THIRD ADDENDUM TO THE ENVIRONMENT IMPACT ASSESSMENT

FOR THE PROPOSED

HULHULÉ-MALÉ BRIDGE PROJECT

May 2016

Prepared for

Ministry of Housing and Infrastructure

Consultant

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ސީ.ޔޫ. ގުދަނުގެ ތެރެއިން

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List of Abbreviations

COADS	Comprehensive Ocean-Atmosphere Data Set
DO	Dissolved Oxygen
EIA	Envrionmental Impact Assessment
GHG	Green House Gas
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
KWp	Kilowatt peak
MEE	Ministry of Environment and Energy
MHI	Ministry of Housing and Infrastructure
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.

The following team members undertook additional assessments:

Mr Mohamed Faizan (Impact assessments)

Mr Mohamed Ali (Marine assessments)

Mr Ahmed Haiman Rasheed (Marine assessments)

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

Lead Consultant's Declaration

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

Dr Ahmed Shaig (EIA P02/15)

Proponents Declaration

Re: 3rd Addendumto EIA report for Hulhule Male' Bridge

As the proponent of the proposed project we guarantee that we have read the report and to the best of our knowledge, all information relevant to this project in terms of project description, project construction works and operational aspects provided here are accurate and complete.

Signature:

Name: Aishath Barriya

Designation: Engineer

On behalf of: Ministry of Housing and Infrastructure

Date: 22 May 2016

Executive Summary

The purpose of this document is to assess the potential environmental impacts and mitigation measures for the proposed changes to the Hulhulé-Malé Bridge project. This document is an addendum to the original Environmental Impact Assessment (EIA) prepared for the Bridge project in November 2015. The proponent of this project is Ministry of Housing and Infrastructure.

The addendum is prepared to address the need to use Gulhifalhu NE reef flat to temporarily store large steel structures (Steel Pipe Piles, and Steel Casings) of the bridge. The main rationale for selecting this lagoon is the short distance to the project site, availability of space, access to deep water and relatively calms sea conditions to safely store the structures. The pipes will be removed in 7-8 months. The main reason why the piles have to be stored is due to the difficulties in holding a chartered barge for a 7 month period to store the pipes.

The study area of this project considers the proposed storage site in Gulhifalhu Lagoon and surrounding areas that are likely to be affected by the proposed changes. The site has been affected by past reclamation activities and human activities. The site is also earmarked for future reclamation.

The proposed developments are generally in conformance to the laws and regulations of the Maldives.

The key impacts from the proposed changes are on the marine water quality, marine biodiversity within the pipeline footprint, and health and safety risks to workers.

A number of mitigation measures are proposed for the most significant impacts from the project. These include ensuring only licensed, well-qualified and experienced personnel operate vessels and machineries; undertaking unloading and loading works in calm sea conditions; ensuring strict health and safety measures are followed at site; and to place the pipe fully and perpendicular to the reef flat.

Alternative site was assessed to store the steel structures, at Thilafushi Reef Flat, Hulhumale Reef flat and Hulhule reef. The Hulhumale' site is not suitable due to flight path restrictions and proximity to resorts. Hulhule site does not have enough space and there is too much marine activity in the area. Thilafushi site is suitable but when compared to Gulhifalhu site the distance to bridge site is longer and is more exposed to SW monsoon conditions. All sites have similar environmental impacts. Thus, the proposed Gulhifalhu site was preferred.

Gulhifalhu Investment Limited (GIL) and *Environmental Protection Agency* (EPA) were they key stakeholders consulted for this addendum. The key recommendations from GIL were to take all practical measures to avoid and minimize damage to the reef, and to ensure that the pipes do not block the entrance channel to *Gulhifalhu* located on the eastern side of the reef.

The main recommendations by EPA were to plan all works according to approved EIA and addendums. If any additional components are required to properly follow the EIA procedure. All works conducted outside the scope of the approved EIA reports must be presented as an audit in this addendum. EPA also recommended assessment of Hulhulé site as an alternative for storage of the proposed steel structures.

This report is prepared in accordance to the technical guidelines and EIA regulations, prepared by the Environmental Protection Agency (EPA), and the terms of reference issued by the EPA for this EIA addendum.

ސާރާ ޚުލާސާ

މި ދިރާސާ ރިޕޯޓަކީ ހުޅުލެ-މާލެ ބްރިޖް މަޝްރޫޢަށް ހުށަހަޅާފައިވާ ބަދަލުތަކުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާނެ އަސަރު ދެނެގަތުމުގެ ގޮތުން ތައްޔާރުކުރެވިފައިވާ ދިރާސާ ރިޕޯޓެވެ. މިރިޕޯޓަކީ މި މަޝްރޫޢަށް ޖުލައި 2015 ގައި ތައްޔާރުކުރެވުނު އީއައިއޭ ރިޕޯޓްގެ ތިންވަނަ އެޑެންޑަމެވެ. މި މަޝްރޫޢުގެ އިތުރު ހުރިހާ ބަދަލުތައް ދިރާސާކޮށްފައި ވެއެވެ.

މަޝްރޫޢުގެ ޑިޒައިނުގައި ހުށަހެޅިފައިވާ ބަދަލުތަކުގެ ތެރޭގައި ބްރިޖްގެ ބޮޑުމިނާއި ބޯޅަ ގުޅުމާއި ގުޅޭ ބަދަލުތައް ހިމެނެއެވެ. މި ބަދަލުތަކުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާ އަސަރުތައް ދިރާސާކޮށް، އެ އަސަރުތައް ކުޑަކުރުމުގެ ފިޔަވަޅުތައް ވެސް މި ރިޕޯޓުގައި ބަޔާންކޮށްފައި ވެއެވެ.

މަޝްރޫޢަށް ގެނެވޭ ބަދަލުތަކާއެކު މަޝްރޫޢުގެ ތިމާވެށީގެ ސިފަތަކަށް ބަދަލު އަތުވެދާނެ ކަމަށް ލަފާކުރެވޭ ގޮތުން، ބިނާކުރުމާއި ހިންގުމުގެ މަރުހަލާތަކުގައި ތިމާވެށްޓަށް ކުރާ އަސަރުތައް ދެނެގަނެ ބަލާފައިވެއެވެ.

މަޝްރޫޢުގެ ބަދަލުތަކުގެ ސަބަބުން ދިމާވާ އަސަރުތައް ކުޑަކުރުމަށް ތަފާތު ފިޔަވަޅުތައް ހުށަހަޅާފައިވާނެއެވެ. ހިމެނޭ ގޮތް ހުރިހާ ކަމެއް ބަޔާންކޮށްފައިވާ.

މި ދިރާސާގައި ހާމަކުރެވިފައިވާ އަސަރުތަކުގެ ތެރޭގައި ބަދަލުތަކުގެ ސަބަބުން ކަނޑުގެ ތިމާވެށްޓަށް އަދި މޫދުގެ ފަށްގަނޑަށް ކުރާ އަސަރުތައް ހިމެނެއެވެ. މި މަޝްރޫޢުގެ ބިނާކުރުމުގެ މަރުހަލާގައި ދިމާވާ އަސަރުތައް ކުޑަކުރުމަށް ބޭނުންކުރާ ގޮތްތައް، ގެންދާ ގޮތް ބަޔާންކޮށްފައިވެއެވެ. އަދި ކަނޑުގެ ތިމާވެށިން ހޯދާފައިވާ މަޢުލޫމާތު ބަލައި ސާފުކުރެވިފައިވާނެއެވެ.

މަޝްރޫޢުގެ ތިމާވެށީގެ ސަބަބުން ކުރާ އަސަރު ދެނެގަތުމަށް ކުރެވުނު ދިރާސާތަކުގެ ސަބަބުން ކުރާ އަސަރު ކުޑަކުރެވޭނެ ގޮތްތައް ބަޔާންކޮށްފައިވެއެވެ. މި ގޮތުން ވިލާގިނި ރަށް، ހުޅުލެ، އަދި ހުޅުމާލެ ގައި ހުރި ބިމުގެ ވަށައިގެން ކުރާ އަސަރު ބަލާފައިވެއެވެ.

މި އެޑެންޑަމުގައި ތިމާވެށީގެ އިންވަޔަރަމަންޓަލް މޮނިޓަރިންގ ޕްރޮގްރާމް އެއް ހިމެނޭ ގޮތަށް ތައްޔާރުކޮށްފައިވެއެވެ. މަޝްރޫޢުގެ ބިނާކުރުމުގެ މަރުހަލާގައި އެ ޕްރޮގްރާމް ހިންގުމަށް ފެންނަ ބަދަލުތައް ގެނައުމަށާއި، މަޝްރޫޢުގެ ތިމާވެށީގެ އަސަރުތައް ކުޑަކުރުމުގެ ފިޔަވަޅުތައް ދެނެގަނެ ބަލަހައްޓަން ޖެހޭނެ ގޮތް ބަޔާންކޮށްފައިވާނެއެވެ. މި ގޮތަށް ބަލަހައްޓާ އެއްވެސް ބަދަލުތަކެއް އަންނަނަމަ ޢަމަލުކުރަންޖެހޭ ގޮތް ކަނޑައަޅާފައި ވެއެވެ. މަޝްރޫޢުގެ ތިމާވެށީގެ މޮނިޓަރިންގ ތަކަށް ފާހަގަކުރެވޭ ކަންތައްތައް ދިރާސާކޮށް ރިޕޯޓު ތައްޔާރުކުރަން ޖެހޭނެ އެވެ. އަދި މިގޮތުން ޢަމަލުކުރުމަކީ މަޝްރޫޢުގެ ބަދަލުތަކުގައި ހިމެނޭ ކަމެކެވެ.

ދ ތަކުރާރުކުރެވޭ ގޮތަށް ކަނޑައެޅިފައިވާ ގޮތަށް ކަނޑައެޅުމަށް ބޭނުންވާ ގޮތަށް ކަ

1 INTRODUCTION

1.1 Purpose of the EIA Addendum

This Environment Impact Assessment (EIA) addendum report is an evaluation of the potential environmental, socio-economic and natural impacts of the proposed additional component to the Hulhulé - Malé Bridge Project, Kaafu 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 of the proposed additional component to the project 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 Proponent

The proponent of this project, as proposed in the original project, is Ministry of Housing and Infrastructure of the Maldives.

1.3 Project background and rationale

Hulhulé - Malé Bridge is a project developed to increase the social development and economic opportunities in the Male' urban area. One of the biggest constraints to the full utilization of *Malé – Hulhulé - Hulhumalé* as contiguous unit is the absence of land links.

An EIA was prepared and approved for the project. This report addresses the proposed use of *Gulhifalhu* Lagoon to temporarily store the large steel structure (steel pipe piles, and steel casings). The main rationale the proponent has selected *Gulhifalhu* lagoon is due to the availability of space at the lagoon, to safely store the steel structures in relatively calm conditions near the Bridge Project Site.

Some of the pipes have already been placed in the lagoon. EPA has instructed MHI to prepare an EIA addendum for the activity and to report back the impacts from existing works. This report fulfils this request and other legal requirements.

1.4 Project Scope Summary

As noted above the proposed change to the project, is the use of Gulhifalhu Lagoon as a temporary storage of large steel structures.

In addition, since storing the pipelines on Gulhifalhu Reef was not covered in the original EIA, works already undertaken are addressed as an audit in this report.

More details are provided in the Project Description chapter.

1.5 Consultants, Contractors and Government Institutions

All the EIA related work is undertaken by consultants from CDE Consulting. The contractor for this project is CCCC Second Harbour Engineering Company Limited.

The project is executed by the Ministry of Housing and Infrastructure.

1.6 EIA Scope and Terms of Reference

The scope of this EIA addendum is broadly based on the EIA Regulations 2012. The assessment more specifically adheres to the Terms of Reference (ToR) issued by the Environmental Protection Agency on 19th May 2016. 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, methodology used in the assessment, implementation schedules, site plans and summary of project inputs and outputs *(Chapter 1 and 2).*
- A description of the pertinent national and international legislation, World Bank safeguard policies, 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 about the exiting baseline environmental conditions of the site. These include coastal and marine environment of the site and natural hazard vulnerability of the 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).*
- Assessment of alternatives for the proposed project *(Chapter 7)*

- Environment Management Plan (Chapter 8)
- Details of the environmental monitoring plan *(Chapter 9).*
- Stakeholder Consultation (*Chapter 10*)
- Potential gaps in information *(Chapter 11)*
- Main conclusions (*Chapter 12*)

1.7 Assessment Methodology

1.7.1 General Approach

This EIA is broadly guided by the EIA Regulations 2012.

This report has been prepared to ensure that the significant environmental and social impacts of the proposed change to the project have been considered and assessed at the project planning phase.

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

In order to conduct a broad based and inclusive study, the proponent and the consultant have from the onset ensured the exercise is participatory. As such, discussions have been held with relevant stakeholders.

1.7.2 The Study Area

The study area of this component of the project considers the temporary storage site in *Gulhifalhu* reef. Study area boundary is presented in Figure 1.1 and survey locations map for the project is attached in Appendix C.

