 years	Maldives EPA ground water monitoring standards	10,000	Proponent
Desalinated Plant Intake Water quality	To assess the quality of the intake water sourced for desalination plant	pH, Temperature, Conductivity, Salinity, Dissolved Oxygen, TDS, Total Coliform, Faecal Coliform	Laboratory analysis	3 samples from water intake site	Bi-annually during operations	Maldives EPA desalination plant intake water standards	3,000.00 (approx.. per year)	Proponent
Desalinated Plant Product Water quality	To ensure the quality of product water from desalination plant conforms to the	pH, Temperature, Turbidity, Conductivity, Total Dissolved Solids, Free Chlorine, Boron, Copper, Fluoride, Iron, Total	Laboratory analysis	Storage Tank, 2 random locations on the island,(3	Bi-annually during operation	Maldives EPA desalinated product water	15,000.00 (approx. per year)	Proponent

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency	Applicable standard	Est. Total Costs RF*	Responsible Agency
	standards of potable water	Hardness, Iodine, Nitrates, Nitrite, Ammonia, Phosphate, Sulphate, Sulphide, Total Coliform, Faecal Coliform		samples)		standards		
Coral reef health	To determine the general status of the reef and to determine the species abundance and composition of the reef system	Percent of live coral cover, and fish species abundance and composition	Photo Quadrat survey; Fish census	Transect sites T1, T2	Once annually for 5 years	Maldives EPA standards	Included in environmental consultant fees	Contractor
Noise	To assess and ensure the noise levels during RO plant operation are within acceptable limits	Noise levels Noise complaints received from neighboring residents	Noise meter Logs	At RO plant house	Bi-annually during operation	Ambient noise standard in most OECD countries	Included in environmental consultant fees	Contractor

**Does not include logistic and consultant fees*

9.5 Monitoring report

A detailed environmental monitoring report is required to be compiled and submitted to the EPA annually based on the data collected for monitoring the parameters included in the monitoring plan given in the EIA. This report may be submitted to the relevant Government agencies in order to demonstrate compliance. If required, however, a monitoring report for the proposed work phase may be prepared and submitted to the Ministry of Environment. The report will include details of the site, strategy of data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. In addition to this more frequent reporting of environmental monitoring will be communicated among the environmental consultant, project proponent, the contractors and supervisors to ensure possible negative impacts are mitigated appropriately during and after the project.

9.6 Cost of monitoring

The cost of monitoring is estimated to be Rf 75,000 annually. Professional consultants will be hired to undertake the monitoring and the necessary equipment for monitoring will be procured.

For pre-construction and construction stage monitoring, individual parameter costs are provided in the relevant tables above.

9.7 Commitment to monitoring

The proponent is fully committed to undertake the monitoring programme given in this chapter (see Appendix H).

10 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were conducted for this project to provide information about the proposed project and to seek stakeholder's views on the project. During consultations, stakeholders were provided with a brief description of the project and were asked about their opinions or concerns regarding the project and their recommendations to address the key issues. The following stakeholders were consulted for this EIA;

1. Meedhoo Island Council
2. Meedhoo Public
3. Utility Providers of Meedhoo
4. Health Protection Agency (HPA)
5. Environmental Protection Agency (EPA)

Stakeholder consultations were carried out on 19th July 2016 which included door-to-door consultations and a meeting with the Raa Atoll Meedhoo Island Council.

10.1 Public Consultations

Door-to-door consultations were carried out in R.Meedhoo on 19th July 2016 to conduct a Willingness-to-Pay Survey regarding this project. A minimum of 56 households were interviewed during the process and a brief explanation about the project was given to every individual who was interviewed. A summary of the findings from this survey are given below.

Summary of findings

A total of 56 people were interviewed during the process, with 100% of the respondents stating that it is a good project for the island. Of the 56 respondents, only 3 households wished to pay for the service with a fixed fee rather than pay as per usage by installing a meter. The majority of the respondents (39 households) wish to have a meter installed and pay for the service as per their usage. Two households stated that they only wanted the service if they have to pay no more than 15 laari per litre. Most of the households were unable to identify a specific rate for the service in most instances, but did state that it should be similar to other regional islands where the service is provided. Amongst those that desired a fixed fee, one household stated was that it should be Rf.500 or below, while the other two households were not able to identify a specific fee.

10.2 Meeting with Council and Utility Service providers

The meeting with the island council was held at the council office, whereas the meeting with FENAKA was held at the FENAKA office in the island. Both meetings were held on the 19th of July 2016. Information regarding the project was briefly provided at the start of both meetings. The results are summarised below;

Summary of findings

- All the stakeholders were aware of the project, but only vaguely. The council members stated that they did not know about the project in sufficient detail and that they would like to know more. However, they did state that they met with MWSC, the Ministry of Energy, and the Atoll Council in June.
- The council sees the project as vital and stated that the people of R.Meedhoo need it.
- The council stated that the groundwater quality of the island is very poor during the North East Monsoon, and that the groundwater quality is poorest in the Eastern side of the island. They also stated that groundwater can visibly appear murky at times.
- The people of R.Meedhoo use rainwater for drinking and cooking, whereas groundwater is normally used for laundry and showering.
- The council believes that the island does not have water storage facilities of an adequate scale, in the event of a water shortage.
- Upon being asked about water shortages, the council stated that they faced a water shortage this year and that they contact disaster management in such events.
- The council informed us that the island was gifted 14, water storage tanks ("Kalhu Han"), each with a capacity of 5000 litres. However, the council stated that the storage tanks were not installed yet.
- The proposed site for the RO plant has already been identified and allocated by the island council for this project.
- All households keep their own storages of rainwater for cooking and drinking purposes.
- There is an existing network of cables laid under the roads by FENAKA, Dhiraagu. Furthermore, the council stated that a few cables belonging to Ooredoo exist as well. The cables by Dhiraagu are only laid to the main public offices, the island health post and the school.
- The main existing cables are laid at a depth of 2 meters, 5 feet away from the walls.
- Electricity cables that were in use before FENAKA existed in the island, are still in the ground.

- The council let us know that an old and unusable RO plant exists in the North West corner of the island, and that it was very badly damaged during the construction of the island's harbour.
- There aren't any ongoing infrastructure projects in the island at the moment, the sewerage project that was started in June 2015 has been completed.
- The council anticipated that there would be a fee for the kind of service proposed by the Water Supply Project. The consensus amongst the councillors is that the fee should be dependent on the amount of water used by each household, and that a system utilizing water usage measuring meters would be optimum. The council stated that this would be the fairest method. They also stated the price of water per litre should be the same as Male'.
- Upon being asked whether they have any concerns regarding the project, the council stated that they do not have any major concerns regarding the project and that they only wish for its speedy progression and completion.
- The council wishes for proper communication between the government, contractor and the council in regards to the project.
- The council stated that the contractors should arrive at the island well prepared for the project.
- FENAKA stated that they did not have any staff specially allocated for the water supply project in the island yet.
- FENAKA let us know that there are 3 power generators in the island, two, 150 KW generators and one, 400 KW generator. Peak demand for electricity is during the weekends, normally, and during noontime in the North East Monsoon.

Table 10.1: List of People Consulted

#	Name	Office	Contact	Email
1	Ibrahim Moosa	President	7978575	ibumoosa@gmail.com
2	Ibrahim Saeed	Vice President	9160916	
3	Mohamed Ali	Director	9691694	Feeroazu@gmail.com
4	Mohamed Naaif	Council	9996774	-
5	Ibrahim Hassan	Council	7741388	-
6	Zameer	FENAKA	7896200	

10.3 Health Protection Agency (HPA)

Date: 10 July 2016

Venue: HPA

Participants: Aminath Shaufa (Public Health Program Coordinator), Moosa Haneef (Senior Public Health Program Officer)

Summary of Discussions

- Currently, HPA has no guideline or regulation for water treatment process and for the quality of product water.
- HPA is in the process of formulating a safety guideline for water use and management.
- The main concern is with regards to treatment of water and disinfection. Often times, issues rise during post treatment and disinfection process. Negligent post treatment of water can be detrimental to the people at the receiving end and can lead to water borne diseases. HPA recommends ensuring safety provision of water to the island community by conducting the testing process in a thorough manner prior to releasing into the network loop.
- HPA also recommends maintaining the water storage systems and gutter systems clean.

10.4 Environmental Protection Agency (EPA)

Date: 21 July 2016

Venue: EPA

Participants: Aishath Yamany Hassan (Microbiologist), Aminath Nizar (Engineer), Ali Nishan (Assistant Environment Officer), Fathimath Reema (Director), Yazeed Ahmed (Director).

Summary of Discussions

- The gravity network must be laid in a proper bed, if it is established inappropriately it will lead to stagnation of water producing a breeding ground for mosquitoes.
- The water network must comply with the sewerage guideline and the first flush device should be automatic, it should not be semi-automatic or manual.
- Ensure the rainwater from storage tanks has a residual chlorine count of 0.02 mg/L prior to sending it for treatment and processing.
- The buildings allocated for rainwater harvesting system must have a 15-year sustainability period and owners of these buildings or institutions must be informed that the roofs will be used for 15 years. If roofs need to be changed or serviced during this time period, the proponent must be responsible and they must provide commitment that

they will be maintaining the roofs of these buildings.

- The water supply system must be designed to cater 25% of the total demand throughout the year and rainwater must be produced three times more than the desalinated water to ensure continuous supply of water even during the dry periods.
- EPA advised that the current forecast for water consumption at 20 Litres per day is not sufficient as it is the minimum requirement for basic needs. EPA recommends a projection of 35 Litres per day.
- Future water demand must be calculated including public, institutions, utility centers and marine vessels in the island. Accordingly, the rainwater collecting tanks must have the capacity to hold water to cater three times the yearly demand. The rainwater-holding tank must also be designed for a 15-year sustainability period.
- Locations allocated for flush out points must be erosion resistant and EPA advises to lay the flush out lines directly into the sea. If flush out points are on the beach, appropriate mitigation must be taken to prevent sediment loss and erosion. The flush out line could be combined with the brine discharge line to avoid this.
- The water distribution system must have a pressure head of 21-25 m.
- EPA does not encourage overhead tanks as this poses issues during times of crisis or if the island needs to be expanded.
- EPA recommends to use two pumps for water distribution, one on standby and the other as a backup.
- As there is an ongoing sewerage project in the island, EPA recommends leaving a buffer distance between cables of both systems. EPA advises to refer to the 'Criteria and Technical Specification for water supply and sewerage systems' for details on this. The cables must also be color coded.
- The contractor must ensure that no damages are caused to the existing cable lines in the island.
- Mitigation measures must also be taken while managing and disposing the mud after borehole drilling. EPA advises that it must be segregated and the sediments must be treated as general waste.
- The contractor or the proponent must ensure a proper customer service should be provided for the project. The project must be delivered to the island in the best manner.

11 Potential Data Gaps and Assessment Limitations

11.1 Gaps in Information

The environment of Maldives is generally poorly understood. This may be due to the lack of detailed studies in the Maldives. Much of the literatures on coral islands are derived from studies done in the Pacific which unfortunately has very different climatic and geologic settings.

Detailed environmental analysis for an EIA is often required to be undertaken in a relatively short period of time. Give the seasonal climatic variations in Maldives and the differences in local geomorphologic and climate settings in individual islands such a short time frame is often too little to assess selected aspects of the environment. This problem is compounded by the absence of long-term studies in other parts of Maldives. Hence, most EIA's end up being based on an environmental snapshot of specific point in time. However, experienced EIA specialists can deliver a close match to reality based on a number of similar assessments. In this regard, the following gaps could be identified in information.

- Absence of long-term site specific or even regional data (at least 2 years). Most critical data include current, wave and terrestrial modification history.
- Absence of historical and long-term records on reef and lagoon environment.
- Lack of detailed data on geology and soil due to time limitation in EIA submission.

These gaps are seriously considered in the assessment and care has been taken to address the issue in designing mitigation measures and the monitoring programme.

11.2 Uncertainties in Impact Prediction

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. As note earlier, there is also no long term data and information regarding the particular site under consideration, which makes it difficult to predict impacts. It is important to consider that there will be uncertainties and voluntary monitoring of natural processes as described in the monitoring programme is absolutely essential.

12 Conclusions

The assessment shows that the RO systems can be developed on the island with limited implications on the environment. The assessment shows that the proposed developments involve significant impacts on the marine environment and terrestrial environment due to brine outfall construction, brine discharge, ground excavation and operation of vehicles and machinery. The project also involves moderately significant health and safety risks due to equipment handling and pollution. However, the predicted impacts can be minimized considerably with the proposed mitigation measures. Significant impacts of operation stage include marine degradation due to brine discharge, increased GHG emissions due to RO plant and operation of pumps stations, and increased cost of living due to additional cost in purchasing water. The assessment shows that the proposed project has many positive impacts including improved quality and accessibility to potable water, protection of groundwater aquifer, reduction of water related disaster risk, and increased employment and business opportunities

The key conclusions of this EIA are summarized below.

12.1 Proposed Systems

- Reverse Osmosis desalination technology has been determined as the most appropriate technology, given the proven record of success in Maldives. The project proposes to establish an integrated water supply system in Meedhoo by installing two modules of 40 m^3 RO plants and establishing a rainwater harvesting system.

12.2 Environmental Aspects

- Overall the project is beneficial to the environment specifically due to improved quality and accessibility of potable water and the protection of groundwater aquifer from over-extraction.
- Although there are negative impacts from all activities of the project, only a small number of activities cause relatively significant adverse impacts.
- Activities with the highest potential to cause negative impacts are excavation, operation of desalination plant, construction of brine outfall, and discharge of brine water.
- Adverse impacts from operation of desalination plant are mostly related to power consumption and associated air emissions.
- With proper mitigation measures, the project is not expected to cause significant damage to the environment.

12.3 Socio-economic Aspects

- The proposed water supply system will significantly improve the quality and accessibility of potable water in the island Meedhoo.
- The result of willingness to pay survey shows that residents of Meedhoo are willing to pay for water supply system. Majority of the people consulted wish to pay as per usage.

In conclusion, this project has been designed in conformance to the relevant laws and regulations of Maldives but requires final approval from EPA for the detailed drawings. Given the positive outcomes associated with this project, overall conclusion is that this is a beneficial project for the island community of Meedhoo.

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APPENDIX A – Approved Terms of Reference

TOR Number: 203-EIARES/438/2016/115

Terms of Reference for Environmental Impact Assessment for the proposed Water Supply System Project in Meedhoo, Raa Atoll

The following is the Terms of Reference (ToR) following the scoping meeting held on **27/06/2016** for undertaking **the EIA for the proposed Water Supply System Project of R.*Meedhoo.* *The proponent of this project is Ministry of Environment and Energy.***

The proposed design and build of water supply system of Raa Meedhoo aims to establish an integrated water resource management system in the island of Raa Meedhoo by designing and building of water supply network, water storage tanks and Reverse Osmosis (RO) plant.