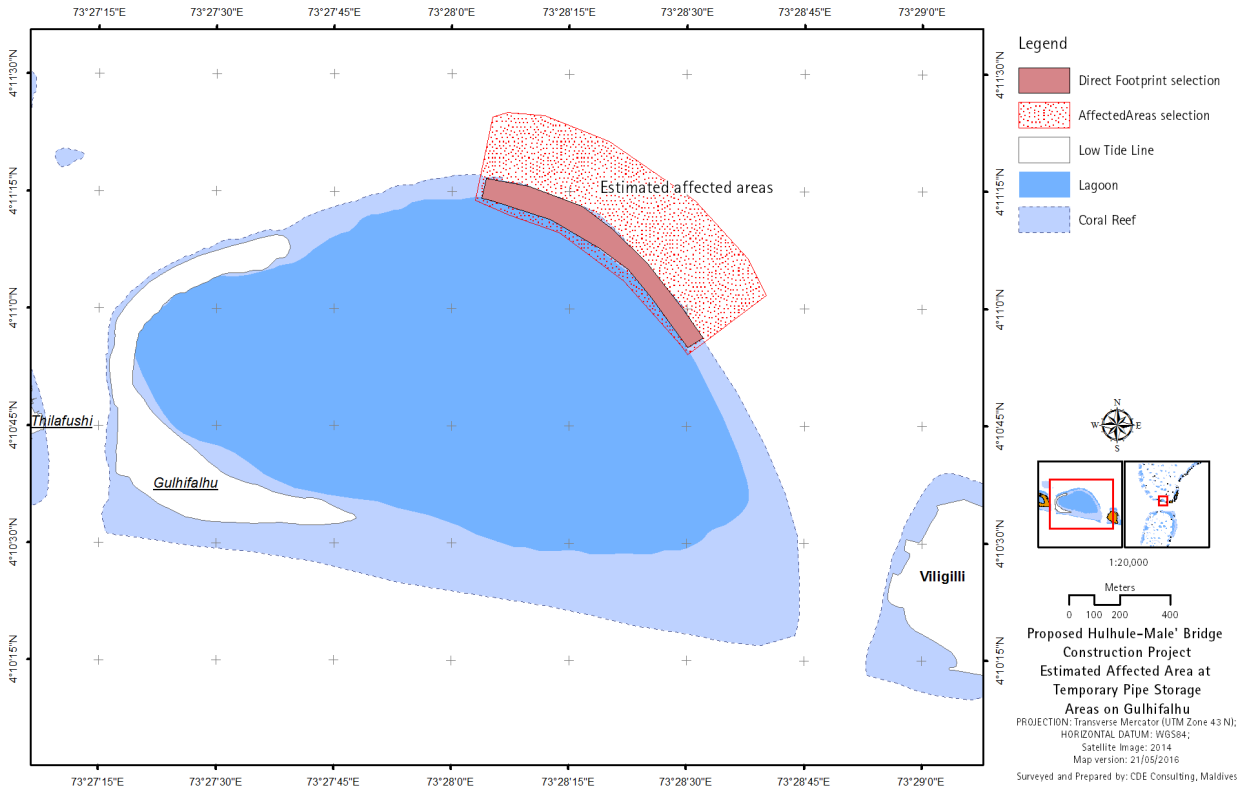


Figure 1.1: Study Area boundary

1.7.3 Field Observations

Field assessments were undertaken on 18th May 2016. Field visits mainly covered audit of the existing condition of the proposed storage site.

In addition stakeholder consultations were carried out with the Environmental Protection Agency (EPA) and Gulhifalhu Investment Limited (GIL) specifically for this assessment.

Visual Snorkelling Survey

Visual snorkelling surveys were carried out at locations of the Gulhifalhu Lagoon where steel pipes and casings have been placed. General status of these sites were recorded, special attention was given to record any damages to the reef, types of corals and fishes present at these sites.

Manta Tow Survey

Manta tow survey was conducted to determine the general benthic cover and reef condition along the study area. A snorkeler (observer) was towed behind a slow moving boat, along the reef edge for a series of set periods of 2 minutes. At each stop the observer noted down the estimate percentage coverage of Live Coral, Coral Rubble, Dead Coral covered in Algae (DCA), Sand, Rock, and general fish life at these sites.

Photo Quadrat Survey

Benthic composition was assessed by taking ten high-resolution images every 5 m (pictures covering 0.5 m^2, of the seabed) on the side of the 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. 25 random points per picture were analysed to characterize the substrate composition (sample size: 250 points per transect).

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 shown below:

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

1.7.4 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:

- The original EIA prepared for the Hulhulé - Malé; Bridge project.
- The First Addendum to the EIA.
- The Second Addendum to the EIA

1.7.5 Key Stakeholder Consultation

Stakeholder consultations were undertaken with the following stakeholders:

- Environmental Protection Agency (EPA)
- Gulhifalhi Investment Limited (GIL)

1.7.6 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 changes to the project, 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 report EIA

1.7.7 Report Format

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

1.8 Study Team Members

The team members of this EIA are:

Dr Ahmed Shaig (EIA and coastal environment Specialist)
Mr Mohamed Faizan (Marine Assessments)
Mr Mohamed Ali (Marine Field Surveys)
Mr Ahmed Haiman Rasheed (Marine Field Surveys)

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

2 PROJECT DESCRIPTION

2.1 Project Location

The proposed location for storage as mentioned earlier is *Gulhifalhu* Lagoon, specifically from the northern to north-eastern reef flat of the lagoon.

2.2 Project Outline and Project Site Plan

The proposed change to project is outlines below:

i. Unloading steel structures onto *Gulhifalhu* Lagoon, from respective barges

ii. Storage of steel structures at *Gulhifalhu* Lagoon (est. period 7 months)

iii. Loading the steel structures stored in *Gulhifalhu* Lagoon, onto barges and transportation to the bridge project site

The steel structure unloading and storage site in *Gulhifalhu* Lagoon is provided in in Figure 2.1.

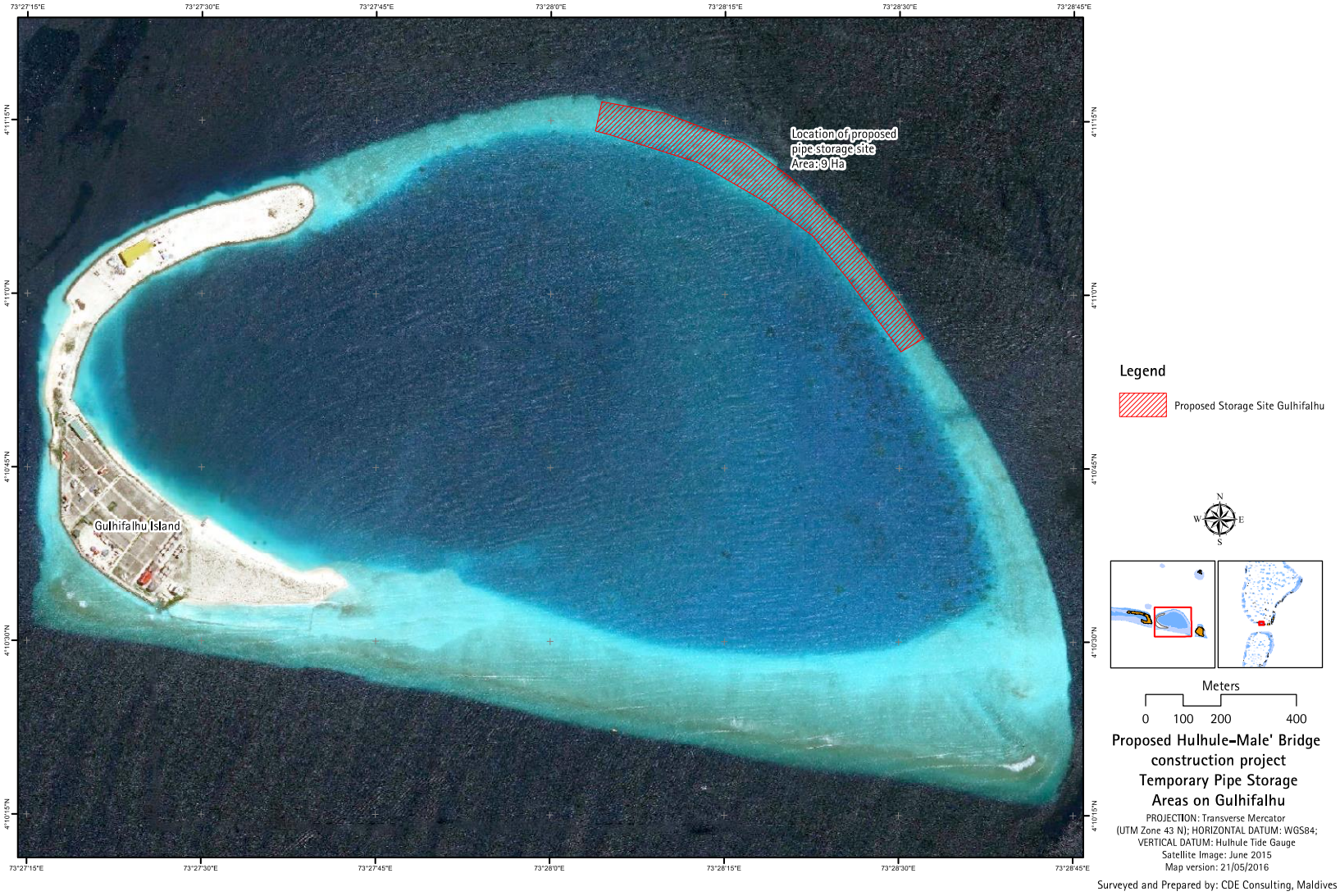


Figure 2.1: Location of proposed project site

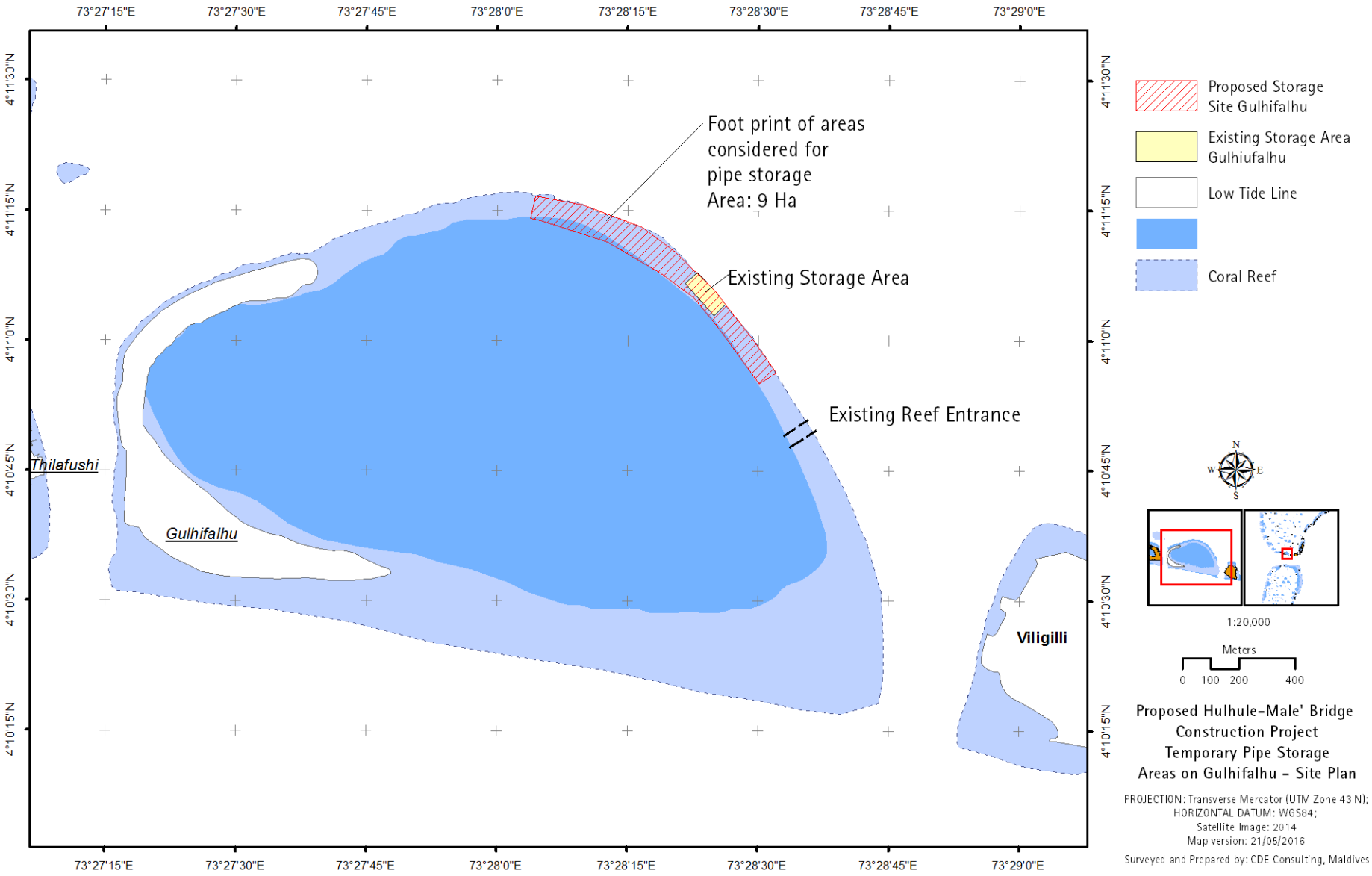


Figure 2.2: Site plan for Temporary Storage Area

2.3 Detailed Project Outline

2.3.1 Placing Steel Pipes on Reef Flat

Steel pipes and casings will be brought to the site on barges. All pipes and casings will be securely attached to cables, and hoisted using crane mounted on the barge, and placed onto the reef flat. Details of steel structures are presented in table 2.1.

Table 2.1: Details of steel structures to be stored in Gulhifalhu Lagoon

Steel Structure	Dimensions (m)	Quantity	Remarks
Steel Pipe Casing	3.2 × 50.3	3	Transferred to Site via chartered barges (KOTA BAKAT, and KOTA GUNGA) for this component.
Steel Pipe Casing	3.6 × 71.3	4	
Steel Pipe Casing	3.6 × 73.3	1	
Steel Pipe Pile	3.6 × 60.5	2	
Steel Pipe Pile	3.6 × 64.5	2	
Steel Pipe Pile	3.6 × 66.5	2	
Steel Pipe Pile	3.6 × 70	1	
Steel Pipe Pile	3.6 × 73.3	6	
Steel Pipe Casing	3.6 × 73.5	7	Transferred to Site via VILLA BARGE 3
Steel Pipe	-	3	Details not available

2.4 Demobilization

All steel structure will be loaded onto barges, using cranes mounted on the barges and moved to the bridge project site, by the contractor.

All waste materials will be collected and transported to the designated waste disposal site in Thilafushi Island in accordance with Waste Regulation 2013. Reusable construction materials such as steel pipes and plates will remain with the contractor for future use. Contractor is responsible for transportation of these reusable items out of the country. If the contractor chooses to retain any material used in the project in Male', it will be stored in a designated site at Thilafushi Island.

2.5 Project Schedule and Life Span

Mobilisation of the steel pipes will begin after the EIA is approved. Government has placed urgent demands on this project. The steel pipes will be stored at *Gulhifalhu* Reef for about 7 months. The proposed activities of this addendum will have no effect on the existing work plan for the project.

2.6 Summary of Project Inputs and Outputs

Summaries of the types of materials that will go into the project and from where and how this will be obtained are given in the original EIA. A summary of the specific inputs for the components covered in this addendum is given in Table 2.2. Table 2.3 summarizes the outputs of components covered in this addendum

Table 2.2: Major Inputs

Input resource(s)	Source/Type	How to obtain resources
Material for bridge construction	Steel Pipe Piles, and Cases	Import – Main Contractor's responsibility.
Energy	Diesel/ Electricity	Import or purchase from local suppliers

Table 2.3: Major Outputs

Output Source/Type	Quantity	How it will be dealt with
Noise	70- 95 dBA	No special measures will be taken
Waste oil	Small quantity	Barrelled and transported to Thilafushi Waste Management site

3 POLICY AND LEGAL FRAMEWORK

This project conforms to all relevant laws and regulations of the Maldives. Refer to the initial EIA of Hulhulé – Malé Bridge Project for a complete list of applicable laws, regulations and guidelines relevant to the project. These legal and policy provisions have to be fully respected in carrying out the proposed project. All contractors and sub-contractors will be informed of these requirements.

4 EXISTING ENVIRONMENT

Most of the baseline data required for this addendum has been provided in the initial EIA for Hulhulé - Malé Bridge Project (2015). As this addendum involves a relatively minor additional component, description of the existing environment is limited to the Terms of Reference provided by the EPA for this addendum. Refer to the following sections in the initial Hulhulé – Malé Bridge EIA for baseline data relevant for this assessment;

- Section 4.1: Meteorology (page: 54)
- Section 4.2: Hydrology (page: 60)
- Section 4.3: Topography, Geology and soils (page: 72)
- Section 4.4: Water (page: 78)
- Section 4.5.2: Marine Ecology (page: 90)
- Section 4.6: Air quality, Noise and Vibration (page: 108)

Assessment of the current condition of *Gulhifalhu* lagoon has been carried out specifically for this addendum. The findings of the survey are provided in the following sections.

4.1 Reef condition at Gulhifalhu Lagoon

Field observations carried out on 18th May 2016 showed that 12 steel structures have been placed on the reef flat on the northern side of *Gulhifalhu*. The detail of these structures provided by the proponent is listed in the table below.

Table 4.1: Details of Steel Structures stored in Gulhifalhu Lagoon

Steel Structure	Dimensions (m)	Quantity
Steel Pipe Pile	3.6 × 60	1
Steel Pipe Pile	3.6 × 58.5	2
Steel Pipe Pile	3.6 × 65.5	2
Steel Pipe Casing	3.2 × 56	2
Steel Pipe Casing	3.2 × 50	2
Steel Pipe Casing	3.6 × 71	3

The reef flat at this site is mainly rocky bottom, covered in sand and coral rubble. The predominant live coral type observed was an azooxanthallae type coral species (*Tubastrea micrantha*). In addition isolated massive, short-thick branched, and digitate type coral colonies were observed across the reef flat. Most coral colonies observed short thick branched and digitate type corals were either completely or partially bleached, possibly due to heat stress. In addition large numbers of *Ascidians* (Sea Squirts) were observed on the rocky bottom, possible indication of high nutrient availability in this area. Signs of physical damage to few coral colonies near the pipe were observed during the visual snorkelling survey.

The following table summarizes manta tow survey that was conducted along proposed area for unloading and storage of the steel structures. The numerical values in the table for each substrate category refer to percentage estimate benthic cover: **1** = 0-10%, **2** = 11-30%, **3** = 31-50%, **4** = 51-75% and **5** = 76-100%.

Table 4.2: Summary of Manta Tow Survey on the reef flat of Gulhifalhu Lagoon, 18 May 2016

Tow no.	% Live Coral	% Rock	% Coral Rubble	% Sand	% DCA	Bleached corals	Remarks
1	1	2	2	2	1	1	• Mostly sand and Coral rubble. • Few bleached *Pocillopora colonies*
2	1	2	2	2	1	1	• Mostly sand and coral rubble. • Few bleached *Acropora* and *Pocillopora* colonies. • Many of *Tubastrea micrantha* colonies observed
3	1	2	2	3	1	1	• Mostly sand and coral rubble. • Few bleached *Acropora* and *Pocillopora* colonies. • Many of *Tubastrea micrantha* colonies
4	1	2	2	3	1	1	• Isolated massive type corals (*Porites* species). • Many of *Tubastrea micrantha*, colonies. • Many of sea squirts
5	1	2	2	3	1	1	• Isolated massive type corals (*Porites* species). • Many of *Tubastrea micrantha*, colonies. • Many of sea squirts
6	1	1	2	3	1	1	• Mostly sand, • Isolated massive type corals (*Porites* species). • Many of *Tubastrea micrantha*, colonies. • Many of sea squirts
7	1	1	2	3	1	1	• Mostly sand • Few bleached *Acropora* (tabular) and *Pocillopora* type corals

4.1.1 Fish Census and Benthic Substrate Survey

Fish census and benthic substrate survey was conducted at 5 m depth at two locations of Gulhifalhu lagoon (northern, and eastern sides – see Survey Locations Map). A summary of fish census surveys conducted is presented in Appendix F.

Transect 1 (North)

This site is situated to the north of the reef. The reef at 5 m is steeper (approximately 60 degree gradient), but is then mottled with near-vertical sections at 10 m, as well as gullies and a jagged crest. The main substrate is comprised of rock and this is heavily covered with CCA and ascidians, and coated with a layer of coral rubble sand in many places (Figure 4.10). Coral cover is low along the transect at 5 m (2 %). The highest abundance of fish species found here are plankton feeders, suggesting a high nutrient load; the high abundance of ascidians strengthens this hypothesis.

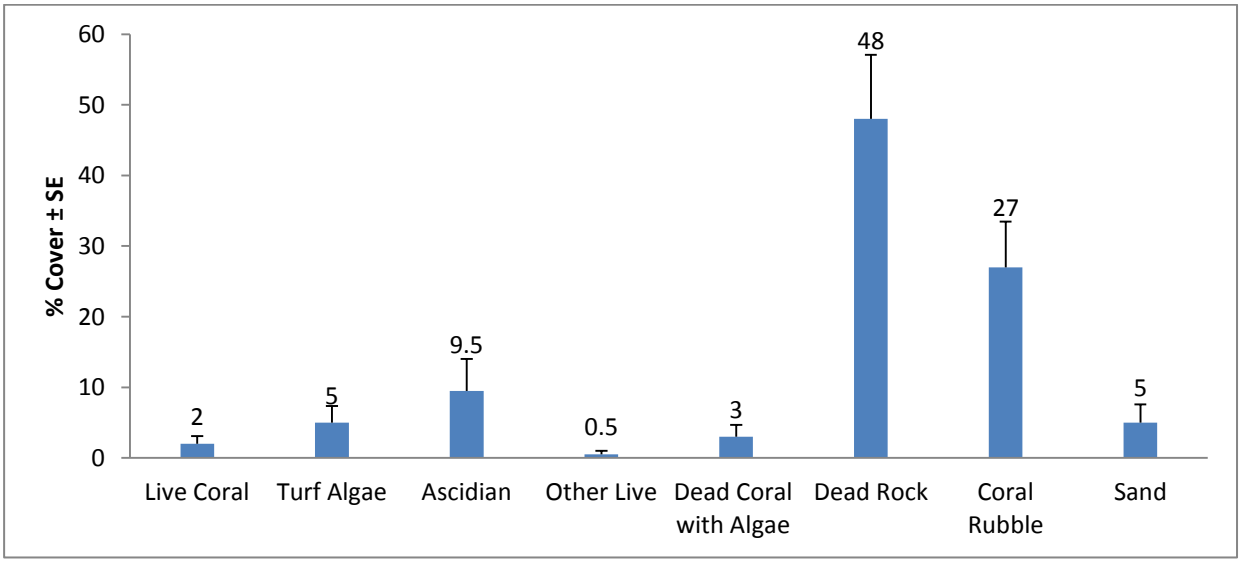


Figure 4.1: Benthic subsrate composition at 5 m depth along Transect 1, 18th May 2016

Transect 2 (East)

Similar to previous site, main benthic substrate at this site is rock, covered in coral rubble and sand (Figure 4.11). Live hard coral is very low at 5 m depth, with just over 5 %. There were a few small colonies of *Acropora digitifera* but the majority of coral genera found belong to massive and encrusting life forms. Apart from the usual planktivorous fish species, there was also a surprisingly high number of butterflyfish (*Chaetodon guttatissimus*), which are mainly coralivorous but they also feed on zooplankton, which will be the situation here.

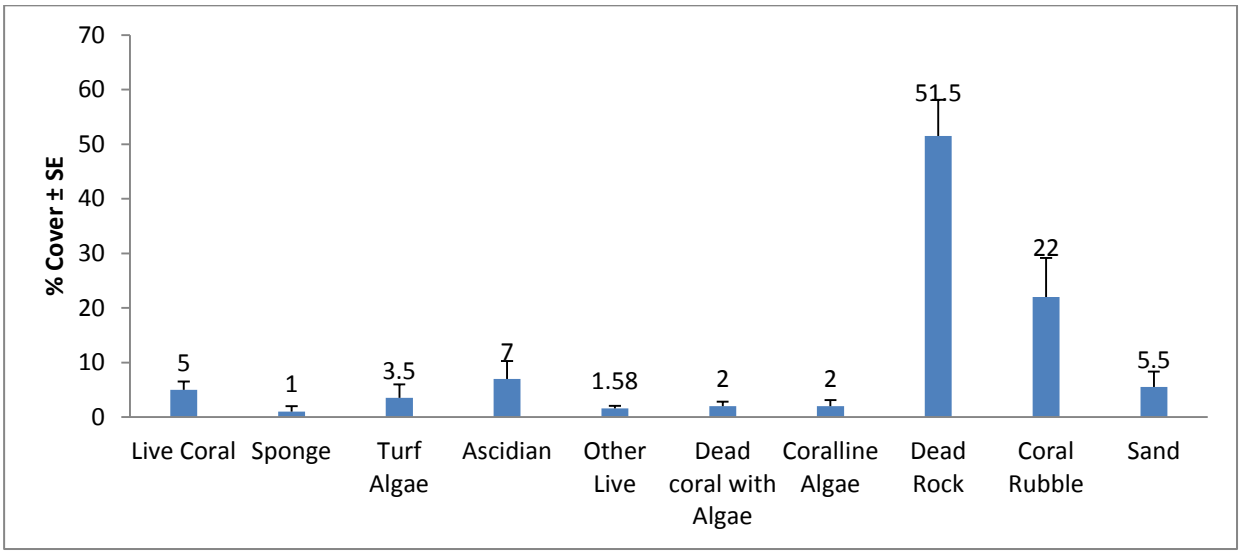


Figure 4.2: Benthic subsrate composition at 5 m depth along Transect 2, 18th May 2016