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

1. **Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed**.** Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this project is link other activities that are carried out or that is being carried out within the project boundary. Identify the project financing and institutional arrangements relevant to the project. This should include the following information:

   - Name and contact details of the proponent
   - Rationale and background to the project
   - Aims and objective of the project
   - Information of the project/activity and the tasks already completed
   - Information and other activities that have been carried out or that is being carried out within the project boundary.
   - Institutional arrangements relevant to this project
   - Project Location and boundaries of the study area

2. **Study area** – Submit a minimumA3 size scaled plan with location of proposed facility. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size.

3. **Scope of work** – Identify and number tasks of the project including preparation, construction and decommissioning phases.

   Task 1. Description of the proposed project

   Desalination Plant Design

   a) Submit an A3 size plan of proposed RO systems with labeled drawings
   b) Describe the technology (reverse osmosis, disinfection) and capacity (envisage population growth in the next 30 years);
   c) Water storage tank capacity;
   d) Water quality monitoring and water security logistics

e) Describe operations for dewatering excavations for pump stations and pipeline installation;
f) Describe rain water collection potential in the proposed project site
g) Specify materials, equipment, heavy machinery, staff estimate (quantity and period of time), key personnel positions, intermittent technical expertise required;
h) Project management: Include communication of construction details, progress, target dates and duration of works, construction/operation/closure of labor camps, access to site, safety, equipment and material storage, waste management from construction operations (mainly dredged materials), power and fuel supply;
i) Specify an emergency water supply plan if system fails;

<u>Brine Outfall Pipeline</u>

a) Justify brine outfall site selection depth and distance from shore using oceanographic and ecological information. Currents and waves ought to disperse the discharged water with minimum impacts on marine ecosystems and economic activities.
b) Describe equipment needed and construction methods for laying the offshore pipeline including handling transportation.

<u>Borehole</u>

a) Description of borehole design and location of boreholes
b) Description and justification of borehole locations
c) Description of equipment needed and construction methods for boreholes drilling.

<u>Distribution network</u>

a) Detailed description of the distribution network including pipe materials, house connections, water metering and pumping facilities.

<u>Temporary facilities</u>

Project management: Include communication of construction details, progress, target dates and duration of works, construction/operation/closure of labor camps, access to site, safety, equipment and material storage, water supply, waste management from construction operations (mainly dredged materials), power and fuel supply temporary site setup;

Task2. Descriptions 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. <u>Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline.</u> 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.

<u>The baseline data will be collected before construction and from at least two benchmarks</u>.

<u>All data must be collected as per the requirements of the EPA Data Collection Guidelines (published on www.epa.gov.mv). The report should outline detailed methodology of data collection utilized.</u>

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:

<u>Climate</u>

- Temperature, rainfall, wind and waves,
- Risk of hurricanes and storm surges;

Hydrography/hydrodynamics (localized maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;

Physical parameters

- Marine water quality assessment measuring these parameters; temperature, pH, salinity, total dissolved solids, conductivity, dissolved oxygen, BOD, COD, total coliform and faecal coliform from a minimum of 2 locations
- Ground water quality assessment of desalination plant site and borehole locations and an additional 2 locations from the island, measuring these parameters; temperature, pH, salinity, conductivity, and Oil (total hydro carbon).
- Noise level near the proposed desalination plant area

Biological Assessment

Marine:

- A quantitative and qualitative assessment of coral reef environment (the benthic coral fauna and fish fauna cover) at the proposed brine concentrate discharge area and alternative locations

Terrestrial

- Type of vegetation, exact number and extent of vegetation to be cleared (if any).
- Terrestrial baseline monitoring surrounding all inland developments (See www.epa.gov.mv for monitoring guidelines). Include a description of all flora and fauna and any threatened or endangered species in the area.

Socio-economic environment

Assessment of socio-economic conditions of R.Meedhoo

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

Hazard vulnerability:

- Vulnerability of the site to flooding.

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

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project.

- Concept design approval from MEE
- Land approval from MEE

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

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:

Task 4. Potential impacts (environmental and socio-cultural) of proposed project– 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 vegetation and fauna from land clearance activities, lifting stations and pipe works;
- Impacts on ground water quality;
- Impacts from marine habitat destruction which may affect fish stocks and species diversity and density of invertebrates,
- Equipment, technical and spillage impacts during construction.
- Impacts on marine water quality
- Impacts on soil;

Impacts on the socio-economic environment

- Noise impacts on local population;
- Aesthetics on-land and underwater impacts from intake and brine outfall pipelines affecting recreational users (tourism industry);
- Increased demands on natural resources and services (power supply, land availability);
- Land use displacement and economic opportunities.

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

Task 5. Alternatives to proposed project – Describe alternatives including the *"no action option"* should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include alternative location, construction technologies, taking into account environmental, social and economic factors. 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. 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 ground water and sea water quality. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, financial 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.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) –
Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, government authorities, NGOs, engineers/designers, development managers, staff and members of the general public. The EIA report should include a list of people/groups consulted and summary of the major outcomes. The following parties should be consulted;

a) Utility Providers of R.Meedhoo
b) R.Meedhoo Public
c) R.Meedhoo Island Council
d) EPA
e) HPA

Presentation- The environmental impact assessment report, to be presented in digital format, should be concise and focused on significant environmental issues. It should contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations of or any references used in interpreting those data. The environmental assessment report should be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2012 and subsequent amendments.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 6 months from the date of this Term of Reference.

27 June 2016

APPENDIX B – Site Plan and required land use permits

29/5/16

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

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ނަންބަރު: 438-PDU/MWSC/2016/67

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INCOMING CORRESPONDENCE								
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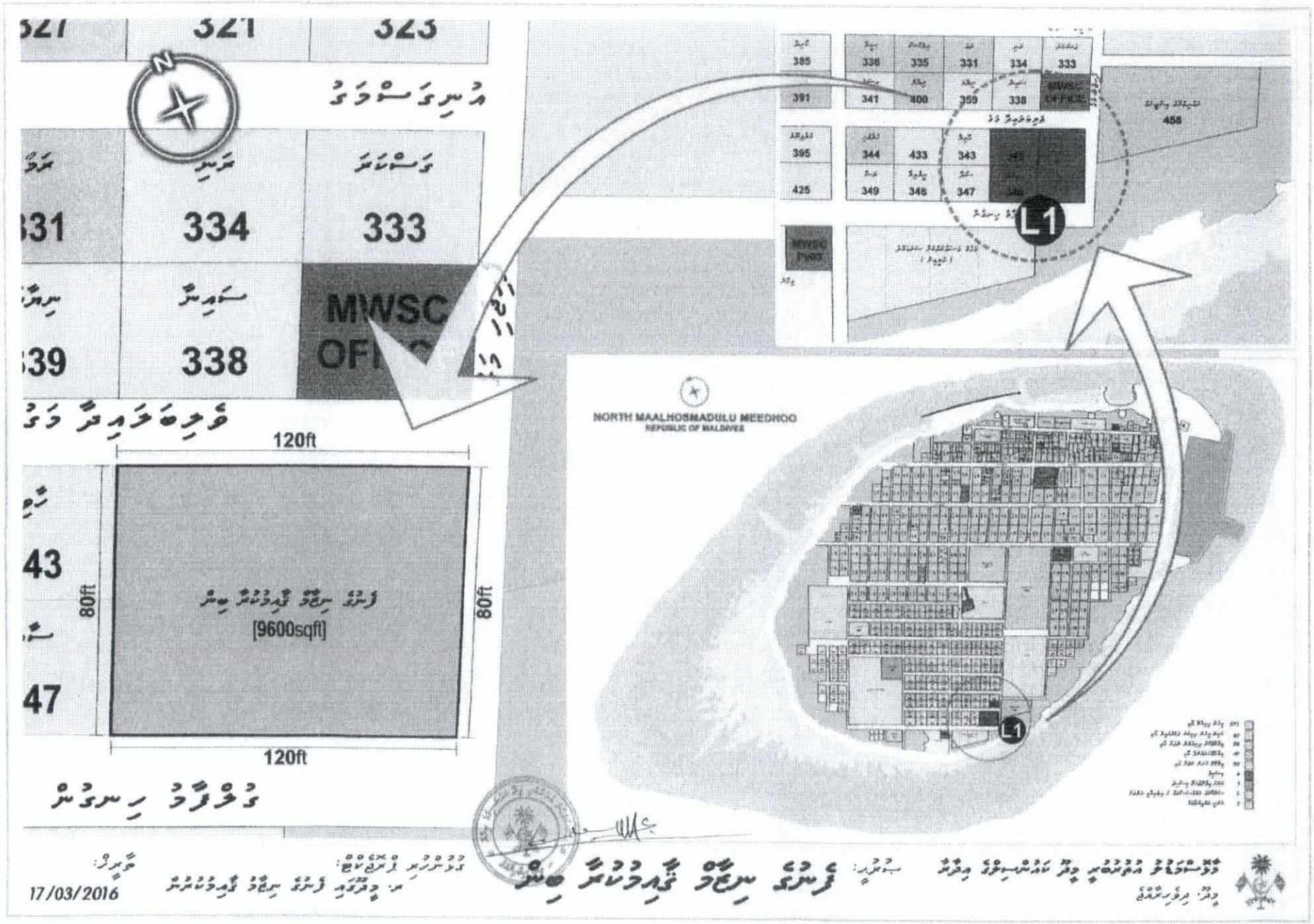
މާލެ ވޯޓަރ އެންޑް ސީވަރޭޖް ކޮމްޕެނީ ލިމިޓެޑް
މާލެ، ދިވެހިރާއްޖެ.

Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
+(960) 301 8300
+(960) 301 8301
www.environment.gov.mv
ގްރީން ބިލްޑިންގ، ހަނދުވަރީ ހިނގުން،
މާފަންނު، މާލެ، 20392، ދިވެހިރާއްޖެ.
secretariat@environment.gov.mv
www.twitter.com/ENVgovMV
www.facebook.com/environment.gov.mv


321
323
331
334
333
339
338
MWSC
120ft
80ft
[9600sqft]
NORTH MAALHOSMADULU MEEDHOO
REPUBLIC OF MALDIVES
L1
17/03/2016

بسم الله الرحمن الرحيم

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

ފަރުގަސްދާއި ތާވަލާއި ތަރައްގީ ވަޒާރާ
ދަތުރު، ތާވަލާއި ގަޑިތަކުގެ.

Date: 9 June 2016

No: 438-PDU/MWSC/2016/75

Mr Ibrahim Fazul Rasheed

Managing Director,
Male Water and Sewerage Company,
Male', Maldives.

Dear Sir,

Subject: Concept Design of R. Meedhoo Design and Build Water Supply System

This is in reference to captioned concept design of R. Meedhoo received on 29th May 2016, discussed with MWSC on 5th June 2016.

We hereby approve the concept design submitted for R.Meedhoo design build water supply system and request you to commence EIA and Detailed Design work in accordance with EPA guidelines.

Sincerely,

Mohamed Mustafa
Director

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

ފަރުގަސްދާއި ތާވަލާއި ތަރައްގީ ވަޒާރާ،
ދަތުރު، ތާވަލާއި ގަޑިތަކުގެ، 20392، ދިވެހިރާއްޖެ.
secretariat@environment.gov.mv
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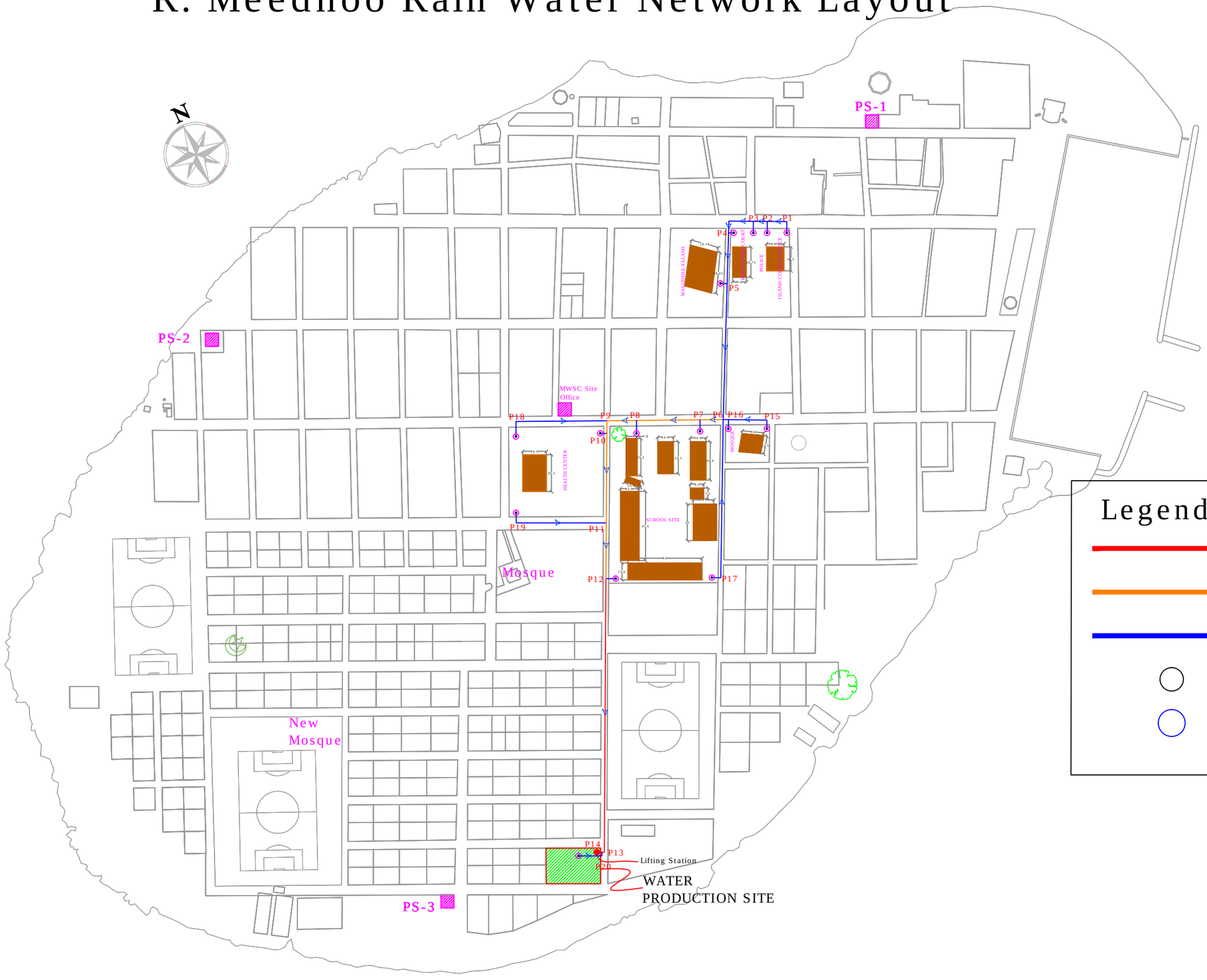
www.facebook.com/environment.gov.mv