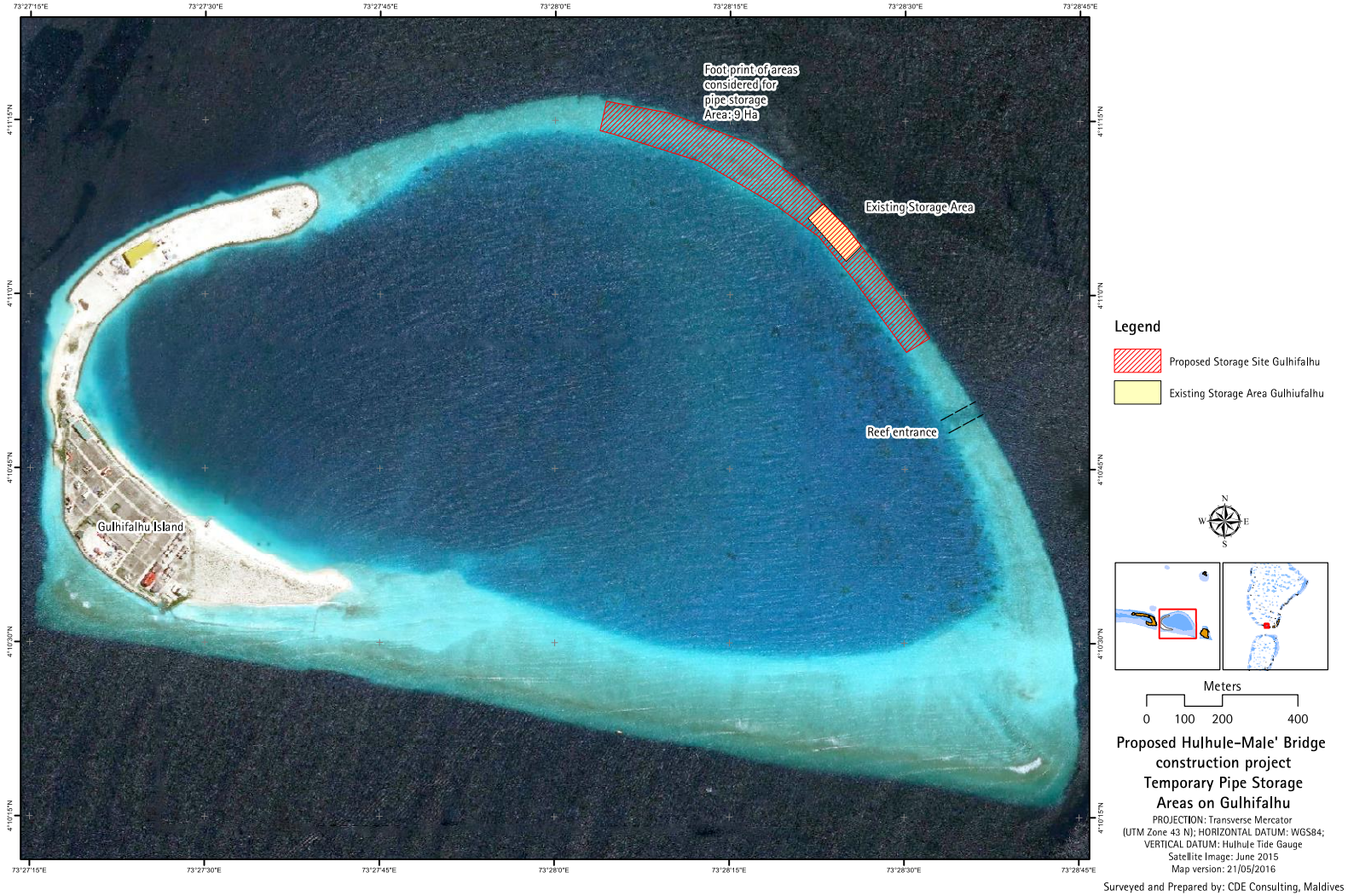


Figure 4.3: Location map of existing storage area in Gulhifalhu Lagoon

Figure 4.4: Steel pipes placed on reef flat

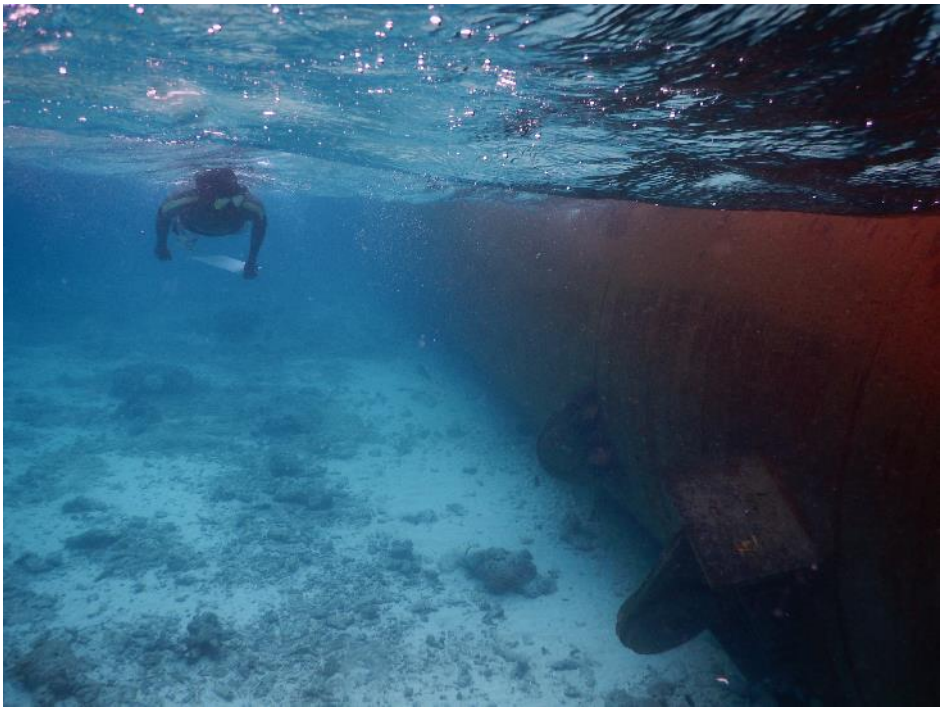


Figure 4.5: Surveyor inspecting the site where steel pipes were deployed

Figure 4.6: Steel pipe placed on northern side of Gulhifalhu

Figure 4.7: Massive coral colony observed in between two steel pipes

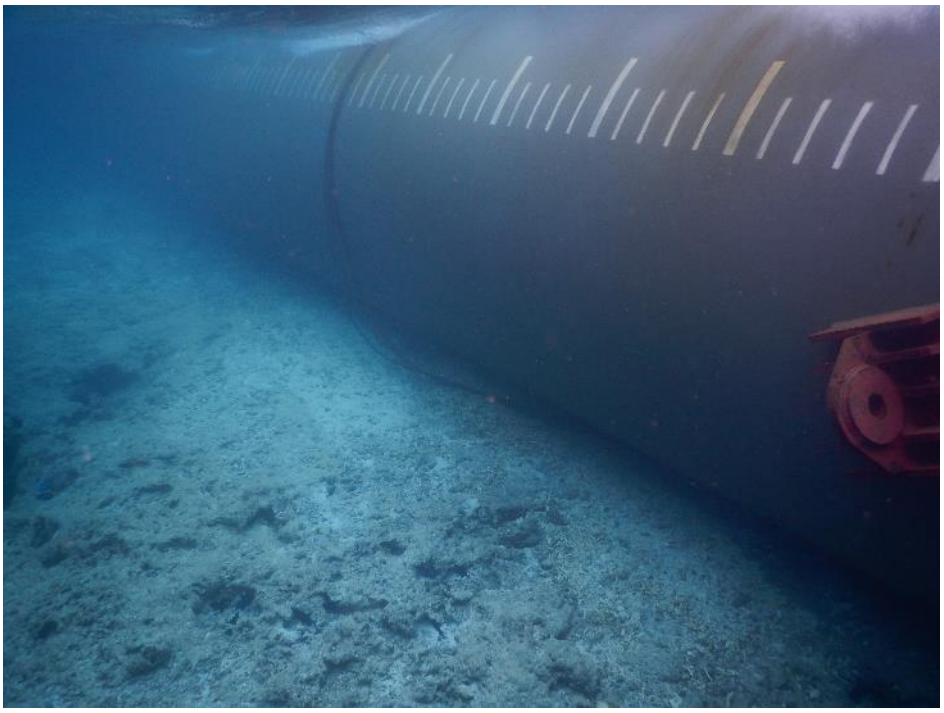


Figure 4.8: Reef flat where steel pipes are placed is mainly a rocky habitat covered in sand, and coral rubble

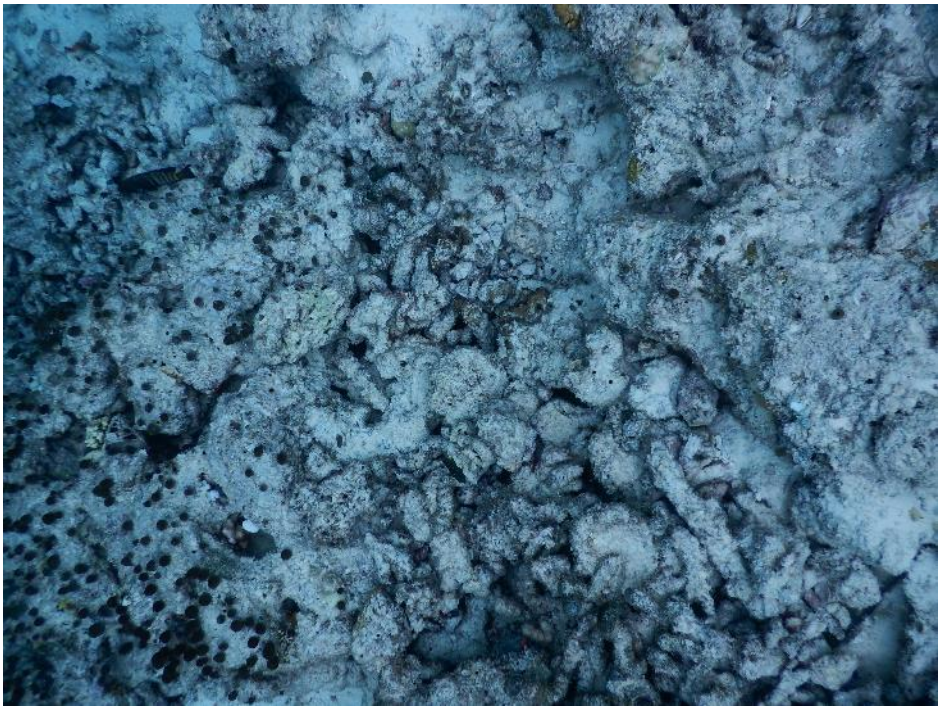


Figure 4.9: Typical benthic composition observed along Transect 1, Gulhifalhu

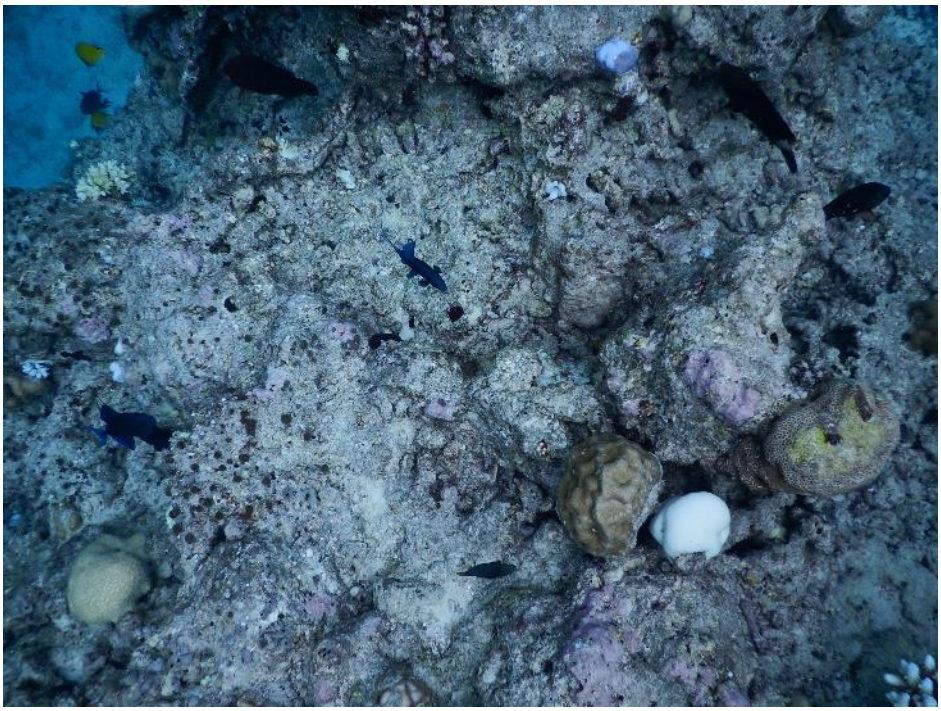


Figure 4.10: Typical benthic composition observed along Transect 2, Gulhifalhu

4.2 Reef condition at Thilafushi Lagoon

Similar to Gulhifalhu, the top reef is mainly made up of rocky pavement covered in coral rubble and sand. Live coral coverage across the reef flat is very low (ranging between 1 – 10%), and was large percentage of corals were either completely or partially bleached, possibly from heat stress. The numerical values in the table for each substrate category refer to percentage estimate benthic cover: **1** = 0-10%, **2** = 11-30%, **3** = 31-50%, **4** = 51-75% and **5** = 76-100%.

Table 4.3: Summary of Manta Tow Survey carried out along top reef of Thilafushi Alternative Storage Area

Tow no.	% Live Coral	% Dead Rock	% Coral Rubble	% Sand	% DCA	% Bleached	Comments
1	1	3	2	1	1	1	Dominate coral types *Acropora* and *Pocillopora species (bleached)*
2	1	3	2	1	1	1	Dominate coral types *Acropora* and *Pocillopora species (bleached)*
3	1	2	2	2	1	1	Dominate coral type at this tow area is *Porites* (massive) species. *Acropora* and *Pocillopora species appear bleached*
4	1	2	2	2	1	1	*Porites* massive type corals were most abundant.
5	1	3	2	1	1	1	Mostly dead rock, rubble and sand. Dominate coral types *Acropora* and *Pocillopora species (bleached)*
6	1	3	2	1	1	1	Mass coral bleaching observed
7	1	3	2	1	1	2	Mass coral bleaching observed

Photo quadrat survey shows similar results to the tow survey; rocky pavement covered in coral rubble and sand made up the main benthic substrate at this site. Live coral coverage at this site was very low (4.5%). Similar to Gulhifalhu transects the most abundant fish families recorded belonged to planktivores, appendix F presents summary fish census survey conducted at this site.