R. Meedhoo Rain Water Network Layout

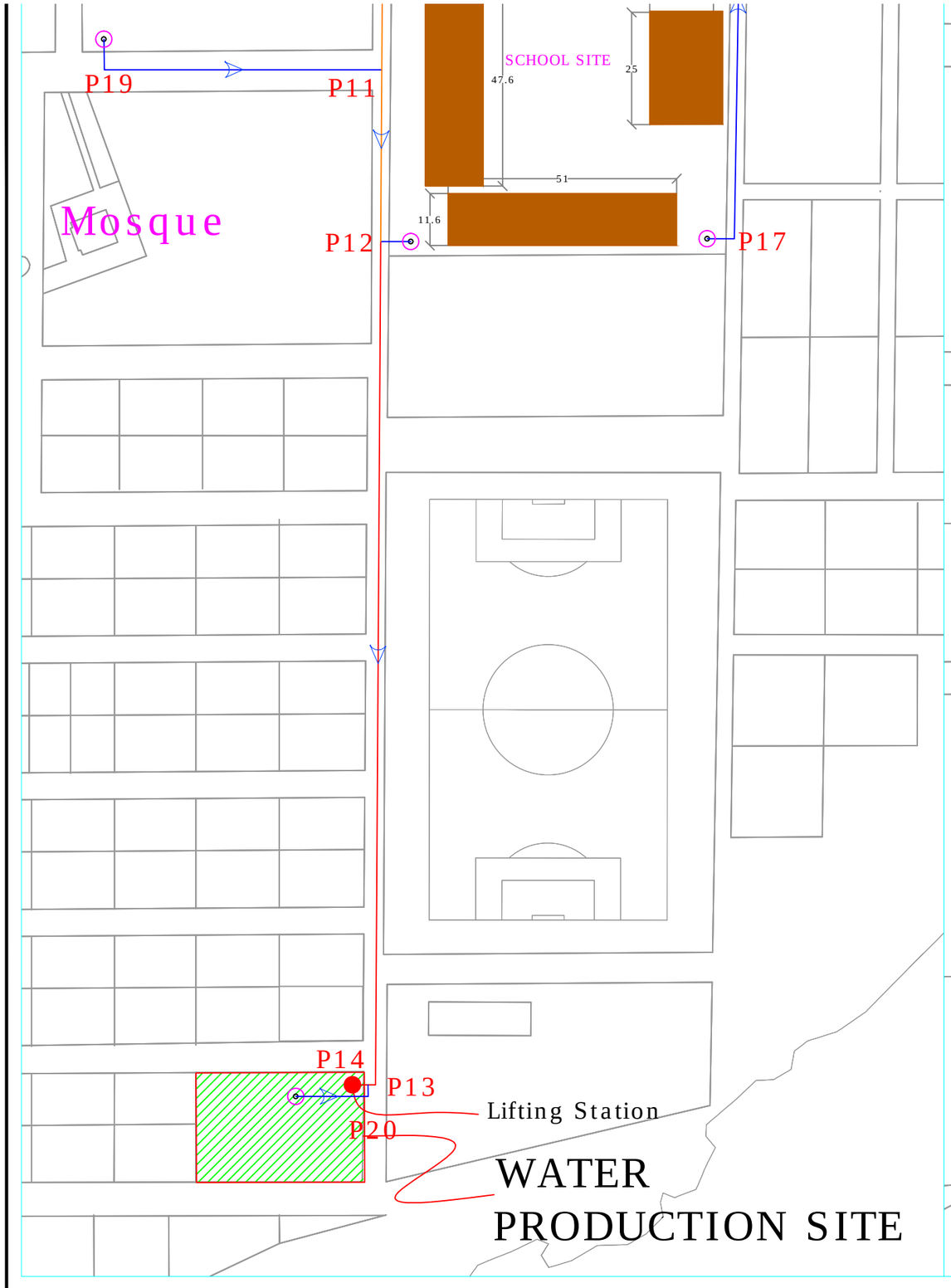


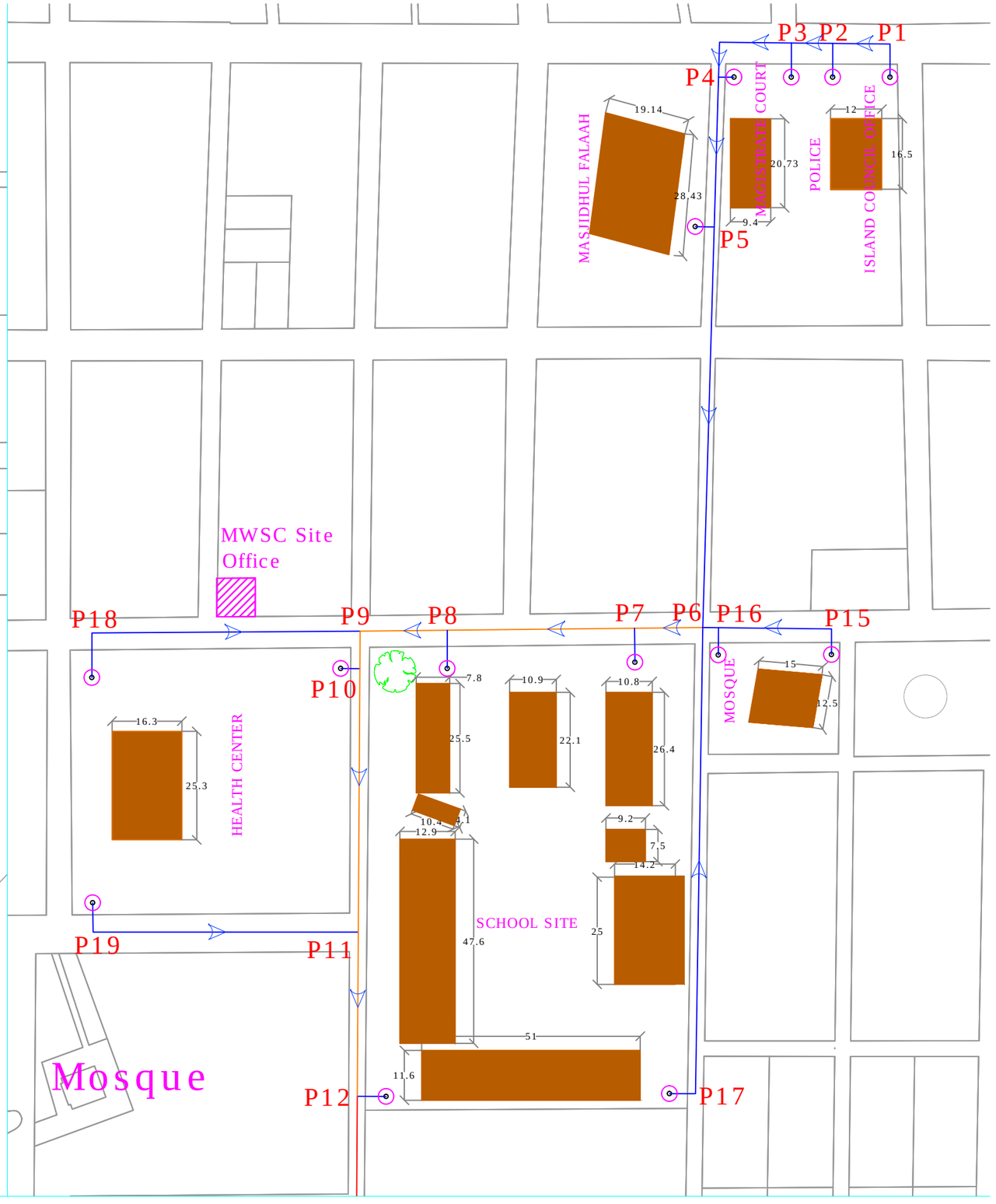
Legend

- 250mm OD UPVC Pipeline
- 200mm OD UPVC Pipeline
- 160mm OD UPVC Pipeline
- Catchpits (Inspection Chambers)
- Lifting Station

MWSC
MALE' WATER & SEWERAGE COMPANY PVT LTD.
AMEENEE MAGU, MACHCHANGOLHI MALE' 20-01 REPUBLIC OF MALDIVES
Tel: (+960) 323209, Fax: (+960) 324306, E-mail: mwsc@dhivehinet.net.mv

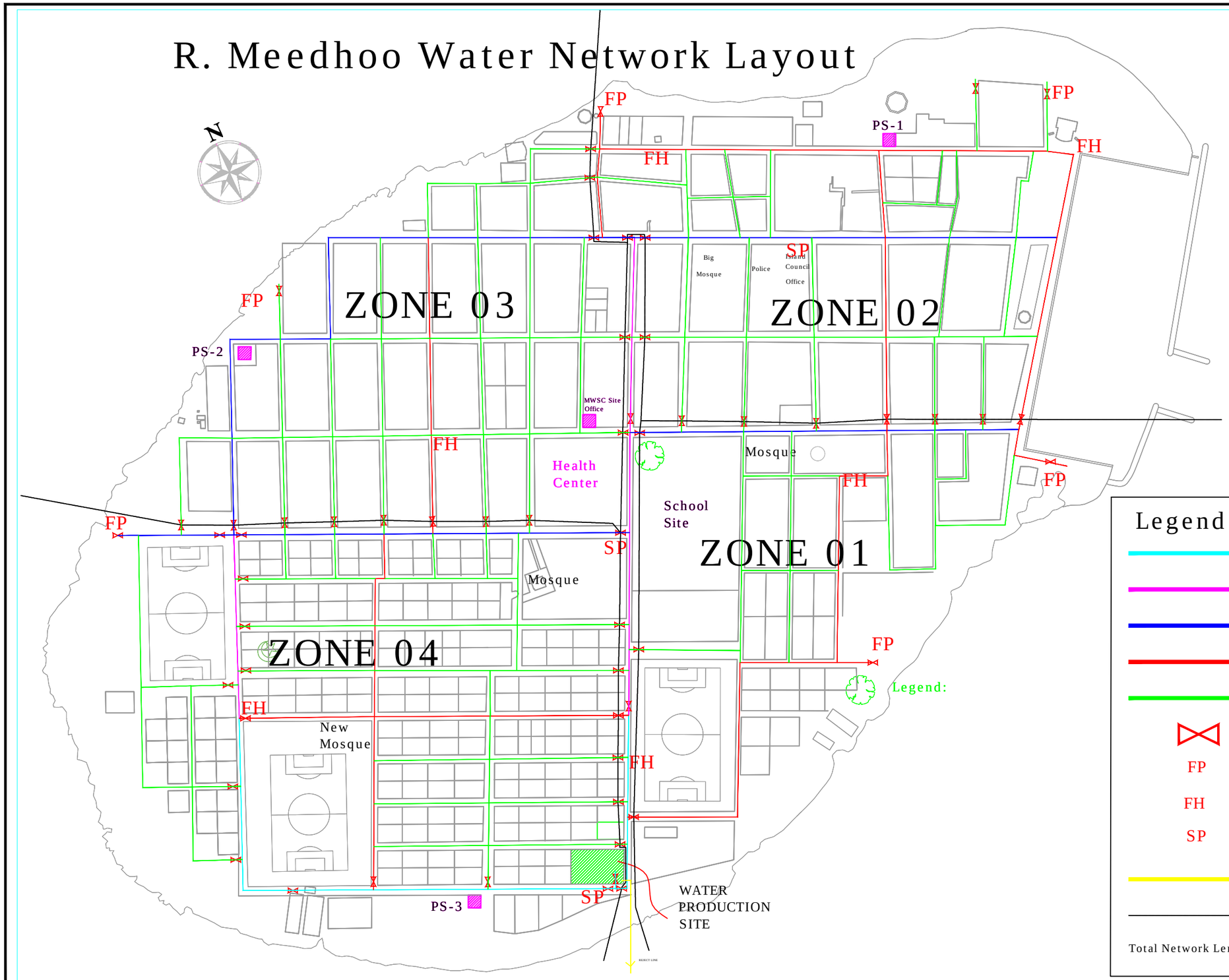
CLIENT: MINISTRY OF ENVIRONMENT AND ENERGY, MALDIVES	PROJECT: DESIGN & BUILD BASIS FOR INTEGRATED WATER SUPPLY AND DISTRIBUTION SYSTEM AT R.MEEDHOO	SCALE: NTS	DRW NO. : RMEDH-RWN-01	DESIGN BY: MIDHATH	DRAWN BY: FAZEELA	AMMENDMENTS:
	CONTENTS: RAINWATER NETWORK - LAYOUT	DATE: 10 JULY 2016	Page: A-1	STRUCTURAL DESIGN BY:	CHECKED BY:	





MWSC MALE' WATER & SEWERAGE COMPANY PVT LTD. AMEENEE MAGU, MACHCHANGOLHI MALE' 20-01 REPUBLIC OF MALDIVES Tel: (+960) 323209, Fax: (+960) 324306, E-mail: mwsc@dhivehinet.net.mv	CLIENT: MINISTRY OF ENVIRONMENT AND ENERGY, MALDIVES	PROJECT: DESIGN & BUILD BASIS FOR INTEGRATED WATER SUPPLY AND DISTRIBUTION SYSTEM AT R.MEEDHOO	SCALE: NTS	DRW NO. : RMEDH-RWN-02	DESIGN BY: MIDHATH	DRAWN BY: FAZEELA	AMMENDMENTS:
		CONTENTS: RAINWATER NETWORK - CLOSE VIEW	DATE: 10 JULY 2016	Page: A-2	STRUCTURAL DESIGN BY:	CHECKED BY:	

R. Meedhoo Water Network Layout



Legend

- 225mm OD PE Pipeline (PN10)
- 160mm OD PE Pipeline (PN10)
- 110mm OD PE Pipeline (PN10)
- 90mm OD PE Pipeline (PN10)
- 63mm OD PE Pipeline (PN10)
- Gate Valves (57 Nos.)
- FP — Flushing Points (6 Nos)
- FH — Fire Hydrants (6 Nos.)
- SP — Sampling Points (3 Nos.)
- Reject Line (225mm PE Pipeline)
- Zonal Boundaries (Total 4 zones)

Total Network Lenght: 11,136 m (Including Future Development Areas)

MWSC
MALE' WATER & SEWERAGE COMPANY PVT LTD.
AMEENEE MAGU, MACHCHANGOLHI MALE' 20-01 REPUBLIC OF MALDIVES
Tel: (+960) 323209, Fax: (+960) 324306, E-mail: mwsc@dhivehinet.net.mv

CLIENT:	PROJECT:	SCALE:	DRW NO. :	DESIGN BY:	DRAWN BY:	AMMENDMENTS:
MINISTRY OF ENVIRONMENT AND ENERGY, MALDIVES	DESIGN & BUILD BASIS FOR INTEGRATED WATER SUPPLY AND DISTRIBUTION SYSTEM AT R.MEEDHOO	NTS	RMEDH-RWN-03	MIDHATH	SUNAN	
	CONTENTS: WATER NETWORK	DATE: 10 JULY 2016	Page: A-3	STRUCTURAL DESIGN BY:	CHECKED BY:	

APPENDIX C –Water Quality Results

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

بسم الله الرحمن الرحيم

MWSC

WATER QUALITY TEST REPORT

Test Report No: 300678/2016/54

Customer Informations : ***Aurinko Pvt Ltd***
H.Orchidmaage 4th Floor
Ameeru Ahmed Magu
Male'
Rep.of Maldives