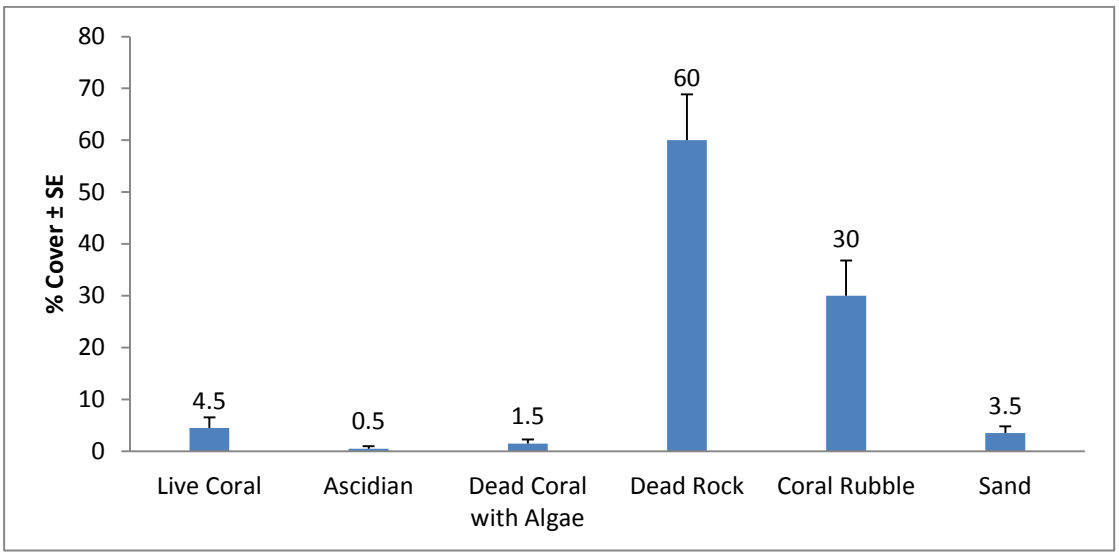


Figure 4.11: Benthic composition at alternative storage site at Thilafushi (Transect 3), 18 May 2016

Figure 4.12: Typical benthic composition observed top reef at Thilafushi, 18 May 2016

5 IMPACT IDENTIFICATION

5.1 Introduction

Potential adverse and beneficial impacts of unloading, and storing steel structures in *Gulhifalhu* Lagoon are identified and evaluated in this section. Refer to the original EIA for a complete impact identification evaluation of the Hulhulé-Malé Bridge project.

Significant impacts are identified and evaluated in two stages. The first stage identifies the environmental and socio-economic components that may be impacted from the proposed alteration. The second stage determines the significance of the impacts. 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 additional components of this addendum is 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 placing steel pipes at *Gulhifalhu* reef flat.

- 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.

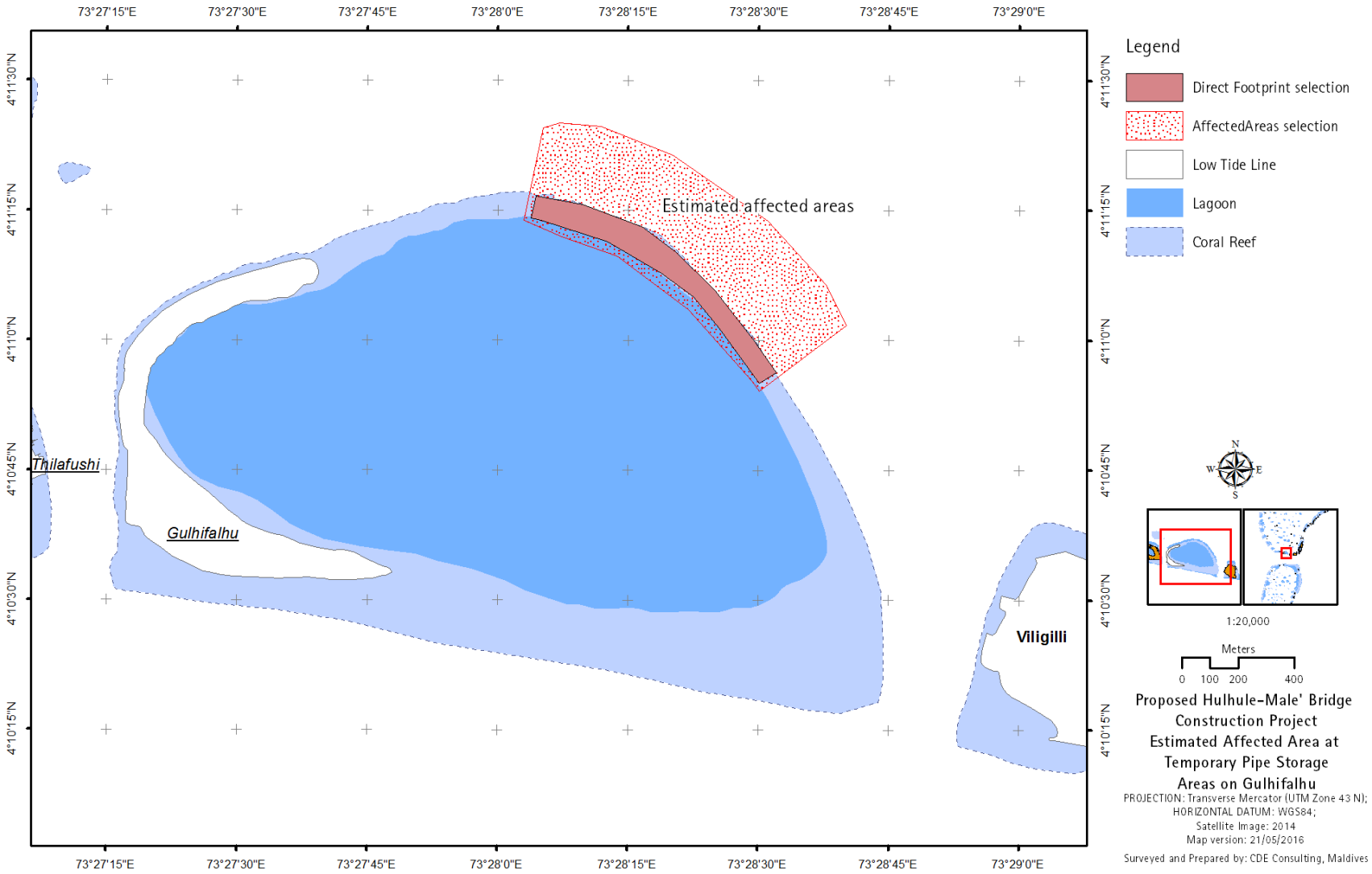


Figure 5.1: Estimated affected affected areas at Temporary pipe storage area

Table 5.1: Impact Identification Matrix

Project Activity	Ambient noise level	Ambient air quality	GHG emissions	Groundwater	Hydrodynamics	Reef Structure	Marine water	Terrestrial Flora and Fauna	Soil Condition	Marine Flora and Fauna	Reef Structure Integrity	Landscape Integrity/ Scenery	Natural Hazard Risk	Health and Safety	Demand for Resources and Services	Social Cohesion	Marine Traffic
Transportation of steel structures to site	-	-	-	x	x	x	-	x	x	x	x	-	x	x	x	x	x
Unloading steel structures onto reef	-	-	-	x	x	x	-	x	x	-	x	-	x	-	x	x	-
Storage of steel structures	x	x	x	x	x	-	x	x	x	-	x	-	x	x	x	x	-
Loading steel structures onto barges	-	-	-	x	x	x	-	x	x	-	x	-	x	-	x	x	+
Transportation of steel structures to project site	-	-	-	x	x	x	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	Potential impacts	Nature/ Distribution/ Duration/ Magnitude	Reversibility	Significance
Noise level	**Noise Pollution;** Operation of tugboats, and crane-mounted barges is expected to generate high noise.	Direct/negative; Project site (*Gulhifalhu*); Short term; Minor negative	Reversible	Minor significance
Marine water quality	**Water pollution;** As this component of the project involves usage of marine vessels (tug-boats, crane-mounted barges), accidental spillage of oil and other chemicals may occur, and degrade the overall quality of marine water. In addition, unloading, and loading of large steel structures on and from the reef is likely to temporarily elevate the levels of suspended solids, and turbidity of seawater temporarily.	Direct/negative; Project site (*Gulhifalhu*); Short term; Moderate negative change	Reversible – *with high cost*	Moderately significant
Marine flora & fauna	**Loss of benthic fish community;** Coral life and sessile benthic life within the direct footprint of steel structure deployment areas will be lost. Marine life (especially corals and sessile life forms) may incur physical damages that are either sub-lethal or lethal during loading and unloading process. Prolonged shading of corals, and other light dependent organisms by the steel structures may have sub-lethal to lethal effects on them. Additionally, degradation of water quality at this area will adversely impact the marine life in this area.	Direct/negative; Project site (*Gulhifalhu*); Long term; Major negative change	Reversible – *with high cost*	Moderately significant – *the top reef at this area is a rocky habitat, only isolated coral colonies occur within the footprint. Live coral occurrence on the upper reef slope is also low.*
Visual amenity	**Loss of visual amenity;** Temporary storage of large steel pipes on the reef may adversely impact the visual amenity of the site	Direct/negative; Storage areas (*Gulhifalhu*); Short term; Minor negative change	Reversible	Moderately Significant – *Short term*
Health and Safety	**Risks to Health and Safety;** Operation of crane mounted onto the barge involves considerable risk to the health and safety of workers, unless adequate health and safety measures are taken.	Direct/negative; Project site (*Gulhifalhu*); Long term; Major negative	Irreversible	Highly Significant – *accidents may be fatal*

Impact area	Potential impacts	Nature/ Distribution/ Duration/ Magnitude	Reversibility	Significance
Reef Structure	**Reef slope failure;** If the steel structures are placed closer to the reef slope, there is possibility of reef slope failiture	Direct/negative Project Site (Gulhifalhu) Permanent; Major negative	Irreversible	Highly significant
Marine traffic	**Impede marine traffic;** Steel pipes will block direct vessel movement across *Gulhifalhu* reef, at the temporary storage area.	Direct/negative; Project Site (*Gulhifalhu*); Short term; Moderate negative change	Reversible	Moderately Significant – *Short term. No steel structures will be placed at the entrance channel to Gulhifalhu, which will allow for marine traffic in and out of Gulhifalhu during the storage period.*

6 SIGNIFICANT IMPACTS AND MITIGATION MEASURES

6.1 Impacts on Natural Environment and Mitigation Measures

6.1.1 Marine Water Quality

Accidents may occur during the operation of marine vessels (e.g. crane-mounted barges, tugboats) to transport, unload, and load steel structures at *Gulhifalhu* lagoon that may lead to spillage of oil, and other chemicals into the sea. Exposure to oil and chemical spillages are known to have numerous adverse effects on marine life forms. Effects vary from physiological abnormalities in larvae exposed to oil contamination, to direct smothering of corals and other marine life forms. Furthermore some of these effects may persist for months to years.

Unloading of steel structures onto the reef flat may generate sediment plumes, elevating the level of suspended solids and turbidity in the water column. Reducing the overall water quality at the site. Sediment dispersal is expected to occur at a moderate scale.

Mitigation Measures

- Brief all personnel on fragility and importance of coral reefs and its associated marine life, and the potential adverse impact of an oil spill on this ecosystem.
- Only licensed, well-qualified, and experienced personnel must operate marine vessels used in the project.
- Where practical avoid operation of marine vessels in rough sea conditions.
- All fuels and chemicals on-board must be stored in securely closed containers, in secure locations of the vessel.
- All vessels should be equipped with proper and adequate spill-kits, and personnel adequately trained to use spill-kits.
- In an event of an accidental spillage all relevant authorities (e.g. Maldives National Defence Force, Coast Guard, Environmental Protection Agency, and the Ministry of Environment and Energy) must be informed, and instructions of these authorities must be followed to minimize and ideally eliminate all potential damages.
- Carryout unloading and loading works during calm and low-tide hours of the day.
- Complete unloading and loading works in the shortest time period possible.

6.1.2 Marine Biodiversity

Coral and other sessile marine life within the direct footprint of steel structures will be permanently lost. Coral colonies and other marine life may sustain physical damages during unloading and loading of large steel structures onto the reef flat. However, given that this footprint has very low few coral colonies, the overall impact on coral life is not expected to be significant.

Given the size of the steel structures, they may prevent light from reaching some benthic life forms growing on the upper reef slope. Prolonged shading may have sub-lethal to lethal effects on light dependent species (e.g. corals that rely on photosynthetic algae).

Degradation of water quality (as discussed in 6.1.1) is adversely affect marine in this area. The key concern is risk of oil spillage, which can have a variety of detrimental effects on marine life.

Mitigation Measures

- Only licensed, well-qualified and experienced personnel must operate the marine vessels and crane to unload and load the steel structures onto the reef.
- Boundary of the unloading area properly marked, to ensure no material is unloaded outside this area.
- Instruct all personnel involved in this component to restrict activities within the set boundary.
- Brief all personnel involved in this component about the importance and fragile nature of coral reef ecosystem.
- Carryout unloading and loading activities in calm sea conditions, during low-tide hours.
- Complete all activities in the shortest time possible.
- Close supervision by adequately qualified and experienced personnel to ensure no steel structures are unloaded outside the set boundary and no unnecessary damage is caused to the reef.
- Ensure all mitigation measures proposed to prevent, contain and clean up oil spillages are undertaken (refer to 6.1.1).

6.1.3 Reef Structure

Steel structures are large and heavy; hence placing them near the reef slope poses risk of reef slope failure.

Mitigation Measures

- Place the pipe fully and perpendicular to the reef flat.
- Place the pipes away from the reef slope

6.2 Impacts on the Socio-economic Environment and Mitigation Measures

6.2.1 Noise, Vibration and Air Emission

Operation of heavy machinery is expected to generate high noise levels. In addition, smoke and Green House Gases released by the vessels and machinery is likely to degrade the air quality.

Noise and Air Emission impacts have already been covered to a large extent in the Original EIA and the first Addendum, and it is to be noted that the proposed changes in this addendum are unlikely to have any significant cumulative impacts on Noise and Air Emission levels of the project.

Mitigation Measures

- Properly tune and maintain all vessels, vehicles and machineries.

6.2.2 Health and Safety

Operation of crane mounted onto the barge involves considerable risk to health and safety of workers unless adequate measures are taken to prevent and minimize these risks.