Date: 25/07/2016

Sample Description / Location~	R. Meedhoo		TEST METHOD	UNIT
	Outfall SW1	Outfall SW2		
Sample Type~	Sea water			
Sampled Date~	19/07/2016			
Sample Received Date	20/07/2016			
Test Requisition Form No.	900165468			
Sample No.	825662	825663		
Date of Analysis	20/7/2016 - 24/7/2016			
PARAMETER	ANALYSIS RESULT			
Physical Appearance	Clear with particles	Clear with particles	Visual	-
Conductivity	53300	52000	Method 2510 B. (adapted from Standard methods for the examintation of water and waste water, 22nd edition)	µS/cm
pH	8.06	8.12	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Salinity	35.20	32.24	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Dissolved Oxygen (DO)	7.98	7.99	Standard Methods 19th edition APHA	mg/L
Temperature	21.7	26.1	Electrometry	°C
Total Dissolved Solids (TDS)	26700	26000	Electrometry	mg/L
Total Coliforms	0	0	Colilert®-18/Quanti-Tray®	MPN/100mL
Faecal Coliforms	0	0	Colilert®-18/Quanti-Tray®	MPN/100mL

Keys:
µS/cm: Micro Siemens per centimeter, **mg/L:** Milligram Per Liter, **‰:** Parts Per Thousand, **°C:** Degree Celcius, **MPN:** Most Probable Number

Checked by:	Approved by:
Abdulla Rasheed Senior Quality Officer	Mohamed Eyman Senior Technical Officer

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information Supplied by the customer

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

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

بسم الله الرحمن الرحيم

MWSC

WATER QUALITY TEST REPORT

Test Report No: 300678/2016/55

Customer Informations : ***Aurinko Pvt Ltd***
H.Orchidmaage 4th Floor
Ameeru Ahmed Magu
Male'
Rep.of Maldives

Date: 25/07/2016

Sample Description / Location~	R. Meedhoo			TEST METHOD	UNIT
	GW1	GW2	GW3		
Sample Type~	Ground water				
Sampled Date~	19/07/2016				
Sample Received Date	20/07/2016				
Test Requisition Form No.	900165468				
Sample No.	825664	825665	825666		
Date of Analysis	20/7/2016 - 24/7/2016				
PARAMETER	**ANALYSIS RESULT**				
Physical Appearance	Pale yellow with particles	Clear with particles	Clear with particles	Visual	-
Conductivity	19480	674	14100	Method 2510 B. (adapted from Standard methods for the examintation of water and waste water, 22nd edition)	µS/cm
pH	7.24	7.79	7.24	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Salinity	11.57	0.33	8.15	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Temperature	27.4	26.4	26.8	Electrometry	°C
Total Petroleum Hydrocarbon (TPH)	23.4	0.27	0.14	UV Fluorescence	mg/L

Keys:
µS/cm: Micro Siemens per centimeter, **mg/L:** Milligram Per Liter, **‰:** Parts Per Thousand, **°C:** Degree Celcius

Checked by:	Approved by:
Abdulla Rasheed Senior Quality Officer	Mohamed Eyman Senior Technical Officer

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
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**********END OF THE REPORT**********

APPENDIX D– Survey Locations

Legend

- Currents
- Ground Water Samples
- Soil Profiles
- Marine Water Samples
- Marine Transects
- Outer reef line

N W E S

Meters

0 25 50 100

Meedhoo Island, Raa Atoll Desalination plant and network establishment project Survey Locations

PROJECTION: Transverse Mercator (UTM Zone 43 N); HORIZONTAL DATUM: WGS84; VERTICAL DATUM: Hulhule Tide Gauge
Map version: 03/08/2016

Surveyed and Prepared by: CDE Consulting, Maldives

Ground water samples

code	X	Y
G1	73.3543	2.35613
G2	73.3556	2.35808
G3	73.3551	2.35413

Marine Transects

Site_ID	X_Start	Y_Start	X_Start	Y_Finish
T1	72.9539	5.45465	273346	5.45476
T2	72.9521	5.45502	273053	5.45525

Marine Water Sampling

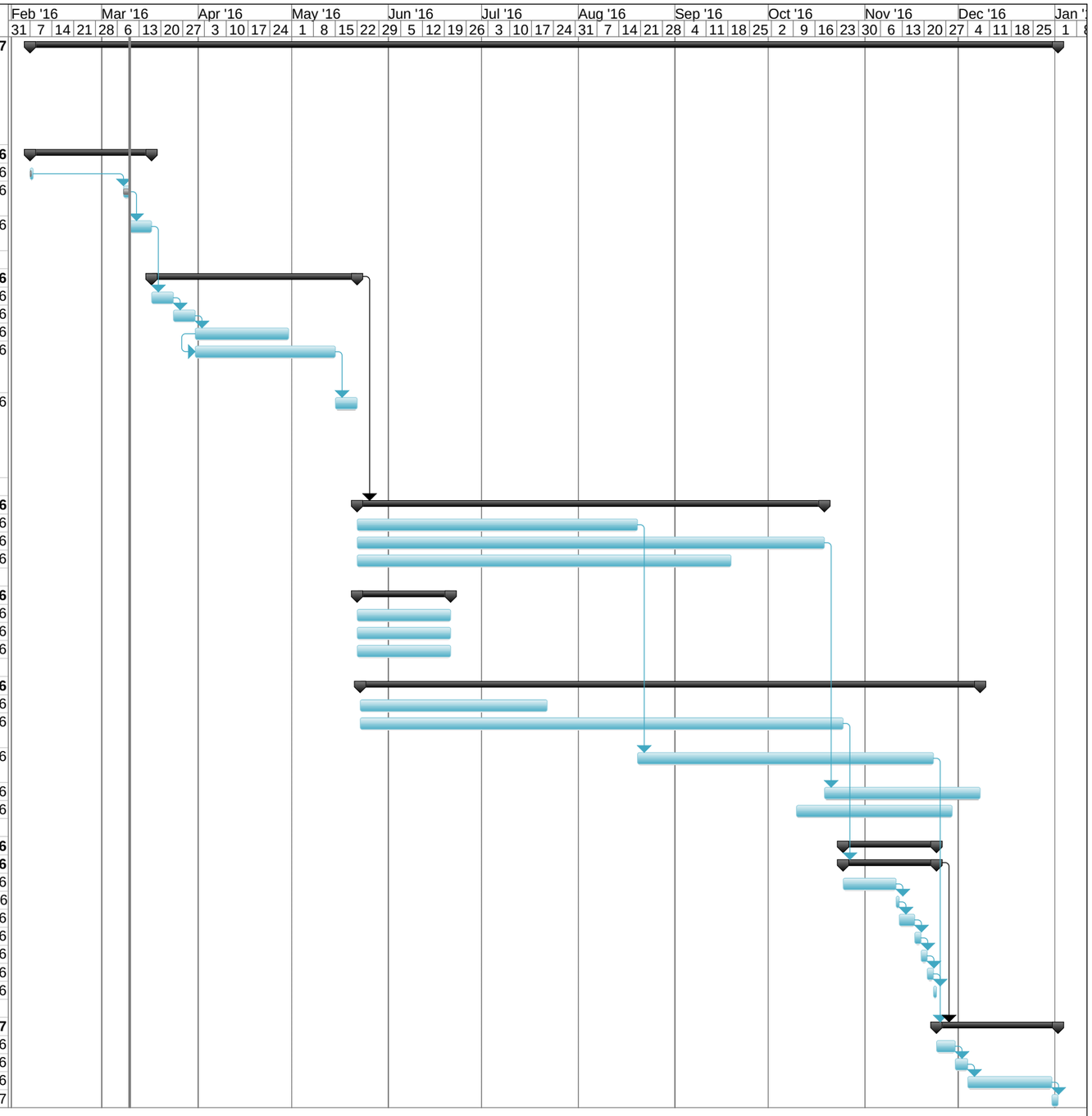
code	X	Y
W1	72.9542	5.45456
W2	72.9518	5.45502

Currents

SiteID	X	Y
C1	72.9491	5.45628
C2	72.9512	5.4556
C3	72.9536	5.45462
C4	72.9559	5.45471
C5	72.9545	5.45541

APPENDIX E–Work Plan

ID	Task Name	Duration	Start	Finish
1	**Design and Build Basis for Water Supply Network, Water Storage Tanks & Reverse Osmosis Plant and Allied Works Based on Integrated Water Resources Management Approach in R.Meedhoo, Maldives**	**330 days**	**February 7, 2016**	**January 1, 2017**
2	**Site Mobilization for Design & Survey**	**39 days**	**February 7, 2016**	**March 16, 2016**
3	Agreement signing	1 day	February 7, 2016	February 7, 2016
4	Survey works (For design of Water Production System)	2 days	March 8, 2016	March 9, 2016
5	Approval of Water production & facility Land - by Client	7 days	March 10, 2016	March 16, 2016
6				
7	**Designs and Drawings**	**66 days**	**March 17, 2016**	**May 21, 2016**
8	Preparation of concept design	7 days	March 17, 2016	March 23, 2016
9	Approval of Concept design - by Client	7 days	March 24, 2016	March 30, 2016
10	EIA	30 days	March 31, 2016	April 29, 2016
11	Detail Design Development of Water Network including rain water harvesting, RO building, Tank foundations etc	45 days	March 31, 2016	May 14, 2016
12	EIA & Design approvals by EPA & MEE (Note: Different componets of the design may vary and send seperately for approval. On approval of one component the civil component of the work will start accordingly, on component basis).	7 days	May 15, 2016	May 21, 2016
13				
14	**Procurement of Materials**	**150 days**	**May 22, 2016**	**October 18, 2016**
15	Pipes and fittings	90 days	May 22, 2016	August 19, 2016
16	Tanks	150 days	May 22, 2016	October 18, 2016
17	Pumps, Generators, electric Panels..etc	120 days	May 22, 2016	September 18, 2016
18				
19	**Site Mobilization for Construction**	**30 days**	**May 22, 2016**	**June 20, 2016**
20	Establishment of Contractors office	30 days	May 22, 2016	June 20, 2016
21	Establishment of Material Storage	30 days	May 22, 2016	June 20, 2016
22	Establishment of Accomodations	30 days	May 22, 2016	June 20, 2016
23				
24	**Civil Works**	**199 days**	**May 23, 2016**	**December 7, 2016**
25	Borehole	60 days	May 23, 2016	July 21, 2016
26	RO building, Tank Foundations, Degassifier Foundation, Brine well, & Rainwater lifting station	155 days	May 23, 2016	October 24, 2016
27	Water network pipe laying including rainwater harvesting network	95 days	August 20, 2016	November 22, 2016
28	Erection of Tanks & internal piping	50 days	October 19, 2016	December 7, 2016
29	Reject Pipeline	50 days	October 10, 2016	November 28, 2016
30				
31	**Mechanical & Electric works**	**30 days**	**October 25, 2016**	**November 23, 2016**
32	**Installation and Commissioning**	**30 days**	**October 25, 2016**	**November 23, 2016**
33	Installation of RO plant	17 days	October 25, 2016	November 10, 2016
34	Installation of Borehole pumps	1 day	November 11, 2016	November 11, 2016
35	Installation of Generator	5 days	November 12, 2016	November 16, 2016
36	Installation of Degassiffier	2 days	November 17, 2016	November 18, 2016
37	Commissioning Water Production system	2 days	November 19, 2016	November 20, 2016
38	Installation of Distribution system & disinfection system	2 days	November 21, 2016	November 22, 2016
39	Commissioning of distribution pump system	1 day	November 23, 2016	November 23, 2016
40				
41	**Testing & Commissioning**	**39 days**	**November 24, 2016**	**January 1, 2017**
42	Testing and commsioning	6 days	November 24, 2016	November 29, 2016
43	Disinfection	4 days	November 30, 2016	December 3, 2016
44	House connections (Pipe laying & Meter Installation)	27 days	December 4, 2016	December 30, 2016
45	Project handover	2 days	December 31, 2016	January 1, 2017



Project: mobilization & construction sch
Date: March 10, 2016

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Progress
Split	External Tasks	Inactive Summary	Manual Summary	Deadline
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

APPENDIX F– List of attendees for the public consultation

Willingness To Pay Survey **Location: R.Meedhoo**

No	Address	Name of Person	How many people live in the household	How many household members earn income	Average income of the House Hold (1000s)	How much is your household willing to pay per month for desalinated piped water	Remarks
1	Meenaaz	Abdul Rasheedh	6	6	15	Meter (As per usage)	Ground water is salty and bad during North East Monsoon
2	Fehige	Zakee	4	4	2	Meter (As per usage)	Ground water is good during South West Monsoon
3	Irudheymaage	Abdul Shakoor	12	10	10	Meter (As per usage)	Need this project as soon as possible.
4	Ohaandhooge	Ahmed Rasheedh	7	2	6	Meter (As per usage)	
5	Shady Corner	Mohamed Naeem	19	-	20	Meter (As per usage)	Good project.
6	Gemana	Abbaas	5	1	10	Meter (As per usage)	
7	Sanoora	Sameer	6	6	-	Meter (As per usage)	
8	Mahidhoo	Hassan Zareer	10	4	40	Meter (As per usage)	
9	Javaahiru Vaadhy	Hassan Habib	7	6	15	Fixed	
10	Jamharuge	Faisal	6	6	17	Fixed	Ground water is salty during North East Monsoon.
11	Sinamaage	Hameedh	10	2	6	Meter (As per usage)	1 litre for 15 laari should be the rate, otherwise, the service should be free.
12	Mooduvillage	Ibrahim Mohamed	14	4	15	Meter (As per usage)	Install water taps at harbor. A lot of fishing boats come to this island to get water.
13	Hihfaseyhage	Nasrulla Ibrahim	4	1	15	Meter (As per usage)	If it's charged than we will pay 15 laari for a litre.
14	Pink House	Shiyam	20	2	20	Meter (As per usage)	Water is a basic need, so it should be for free.
15	Shaadhee Villa	Mohamed Saeedh	12	6	15	Meter (As per usage)	Would like a free water service.
16	Zameen	Ahmed Zameer	8	4	15 - 20	Meter (As per usage)	
17	Kaneerumaage	Aminath Rifaa	7	3	30	Meter (As per usage)	
18	Fathis	Naathifa	8	3	10	Meter (As per usage)	
19	Himmiya	Mohamed Athif	4	2	12	Meter (As per usage)	
20	Seasaw	Ibrahim Ahmed	4	4	30	Meter (As per usage)	
21	Iris	Iqbal	6	3	10	Meter (As per usage)	
22	Dhefram	Fauzan	3	1	9	Meter (As per usage)	
23	Niqaa Ran	Abdul Rasheedh Hassan	4	1	7	Meter (As per usage)	
24	Fescor	Mohamed Ahmed	7	4	20	Meter (As per usage)	
25	Raaruh Rashuge	Mohamed Rameez	7	3	14	Meter (As per usage)	
26	Biriyaanuge	Haleema	5	1	4	Meter (As per usage)	It's better if it's free.
27	Maagasdhoshuge	Fathimath Jabeen	5	1	-	Meter (As per usage)	
28	Asurumaage	Saeedhaa Moosa	3	-	-	Meter (As per usage)	Good project.
29	Noovilaage	Ahmed Sobah	14	3	15	Meter (As per usage)	Good project.
30	Halavelige	Ali Shareef	10	4	20	Meter (As per usage)	
31	Hazaarumaage	Abdul Latheef	8	6	60	Meter (As per usage)	

32	Helengeli	Ali Ibrahim	20	6	50	Meter (As per usage)	Good project.
33	Shabnameege	Ahmed Hassan	6	6	8	Meter (As per usage)	Current water quality is bad.
34	Kaamineege	Nazeera	4	-	-	Meter (As per usage)	
35	Shabnameege 2 vana bai	Nadheema	2	1	5	Meter (As per usage)	
36	Irumatheege	Shaheedhaa	4	2	10	Meter (As per usage)	
37	Dhemina	Ahmed Ibrahim	11	1	7	Meter (As per usage)	
38	Keveli	Saeed Ibrahim	5	2	6	Meter (As per usage)	
39	Bulbulge	Hafsa Ali	12	1	30	Meter (As per usage)	
40	Nirolhu	Mohamed Rafeeu	-	2	25	Meter (As per usage)	
41	Shady Corner	Abdul Azeez	10	5	25	Meter (As per usage)	
42	Black	Ismail	9	4	20	Meter (As per usage)	
43	Fehivina	Ihusaan	8	1	8	Meter (As per usage)	
44	Vaagali	Ibrahim Shareef	4	3	30	Fixed	
45	Fanas	Sobah	7	5	50	Meter (As per usage)	
46	Seenu	Abdulla Saeed	6	2	70	Meter (As per usage)	
47	Nika	Abdul Rauf	8	7	20	Meter (As per usage)	
48	Gaahiraa	Irushaadh	5	1	5	Meter (As per usage)	
49	Falak	Mohamed Ali	6	4	35	Meter (As per usage)	Service quality should be good.
50	Maalan	Ibrahim Rasheed	3	2	25	Meter (As per usage)	
51	Pink House	Ibrahim Ali	17	3	10	Meter (As per usage)	
52	Ambareege	Ishaag Easa	13	6	30	Meter (As per usage)	
53	Fazaa	Ishaag Ali	5	1	10	Meter (As per usage)	
54	Karankaage	Mohamed Ahmed	5	2	15	Meter (As per usage)	Good project.
55	Noovilaage	Ibrahim	14	3	15	Meter (As per usage)	
56	Kashavaru	Ibrahim	5	1	8	Meter (As per usage)	Near Football ground.

Date and Time: 10.7.2016 1300hrs
Stakeholder consultation Health Protection Agency (HPA)

#	Name	Designation	Contact	Email	Sign
1	Aminath Shaufa	Public Health Program Coordinator	7504075	Ashaufa@health.gov.mv	Shaufa
2	Moosa Haneef	S. Public health prog. offr.	7923180	haneef@health.gov.mv	
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Date and Time: **10:00hrs**
Stakeholder consultation **EPA**

#	Name	Designation	Contact	Email	Sign
1	Aishath Yamany Hassan	Microbiologist	7938186	aishath.yamany@epa.gov.mv	
2	Aminath Nizar	Engineer	7701531	aminath.nizar@epa.gov.mv	
3	Ali Nishan	Asst. Environment officer	9192936	ali.nishan@epa.gov.mv.	
4	Fathimath Reema	Director	3335949	fathimath.reema@epa.gov.mv	
5	Yoosuf Ahmed	Director		yoosuf.ahmed@epa.gov.mv	
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

APPENDIX G – CV's of Consultants

Ahmed Shaig

Phone: (+960) 77 88 758 shaig@cde.com.mv

Personal Details

Date of Birth: 19/02/1976 **Nationality:** Maldivian **Gender:** Male **Marital Status:** Married

Permanent Address: Maldives **Present Address:** M. Muleege, Orchid Magu, Male', Maldives.

Education

PhD, Environmental Science, 2009
James Cook University, Townsville, Australia

Research degree on 'Settlement Planning for Natural Hazard Resilience in Small Island States: The Population and Development Consolidation Approach'

BSc Land and Spatial Information Studies/Information Science. (double major), 1999-2001
University of Otago, Dunedin, New Zealand

Diploma in project planning, implementation, monitoring and evaluation, 1995
ILO training Centre, Turin, Italy

Employment History

Director, Environmental Services 2008 to present
CDE Consulting Supervisor: Dr. Simad Saeed
Republic of Maldives Phone: +(960) 7777445
Head of environmental wing

Assistant Under-secretary, Spatial Planning 2002-2004
Ministry of Planning and National Development Supervisor: Hon. Hamdun Hameed
Republic of Maldives Phone: +(960) 332-3919
Head of Spatial Planning Unit. Relevant Tasks include:

- Oversee environment related projects and application of environmental guidelines for planned projects.
- Plan, implement and oversee the development of a National GIS;
- Aid/facilitate/oversee urban planning, housing, land use planning, natural resource planning and environment related projects; Provide assistance in project planning (includes urban and regional planning, natural resources planning)

Project Manager, National Digital Mapping Project 2005 (8 months)
Ministry of Planning and National Development Supervisor: Hon. Hamdun Hameed
Republic of Maldives Phone: +(960) 332-3919

- Project involved aerial photography and satellite imagery of entire Maldives, ground surveying of key settlements, digital conversion of data and setting up a Mapping Unit.

Assistant Planning Officer/Planning Officer 1994-1999
Ministry of Planning and National Development Supervisor: Mr. Mohamed Hunaif
Republic of Maldives Phone +(960) 331-3040
Relevant tasks involved:

- Assisting in the National GIS Development Programme (Junior GIS developer)
- Facilitate urban planning, housing, land use planning, natural resource planning and environment related projects.

Experience in Consultancy

- *September 2002:* Member of the team appointed for environmental surveying and carrying capacity assessment of islands for tourism development in the southern atolls of Maldives for Ministry of Tourism Maldives.
- *October 2002:* Developed the Census GIS for United National Population Fund
- *December 2002:* Developed the Maldives Protected Areas Systems GIS for Maldives Home Affairs Housing and Environment.
- *February 2003*: Participated in the preparation of Royal Island and Spa Resort Annual Environmental Monitoring Report for Royal Island and Spa.
- *April 2003:* Member of the team selected for developing town plans for urban centres in Northern and Southern Regional Development Zones, looking specifically into environmental control measures, for Ministry of Planning and National Development.
- *April 2003:* Participated in the preparation of Environmental Impact Statement for Coastal Modifications on Rihiveli, South Malé Atoll, Maldives.
- *April 2003:* Participated in the surveying and preparation of Environmental Impact Statement for the proposed coastal improvements to address coastal erosion concerns on Royal Island Spa Resort, Baa Atoll, Maldives.
- *May 2003:* Participated in the bathymetry survey and preparation of Initial Environmental Examination for Deepening of Existing Entrance Channel to Service Jetty, Soneva Gili Resort and Spa, North Malé Atoll, Maldives
- *May 2003:* Participated in the preparation of Initial Environmental Examination for development of an access channel into the natural inner lagoon (*Vilu*) of Mayafushi resort, North Ari Atoll.
- *May 2003:* Participated in the preparation of Environmental Impact Assessment for Landaa Giraavaru Pvt. Ltd. for the development of a Four Season's Tourist Resort on the island of Landaa Giraavaru in Baa Atoll, Maldives.
- *June 2003:* Participated in survey and preparation of Initial Environmental Examination for the Development of a Mooring Area and Associated Beach Replenishment in, Boduhithi Club, North Malé Atoll, Maldives.
- *July 2003:* Participated in the surveying and preparation of Initial Environmental Examination for Short-term and Long-term Shore Protection Measures at Alimatha Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Conducted shoreline and vegetation line of Alimatha Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Participated in the surveying for Initial Environmental Examination for Short-term and Long-term Shore Protection Measures at Dhiggiri Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Participated in conducting and preparation of Fun Island Resort Annual Environmental Monitoring Report.
- *July 2003:* Participated in conducting and preparation of Sun Island Resort Annual Environmental Monitoring Report.
- *July 2003:* Participated in conducting and preparation of Holiday Island Resort Annual Environmental Monitoring Report.
- *August 2003:* Developed the Initial Environmental Examination for the construction of Sun Decks along the southern beach of Kudarah Island Resort.
- *September 2003:* Participated in surveying and preparation of Fonaddoo Environmental Impact Assessment Report for the development of fisheries complex, Fonaddoo, Maldives.
- *October 2003*: Participated in surveying and preparation of Kuda Rah Erosion Study and recommendations for shore protection and erosion prevention
- *November 2003:* Conducted vegetation and shoreline survey of Dhonveli Beach and Spa and Four Seasons Report for the Boundary Delineation between the two islands.
- *December 2003:* Contributed to the Landuse Planning Guidelines of Maldives (environmental aspects) for Ministry of Housing and Urban Development.
- *December 2003*: Contributed to the Development of a Building Code of Maldives for Ministry of Housing and Urban Development.
- *January 2004:* Co-author to the Environmental Guidelines for the Development of Resort Islands in Maldives, Ministry of Tourism.
- *February 2004:* Developed the Baa Atoll Spatial Development Plan for Ministry of Planning and National Development.

- *April-July 2004:* Participated in the preparation of the Environmental aspects of the 8 bid proposals for resort Development for various proponents.
- *November 2005:* Participated in the preparation of EIA for L.Gan Resettlement Project for Ministry of Housing.
- *December 2005:* Participated in the surveying and preparation of EIA for Gn Fuvahmulaku Tourist Hotel Development
- *November 2005:* Developed a GIS for strategic planning to select islands for tourism development for Ministry of Tourism.
- *January 2006:* Local consultant for the Strategic Environmental Assessment (SEA) of Maldives Regional Development Plan, for AGRIFOR Consult Consortium, Belgium.
- *June 2006:* Developed the Baa Atoll Resource Management GIS for Ministry of Environment and Energy.
- *August 2006:* Consultant to the Integrated Climate Change System (ICCS) project – Assessment of vulnerability of Maldives Islands and Beaches to climate change
- *September 2006:* Consultant to the ICCS project – Assessment of vulnerability of Maldives Infrastructure to climate change
- *November 2006:* Consultant to the preparation of National Adaptation Programme of Action in Maldives for Ministry of Environment.
- *December 2006*: Environmental Consultant to the United Nations Development Programme (UNDP) Project: Disaster Risk Assessment of Selected nine Safe Islands in Maldives.
- *April 2007:* Prepared the Coastal Erosion Assessment and Management Report for Ga.Meradhoo Island.
- *May 2007:* Participated in the preparation of EIA for N. Randheli Resort Development Project, I&T Management group.
- *June 2007:* Participated in the preparation of Millennium Development Goals, Maldives Country Report.
- *October 2007*: Natural Hazard Assessment consultant to the UNDP Project: Disaster Risk Assessment of Selected Safe Islands in Maldives.
- *November 2007*: Prepared the EIA for proposed coastal protection, beach replenishment and access improvement of Elaa, Thaa Atoll, for Mr Abbas Mohamed, H. Merry Rose.
- *May 2009*: Participated in the preparation of EIA for sand sourcing and beach replenishment project of Viligilli Island, Addu Atoll, for Shangri-La at Viligilli..
- *April 2009:* Participated in the preparation of EIA for N. Maafaru Airport Development Project for Noonu Hotels Pvt Ltd.
- *May 2009:* Participated in the preparation of EIA for resort development in Huvandhumaavattaru, Noonu Atoll
- *June 2009:* Prepared a status of the environment report Randheli Island, Noonu Atoll.
- *July 2009:* Prepared the Environmental EIA for harbour development in Fiyoari, Gaafu Dhaalu Atoll.
- *July 2009:* Participated in the preparation of EIA for Jetty and arrival lounge development project in Gan, Addu Atoll, for Island Aviation Services Private Limited.
- *July 2009:* Team Leader for the socio-economic risk assessment of Selected Safe Islands in Maldives.
- *August 2009:* Coastal erosion data synthesis for selected islands of Maldives, for World Bank Maldives Environmental Management Project.
- *September 2009:* Prepared the beach management plan and development control measures for Reethibeach Island Resort, Baa Atoll.
- *September 2009:* Participated in the preparation of EIA for agricultural island development in Felivaru, Noonu Atoll, for Fantasy Private Limited.
- *September 2009:* Consultant to review the safer islands programme and cost benefit study of mitigation measures in three islands in the Maldives for UNDP.
- *October 2009:* Consultant to the Maldives Environmental Management Project for waste management technical assistance for World Bank.
- *December 2009:* Environmental consultant for advising on resort development and development control measures in Randheli Island, Noonu Atoll.
- *January 2010:* Prepared the beach management plan and development control measures for Shangri-La Island Resort, Addu Atoll.
- *January 2010:* Consultant to the Atoll Ecosystem Conservation project conservation component defining conservation areas and development controls.
- *February 2010:* Prepared the environmental audit of Thunbafushi Island, Kaafu Atoll, for Champa Brothers Private Limited.

- *March 2010:* Prepared the beach management plan and development control for Herathera Island Resort, Addu Atoll.
- *March 2010:* Lead author in the preparation of EIA for power plant upgrading project in Palm Beach Island in Lhaviyani Atoll.
- *April 2010:* Lead author in the preparation of EIA for Seagrass removal and beach replenishment project in Olhuveli Island Resort and Spa, Kaafu Atoll.
- *April 2010:* Prepared an EIA addendum for resort development in Gaakoshibee Island, Shaviyani Atoll.
- *May 2010:* Consultant to undertake island environmental scoping studies in 30 islands in North Maldives to determine islands with resort development potential for GMR Group of India.
- *May 2010:* Lead author in the preparation of EIA for harbour development project in Madidhoo Island, Shaviyani Atoll.
- *June 2010:* Lead author in the preparation of EIA for deep piling project in Olhuveli Island Resort and Spa, Kaafu Atoll.
- *July 2010:* Lead author in the preparation of EIA for the development of an aquaculture site in Kanduoigiri, Kaafu Atoll.
- *July 2010:* Environmental planning consultant for Shangri-La at Viligilli Maldives, Addu Atoll.
- *July 2010:* Environmental planning consultant to the Addu Land Use Planning project (including defining development controls) in Addu Atoll Maldives for South Province Office.
- *August 2010:* Environmental Consultant for the Atoll Ecosystem Conservation Project to declare Baa Atoll as a UNESCO Biosphere reserve.
- *September 2010:* Lead author in the EIA for Seagrass removal and beach replenishment project in Herathera Island, Addu Atoll.
- *September 2010:* Lead author in the EIA for resort redevelopment in Vilamendhoo Island Resort, Ari Atoll.
- *September 2010:* Lead author in the preparation of EIA for Gulhifalhu land reclamation project in Gulhifalhu, Male' Atoll, for Capital Investment and Finance Limited, UK.
- *September 2010:* Participated in the preparation of EIA for sewerage system development project in Miladhoo, Noonu Atoll.
- *October 2010:* Consultant to undertake the coastal adaptation survey of 40 islands in Maldives for Ministry of Housing and Environment.
- *November 2010:* Environmental consultant for advising on resort development and development control measures in Maamigili Island, Raa Atoll
- *January 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Hithadhoo Island, Addu City for Bi-water International Private Limited.
- *February 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Maradhoo Island, Addu City for Bi-water International Private Limited.
- *March 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Feydhoo Island, Addu City for Bi-water International Private Limited.
- *April 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Maradhoo-Feydhoo Island, Addu City for Bi-water International Private Limited.
- *May 2012:* Coastal erosion mitigation assessment and planning for Six Senses Laamu, Laamu Atoll
- *January 2012:* Lead author in the preparation of EIA for sewerage and water system development project in Fuvahmulah Island, Addu City for Bi-water International Private Limited.
- *February 2012:* Coastal erosion mitigation assessment and planning for Fushivelavaru Island
- *March 2012:* EIA for the proposed resort redevelopment project in Conrad Rangali Island for Champa and Crown Resorts
- *March 2012:* EIA for the proposed resort redevelopment project in Gasfinolhu Island Resort, Champa and Crown Resorts
- *May 2012:* Environmental consultant for advising on resort development and development control measures in Gasfinolhu Island, Male' Atoll
- *June 2012:* Environmental consultant for advising on resort development and development control measures in Nakachchaa Huraa Island, Male' Atoll
- *April 2012:* Member of the consultant team that prepared the Tourism Opinion and Profile Survey 2011, Ministry of Tourism.
- *October 2012:* Environmental consultant to the preparation of 4th Tourism Master plan for Ministry of Tourism, Maldives.
- *November 2013:* Environmental consultant for advising on land reclamation, resort development and development control measures in Dhiffushi Island Reef, Male' Atoll.