Mitigation Measures

- Ensure safety signs are properly displayed on-board the vessels
- Ensure the vessels have adequately trained and licensed/certified personnel on-board to operate it safely at all times.
- Brief and train all personnel on-board the vessels of safety features, and measures on the vessels
- Only licensed, well-qualified and experienced personnel to operate the vessels
- Only licensed, well-qualified, and experienced personnel to operate the crane and specialized equipment

- All personnel working on the vessels and barges must be provided with suitable protective gear/equipment.
- All personnel working on the vessels and barges must wear the necessary safety gear (e.g. Hard Head, Safety Boots, Life vests) when undertaking any activity that may involve a risk to health and safety
- Maintain first aid kits on the vessels
- In case of an major accident immediately notify relevant authorities (e.g. Coast Guard, nearest Hospital)

7 ALTERNATIVES

7.1 Alternative Storage Site

7.1.1 Hulhumalé Reef Site

Reef flat of Hulhumalé was assessed as a potential alternative site to store the steel structures.

The main disadvantage of this site is restriction on crane operations as it is in direct pathway of flight landing and take-off zone. In addition given that this site is in close proximity to a tourist resort, the visual impact of storing large steel structures is high.

7.1.2 Hulhulé Site

This is the nearest site to all project activities, and all major construction works are currently being undertaken at this location. Assessment shows that the reef does not provide enough space to safely store the steel structures.

7.1.3 Thilafushi Reef Site

The northern reef flat of *Thilafushi* is a possible alternative storage site for the steel pipes. The main disadvantage of the *Thilafushi* site compared to *Gulhifalhu* would be the additional distance between this site and bridge site. In addition marine traffic near *Thilafushi* will be higher compared to *Gulhifalhu* as major industrial and only designated waste disposal site for greater Male' region is located in *Thilafushi*.

Thus, the alternatives were dismissed in favour of the proposed storage site.

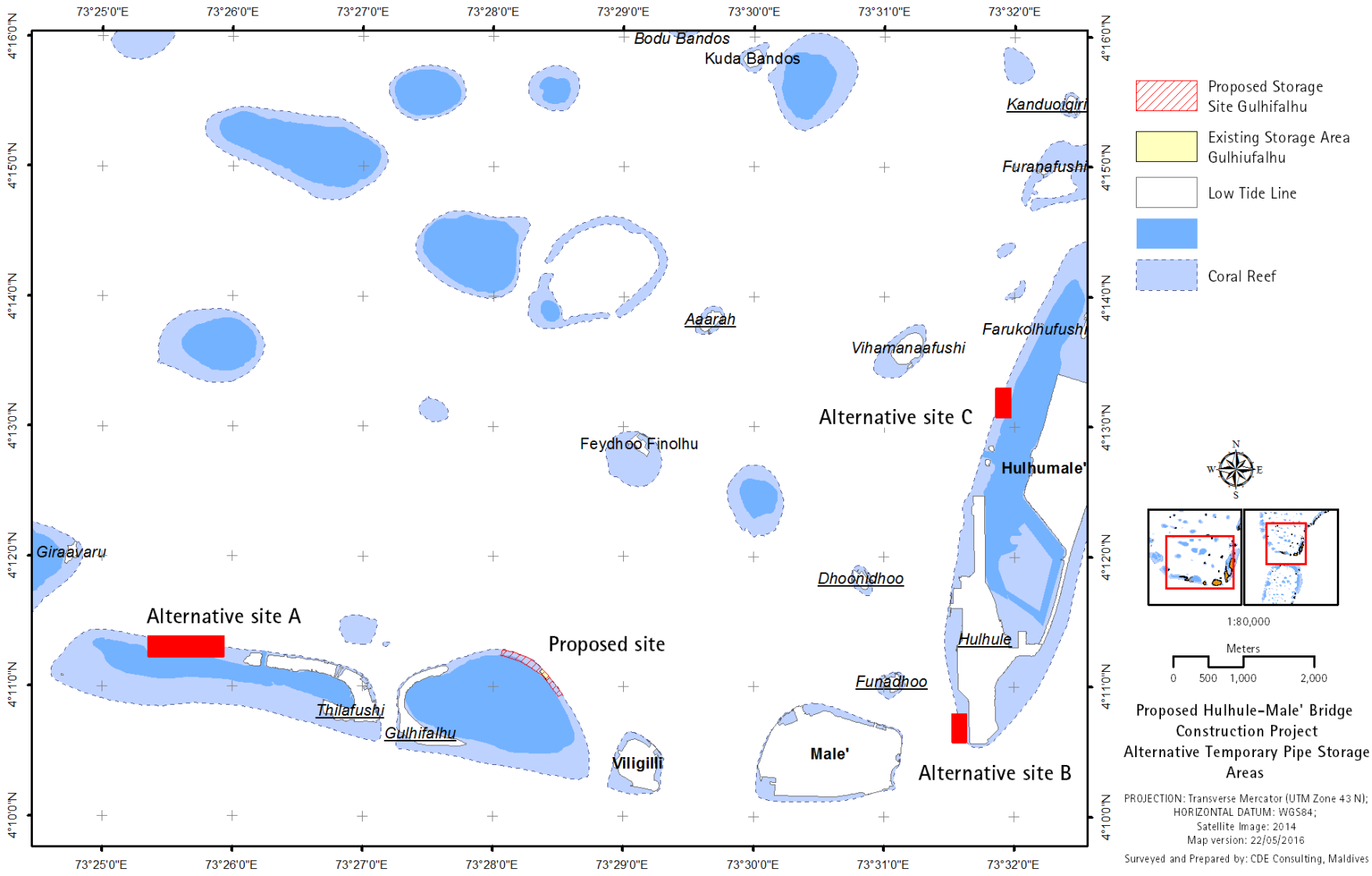


Figure 7.2: Alternative storage areas

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.

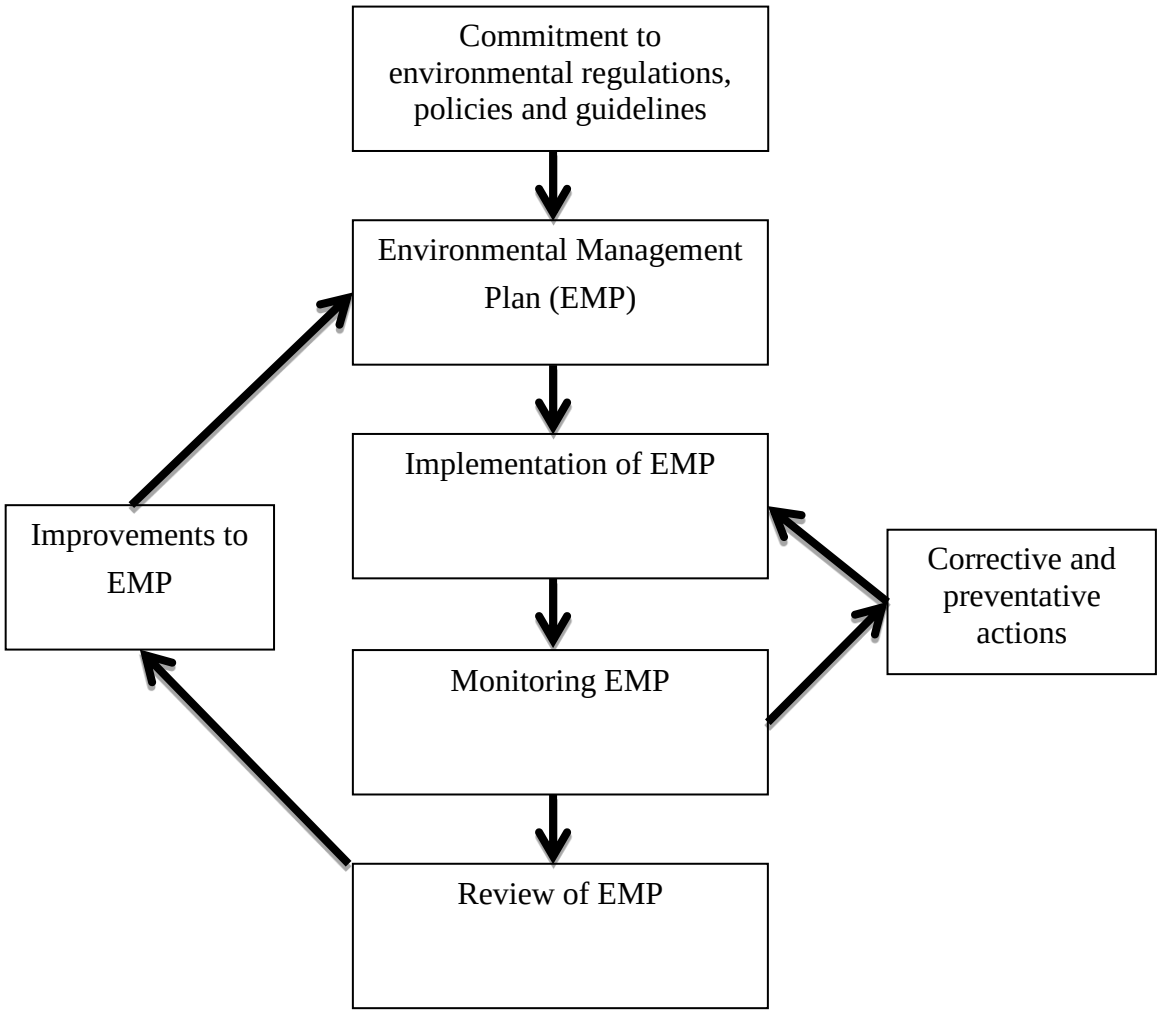


Figure 8.1 : Environmental Management Strategy flow diagram

8.1.1 Management structure and responsibilities

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

- Project proponent: Ministry of Housing and Infrastructure
- Consultants: Environmental consultants and engineers
- Environmental Regulatory Authority: Environmental Protection Agency (EPA)
- Government Authority: Ministry of Housing and Infrastructure
- Contractor: CCCC Second Harbour Engineering Company Limited

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

8.1.2 Project proponent

- Execution of all project activities
- Preparation of EMP
- Monitoring of the project activities
- Submission of annual environmental monitoring reports as required by the EPA

8.1.3 Consultants

- Environmental Consultants
  - Preparation of EMP in consultation with the proponent
  - Monitoring of performance of project activities according to the EMP, as instructed by the proponent
  - 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)
- Project engineer
  - Monitoring contractor compliance to design specifications
  - Reporting contractor compliance for payment purposes
  - Approving structures
  - Guiding contractor on unforeseen issues related to implementing design specifications

8.1.4 Environmental Protection Agency

- Review environmental monitoring report
- Intervention in the event of a breach in environmental permit conditions
- Site visit and inspection

8.1.5 Contractor

- Undertaking construction work as defined by the proponent and project engineer
- Ensure compliance with the EMP during construction stage, including purchase of construction equipment, implementing mitigation measures and monitoring construction site
- Ensure all construction workers are aware of EMP and comply with its requirements

8.2 Management Programme

The proposed management programme is outlined in Table 8.1 below

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, importance of coral reefs, and fragile nature of reef ecosystems, and 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 proposed activity
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
Supervision of project activities	Assign appropriately experienced and qualified personnel to supervise and ensure that all activities are carried out with minimal adverse impact on the environment.	Project proponent	Before commencement of proposed activity
Waste management	All waste are to be segregated, stored temporarily and transferred to the existing waste management site.	Project proponent	Continuous, during implementation of activity
Noise	Strengthen the maintenance of construction equipment.	Project proponent	Continuous, during implementation of activity

Control of marine water quality and marine life	Disposal of any waste oil to the sea is strictly forbidden. Such waste should be gathered and disposed together with other pollutants on the bridge construction site. Prior to unloading steel structures a detailed investigation shall be completed for the sea bed along the bridge pier construction area. Any live coral along the area and within 10m scope of its periphery should be transplanted. All operations shall be handled by experienced personnel and supervised thoroughly.	Project proponent	Continuous, during implementation of activity
Health and safety of staff	Experienced personnel shall be appointed to instruct and supervise work. First aid kit and evacuation facilities shall be made readily available on vessels at all times Vessels and project site will be made accessible only to authorise personnel Work will be carried out during calm weather conditions Oil, chemicals and hazardous materials used on the vessel shall be safely stored and secured. As much as possible, work shall be carried out during the daytime. Safety signs boards will be displayed on the vessels	Project proponent	Continuous, during implementation of activity