- *January 2013:* Environmental consultant for advising on resort development and development control measures in Hankede Island, Addu Atoll
- *January 2013:* Environmental consultant for advising on resort development and development control measures in Hankede Island, Addu Atoll
  June 2013: Local Environment consultant to the WCCM project, HIDRIA and Aquatica, Spain.

Membership of Professional Bodies

- Member of Building Code Committee, Maldives
- Member of Commission on Sustainable development
- Member of the Technical Committee for Developing Spatial Plans for conducting tourism related activities in Ari Atoll.
- Member of Climate Advisory Council to the President of Maldives 2009- to present.
- Registered EIA Consultant in Maldives Environment Protection Agency roster.

Major Publications

SHAIG, A. (2001) "An Overview of Web Based Geographic Information Systems". In Proceedings: Thirteenth Annual Colloquium of the Spatial Information Research Centre. P.A. Whigham (ed). 2 - 5 Dec, Dunedin, New Zealand. University of Otago, pp.255-264.

SHAIG, A. (2006). Climate Change Vulnerability and Adaptation Assessment of the Coastal Infrastructure of Maldives. Technical Paper submitted to Maldives National Adaptation Plan of Action for Climate Change. Ministry of Environment, Energy and Water, Male', Maldives.

SHAIG, A. (2006). Climate Change Vulnerability and Adaptation Assessment of the Land and Beaches of Maldives. Technical Paper submitted to Maldives National Adaptation Plan of Action for Climate Change. Ministry of Environment, Energy and Water, Male', Maldives.

SHAIG, A. (2007) Land Study of Maldives, 2006. Ministry of Planning and National Development, Male' Maldives.

SHAIG, A. and Aslam, M (2007) Detailed Island Risk Assessment Maldives Volume I to Volume IV – Natural Hazard Assessment (Final Draft). UNDP, Male' Maldives

SHAIG, A. (2007) Detailed Island Risk Assessment Maldives Volume I to Volume IV – Environmental Vulnerability Assessment (Final Draft). UNDP, Male' Maldives.

Academic Achievements

2001 Critchlow Associates Prize in Surveying, New Zealand.
Prize awarded annually by University council for the highest standard of Achievement in Spatial Information Studies in University of Otago.
1994 Certificate for best results in General Certificate of Examinations, Advanced Level.
Science Education Centre, Male', Maldives

References

Hamdun Hameed
Member of Parliament
Male', Maldives
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minister@planning.gov.mv

Simad Saeed, Dr
Managing Director,
CDE Consulting
Male', Maldives
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Email: simad@cde.com.mv

David King, Dr.
Associate Proffessor
James Cook University
Townsville, QLD,Australia, 4811
Tel: (+61) 747 81 4441 ,Fax: (+61) 747 81 5581
Email: david.king@jcu.edu.au

Peter Valentine
Head of School, TESAG Department
James Cook University
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Email: peter.valentine@jcu.edu.au

Clarification

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications and my experience. I understand that any willful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Signature Date: 15 July 2013

Mohamed Faizan

Contact Details

Address: H. Pent Land,
Lansimoo Goalhi,
20041 Male',
Maldives

Tel: +960-7501205

E-mail: Mohamed.faizan@gmail.com

Education

August 2012 – September 2014 **University of Malaya, (Malaysia)**
- Master of Technology (Environmental management),
- Dissertation title "Study on the impact of anthropogenic pressure on coral reefs around Cape Rachado, Malacca and recommendations to improve its management"

July 2006- June 2010 **International Islamic University Malaysia, (Malaysia)**
- Bachelor of Biotechnology (Honours).
- Final year thesis title "Spatio-temporal study on coastline changes along Tanjung Lumpur – Cherok Paloh Coast".

June 2002 – June 2004 **Centre for Higher Secondary School, (Maldives)**
- GCE Advanced level.

January 1997 – February 2002 **Majeediyaa School, (Maldives)**
- GCE Ordinary level.

Employment History

July 2014 – Present **CDE Consulting**
- **Environmental Consultant** at CDE Consulting. Roles and responsibilities include preparation of Environmental Impact Assessment reports, undertaking environmental baseline surveys, and conduct environmental monitoring.

June 2010 – July 2012 **CDE Consulting**
- **Environmental Consultant** at CDE Consulting. Responsibilities included undertaking environmental baseline studies for Environmental Impact Assessments, and environmental monitoring. In addition, co-ordination of field surveys.

February 2005 – April 2006 **Integrated Climate Change Strategy**
- **Project Assistant** for the Integrated Climate Change Strategy implemented by Ministry of Environment, Energy and Water (Maldives).
- Responsibilities included assisting the project manager, in preparation of financial reports, organizing workshops.
- Helped launch monthly newsletter on climate change "Nakaiy".

EIA experience

Environmental Impact Assessment (EIA)	Proponent	Date
EIA for the proposed sewerage system project at Kanditheem, Shaviyani - Marine environment assessment and report for the EIA	Male' Water and Sewerage Company Pvt Ltd	April 2014
EIA for the proposed beach replenishment project in Holiday Inn Resort Kandooma, Maldives, South Male' Atoll - Marine environment assessment and report for the EIA	Holiday Inn Resort Kandooma Maldives	April 2014
EIA report for the proposed sewerage system at Maduvvari, Raa Atoll - Undertook the baseline assessment surveys, including stakeholder consultations. Complied the EIA report.	Mr. Ibrahim Shazyl, Venture Maldives Pvt Ltd	February 2012
EIA report for the proposed installation and operation of desalination plant at Hithaadhoo, Baa Atoll - EIA report compilation.	Mr. Ismail Shafeeu, Static Company Pvt Ltd	January 2012
EIA report for the proposed Solid Waste Management facility at Thilafushi - Baseline marine assessments and EIA report compilation.	Tatva Global Renewable Energy (Maldives) Private Limited	December 2011
EIA for the development of a domestic airport on Koodoo, GA. Atoll - Undertook baseline assessments for the EIA, and prepared the existing environment chapter for the EIA.	Bonavvista (Maldives) Private Limited Singapore	October 2011
EIA prepared for the proposed harbor entrance channel dredging project in Bodufolhudhoo Island, North Ari Atoll - Undertook the baseline assessments for the EIA, and prepared the existing environment chapter of the EIA and compiled the overall EIA report.	Ministry of Housing and Environment	August 2011
EIA prepared for the proposed re-development – phase I of Gasfinolhu Island Resort, Kaafu Atoll, Maldives - Baseline marine assessments and report preparation for the EIA.	Mr. Hussain Afeef	July 2011
EIA prepared for the proposed re-construction of Shaviyani Foakaidhoo Harbour - Undertook the marine baseline assessments and, prepared the marine assessment report for the EIA.	Ministry of Housing and Environment	March 2011
EIA for the sewerage system development in N. Miladhoo - Marine environment assessments	Works Corporation Limited	September 2010

PERSONAL DETAILS

Name in Full : Ali Moosa Didi
Date of Birth : 18.06.1985
Gender : Male
Nationality : Maldivian Address:
Permanent : Saraasaruge Aage, S.Hithadhoo
Neelonfaru Magu

Present : Ma. Rose Villa SE, 4th Floor Dhevina Magu
Male'

Telephone : +960 9912001

EDUCATIONAL QUALIFICATIONS

Madharasthul Islamiya School

Certification, University of Cambridge General Certification of Education O/L

Subject English Mathematics
Business Account Commerce
Economics

Secondary School Certificate Islamic Studies
Dhivehi Language

WORK PLACE DETAILS

Commerce Development and Environment Pvt.
H. Orchidmaage, 4th Floor
Ameeru Ahmed Magu,
Male', Republic of Maldives
Telephone: + 960 3312514
Fax: + 960 3315926
E-mail: ali@cde.com.mv

EMPLOYMENT RECORD

January 2004 – December 2008 Commerce Development & Environment Pvt

Assistant Surveyor January 2009 – December 2009 Ryco Investment Pvt
HR. Officer

January 2010 – To Current Date Commerce Development & Environment Pvt Surveyor

WORK EXPERIENCE

Assistant Surveying Officer (Sep 2008 – To Current Date)
-Survey proposed areas for the new projects under the instruction of survey officer.

-Determine precise location and measurements of points, elevations, lines, areas, contours for the construction studying the morphology of the seabed mapmaking and for construction staking, defining and managing parcels data, as-built and profiling.

-Utilize recourses to the optimum level.

-Use company civil/ survey software for contouring, setting alignments, setting points construction, land division.

-Edits and troubleshoot incoming data collector files in accordance with company procedures.

Processing Survey Data's Using Topcon Tools, Surfer, Sonar XP, etc

-Reviews and utilize survey crew field notes. -Imports verified data into the appropriate CAD drawing file, using company standards point layer management and description keys.

-Prepares survey drawings and documents using company standards, prototypes, templates and blocks.

-Operate digital cameras and download photo files into database and/ or CAD drawings.

-Utilize company scanners to transfer reference maps into CAD files to facilitate utility mapping and property line.

-To perform bathymetric and topographical survey before start of the Projects

-Plotting survey data using AutoCAD 2006-2009

-Processing Survey Data's Using Topcon Tools, Surfer, Sonar XP, etc.

-Modeling accurate contours

-Advanced at ESRI ArcGIS (ArcMap, Arc Catalogue)

-GPS, wetland vegetation species identification, extensive geological identification skills

-Preparation of survey maps

-Make sure all the survey instruments are working in good condition.

AHMED HAIMAN RASHEED

PERSONAL DETAILS

Full Name:	**Haiman Rasheed, Ahmed**	NIRC:	**A297924**
Gender:	**Male**	Date of birth:	**September 24, 1993**
Place of birth:	**S.Feydhoo, Republic of Maldives**	Nationality:	**Maldivian**

Permanent Address: **Goal Corner**
S.Feydhoo 19040
Republic of Maldives

Contact Details**:** **(Mobile): +960 7684393**

Email for correspondence: **haiman@cde.com.mv**

EDUCATION

Year	Name of Education Institute	Title of Qualification	Status
2007 – 2009	**DHARUMAVANTHA SCHOOL**	**GCE / IGCSE O' Level under the curriculum of University of Cambridge**	**Graduated**

EMPLOYMENT HISTORY

Time Period	**Position Held, Employee**	**Task assigned**
February 2014 – present	Associate Consultant, CDE Consulting	- Marine surveying (Conducting inspections, surveys & examinations of reefs) - Beach surveying - Compiling Marine reports (Prepare reports on types of surveys conducted
August 2013 – February 2014	Assistant technician, Ministry of Fisheries and Agriculture	- Designing the structure of FAD (Fish Aggregating Device) - Research on the status and pelagic fishes found near FADs
January 2011 – January 2012	Research officer, CDE Consulting	- Marine surveying (Conducting inspections, surveys & examinations of reefs) - Beach surveying - Compiling Marine reports (Prepare reports on types of surveys conducted
December 2009 – June 2010	Research officer, CDE Consulting	- Marine surveying (Conducting inspections, surveys & examinations of reefs) - Beach surveying - Compiling Marine reports (Prepare reports on types of surveys conducted)

REFERENCES

Name	Address, Telephone & Fax	Email, Occupation & Business Title
Ahmed Shaig, PhD	**CDE Pvt Ltd** **4th Floor, Orchidmaage** **Ameer Ahmed Magu, Henveiru** **Male', Maldives** **(Telephone): +960 3312514** **(Fax): +960 3315926**	**Director** **CDE Pvt Ltd** **info@cde.com.mv**
Ahmed Yameen	**Ministry of fisheries and agriculture** **7th Floor, velaanaage** **Ameer Ahmed Magu, Henveiru** **Male', Maldives** **(Telephone): +960 3322625** **(Fax): +960 3326558**	**Assistant director**

Mohamed Ali

ID #:	A 094918
Nationality:	Maldivian
Languages:	English, Sinhalese, Dhivehi
Date of Birth:	13/09/1983
Telephone:	960-790-6007
Email:	mohamed.ali@cde.com.mv

Experience

Marine Environmental Specialist — June 2011- Present
CDE Consulting

Marine Environment Officer — July 2008 – May 2011
Banyan Tree Vabbinfaru

Freelance Lobster Hunter, Shark Fisherman — Jan 2007 - July 2008
Laamu Atoll

Dock Assistant — Sep 2006 - Jan 2007
Tourist Submarine Maldives

Education and Certifications

PADI Rescue Diver	June 2011
PADI Enriched Air Diver	June 2011
Emergency First Responder	May 2011

Basic Computer Science — 2001 - 2006
Singapore Informatics, Colombo Sri Lanka

Profile

I am very passionate about protecting the marine environment. After having worked as both a fisherman and a marine environment officer I am aware of the impact that human activity has on our fragile marine environment. My favorite activities are reef monitoring and planting coral gardens. With my undying passion for the underwater world and also with my vast experience diving all over the Maldives, educating people on the marine environment is my greatest mission, to ensure the preservation and protection of our most valuable treasure. Furthermore, I have got the opportunity to work besides the greatest marine experts in the world namely Prof. J.E.N. Veron,Dr. Norman Queen and Dr. Daphne G. Fautin.

References

N.D. Abdul Azeez Abdul Hakeem
Former Director of Conservation
Mobile: + 960 7784263
Banyan Tree Maldives

Dr. Steve Newman
Former Marine Lab Manager at Banyan Tree
steve.newman@ncl.ac.uk

Robert James
Former Marine Lab Manager at Banyan Tree

Shahdha

Sustainable Development Consultant

CDE Consulting Pvt Ltd

Phone: +960 9700169 E-Mail: shahdha@cde.com.mv

Professional Experience

Sustainable Development Consultant

CDE Consulting Private Limited, Male', Republic of Maldives. **1 March 2015- Present**

- Experience

Environmental Impact Assessments

- EIA for the proposed test drilling For Hulhule'-Male' Bridge construction project
- EIA for the proposed redevelopment of Nasandhura Palace Hotel, Male'
- EIA for the proposed Hulhule'-Male' Bridge Project
- EIA for the proposed construction of a 9-storey building at the compound of ADK Hospital, Sosun Magu, Male', Maldives
- EIA for the proposed tourist development project at Madivaru Island, Kaafu Atoll
- EIA for the proposed land reclamation and resort development project in Ithaafushi Reef, South Male' Atoll
- EIA for the proposed resort development in Bodukaashihuraa, Alifu Dhaalu Atoll, Maldives

Surveys

- Maldives Visitor Survey 2015 for the Ministry of Tourism
- Maldives Democracy Survey 2015 for International Foundation for Electoral Systems (IFES)

Environmental Monitoring Projects

- Environmental and Social Performance Annual Monitoring 2014 for Shangri-La's Vilingili Resort & Spa, Addu Atoll, Maldives

- Key Skills and Competencies

- Ability to interpret environmental laws and regulations and act accordingly
- Sound knowledge of environmental management procedures and assessment of risk
- Solid understanding of waste management, climate change, disaster prevention and mitigation, and coastal environment and processes
- Profound knowledge of sustainable development issues
- Ability to assess and analyze complex social problems
- Competent in identifying and communicating with stakeholders
- Skilled in data collection, analysis and report writing

Clinical Assistant

Indhira Gandhi Memorial Hospital, Male, Republic of Maldives **February 2010- December 2011**

Relief Teacher

HDh. Atoll School, HDh. Vaikaradhoo, Republic of Maldives **July 2009- November 2009**

Academic Qualifications

Bachelor of Environments 2012-2014

Major: Environmental Geographies, Politics and Cultures,

The University of Melbourne, Melbourne, Victoria, Australia.

Advanced Level Edexcel Examination

Higher Secondary Certificate (HSC) Examinations 2007-2009

Center for Higher Secondary Education, Male', Republic of Maldives

Cambridge GCE O-level

IGCSE Examinations

Secondary School Certificate (SSC) Examination 2004-2006

Cener for Higher Secondary Education, Male', Republic of Maldives

Achievements

- Dean's Honours Award for outstanding academic achievement in 2014 (University of Melbourne) 2014
- Australian Development Scholarship 2011
- Fourth place among the National Top 10 Achievers in the Higher Secondary School Completion Examinations 2009 2009
- Second place among the National Top 10 Achievers in the Secondary School Completion Examinations 2006
- Best All Round Student of H Dh. Atoll School 2006
- Haveeru Atolls Scholarship Award 2007-2009
- School Captain at H Dh. Atoll School.
- Student Association's Vice President in 2006 at H Dh. Atoll School 2006
- Deputy and Acting School Captain in 2005 at H Dh. Atoll School
- Student Association's President in 2005 at H Dh. Atoll School 2005

Professional Development and Memberships

- Member of the University of Melbourne Australian Awards Club 2013- 2014
- Participated in the Women's Mentoring Network at the University of Melbourne 2013
- Completed a 21 hours course on Standard First Aid at the Faculty of Health Sciences, Maldives College of Higher Education 2010
- Member of the Science Club at the Center for Higher Secondary Education 2007-2009
- School Prefect Board member at the H Dh. Atoll School 2004-2006

Computer Skills

- Experienced in using Microsoft office Word, Excel, Powerpoint and Project.

Language Skills

	Understanding	Speaking	Writing
English	Excellent	Excellent	Excellent
Dhivehi	Excellent	Excellent	Excellent

Ali Nishaman Nizar

G. Dhoores Villa, 20132
06th March 1988
(00) 960 778 5767
ali.nishaman@gmail.com

A strategic and creative thinker who has effective communication and writing skills, and is ready and willing to use my skills and knowledge to add significant value to aid in your organization's development and enhance its values.

EDUCATION

Cyprus Forestry College (2006 - 2008)

- Adv. Diploma in Forestry

Center for Higher Secondary Education (2004 - 2006)

- Edexcel - G.C.E. A'levels (Statistics, Business, Accounts)
- Cambridge - Certificate in Advanced English

Majeedhiyya School (2001 - 2003)

- Cambridge - O'levels (Mathematics, Economics, Commerce, English, Accounts)

EXPERIENCE

Terrestrial Environment Consultant – CDE Consulting, (July 13 – Present)

- Provides technical assistance to various national and international projects, specifically providing input in areas such as; wetlands, agriculture, forestry, vegetation mapping, mangroves, waste management, composting…etc.
- Working on and contributing to several Environmental Impact Assessment studies.
- In charge of sourcing/developing innovative tools and methodologies for improving teamwork and cohesion at the office.
- Lead designer for iPad based surveys and in charge of the Data Management System for surveys.

Local Consultant – Vegetation Expert – Hidria, Spain, (May 13 – Aug 13)

- Worked as a local consultant for Hidria, on developing the Wetland Management Plan for Addu Hithadhoo Eidhigali Kilhli and Gn.Fuvahmulah Bandaara & Dhandimagu Kilhi.
- Specifically on the areas of terrestrial biodiversity and vegetation mapping.

CSR Consultant – Secure Bag Maldives Pvt Ltd (Jan 12 – Jan 13)

- In charge of all activities of the company to improve its CSR image.
- In charge of handling all the activities carried out on the company owned Private Island. This includes doing various agricultural activities such as hydroponics, goat keeping, poultry, orchid farming, land-based agriculture and agro-tourism. The task involves leading staff personnel of 13 employees on the island.
- Developed a home-based CSR project to organize and reduce household waste.
- Developed a school program to increase awareness of recycling.

Agriculture Implementation Officer (AIO) – Project Implementation Unit, MOFA (Oct 10 – Jun 13)

- Worked on the "Post-Tsunami Agriculture and Fisheries Rehabilitation Programme" & the "Fisheries and Agriculture Diversification Programme"
- In charge of planning, organizing and implementing all the activities under the agriculture component of the project.
- Planning and coordinating all agriculture and cooperative related training programs.
- Focal point for forming and mobilizing agriculture cooperatives in island based communities.
- Lead instructor for conducting Enumerator Training Programs and the Team leader for conducting baseline surveys for FADIP project
- Established 5 agricultural cooperatives in the Maldives and working closely towards the formation of several additional cooperatives.

Head of Agriculture Research & Extension – Ministry of Fisheries and Agriculture (Jan 10 – Sept 10)

- Lead a team of 5 staff at the Agriculture Research and Extension Section in the Capital city and an additional 15 staff at our regional research centers in the North and South
- Devised agricultural research programs that develop and improve agriculture in a sustainable manner in the country.
- Conducted training programs, workshops and awareness session at various venues.

Marketing Manager – BCube Signage Pvt Ltd (Aug 08 – Present)

- In charge of handling all marketing and client relations for the company.
- Designed layouts and concept notes for various publications and marketing campaigns.
- Lead focal point for all communications with the company's foreign suppliers and local clients.

Agriculture Officer – Ministry of Fisheries and Agriculture (Aug 08 – Dec 09)

- Handled the "Training & Extension Unit" (Agriculture Division).
- Planned and coordinated all agriculture related training programs in the Maldives on a daily basis according to the staff availability.
- Promoted general agriculture and other related activities using modern extension methodologies.
- Conducted training programs, workshops and awareness session at various venues.

National Project Assistant – F.A.O, United Nations (Aug 06 – Oct 06)

- Worked on a Post-Tsunami forest rehabilitation project.
- Worked with international consultants on several aspects of Maldivian forestry, agriculture and especially focusing upon Maldivian Mangrove ecosystems.
- Worked closely with community members, local officials and visiting consultants in understanding local environments.
- Studied the different vegetation types in the Maldives (30 islands, mostly including wetlands).

Graphic Designer – BCube Signage Pvt Ltd (Jan 04 – Oct 06)

- Designed various logos and graphics for several clients.
- Created layouts and concept designs for several clients
- Create routine layouts for signboards.
- Design graphic advertisements ready for print, billboard and signboards.

WORKSHOPS / SHORT-TERM TRAININGS ATTENDED

- 2009,
  - Workshop on Strengthening Plant Quarantine and Inspection, Male', Maldives, 15-16 July 2009
  - "Awareness of Food Security" Workshop, Male', Maldives, 22nd October 2009
  - Workshop on Updating and Finalization of the Agriculture Development Master Plan (ADMP), Male, Maldives, 21st December 2009

- 2010,
  - Fisheries & Agriculture Diversification Programme, Financial, Procurement & M&E Training, Male', Maldives, 26-28 January 2010
  - Team Leaders Meeting, 8th Virtual University for Small States of the Commonwealth's (VUSSC) International Training and Materials Development Workshop, Singapore, 14-20 April 2010
  - Prevention, Control and Management of Forest Invasive Species in South Asia, (by APFSIN), Male', Maldives, 29th April 2010
  - 8th Virtual University for Small States of the Commonwealth's (VUSSC) International Training and Materials Development Workshop, Male', Maldives, 15-31 March 2011
  - Loan Administration Training, Hdh.Kulhudhuhfushi, Maldives, 3-8 July 2010
  - Workshop to Finalize the Draft Pesticides and Plant Protection Bill, Male', Maldives, 12-13 July 2010
  - International Workshop on Climate Change Extreme Events Adaptation Practices and Technological Solutions, New Delhi, 16-18 August 2010

- 2011,
  - FADIP "Rolling Baseline Survey" Workshop, Male, Maldives, 2-3 March 2011
  - Knowledge Sharing in Asia Workshop #3: Participatory Techniques in the Field, Godavri, Nepal, 30th March 2011 – 2nd April 2011
  - Knowledge Sharing in Asia Workshop #2: Writing to Share Knowledge Effectively, Godavri, Nepal, 3-6 April 2011
  - Consultation Workshop for Facilitators on Cooperatives and Business Development, UNDP Building, Male, Maldives, 21st April 2011
  - AFE's Workshop on "Value Chain Program Design", Chiang Mai, Thailand, 12-16 September 2011
  - Training of Trainers Workshop on Systematization, Nepal, 8-10 December 2011

- 2012,
  - Workshop on Knowledge Management, tools and techniques (as a trainer for the programme), Maldives, 29th November 2012 – 02nd December 2012
  - Partnering 4 Development Forum, UNDP, Paradise Island Resort, 2nd December 2012

- 2013,
  - Consultative Workshop on ICRAF's Capacity Development Strategy & ICRAF's South Asian Partner's Capacity Needs Assessment, BRAC (Bangladesh Rural Advancement Committee) Centre, 30-31 January 2013
  - Certificate in Co-operative Poverty Reduction, Co-operative College of Malaysia, Malaysia, 3-21 March 2013

ENVIRONMENT IMPACT ASSESSMENT WORK

- Was a member of the team, and provided contributions to both the field work and report writing of the following EIA's:
- Tourism Development Projects:
  - Adh. Bodukaashihuraa Resort Development EIA
  - B. Dhigufaruvinagandu Resort Development EIA
  - K. Madivaru Resort Development EIA
  - Lh. Fushifaru Resort Development EIA
  - N. Thanburudhuffushi Picnic Island Development EIA
  - K. Gasfinolhu Addendum EIA (Palm transplanting)
  - K. Taj Vivanta Resort Shore Protection EIA
- Agricultural Development Projects:
  - Sh. Madidhoo Agricultural Development EIA
  - Lh. Maduvarri Agricultural Development EIA
- Airport Development Projects:
  - R. Ifuru Airport Development EIA
  - N. Maafaru Airport Development EIA
- Major public/ private sector Projects:
  - Tree Top Hospital Development EIA
  - Nasandhura Palace Hotel Redevelopment EIA
  - Male-Hulhule Bridge, Borehole Drilling EIA
  - Male-Hulhule Bridge EIA
  - Addu and Fuvahmulah ESIA for Wetland Project

ACADEMIC ACHIEVEMENTS

Cyprus Forestry College (2006 - 2008)

- Highest Overall Performance: Presidential Prize (2nd prize)
- Best Academic Performance: Nature Conservation
- Best Academic Performance: Ecology
- Best Botanical Collection
- Best Fire Protection Project
- Best Forest Management Project
- Best Nursery Management Project

Center for Higher Secondary Education (2004 - 2006)

- 10th place in the national Top Ten.

Majeedhiyya School (2001 - 2003)

- 8th place in the national Top Ten.
- A Prefect

PROFESSIONAL ACHIEVEMENTS

- Designed and structured an online system to coordinate training programs and staff travel plans. This lead to an overall increase in the number of trainings by 400% from 2008 to 2009.
- Played active roles in the planning and organizing of key events and workshops such as;
  - Agriculture Fair 2009, Hdh.Kulhudhuhfushi
  - Farmers Day 2009, F.Nilandhoo
  - Food Security Workshop 2009, (In collaboration with Department of National Planning)
- Worked with a team from the Sultanate of Oman on a research program focusing on the local mango variety "Dhivehi Anbu". The discovery of the Maldivian mango variety having a polyembryonic seed structure was one of the key findings of the research.
- Co-director and technical advisor for the Agriculture TV program, "dhanduveriya" for a full season, featuring over 13 episodes.
- Group leader in a materials development workshop for a course titled "Diploma in Sustainable Agriculture for Small States" for the Commonwealth of Learning, collaborating with 20 other experts from different parts of the world. My work was focused on writing specifically the chapters of "Agriculture Production Systems" and the "Importance of Working Together (CBPO's)".
- Team leader for the "Fisheries and Agriculture Diversification Program" (FADiP) baseline survey on the RIM'S Impact Questionnaires and the Project Questionnaire which included over 450 households in 4 different islands.
- Introduced an iPad-based real-time data entry system in 2014, that eliminated the need for paper-based questionnaire forms, reduced survey times, improved security features and provided real-time partial analytics on the data for our clients, at CDE. This system has since been replicated in over 5 separate surveys carried out by CDE.

SKILLS

- ICT Competent (MS Applications, Corel Suite…etc)
- Flexible to travel at any time
- Able to Multi-task and work in stressful conditions
- Able to co-ordinate and work with CBPO's / Co-operatives / NGO's
- Decision Making Skills
- Logistical Planning Skills
- Good Interpersonal Skills (Community Consultation Expert, specifically on participatory approaches and conflict resolution exercises)
- Training Skills in "Agri-Business", "General Agriculture", "Hydroponics", "Agro-Forestry", "Home-gardening", "Baseline Surveys" and "Co-operatives".

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

- Bluepeace - an Environmental NGO
  - Advisor on environmental and agricultural issues since the year 2009.
  - Participated in several beach and reef cleanup programs.
  - A member since the year 2008.
- United Artists of Maldives - an association focusing on Maldivian Art and Artisans
  - Sits in the Steering committee of UAM as the Media Coordinator, since January 2013
  - Participated in the International Hay Festival Activities held in the Maldives in 2010.
  - A member since the year 2008.
- UN Global Compact Maldives Network - a network of local private sector parties
  - Representative for Addu Meedhoo Cooperative Society
  - Representative for CDE Consulting

REFEREES

- Dr. Ahmed Shaig,
  Director of Environment, CDE Consulting,
  shaig@cde.com.mv
  +9607788758

- Dr. Aminath Shafia,
  Former State Minister, Ministry of Fisheries and Agriculture,
  shafia@fishagri.gov.mv
  +9607792458

LANGUAGE PROFICIENCY

- Fluent in both writing and reading of Dhivehi (mother tongue)
- Fluent in both writing and reading of English

MARIYAM HANA SAEED

ADDRESS

G. Quest, Alikilegefaanu Magu
Galolhu, 20118, Malé
Republic of Maldives

CONTACTS

960 797 0022

mariyamhanas@gmail.com
hana@cde.com.mv

NATIONALITY

Maldivian

ACADEMIC QUALIFICATIONS

2014
December

Bachelor of Environments
University of Melbourne, Parkville Victoria

Recipient of Australia Awards Scholarship
Majored in Environmental Geographies, Politics and Culture

2010
June

Higher Secondary Education, Edexcel A' Level
Centre for Higher Secondary Education, Male' Maldives

Achieved Fourth Place among the National Top 10 Achievers in 2010

Maths (Mechanics)	A	Biology	B
Chemistry	A	Physics	B
Islam	A	Dhivehi	B

2007
November

Secondary Education, GCE O' Level
Aminiya School, Male' Maldives

Achieved First Place among the National Top 10 Achievers in 2007

Maths	A	Physics	A	English (IGCSE)	B
Biology	A	Computer Studies	A	English (GCE)	A
Chemistry	A	Dhivehi	A	Islam	A

LANGUAGES

English
●●●●● Fluent

Dhivehi
●●●●● Fluent

SKILLS

+ Excellent customer service skills
+ Expert knowledge in environment and development field
+ Familiar with the concept of environmental psychology
+ Knowledge on coastal landforms and processes
+ Familiar with risk assessment projects
+ Experience in communicating effectively with key decision makers and clients
+ Ability to learn quickly and understand complex work
+ Excellent organisation skills
+ Excellent computer skills

EMPLOYMENT HISTORY

March 2015 to Present

Sustainable Development Consultant | **CDE Consulting, Malé, Maldives**

Specialised Work Areas | **Renewable energy, Water, Sewerage and Housing**

Duties

+ Involved in cross-business, community and regulatory agencies
+ Contribute to development plans, policy analysis, institutional and sectoral reviews, project appraisals and designs
+ Planning and designing of strategies and programs of intervention on key social issues, major economic sectors and environmental issues
+ Conduct consultation, education and outreach programs
+ Prepare baseline, suitability analysis, due diligence, consultation, impact assessment, monitoring and evaluation and audit reports
+ Research and maintain up to date knowledge about current policies, best practices and potential future policies.

February 2011 to January 2012

Administrative Assistant | **The President's Office, Malé, Maldives**

Duties

+ Monitored the policies under governance section in the Policy Office
+ Organised meetings of Narcotics Control Council board and updated the progress of the policies and actions under the council
+ Managed all admin-oriented work in the section, updating minutes of each council meeting, updating databases, and filing
+ Led administrative work to organise the 17th SAARC Summit in November 2011 and worked in coordination with other government bodies, private agencies and key decision makers to organise meetings and circulate information

EXPERIENCE

EIA for the proposed development of a tertiary hospital

Year . 2015
Location . Hulhumalé
Client . Tree top Health Pvt Ltd
Position . Team leader
Activities Performed
Stakeholder consultations, socioeconomic impact assessment and contributed to report writing

EIA for the proposed redevelopment of Nasandhura Palace Hotel

Year . 2015
Location . Malé
Client . NPH Investments Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Stakeholder consultations, conducted baseline surveys and contributed to report writing

EIA for the proposed construction of a 9-storey building at the compound of ADK Hospital

Year . 2015
Location . Malé
Client . ADK Hospital Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Contributed to report writing

EIA for the proposed land reclamation and resort development project at Ithaafushi Reef

Year . 2015
Location . South Malé Atoll
Client . Sumaiyya Holdings Pvt Ltd
Position . Team Leader
Activities Performed
Designed stakeholder consultations, socioeconomic assessment and contributed to report writing

EIA for the proposed land reclamation and resort development project at Bodukaashihuraa

Year . 2015
Location . Adh. Atoll
Client . Millennium Capital Management Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Undertook baseline surveys, Stakeholder consultations, and contributed to report writing

EIA for the channel dredging and beach replenishment activities at Canareef Resort Maldives

Year . 2015
Location . Addu City
Client . Canareef Resort Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Contributed to report writing

EIA for the proposed resort development project at Kudadhoo Island

Year . 2015
Location . Lhaviyani Atoll
Client . Champalars Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Contributed to report writing

EIA for the proposed land reclamation and resort development project at Madivaru Island

Year . 2015
Location . Kaafu Atoll
Client . Shuaz Investments Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Undertook baseline surveys, Stakeholder consultations, and contributed to report writing

EIA for the proposed Hulhule' – Male' bridge project

Year . 2015
Location . Malé
Client . Ministry of Housing and Environment
Position . Consultant for Water and Energy
Activities Performed
Contributed to report writing

EIA for the proposed test drilling for Hulhule' - Male' bridge construction project

Year . 2015
Location . Malé
Client . Ministry of Housing and Environment
Position . Consultant
Activities Performed
Stakeholder consultations and contributed to report writing

EIA for the proposed harbour maintenance project at Cheval Blanc Randheli

Year . 2015
Location . Noonu Atoll
Client . Cheval Blanc Randheli Maldives
Position . Consultant
Activities Performed
Designed questionnaire for stakeholder consultations, undertook baseline surveys, socioeconomic impact assessment and contributed to report writing

EIA for the proposed resort development project at Miriandhoo island

Year . 2016
Location . Baa Atoll
Client . Miriandhoo Maldives Resorts Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Designed questionnaire for stakeholder consultations, undertook baseline surveys, socioeconomic impact assessment and contributed to report writing

EIA for the proposed land reclamation and resort development project at Maagaa reef

Year . 2016
Location . North Ari Atoll
Client . Big Stone Investments Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Designed questionnaire for stakeholder consultations, undertook baseline surveys, socioeconomic impact assessment and contributed to report writing

EIA for the proposed resort development project at Aluvifushi island

Year . 2016
Location . Dhaalu Atoll
Client . Ocean Islands Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Contributed to report writing

EIA for the proposed land reclamation and resort development project at Rasdhoo Madivaru

Year . 2016
Location . North Male' Atoll
Client . Veli Madivaru Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Socioeconomic impact assessment and contributed to report writing

EIA for the proposed Raffalhuhuraa land reclamation and resort development project at Mai Falhu Reef

Year . 2016
Location . Kaafu Atoll
Client . Mesa RF Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Socioeconomic impact assessment and contributed to report writing

EIA for the proposed nationwide submarine cable by Ooredoo Maldives

Year . 2016
Location . Maldives
Client . Ooredoo Maldives
Position . Consultant for Water and Energy
Activities Performed
Socioeconomic impact assessment and contributed to report writing

EIA for the proposed development of plot N3-55 under 3,000 housing units project

Year . 2016
Location . Hulhumalé
Client . Sea Life Global Inc Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Designed methodology and survey questionnaires for public consultations, stakeholder consultations, socioeconomic impact assessment and contributed to report writing

EIA for the proposed development of plot N3-56 and N3-57 under 3,000 housing units project

Year . 2016
Location . Hulhumalé
Client . Sea Life Global Inc Pvt Ltd
Position . Consultant for Water and Energy
Activities Performed
Designed methodology and survey questionnaires for public consultations, stakeholder consultations, socioeconomic impact assessment and contributed to report writing

Maldives visitor survey 2015

Year . 2015
Location . Hulhule
Client . Ministry of Tourism
Position . Team leader and Enumerator
Activities Performed
Supervised survey enumerators and conducted the survey

Maldives democracy survey 2015

Year . 2015
Location . Maldives
Client . International Foundation for Electoral Systems (IFES) and Transparency Maldives
Position . Team leader and Enumerator
Activities Performed
Supervised survey enumerators and conducted the survey

Environmental and social performance annual monitoring report of Shangri-La's Vilingili Resort & Spa 2014

Year . 2015
Location . Addu City
Client . Shangri-La's Vilingili Resorts & Spa
Position . Consultant for Water and Energy
Activities Performed
Quantifying energy production and consumption rate, water quality assessment and analysis advice and reporting.

Environmental and social performance annual monitoring report of Shangri-La's Vilingili Resort & Spa 2015

Year . 2016
Location . Addu City
Client . Shangri-La's Vilingili Resorts & Spa
Position . Consultant for Water and Energy
Activities Performed
Quantifying energy production and consumption rate, water quality assessment and analysis advice and reporting.

Environmental monitoring of Vilamendhoo Resort & Spa

Year . 2015
Location . Alifu Dhaal Atoll
Client . Vilamendhoo Resort & Spa
Position . Consultant for Water and Energy
Activities Performed
Water quality assessment, beach profiling, coastal area surveying, Energy audit

Finolhu Villas energy audit 2015

Year . 2015
Location . Kaafu Atoll
Client . Finolhu Villas
Position . Consultant for Energy
Activities Performed
Conducted an onsite comprehensive energy audit of the resort, quantified energy consumption and production patterns, data analysis and report writing.

Feasibility study for solar panel installation in F.Nilandhoo

Year . 2015
Location . Faafu Atoll
Client . F.Nilandhoo
Position . Consultant for Energy
Activities Performed
Conducted baseline surveys of potential buildings for solar panel installation, gathered baseline information about the existing power generation capacity, demand and expenditure for fuel and powerhouse maintenance, data analysis and contributed to report writing.

Understanding the risks to and vulnerability of energy sector to climate change in tourist resorts of the Maldives

Year . 2015 - 2016
Location . Maldives
Client . Tourism Adaptation Platform / UNDP
Position . Consultant for Energy
Activities Performed
Undertook baseline studies on dependency of the Maldives to fuel and its vulnerability; designed methodology and energy audit questionnaire; conducted a comprehensive energy audit in Vilamendhoo Resort & Spa, Kurumba Maldives, Bandos Island Resort,The Sun Siyam Irufushi Maldives, Embudu Village; data analysis and presentation of audit findings. Conducted workshops with engineers in each of the 5 resorts on climate change awareness and vulnerability of tourist resorts to climate change. Conducted a workshop to present the findings of the project to stakeholders.

Introducing green healing hospital concept at Adh. Atoll Hospital

Year . 2016
Location . Adh. Mahibadhoo
Client . Adh. Atoll Hospital
Position . Consultant for Energy and Water
Activities Performed
Conducted the energy and water audits of the hospital, consulted hospital engineers and utility providers of the island, conducted a feasibility assessment of the hospital roofs for solar panel installation, data analysis and presentation of findings with recommendations, conducted a workshop to present the findings of the baseline study to hospital staff and community member.

Desalination plant registration at Conrad Maldives Rangali Island

Year . 2015
Location . Alifu Dhaal Atoll
Client . Conrad Maldives Rangali Island
Position . Consultant for Water
Activities Performed
Undertook baseline studies and facilitated the registration process

Desalination plant registration at Kudarah Island Resort

Year . 2016
Location . Alifu Dhaal Atoll
Client . Kudarah Island Resort
Position . Consultant for Water
Activities Performed
Undertook baseline studies and facilitated the registration process

Desalination plant registration at Mirihi Island Resort

Year . 2015
Location . Alifu Dhaal Atoll
Client . Mirihi Island Resort
Position . Consultant for Water
Activities Performed
Undertook baseline studies and facilitated the registration process

Terminal Evaluation for the project titled increasing climate resilience through an integrated water resource management programme in Ha.Ihavandhoo, Adh.Mahibadhoo Gdh.Gadhdhoo

Year . 2015
Location . Ha. Ihavandhoo, Adh. Mahibadhoo and Gdh.Gadhdhoo
Client . UNDP
Position . National consultant
Activities Performed
Reviewed project documents, conducted stakeholder consultations, logistics management, designed survey methodology and questionnaire for consultations in coordination with the international consultant, visited the three islands and conducted council meetings and public consultations with focused groups. Contributed to report writing and presented preliminary findings to stakeholders.

APPENDIX H – Commitment Letter

بسم الله الرحمن الرحيم

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

ފަރުގަސްދާއި ތާވަލާއި ތަރައްގީގެ ވަޒާރާ
ދަތުރު، ދިވެހިރާއްޖެ.

Date 11 August 2016

No: 438-PDU/203/2016/68

Mr. Ibrahim Naeem
Director General
Environmental Protection Agency
Male', Republic of Maldives

Dear Sir,

Sub: EIA for the Proposed Water Supply System in R Meedhoo

As the proponent of the captioned project, we confirm that we have read the report and hereby confirm our commitment to carry out and bear costs of environmental mitigation measures and monitoring outlined in the EIA report.

Sincerely,

Ajwad Mustafa
Permanente Secretary

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

ފަރުގަސްދާއި ތާވަލާއި ތަރައްގީ ވަޒާރާ،
ދަތުރު، ދިވެހިރާއްޖެ، 20392
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www.facebook.com/environment.gov.mv

cde CONSULTING

www.cde.com.mv

ނަންބަރު: CDE-L/0816/129

ރ.އަތޮޅު ކައުންސިލްގެ ރައީސަށް،

ވެދުން ސަލާމަށްފަހު ދަންނަވަމެވެ.

ރ.މީދޫގައި ބޯފެން އުފެއްދުމާއި ސަޕްލައިކުރުމުގެ ނިޒާމް ގާއިމްކުރުމުގެ މަޝްރޫޢުއިން ތިމާވެށްޓަށް އަސަރުކުރާނެ މިންވަރު ބަލާފައިވާ ރިޕޯޓް (އީ.އައި.އޭ ރިޕޯޓް)، ތިމާވެށީގެ ގަވާއިދުގެ 69 ވަނަ މާއްދާ ގައިވާ ގޮތުގެ މަތިން، ތިޔަ އިދާރާއިން ހިއްސާ ކުރުމުގެ ގޮތުން މިސިޓީއާއެކު ފޮނުވީމެވެ. މީގެ، މިސިޓީގެ ތިރީގައި އޮތް މި ރިޕޯޓް ލިބުނުކަމުގެ ރަސީދު ފުރިހަމަ ކޮށްދެއްވުމަށްފަހު ޕްރިންޓްކޮށް އަދި ސްކޭންކޮށްގައި މިސިޓީގެ ހަވާލާދީ ފެކްސް ނަންބަރު 3315926 ނުވަތަ hana@cde.com.mv އަށް ފޮނުއްވައި ދެއްވުން އެދެމެވެ.

އިޙްތިރާމް ޤަބޫލުކުރައްވުން އެދެމެވެ.

9 އޮގަސްޓު 2016

ޚާދިމުކުމް

[signature]

ސިމާދު ސަޢީދު

މެނޭޖިންގ ޑިރެކްޓަރ

ރ.އަތޮޅު ކައުންސިލް، އުނގޫފާރު

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