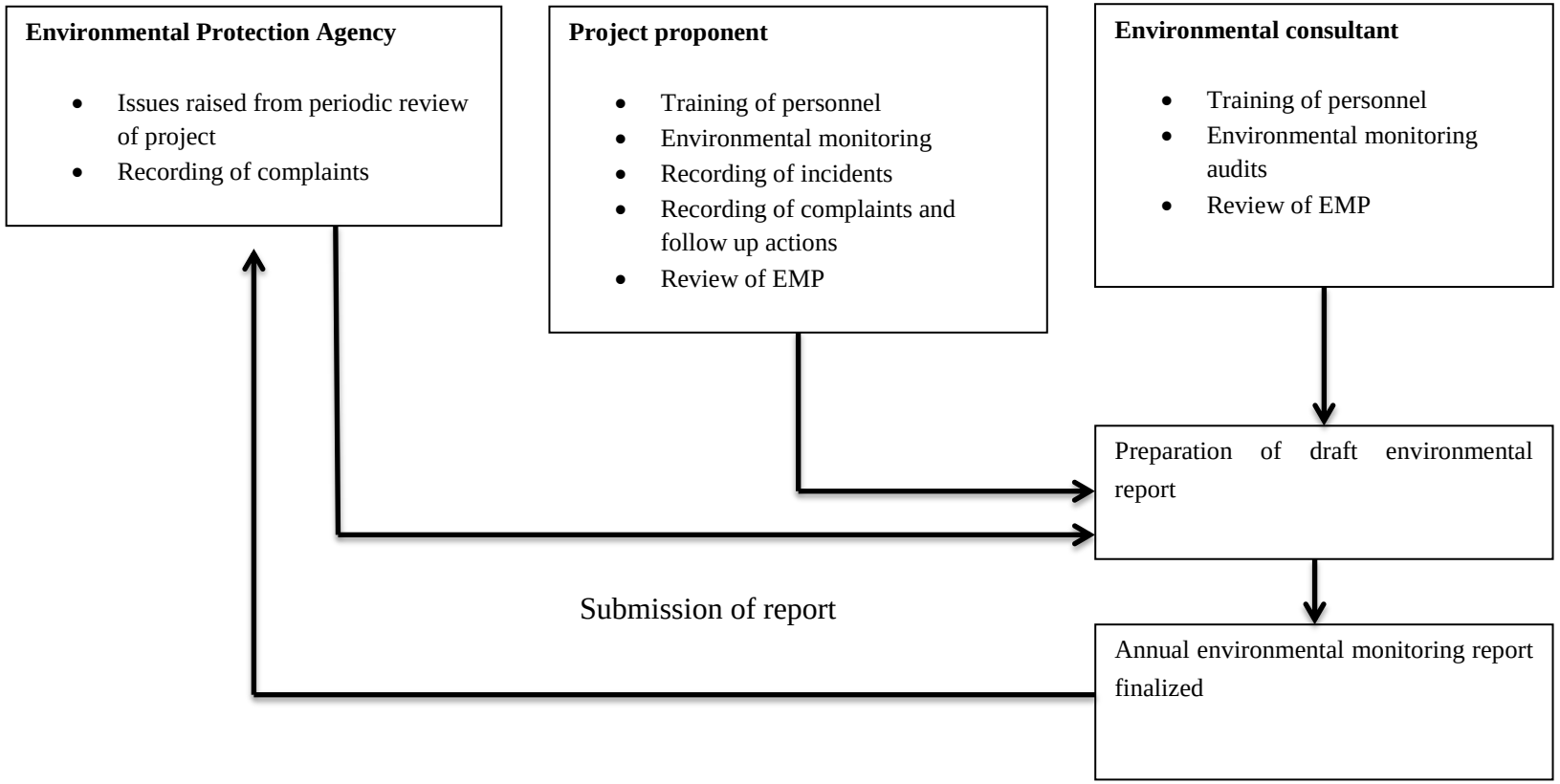
8.3 Communications

This EMP will be communicated to all actors with responsibilities for its implementation, including all parties involved in the construction and operation of the bridge.

Regulatory filings such as the EIA and annual monitoring reports submitted to the EPA are an important part of external communications related to the environmental and social performance of the project. Potential risks and procedures included in the EMP to reduce identified risks will also be communicated to relevant stakeholders, such as the surrounding communities.

Environmental and social reporting shall be undertaken to provide evidence of the ongoing implementation of the EMP and will cover 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 reporting shall constitute an annual report of the environmental performance of the facility and operations. The annual environmental reporting process is summarized in Figure 8.2.

Figure 8.2: Environmental Management Plan for construction and operation phase



9 ENVIRONMENTAL MONITORING PLAN

9.1 Introduction

This chapter will outline the monitoring plan for the proposed additional component of the 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 Monitoring during Implementation Phase

The following aspects will be monitored during the implementation of the additional components to ensure that environmental impacts are minimized.

1) **Signs of oil leakages** from vessels/equipment/machineries used in the project

Table 9.1: Monitoring Schedule

Monitoring Attribute	**Indicator**	**Methodology**	**Locations & samples**	**Frequency**	**Applicable standard**	**Est. Total Costs USD[1]**
Reef Ecology	Coral cover and Fish species composition	Photo Quadrat Surveys, and Fish Census	Transect 1 and Transect 2 in *Gulhifalhu* (refer to Survey locations map)	Once on completion of project	EPA marine assessment standard	2500

[1] *Does not include logistic costs*

9.4 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.

9.5 Cost of monitoring

Cost of monitoring for the components proposed in this addendum estimated to be US$ 2500 – US$ 3000. Professional consultants will be hired to undertake the monitoring and the necessary equipment for monitoring will be procured.

Individual parameter costs are provided in the relevant tables above.

9.6 Commitment to monitoring

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

10 STAKEHOLDER CONSULTATIONS

Stakeholder consultation regarding the usage of *Gulhifalhu* lagoon for temporary storage of steel structures.

10.1 Gulhifalhu Investment Limited (GIL)

Date: 19 May 2016
Time: 13:00

Venue: Gulhifalhi Investment Limited

Participants:

#	Name	Organization	Designation	Address
1	Abdullah Fazeel	GIL	Managing Director	H. Aagadhage, 2nd Floor, Boduthakurufaanu Magu
2	Khadeeja Neena	GIL	General Manager	H. Aagadhage, 2nd Floor, Boduthakurufaanu Magu
3	Areen Ahmed	GIL	Asst. General Manager	H. Aagadhage, 2nd Floor, Boduthakurufaanu Magu
4	Mohamed Faizan	CDE Consulting	Environmental Consultant	Faizan@cde.com.mv
5	Mohamed Aiman	CDE Consulting	Research Assistant	Aiman@cde.com.mv

Proceedings:

- A summary of the proposed project component was shared with GIL team.

Summary of discussions:

- GIL does not have any reservations for the usage of the reef flat to store
- GIL recommended that all works be undertaken with precaution to avoid and minimize any damage to *Gulhifalhu* Reef.
- No steel structures should be placed on the entrance on the eastern side of Gulhifalhu Lagoon

10.2 Environmental Protection Agency

The key concerns and recommendations by EPA are as follows:

- To undertake all project activities as per the approved EIA reports.
- Carryout an audit to all works carried out outside the approved EIAs.
- Assess possibility of using Hulhule' site as an alternative for storage of steel structures.

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.
- Lack of current and wave data as the wave and current gauges for the project are currently deployed in the lagoon and will require some time to extract.

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.

Similar projects, at this scale, have not been undertaken in the Maldives and similar scale project in coral reef and atoll environment setting is rare. This poses a challenge in accurately predicting the impacts from the project

12 CONCLUSIONS

The key conclusions of this addendum are summarized below.

- This Environment Impact Assessment (EIA) addendum report is an evaluation of the potential environmental, socio-economic and natural impacts of the proposed alteration to the Hulhulé-Malé Bridge Project, Kaafu Atoll.
- The proposed additional component involves storage of steel structures in *Gulhifalhu* Lagoon.
- The study area of this addendum is *Gulhifalhu* Lagoon.
- The proposed component is generally in conformance to the laws and regulations of the Maldives.
- The key impacts from the proposed unloading and storage of steel structures in the lagoon, direct loss of marine life within the storage footprint, potential for water quality degradation from the project, and potential health and safety risks.
- A number of mitigation measures are proposed for the most significant impacts from the project. These include ensuring only licensed, qualified personnel operate vessels and machineries on-board, demarcating the storage boundary, carrying out the unloading and loading works in calm sea conditions. In addition, health and safety measures are proposed to minimize the risks to workers.
- Reef flat at *Thilafushi, Hulhumale' and Hulhule'* was assessed as a possible alternative site for storage of steel structures. However these sites were dismissed in favour of the proposed location.
- The stakeholder consulted for this addendum are; Gulhifalhu Investment Limited (GIL),
- The key recommendations from GIL were to take all practical measures to avoid and minimize damage to the reef, and to ensure that the pipes do not block the entrance channel to *Gulhifalhu* located on the eastern side of the reef.
- The monitoring plan has been designed with a focus to analyse the significant impacts over time. Cost of monitoring is estimated at US$2500 – US$3000.
- A management framework has been proposed and it is essential that this framework be used in the construction and operation stage of the project.
- The proposed activities of this addendum is vital to the timely completion of the ongoing Hulhule-Male Bridge Project and it is recommended to go ahead with the project along with the suggested mitigation measures in this report.

13 REFERENCES

CHINA SHIPPING ENVIRONMENT TECHNOLOGY AND CDE CONSULTING (2015), *EIA for the proposed Hulhule'-Male' Bridge Project, Kaafu Atoll,* Maldives.

CHINA SHIPPING ENVIRONMENT TECHNOLOGY AND CDE CONSULTING (2015), *Additional Information for the EIA of the proposed Hulhule'-Male' Bridge Project, Kaafu Atoll,* Maldives.

APPENDIX A – Terms of Reference

TOR Number: 203-EIARES/138/2016/121

Terms of Reference for the Third Addendum to the Environmental Impact Assessment of the Male'-Hulhule' Bridge Project

The following is the Terms of Reference (ToR) for undertaking the EIA for the Third Addendum for the Proposed Male'-Hulhule' Bridge Project. ***The Proponent of the Project is Ministry of Housing and Infrastructure.***

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** - Identify the additional component to Male'-Hulhule' Bridge Project to be assessed and explain the executing arrangement for the environmental assessment. Describe the rationale for the proposed components.

2. **Study area** – Submit an A3 size scaled plan with indications of all the proposed on land and marine infrastructures. Specify the boundaries of the study area for the environmental impact assessment highlighting the location and size of the proposed facility. The study area should include adjacent and nearby environmentally important areas (e.g. coral reef, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Justification for site selection is required. Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

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

Task 1. Description of the proposed additional components of the project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. Establish the activities which are marine-based and which are land-based. All inputs and outputs related to the proposed activities shall be justified. The description of the proposed additional components to the project shall consider the following.

a) Details of the proposed components, justification for the proposed components, a full description of how the additional project activities will be undertaken including work methods and the project schedule.
b) Clearly labeled site plan of the project boundary, with regard to the proposed component.
c) Project inputs and outputs of the proposed components.
d) Long term plan in case of any similar events

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;

Task 2. 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. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in

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Website: www.epa.gov.mv

such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

The baseline data will be collected before construction and from at least two benchmarks.

All 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.

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:

Hydrography/hydrodynamics (localized maps)

- Sea water quality at proposed site: Temperature, pH, Electrical Conductivity, Total Suspended Solids, BOD, DO.
- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector. Include map;
- Marine habitat status including coral reef health, sea grass beds and benthic and fish community description at the impact boundary.

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. Legal requirements:

- Any required approvals from relevant government authorities

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.

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"*. 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 alternatives for environmental, social and economic

considerations. The report should alternative technologies and highlight how the locations were 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. Alternatives should be discussed for alternative locations such as South West Side of Hulhule'.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Mitigation measures must also be identified for both construction and operation phase. Cost of the mitigation measures, equipment and resources required to implement those measures should be specified. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. 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, in addition to the issues addressed in the existing monitoring plan, to ensure compliance to mitigation measures. Details of additions to the existing monitoring programme including the additional physical and biological parameters to be monitored, frequency, duration and cost commitment from responsible person, detailed reporting timetable and ways and means of undertaking the monitoring programme must be provided.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – EIA report should include a list of people/groups consulted and what were the major outcomes. Identify appropriate mechanisms to supply stakeholders and the public with information about the development proposal and its progress.

- Government Entity responsible for Gulhifalhu

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

19 May 2016

APPENDIX B – Site Plan

Legend

- Proposed Storage Site Gulhifalhu
- Existing Storage Area Gulhiufalhu

N
W E
S

Meters

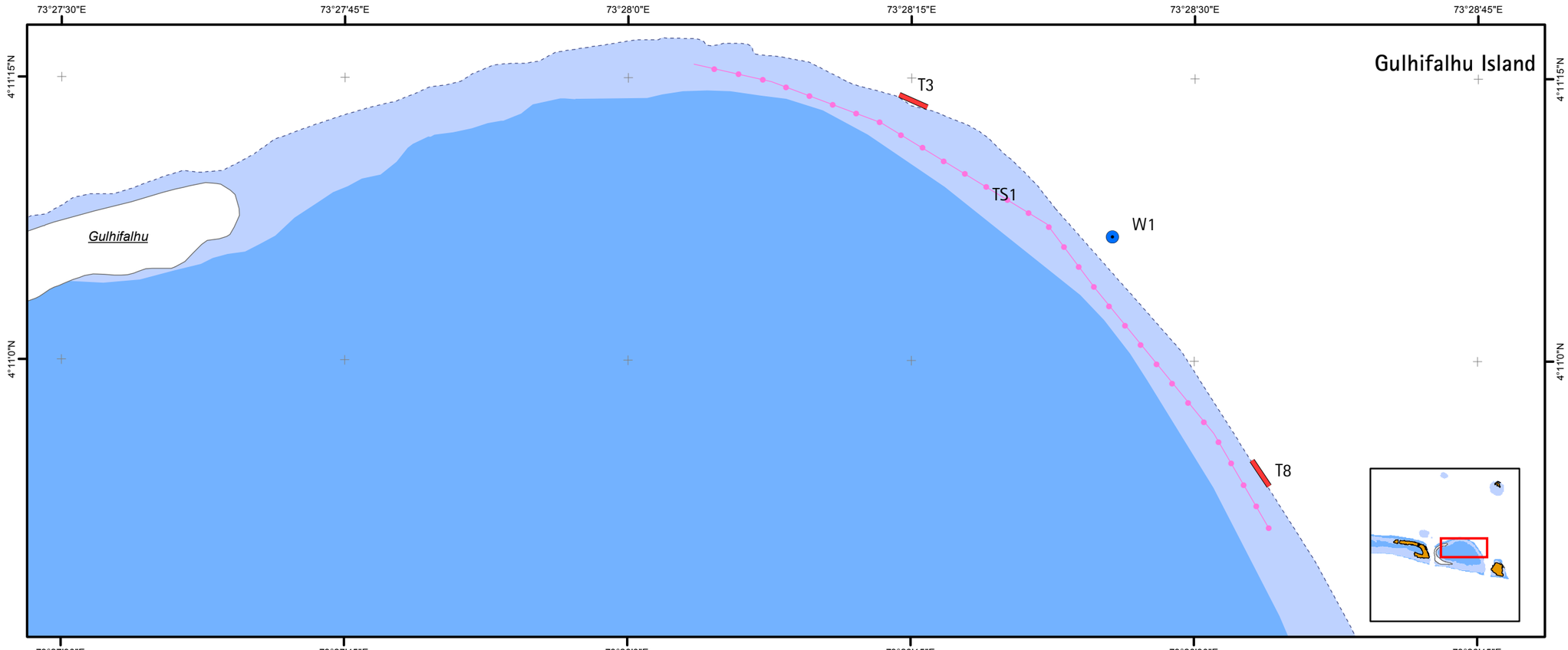
0 100 200 400

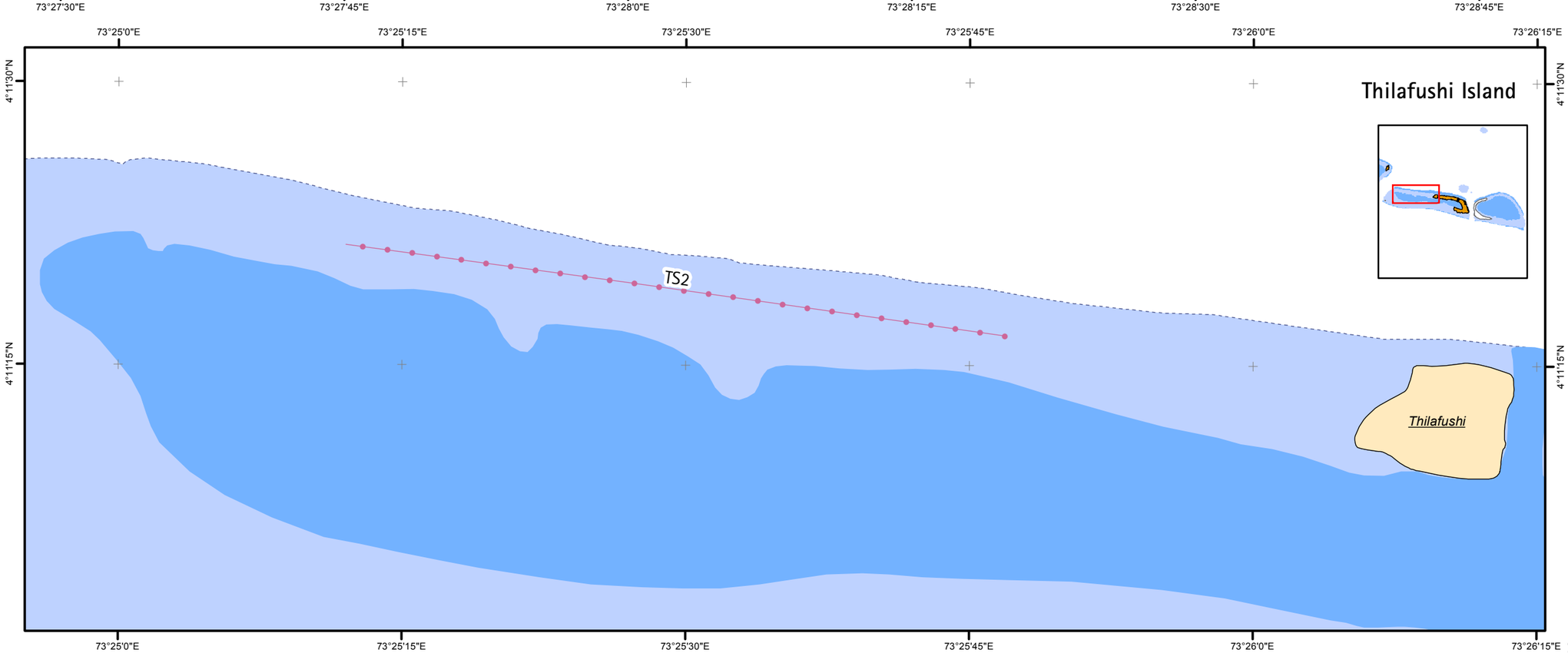
Proposed Hulhule-Male' Bridge construction project
Temporary Pipe Storage Areas on Gulhifalhu

PROJECTION: Transverse Mercator
(UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Hulhule Tide Gauge
Satellite Image: June 2015
Map version: 21/05/2016

Surveyed and Prepared by: CDE Consulting, Maldives

APPENDIX C – Survey Locations





Legend

- Marine Transects
- Timed Swims
- Marine Water Samples
- Vegetation Line
- Low Tide Line
- Lagoon
- Coral Reef

Water Samples

code	X	Y
W1	73.4738	4.18516

Marine Transects

Site_ID	X_Start	Y_Start	X_End	Y_End
T3	73.4707	4.18726	73.4711	4.18707
T8	73.4762	4.1815	73.4759	4.18187

N
W E
S

Meters

0 100 200 400

Proposed Hulhule-Male' Bridge construction project
Temporary Pipe Storage Areas Component
Survey Locations - Thilafushi and Gulhifalhu

PROJECTION: Transverse Mercator
(UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Hulhule Tide Gauge
Satellite Image: June 2015
Map version: 21/05/2016

Surveyed and Prepared by: CDE Consulting, Maldives

APPENDIX D – 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
Tel: (+960) 3323414
minister@planning.gov.mv

Simad Saeed, Dr
Managing Director,
CDE Consulting
Male', Maldives
Tel: +960 777 7445
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
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Townsville, QLD,Australia, 4811
Tel: (+61) 747 81 4441 ,Fax: (+61) 747 81 5581
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

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

APPENDIX E – Stakeholder Meeting Attendance

Meeting Attendance Form

Details: Hulhule'-Male' Bridge EIA Addendum for placing steel pipes on Gulhifalhu Location: GIL Office Date: 19/05/16

#	Name	Designation	Office	Address	Mobile	Signature
1	Abdulla Fazeel.	Managing Director	GIL	H. Aagadheeru, 2nd Fl Boduthakurufaanu Magu	7774577	
2	Khadeeja Neena.	General Manager	GIL	H. Aagadheeye, 2nd Fl Boduthakurufaanu Magu	9993558	
3	Areen Ahmed.	Asst. General Manager	"	"	7779598	
4						
5						
6						
7						
8						
9						
10						
11						
12						

APPENDIX F – Summary of Fish Census

Family	Species	Abundance Categories		
		Gulhifalhu - T1	Gulhifalhu - T2	Thilafushi - T3
Serranidae (Groupers)	*Cephalopholis argus*	0	2	2
	Aethaloperca rogaa	2	2	0
Serranidae (Basslets)	*Pseudanthias squamipinnis*	3	0	0
Lethrinidae	*Monotaxis grandoculis*	0	2	2
Nemipteridae	*Scolopsis bilineata*	2	0	2
Lutjanidae	*Lutjanus kasmira*	5	0	0
	Lutjanus bohar	0	0	2
Caesionidae	*Caesio lunaris*	5	3	0
	Pterocaesio tile	0	3	0
Mullidae	*Parupeneus barberinus*	0	0	2
	Parupeneus pleurostigma	2	0	0
Chaetodontidae	*Hemitaurichthys zoster*	3	0	4
	Chaetodon lunula	0	0	2
	Chaetodon trifasciatus	0	2	2
	Chaetodon kleinii	2	2	0
	Chaetodon citrinellus	0	2	2
	Chaetodon guttatissimus	0	5	2
	Chaetodon falcula	0	0	2
	Chaetodon auriga	0	0	2
	Chaetodon collare	2	0	2
	Forcipiger flavissimus	3	2	2
	Heniochus diphreutes	6	5	0
Pomacanthidae	*Pygoplites diacanthus*	2	2	2
Pomacentridae	*Amphiprion clarkii*	0	0	2
	Dascyllus trimaculatus	0	3	4
	Chromis dimidiata	0	3	4
	Chromis weberi	0	0	2
	Pomacentrus caeruleus	2	0	3
	Pomacentrus philippinus	0	2	0
	Abudefduf vaigiensis	2	0	0
Labridae	*Halichoeres hortulanus*	0	2	3
	Labroides dimidiatus	0	0	2
	Gomphosus caeruleus	2	2	3
	Thalassoma amblycephalum	4	5	4
	Thalassoma hardwicke	0	0	2
	Thalassoma lunare	0	2	0
	Hemigymnus fasciatus	0	0	2

Family	Species	Abundance Categories		
		Gulhifalhu - T1	Gulhifalhu - T2	Thilafushi - T3
Scaridae	*Cetoscarus bicolor*	2	0	2
	Scarus strongylocephalus	0	2	0
	Scarus sordidus	2	3	3
	Scarus niger	0	0	2
	Scarus rubroviolaceus	0	2	2
Pinguipedidae	*Parapercis millipunctata*	0	0	2
Zanclidae	*Zanclus cornutus*	0	2	2
Acanthuridae	*Acanthurus leucosternon*	2	2	2
	Acanthurus nigricauda	2	0	0
	Acanthurus auranticavus	2	5	0
	Ctenochaetus striatus	5	6	4
	Zebrasoma desjardinii	0	2	0
	Zebrasoma scopas	2	2	2
	Naso lituratus	3	2	0
	Naso brevirostris	4	0	2
	Naso hexacanthus	3	5	4
Balistidae	*Balistoides viridescens*	0	2	2
	Melichthys indicus	2	0	2
	Pseudobalistes flavimarginatus	2	0	2
	Odonus niger	6	6	6
	Sufflamen bursa	2	0	0
	Balistoides conspicillum	0	1	0
Chelonidae	*Eretmochelys imbricata*	1	0	0

APPENDIX G - Letter of Commitment to Monitoring

بسم الله الرحمن الرحيم

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

ހިޔާސީ ތަނާ ހަވާލާ ކުރެވިފައިވާ ގޭގެ ހަ ތަރައްގީ ވަޒާރާތް
ދަގު، ދިވެހިރާއްޖެ.

Date: 22 May 2016

No: 138-PIS1/203/2016/126

Mr. Ibrahim Naeem
Director General
Environmental Protection Agency,
Ministry of Environment and Energy,
Green Building, Male',
Maldives.

Dear Sir,

This is in reference to the 3rd Addendum to EIA report for the proposed Hulhule-Male' Bridge. As the Proponent of the project, we assure you our commitment to undertake the proposed mitigation measures and monitoring programme as given in the report.

Thanking you

Sincerely,

Aishath Barriya,
Engineer

Ameenee Magu, Maafannu, Male', 20392, Republic of Maldives.
ދަމީނީ ދާދި، ދާދަންނު، ދަގު، 20392، ދިވެހިރާއްޖެ.
+(960) 300 4 300
+(960) 300 4 301
secretariat@housing.gov.mv
www.housing.gov.mv
www.facebook.com/housing.gov.mv
www.twitter.com/HousingGovMv

APPENDIX H – Acknowledgement of Receipt by Malé City Council

بسم الله الرحمن الرحيم

cde CONSULTING

www.cde.com.mv

ނަންބަރު: CDE-L/0516/73

މާލެ ސިޓީ ކައުންސިލްގެ މުޙްތަރަމް،

ވެދުން ސަލާމަށްފަހު ދަންނަވަމެވެ.

މާލެ ހުޅުލެ ބްރިޖް އިމާރާތް ގެ 3 ވަނަ އެޑެންޑަމްގެ މަސައްކަތުގެ ސަބަބުން ތިމާވެއްޓަށް ކުރާނެ އަސަރު ވަޒަންކުރުމުގެ ގޮތުން ތައްޔާރުކުރެވިފައިވާ އީ.އައި.އޭ ރިޕޯޓް، ލާމަރުކަޒީ ޤާނޫނުގެ 69 ވަނަ މާއްދާ ގައިވާ ގޮތުގެ މަތީން ތިޔަ ކައުންސިލާއި ހިއްސާ ކުރުމުގެ ގޮތުން މިސިޓީއާއެކު ފޮނުވީމެވެ. ވީމާ، މިސިޓީގެ ތިރީގައި އެވާ މި ރިޕޯޓް ކައުންސިލަށް ލިބުނުކަމުގެ ސޮއިކޮށް ފުރިހަމަ ކޮށްދެއްވުމަށްފަހު ވީއެންމެ އަވަސް ފުރުޞަތެއްގައި މިއޮފީހަށް ހަވާލުކުރެއްވުން ނުވަތަ މިއޮފީހުގެ ފެކްސް ނަންބަރު 3315926 ނުވަތަ faizan@cde.com.mv އަށް ފޮނުއްވައި ދެއްވުން އެދެމެވެ.

އިޙްތިރާމް ގަބޫލުކުރައްވުން އެދެމެވެ.

22 މޭ 2016

ޚާދިމުކުމް

ސިޔާދު ސަޢީދު

މެނޭޖިންގ ޑިރެކްޓަރ

މާލޭ ސިޓީ ކައުންސިލް، މާލެ

އީ.އައި.އޭ ރިޕޯޓް ލިބުނު ކަމުގެ ލިޔުން

ރިޕޯޓުގެ ނަން: މާލެ ހުޅުލެ ބްރިޖްގެ 3 ވަނަ އެޑެންޑަމްއިން ތިމާވެއްޓަށް ކުރާނެ އަސަރު ވަޒަންކުރުމުގެ ރިޕޯޓް

ހަވާލުވި ފަރާތް: [illegible]

މަޤާމު: [illegible]

އިދާރާގެ ނަން: ސިޓީ ކައުންސިލް

ބަލައިގަތް ތާރީޚް: 22/5/16

ސޮއި:

ބަލައިގަތް ގަޑި: 11:16

ތައްގަނޑު: