First Addendum

ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Coastal Protection Project at Villimale, North Male' Atoll, Maldives

Proponent: Ministry of Environment and Energy

Sandcays

July 2016

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Consultants Declaration

This First Addendum to the EIA for the proposed coastal protection project at Villimale, has been prepared according to the EIA Regulations 2012. I certify that the statements in this Environmental Impact Assessment study are true, complete and correct to the best of my knowledge and abilities.

Hussain Fizah

Consultant Registration No. EIA01/14

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بسم الله الرحمن الرحيم

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

ފަރުގަދަ ދާއިރާ ގައުމީ ބަދަލުވުން ދިރާސާ ބަލައި ގެންދާ ބޭނުންފުޅުވާ ފަރާތްތަކަށް ލިޔެ ފޮނުވާ ސަރުކާރުގެ ދާއިރާ ގައުމީ ބަދަލުވުން ދިރާސާ ބަލައި ގެންދާ ބޭނުންފުޅުވާ ފަރާތްތަކަށް ލިޔެ ފޮނުވާ ސަރުކާރުގެ

Proponent's Declaration and Commitment

This is in reference to the First Addendum to the EIA for the proposed coastal protection project at villimale, North Male' Atoll, Maldives

As the Proponent of the project, we assure you our commitment to undertake the proposed mitigation measures and monitoring programme given in the report.

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

Hassan Azhar

Assistant Director

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Executive Summary

This report addresses environmental concerns of the proposed change to shore-protection measures for Villingilli western coast. The initial proposal had a rock boulder revetment at the western side of the island. However, due to distance between reef edge and proposed revetment, a section of this revetment could not be implemented. The proponent therefore proposes this section of revetment to be constructed using concrete T- Unit Blocks. The total length of proposed revetment is 255m; currently 200m of the revetment is constructed using rock boulders; 55m of the remaining revetment is proposed to be constructed using T-Blocks.

As the only proposed change is material used for revetment, there is little change to impacts predicted during the initial EIA process. The most significant of which is change to local wave and current regime due to relatively less energy absorption by the T- Unit blocks and change to wave dispersion mechanism. Compared to initially proposed rock boulders, T-Unit blocks reflect waves more and may therefore induce turbulence; however, construction of rockboulder revetments require more space for base. The proposed location for revetment construction is very close to reef edge and a section of proposed revetment could not be implemented due to absence of enough space for rockboulder revetment base.

As identified in the EIA process, during construction of the revetment, there will be some degree of sedimentation in the area. However, due to strong currents and small amount of excavation required, sedimentation is not expected to cause significant environmental loss.

Due to limited negative impacts predicted for the proposed change in revetment, no major mitigation measures were identified. However, it is strongly recommended to adhere to mitigation measures proposed in initial EIA.

ސާދާ ހުލާސާ

މިރިޕޯޓަކީ ވިލިމާލެ ހުޅަނގުފަރާތު ގޮނޑުދޮށް ހިމާޔަތް ކުރުމަށް ކުރެވުމުން އަންނަ މަސައްކަތުގެދަށުން ހަދަމުންއަންނަ ބޭރުފަޅުގެ އެއްގަމުބޯޑަރުގެ ބަޔައް ކޮންކްރީޓް ޖެ-ޓީސް ބްލޮކް އަޅާ ބަދަލުކުރުމަށް ހުށަހެޅިފައިވާ ހުށައެޅުމަށް ތިމާވެށީގެ ގޮތުން ދިރާސާ ކުރުމަށް ހެދިފައިވާ އެޑެންޑަމްއެވެ.

2015 ވަނަ އަހަރު ކުރެވުނު ފުރަ މި މަސައްކަތުގެ ދަށުން ހުޅަނގުފަރާތުގައި 255މ ގެ ބޭރުފަށް އެއްގަމު ބޮއްޖެއް ބުރަން ހުށައެޅި މި ބޯރީގެ 200މ ފުރިހަމަކުރެވިފައިވެއެވެ. ނަމަވެސް ބާކީ އޮތް 55މ ގެ ބޯރި ބޭރުފަށް ޖެހުން ކޮންޖެކްޓެހަރު ވަނީ ނުވެވިފައެވެ. މި 55މ ހިސާބުގެ ފަރު ހަދަމުން އަންނަ ބޮއްބޮއި މާ ގޮތްވުމުން ބޭ ހިލަ ޖެހުމަކީ މިކަމަށް އެންމެ އެކަށީގެންވާ ގޮތް ކަމަށް ނުފެންނާތީ ބޭރުފަޅުގެ ބަދަލުގައި ޖެ- ޓީސް ބްލޮކްސް ބޯރީގެ ބާކީބައި ޖެހުމަށް ވަނީ ހުށަހެޅިފައެވެ.

މި މަސައްކަތުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާނެ ފާހަގަކުރެވޭ މައިގަނޑު ބަދަލަކީ، ބޯރީގައި ޖެހި ހިލާއި ރަށް މަތިވެރިގެ ބަދަލުގައި ތިރިފަށަކީ ބޯރި ކައިރި ގަދަވެދާނެއެވެ. ބޭ ހިލައިން ބޯރި ޖެހުމުން ހިލާއި ރަށ ބޯރީގެ އާރަ ވަޒަންކުރަ ބޭރު ކެނޑޭ ގޮތްވެއްޖެއެވެ. ނަމަވެސް ޖެ-ޓީސް ބޮލާކްސް ބޯރީގެ އަސަރު ނޫން ބޭރު ކަމާއި އެންމެ ބޭނުމަށް އެއްވެސް ބޯރިގަނޑު ކައިރި ގަދަވާގޮތްވެއެވެ. މިކަމުގެ ސަބަބުން ބޯރިގަނޑުގެ ދަށުން ފެނިދާނެ ގޮތް ހަމައެކަނި ވެއެވެ. އެހެންނަމަވެސް މިކަން ހުއްޓުވުމަށް ބޯރީގެ ބޭގައި ބޭރުފަޅުގެ ހިމާޔަތް ފުރަން އެދިއާކު ހުށަހަޅާފައިވުން މިގޮތަށް ބޯރިގަނޑު ފުން އެންމެ ރަނގަޅުކަމުގައި ފެނެވެ.

މިގެ އިތުރުން ބޯރިފުރަމަށް ކޮންމެވެސް ވަރަކަށް ކޮންނަން ޖެހޭތީވެ މިހިސާބުގެ މޫދު ކިލަނބުވާނެއެވެ. މި މަސައްކަތުގެ ކުރެހުމުންނާއި ހިސާބުގެ ދިރު މުދަރަ މަދުކުރުމަށް މިއީ ތިމާވެށްޓަށް ލިބޭ ގެއްލުން ކުރެހުމެއް ހުރުމުގައި ކަނޑަ އެކުލަވާލައެވެ.

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1 Introduction

This addendum to EIA report has been prepared in order to establish further impacts that may be associated with the proposed change to revetment which deviates from the initial Coastal Protection EIA concept in Villimale'.

The findings of this report are based on the EIA for the Proposed Coastal Protection Project at Villimale' (approved by EPA on 30th September 2015) as well as field data collected on 20th of August 2016. This report has been prepared in accordance with the EIA Regulations 2012.

The methods used to identify, predict and assess impacts are based on matrices that have been established by the Consultants over a long period. In the matrix, the consultants assign a likert-scale number to represent the magnitude, significance, duration and spatial extent of the potential impact for each project activity against the key environmental and socio-economic components that the specific project activity may have an impact on. The product of the magnitude, significance, duration and spatial extent for each activity and component is summed up to measure the exact nature of the impacts by each activity and the overall impact of the proposed project is the sum of all activities.

2 Project Description

2.1 Project Proponent

The Proponent is the same as that given in the EIA report, i.e. Ministry of Environment and Energy.

2.2 Project Location

The proposed revetment is on the western side of Villingili.

Figure 2-1: Location of revetment

2.3 The Project

As has been described in the initial EIA, old revetment at this location had fallen loose and was no longer functioning; therefore, a new 255m revetment was proposed to be constructed at the location with rock boulders in 2015. However, during implementation stage, it was found out the distance from drop off and proposed revetment is too small for a section and hence couldn't be constructed. As such, rock boulder revetment has been proposed to be changed to T-Unit blocks for a section (55m) of this revetment. 200m of the initially proposed revetment has already been constructed using rock boulders.

2.3.1 Need and Justification for the Proposed Change

Rock boulder was chosen as the most suitable material for revetment construction during initial design as it provides maximum energy absorption and are cost effective as well as aesthetically pleasing (Figure 2-2). However, for rock boulder revetments to perform efficiently as well as maintain structural integrity for long periods of time, a suitable slope is necessary. Generally, it is understood the slope of rock boulder revetments should not be steeper than 1V:2H. Elevation on the beach at proposed beach was found to be +1m from MSL on average while the depth around the proposed revetment area (reef flat) was found to be -2m from MSL. This means the revetment would have a rough vertical displacement of 3m; as such ideally, the revetment should have a minimum base of 6m. In some documentations (such as guidelines released by New York state Department of Environmental Conservation), maximum recommended slope of a random-placed armor stone revetment is 1V:1.5H; slopes greater than this will tend to be unstable. Even in this case, a minimum base of 4.5m is required for the proposed revetment.

However, reef flat only extends up to 3m from shoreline at a section of the proposed revetment whereby it gives way to a drastic drop off (estimated 14V:1H slope at drop off).

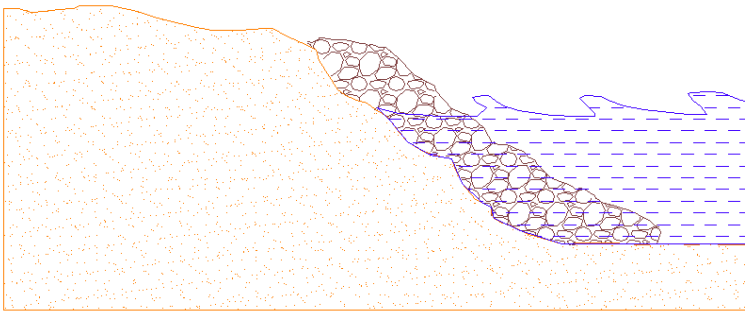

Figure 2-2: A Typical Rock-Boulder Revetment

In contrast to Rock Boulder revetments, T-Unit blocks revetments are constructed vertically without a slope, consequently T- Unit block revetments do not require as much space for base compared to rock-boulders; which is why T- Unit blocks were selected as the alternative option for Rock Boulder revetment.

The duration of the project is the same as that proposed in the EIA report.

Figure 2-3: Proposed Project Components

PROPOSED NEW QUAYWALL (SEE DETAIL)

90.517

EXISTING STRUCTURES

PREVIOUSLY PROPOSED REVETMENT

16.704

11.179

N

NEWLY BUILT REVETMENT

EXISTING BREAKWATER

PROJECT TITLE
VILLINGILI COASTAL PROTECTION PROJECT

CLIENT
MINISTRY OF ENVIRONMENT AND ENERGY

CONSULTANT
-

DRAWING TITLE
CONCEPT

SHEET TITLE
MAP VIEW

DRAWING NUMBER
MTCC/15/T10/01CB/C002

08A
SHEET 01 OF 03

SUREVEYED BY:	DESIGNED BY:	CHECKED BY:
HAMDHOON, MUNAH	ANAS	-
DRAWN BY:	DATE	DATE
ANAS	20/03/2016	-
FILE NAME:	CONTRACT NUMBER:	
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MTCC
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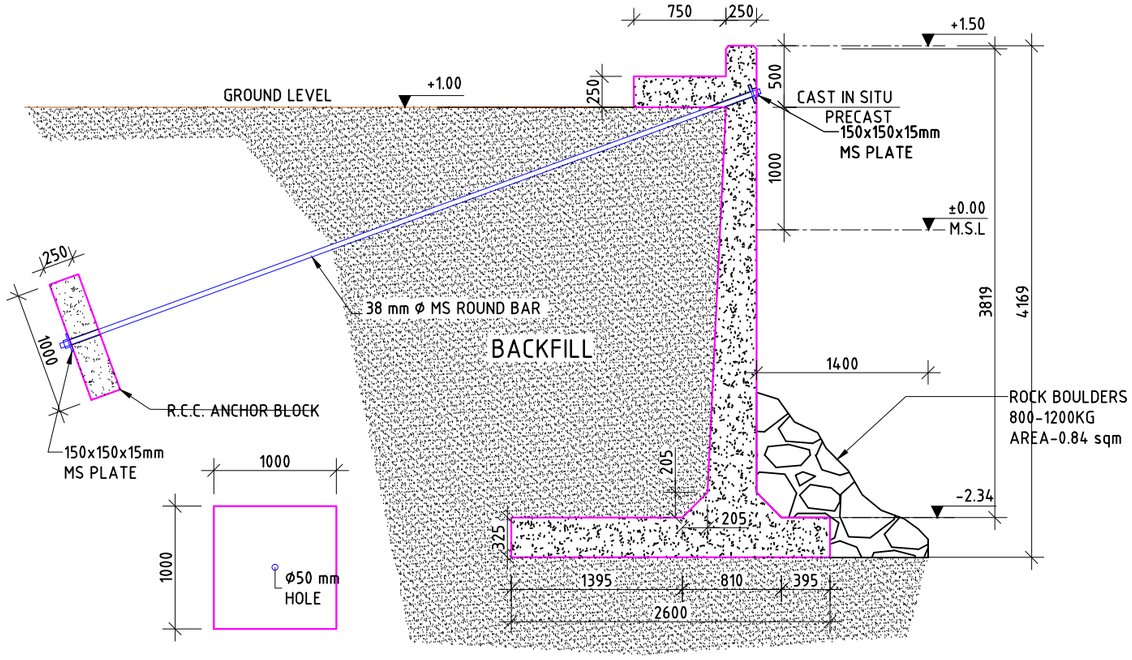

CROSS SECTION

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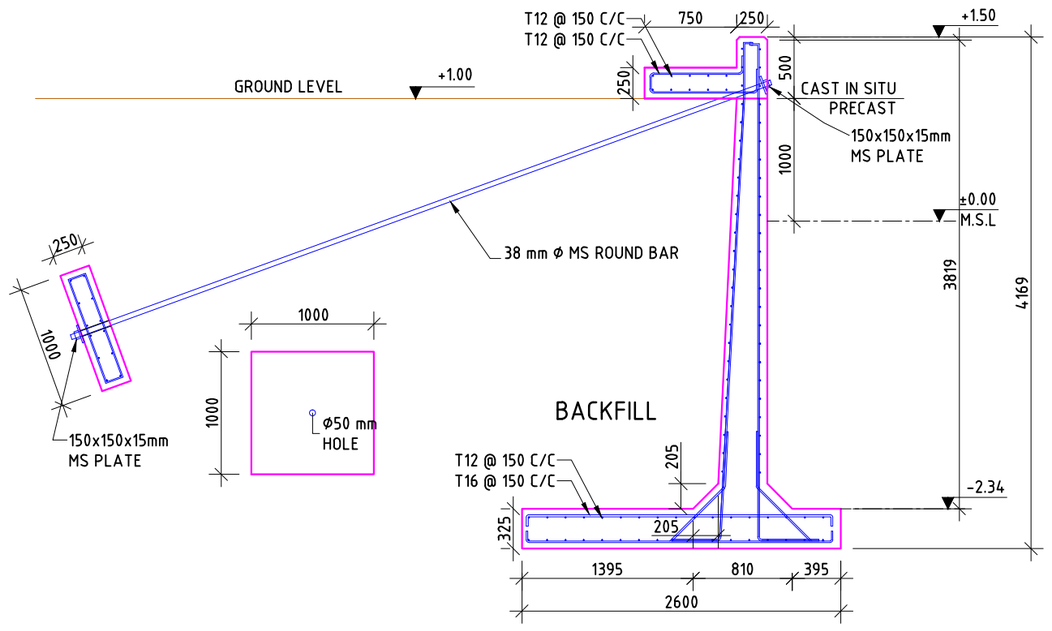

REINFORCEMENT DETAILS

SCALE 1:50

M T C C
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REV	DESCRIPTION	DATE	APPR
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CONCEPT BY: MEE
DATE: -
FILE NAME: T10 01 CB C002 08A.DWG
CONTRACT NUMBER: -
PAPER: A3
SCALE: 1:50

SURVEYED BY: HAMDHOON, MUNAH — DATE: 3/2/2015
DRAWN BY: ANAS — DATE: 20/03/2016
DESIGNED BY: - — DATE: -
CHECKED BY: - — DATE: -

CLIENT: MINISTRY OF ENVIRONMENT AND ENERGY
CONSULTANT: -

PROJECT TITLE: VILLINGILI COASTAL PROTECTION PROJECT
DRAWING TITLE: CONCEPT
SHEET TITLE: QUAYWALL DETAILS

DRAWING NUMBER
MTCC/15/T10/01CB/C002
08A
SHEET 03 OF 03

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3 Existing Environment

The existing environment of the island has been discussed in detail in the EIA report. This report has been compiled based on some of the baseline data from the EIA survey and additional surveys conducted on 20th of August 2016.

3.1 Marine Ecology of the project area

In the initial EIA, 3 sites on the reef were assessed for marine lifeforms; M1, M2 and M3 (Figure 3-1).

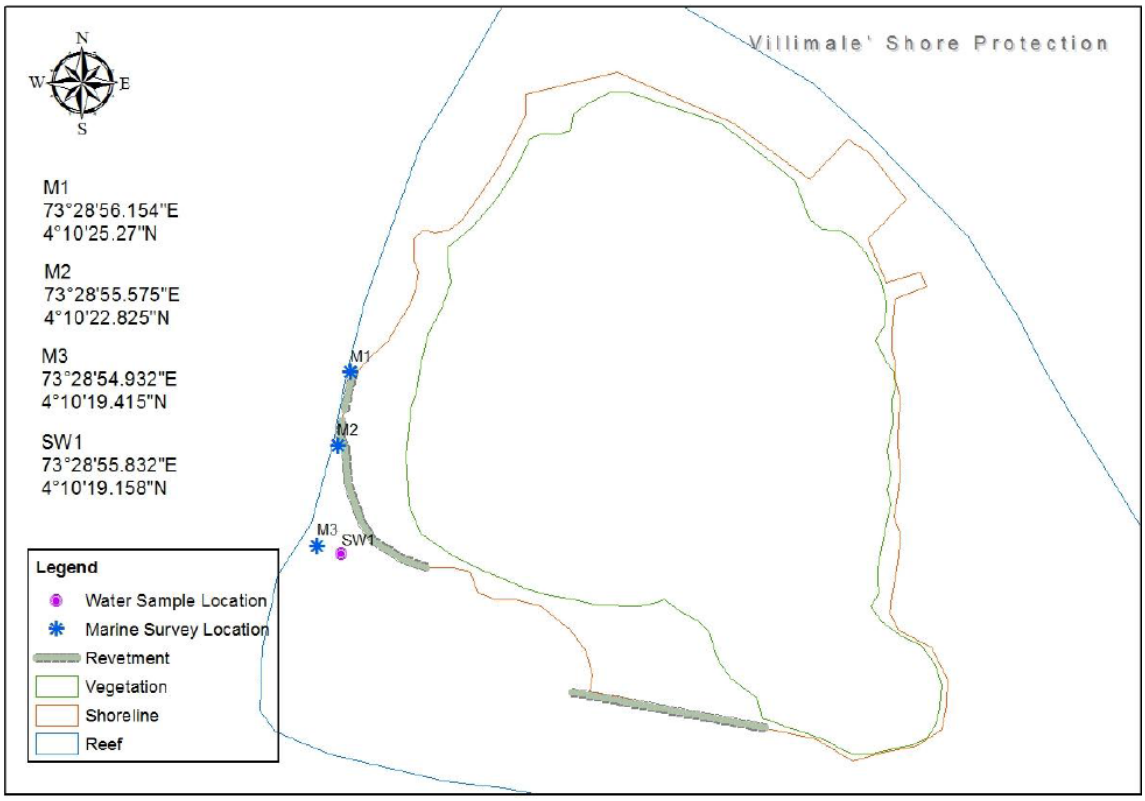


Figure 3-1: Survey Locations used in the initial EIA (Water Solutions, 2015. Villimale' Coastal Protection EIA)

As part of this assessment, these sites were revisited and photo quadrats were used to examine change to benthos. Same methodology as the EIA was used to do this exercise and results are presented below.

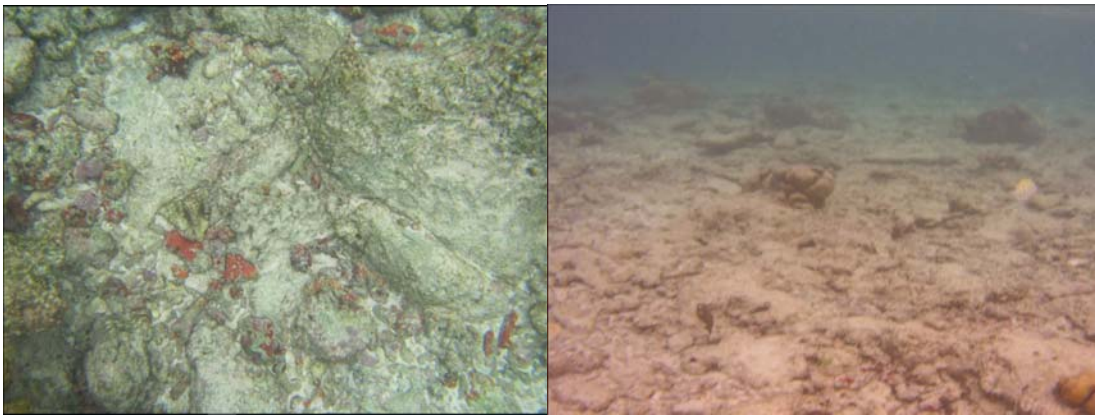
HC: All living coral including bleached coral; includes fire, blue and organ pipe corals

RC: Any hard substrate; includes dead coral more than 1yr old and may be covered by turf or encrusting coralline algae, barnacles, etc

RB: Reef rocks between 0.5 and 15cm in diameter

SD: Sediment less than 0.5cm in diameter; in water, falls quickly to the bottom when dropped.

3.1.1 Site 1 (M 1)



Site 1 was chosen from the northern part of the proposed project area. This area has very narrow reef flat and is the area where the proposed change to revetment under this addendum is focused on. Initial EIA studies showed that there were no live corals in the area and the benthos was dominated by hard substrate; such as dead coral covered by turf or encrusting coralline algae. No significant change has been observed at this site at present compared to baseline.

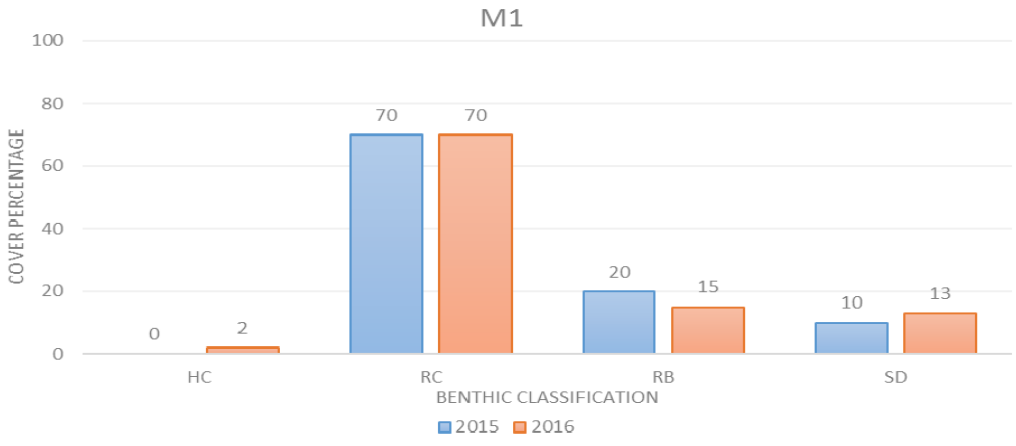


Figure 3-2: Benthic Cover percentages of M1

3.1.2 Site 2 (M2)

Site 2 was chosen from towards the middle of the proposed revetment. Similar to Site 1, this site was dominated by hard coral substrate with algae. However, few live coral colonies were also observed. No change from baseline was observed during this survey.

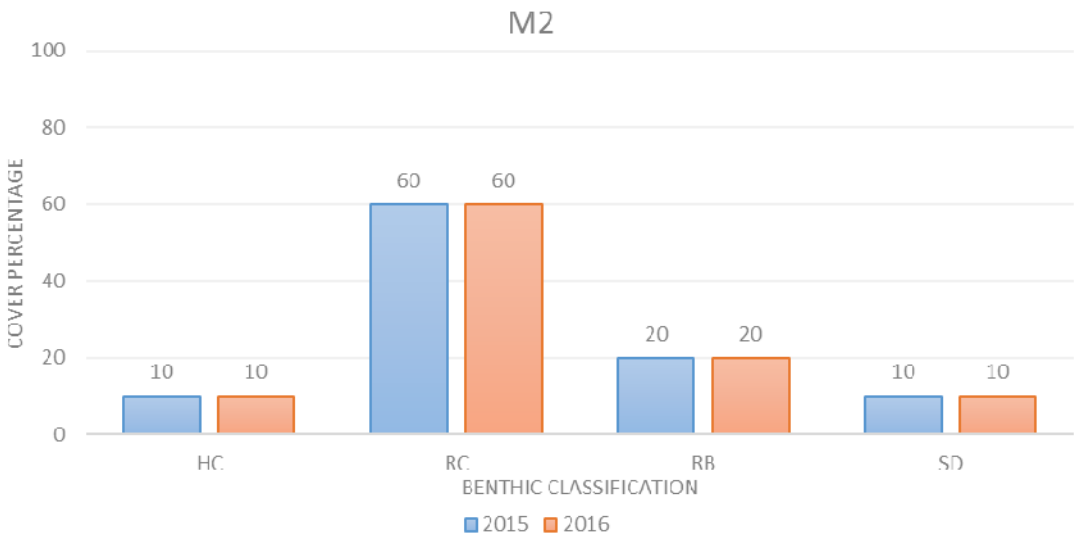
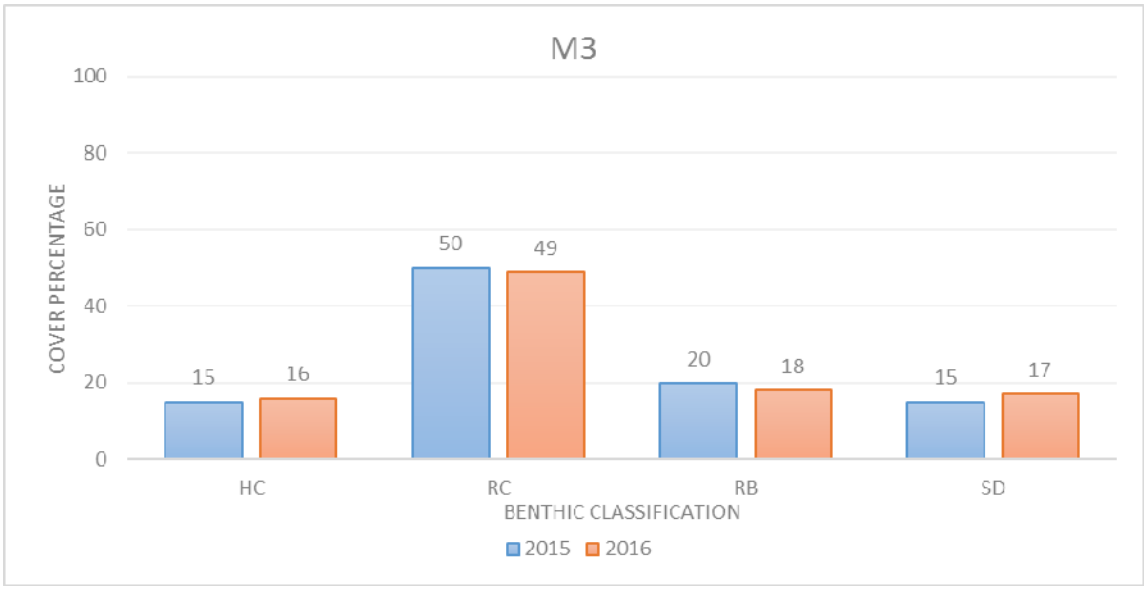


Figure 3-3: Benthic Cover percentages for M2

3.1.3 Site 3 (M3)

Site 3 was chosen from south of project area. Similar tmao previous two sites, the benthos was dominated by dead coral with algae. However, in contrast to the other sites more live corals were observed at this site.



3.2 Fish Community

Fish community at the three marine sites were also examined under this assessment. No significant changes from that of the baseline was identified where triggerfish, surgeonfish and parrotfish were in abundance at all sites.

Table 3-1: Fish census results (WS 2015)

Family	Site A	Site B	Site C
Angelfishes (Pomacanthidae)	R	-	-
Anthias	-	-	-
Batfish	-	-	-
Bigeyes (Priancanthidae)	-	R	-
Blennies	-	-	-
Butterflyfishes (Chaetodontidae)	C	-	-
Damselfishes (Pomacentridae)	R	-	-
Emperors	-	-	-
Fusiliers (Caesionidae)	-	-	-
Goatfishes	-	R	C
Gobies	-	-	-
Groupers	R	C	C
Hawkfishes	-	-	-
Jacks	R	-	-
Moorish idol (Zanclidae)	C	C	C
Parrotfishes (Scaridae)	A	C	A
Pipe fish	-	-	-
Rudderfishes (Kyphosidae)	-	-	-
Snappers (Lutjanidae)	-	A	R
Squirrelfishes (Holocentridae)	R	-	-
Surgeonfishes (Acanthuridae)	A	A	C
Sweetlips	R	-	-
Triggerfishes (Balistidae)	A	A	A
Wrasses (Labridae)	C	C	C

A= Abundant (Meaning that during the 15 minute time swim survey, species counts were recorded more than 50, hence it is difficult to count their numbers).
C=Common (Meaning that during the 15 minute time swim survey, they were spotted occasionally and throughout the survey, but their numbers were less than 50)
R=Rare (Meaning that during the survey, only few of these species were observed, often 1 or 2.
Blank cells indicate zero occurrences.

3.3 Marine water quality

Marine water quality has been measured for Sites 1, 2 and 3. Based on the data obtained, water quality at the sites was found to be relatively good with low levels of turbidity and TSS. However, a notable increase in turbidity and TSS was found at site 3.

Table 3-2: Marine water quality

	Units	Site 01	Site 02	Site 03
Temperature	ºC	29.35	28.94	29.04
Electrical Conductivity	uS/cm	47812	47980	47740
Total Dissolved Solids	mg/l	32650	32120	32010
Salinity	ppt	30.97	30.81	31.31
Dissolved Oxygen	mg/l	5.11	7.51	8.72
pH		7.95	8.04	8.20
Turbidity	NTU	0	1	2
Total suspended solids	mg/l	0	0.5	1.6

3.4 Depth Profile

A depth profile at Site 1 (M1) was taken during the survey and is presented below. As can be seen from the profile, reef edge can be found roughly 3m from shoreline.

3.5 Hydrodynamics of the project Area

The currents in the area were assessed during field survey and based on general current flow in Maldives, currents in the project area during construction phase were predicted. The figure below shows general hydrodynamics of the area. During southwest monsoon; from April up to November, due to the channel between Villingili and Gulheefalhum, currents are usually southerly to southwesterly.

Due to extensive coastal modifications such as seawalls, revetments and harbours, seasonal erosion and accretion of sand was not observed within the vicitiny of project site.

3.6 Natural hazard vulnerability

As the site is on the coastline, it would be very vulnerable to natural hazards such as tidal waves or other high wave events such as tsunamis. The engineered sea walls around Malé and Villimale', so far has proven to be an effective defence mechanism to such natural hazards.

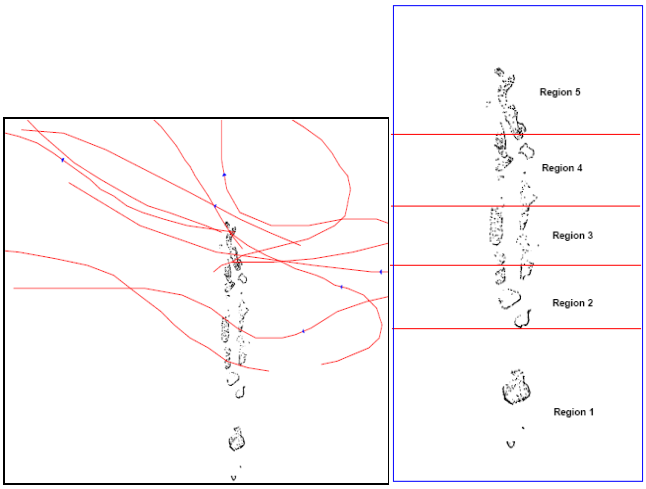
The worst natural hazard that was faced by Malé was that of the tidal wave in 1987 and the tsunami. When the tidal wave hit the Maldives on 11 April 1987, Malé had poorly built breakwaters around it and about a third of Malé was affected by severe flooding resulting in severe damage to the breakwater and retaining walls around the island. A number of houses were damaged or destroyed and several people evacuated and became homeless although no loss of life was reported. Following this incident, under a grant aid from the Government of Japan, the entire perimeter of Malé was protected by revetments and breakwaters that stood the test of time when the tsunami hit the island on 26 December 2004. On that day, several islands on the eastern coast of Maldives were badly damaged by the tsunami but Malé had very little damage due to the breakwater and revetments around it. However, due to the low-lying nature of the island, the peripheral areas including the area behind the ferry terminal has had severed days during tidal surges.

The project location is on the west side of Villingili where there are weakened oceanic swells from the southwest acting constantly.

Natural hazard vulnerability risks related to global warming and subsequent sea level rise remains a cause for concern. The vulnerability is further aggravated by the fact that rainfall in the region is of high intensity but short duration, which may be affected due to changes in global precipitation patterns related to climate change. However, the proposed project area has not had flooding due to rain.

In Developing a Disaster Rick Profile for Maldives by UNDP (2006), the natural vulnerability of the islands and atolls of the country to potential hazards have been modelled to understand the risk factors of the country. In that report, the disaster risk scenario for Maldives was described as moderate in general.

Referring to Suffir-Simpson Scale, the proposed site is considered fairly safe zone when cyclonic winds and storm surges over the Maldives are concerned and also low risk when tsunamis and earthquakes are concerned (RMSI/UNDP 2005).

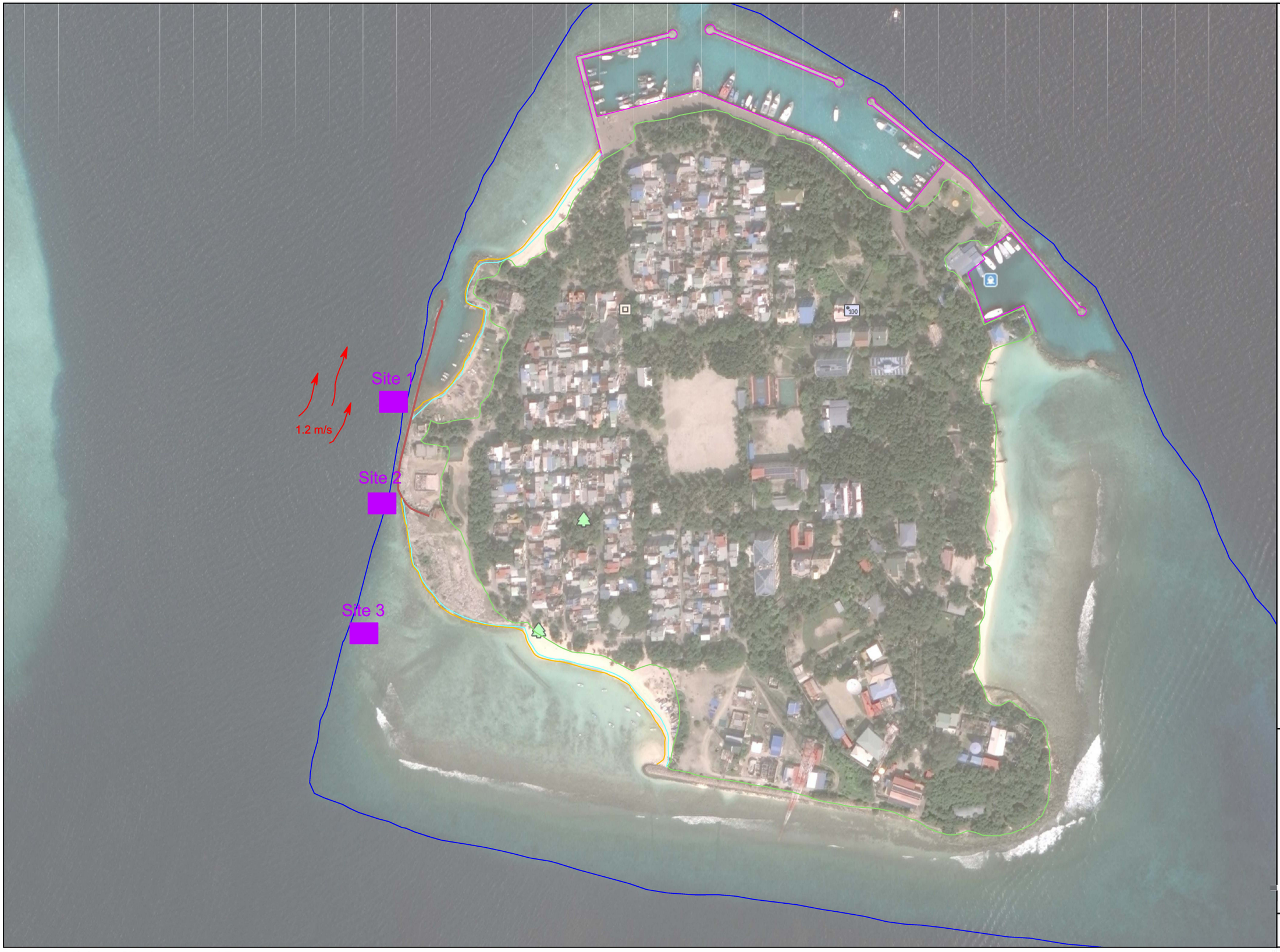


Hazard Zone	Probable Maximum Wind Speed (knots)	Saffir-Simpson Scale
1	0.0	0
2	55.9	0
3	69.6	1
4	84.2	2
5	96.8	3

Figure 3-4: Natural hazard map of Maldives (after UNDP, 2005)

The stormy weathers around the world are affecting coral reef systems directly and indirectly due to global climatic changes. Intense storms can wipe out the natural coral "recruitment" process (Daily Science, April 29, 2008) as a direct effect of climatic change. Healthy coral reef systems are vital assets to many economies around the world on which large numbers of island communities depend on range of fisheries activities including Maldives. In Maldives for instance according to NAPA (2006) local demand on reef fishery has increased in recent years. Therefore, the concern of natural hazard vulnerability on coral reefs in Maldives is very high, which needs a solution through local and global effort.

Figure 3-5: Shorelines and Monitoring Locations.



Proponent: Ministry of Environment and Energy
Consultant: Sandcays

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MALDIVES TRANSPORT & CONTRACTING COMPANY PLC
SURVEY,DESIGN AND DEVELOPMENT SECTION
CONSTRUCTION AND PROJECT MANAGEMENT DEPARTMENT, MTCC TOWER, BODU THAKURUFAANU MAGU, MALE' 20057, REPUBLIC OF MALDIVES,
PHONE:+(960) 332 6822,FAX: +(960) 333 2835
E-MAIL: survey@mtcc.com.mv

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CLIENT MINISTRY OF ENVIRONMENT AND ENERGY	SURVEYED BY: HAMDHOON, MUNAH	DATE 3/2/2015	CONCEPT BY: MEE		DATE -
	DRAWN BY: ANAS	DATE 20/03/2016	FILE NAME: T10 01 CB C002 08A.DWG		
CONSULTANT -	DESIGNED BY: -	DATE -	CONTRACT NUMBER: -		
	CHECKED BY: -	DATE -	PAPER A3		SCALE 1:1000

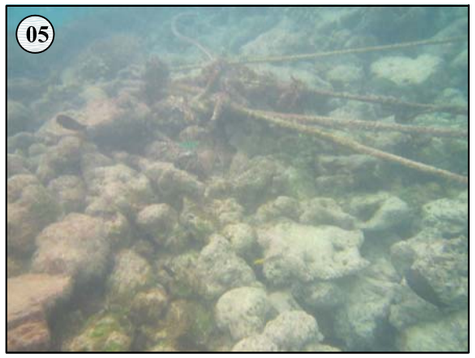
PROJECT TITLE
VILLINGILI COASTAL PROTECTION PROJECT

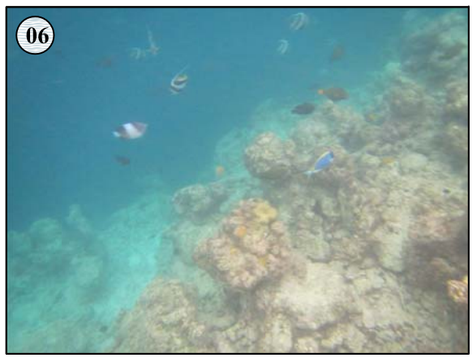
DRAWING TITLE
CONCEPT

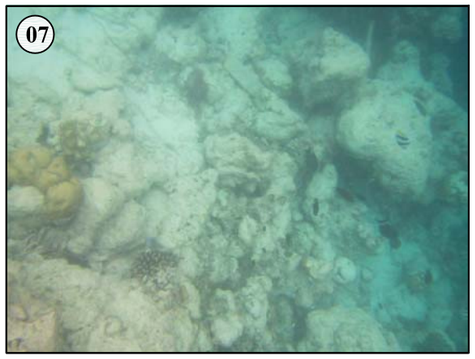
SHEET TITLE
LAYOUT W/ CONTOUR

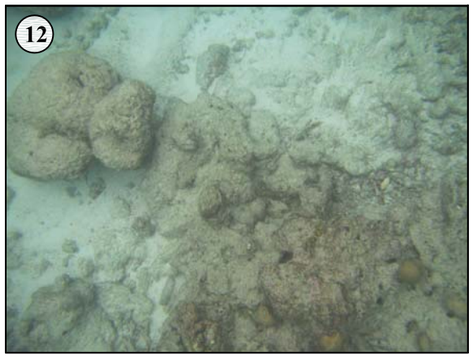
DRAWING NUMBER
MTCC/15/T10/01CB/C002
08A
SHEET 02 OF 03

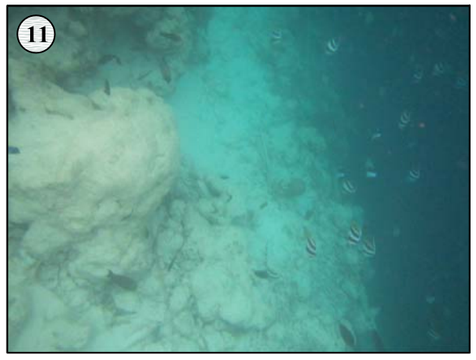
Figure 3-7: Photographic representation of project site

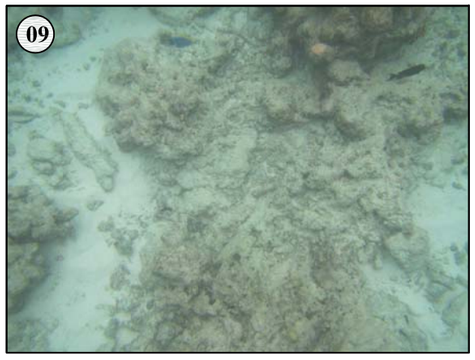


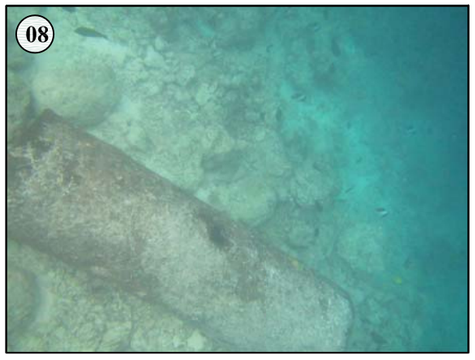












4 Impacts

4.1 Impacts related to the proposed component

4.1.1 Changes in Coastal Waters

During construction of the revetment, some degree of excavation will be required; this will result in excessive rate of suspended particles in water and would affect the quality, quantity and intensity of light reaching reef organisms hence; it will affect coral metabolism, productivity and growth of reef building corals. The effects of turbidity due to dredging on corals may be lethal, sub-lethal or acute or chronic depending on the intensity and duration of disturbance. This impact has already been addressed in the initial EIA report and due to proposed change of revetment material, there will be a slight increase in magnitude of this impact. However, during the field survey it was found there were minimal amounts of live corals at the location; as such significance of this impact is very small for this project.

4.1.2 Impacts on the Oceanography of the Area

One of the most significant impacts of the proposed change would be the impact on oceanography of the area; solid T-Unit blocks would have relatively low energy absorption in comparison to the initial rockboulder revetment. More instances of wave reflection and thereby increase in turbulence in the locale of the proposed revetment is expected to occur due to the proposed change. This may induce scouring at the foot of revetment and thereby lead to structural and in turn functional collapse of the structure. Nonetheless, if revetment is designed correctly where the slabs are erected from a sufficient depth with proper toe protection, structural failure can be avoided. In the current design, rockboulders have been proposed to be used as toe protection, as such scouring and structural collapse is not expected. Similarly, up-drift and down-drift of the T-Unit blocks are rockboulder revetment and breakwater, as such, coastal erosion due to the proposed structure is not envisaged.

4.1.3 Impacts on Reef Fish and Other Marine Organisms

As a result of dredging and its consequential impacts on the physical and biological environments, a large number of baitfish, reef fish and other marine organisms will be associated with this impact and will be affected in terms of declining in its numbers and

diversity as well as eventual death in certain species. Also as a direct consequence, sedimentation may reach long distances within the same reef as well as to other reefs in close proximity causing similar threats. The proposed component involves relatively small excavations and is expected to be completed within a short period of time. As such any decline in fish population due to increased sedimentation is likely to revert back to original values after a short duration.

4.2 Uncertainties in Impact Prediction

The level of uncertainty, in the case of the proposed dredging is expected to be low due to the experience of such dredging in similar settings in the Maldives. Nevertheless, it is important to consider that there are elements that are new and that there will be uncertainties, especially in terms of impacts on the hydrodynamics and to undertake voluntary monitoring as described in the monitoring programme given in the EIA report.

4.3 Mitigation Measures

4.3.1 Reducing Sedimentation and Its Impacts

As described earlier, one of the significant impacts from this project will be sedimentation. However, due to low amount of live corals at the location and short period of time, no special mitigation measures would be needed. Natural dispersion of sediment will be sufficient. Mitigation measures proposed in the EIA report, such as workforce awareness and timing would be sufficient. As backfilling requirement would stay same, mitigation measures proposed in the EIA report will be valid and should be adhered to.

4.3.2 Impacts to Oceanography

As has been described in the previous section, no significant negative impact is predicted from the proposed project component, as such no specific mitigation measures are proposed. Nonetheless, mitigation measures proposed in the initial EIA should be adhered to and monitored.

5 Alternatives

5.1 Introduction

This section looks at alternative ways of undertaking the proposed project. There are two basic options: (1) leave the problem as it is (no project option), or (2) take measures to resolve the problem (undertake the project options). If the project were to continue, it would be necessary to take economic, ecological and social aspects of the project into consideration and ensure that these concerns exist within a delicate balance. Neither the economic benefits nor the social and ecological concerns can be avoided. Therefore, it is important to consider all options and ensure that the best available option(s) is/are chosen to solve the issues/problems.

Not all the impacts of a project can be completely prevented, however, with the use of appropriate technology and management measures; the magnitude of most of these impacts can be either reduced or minimized. Nevertheless, the effectiveness of these technology and mitigation measures highly depends on the environmental condition and procedures in which they are applied in the field. On the other hand, there are complex and sophisticated procedures of minimizing environmental impacts by means of alternative methods to some of the activities. Often, alternative means are not economically competent with the extent of the project itself. However, to some of the activities where predicted impacts and its magnitudes on the environment are very adverse, alternate means must be applied considering long-term benefits from use of alternatives, as short-term environmental restorations can become very costly.

Due to nature of the proposed project, there are very few practical alternative options.

5.2 No project option

No project alternative for this component would mean;

- A break in coastal protection at the western side
- Less cost for proponent
- No further damage to coral reef at the project area

If the proposed revetment is not constructed, there will be a break in coastal protection structure at the western side; compromising the entire protection plan. A part of the revetment is already constructed and if the rest of the revetment is not constructed, wave and currents

will erode from the sides of the already constructed revetment and lead to structural failure. Therefore, this option is not recommended.

5.3 Alternative Materials for Revetment

As has been described in the initial EIA, there are few options as materials for coastal protection structures. First, there is coral rubble as used in some parts of the existing structures. However, coral mining is banned and this option shall not be considered. The reuse of corals in the existing structures is an option. However, they would not be sufficient or may not provide adequate protection. Second option is the use of rock boulders or tetra pods, which would be strong enough to survive strong waves. However, tetra pods are not cost effective in addition to larger base requirement whereas rockboulder revetment could not be constructed due to small base length available. Third option is the use of geotextile tubes or bags. Geotextile tubes or bags do not have any inherent advantage over the proposed T-unit blocks apart from cost. Though they are cheap, geobags will require sand to use as fill and have shorter lifespan. In addition, in high energy environments, they are not as effective as proposed and would require larger base area relative to the proposed. Therefore, the proposed T-Unit blocks are the best alternative in this setting for the revetment.

6 Environmental Monitoring

As there are no significant changes to project site or environmental parameters the impacts will reach, no additional monitoring requirement is identified by the consultant for this component; i.e. monitoring schedule given in the initial EIA is considered appropriate and sufficient to address impacts from the proposed component as well.

7 Conclusions

There are no major additional environmentally significant impacts from the proposed change to revetment material. Therefore, the consultants do not see any issues in the project proposal.

8 References

Water Solutions (2015), *EIA for the proposed coastal protection project at Villimale, North Male" Atoll, Maldives,* WS

MEECO (2015), *EIA for Construction of K.Villingili West Harbour & Slipway Project,* MEECO

Sandcays (2015), *EIA for the proposed coastal protection at M. Naalaafushi*, Sandcays

9 Appendices

Appendix 1: Terms of Reference

Appendix 2: EIA Decision Statement

Environmental Protection Agency EPA

203-EIARES/438/2016/123

Terms of Reference for Addendum to the Environmental Impact Assessment for Concrete Revetment between the two Breakwater at the Slipway

The following is the Terms of Reference (ToR) for undertaking an addendum to EIA for the Concrete Revetment between the two Breakwaters at the Slipway in Villingili, Kaafu Atoll.

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

1. **<u>Introduction to the project</u>** – Describe the purpose of the Addendum and the background of the project and the tasks already completed. Clearly identify the rationale and objectives to enable the formulation of alternatives.

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

3. **<u>Scope of work</u>**– Identify and number tasks of the project including site preparation, construction and decommissioning phases. The following tasks shall be completed:

   Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. Discuss the following project details.

   - Coastal defence construction and justification;
   - Installation of concrete quaywall with rock revetment;
   - Measures to protect environmental values during construction and operational phase;
   - Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills).

   <u>Coastal structure construction</u>

   - Details and justification of location, number, size and materials of coastal protection structures;
   - Construction methods, materials, equipment, man power, expertise and scheduling.

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

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

Geology and geomorphology

- Bathymetry of the project areas (use maps);
- (Seasonal) patterns of coastal erosion and accretion (see appendix for monitoring details), and
- Characteristics of the seabed at project area(s) areas to assess direct habitat destruction and turbidity impacts during construction;

Hydrography/hydrodynamics

- Currents at the proposed project areas and up and downdrift locations;
- Recent shoreline configuration of the project area
- Sea water quality at the project area as well as updrift location for temperature, pH, electrical conductivity, salinity, dissolved oxygen, turbidity and total suspended solids.

Ecology

- Benthic and fish community monitoring at project site;
- 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;
- Landscape integrity

Hazard vulnerability:

- Vulnerability of area to flooding and storm surge.

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.

Task 4. Potential impacts of the proposed project– The EIA addendum report should identify all the impacts (direct, indirect and cumulative) and evaluate the magnitude and significance This shall include:

Impacts on the natural environment

- Impacts on marine habitats including damages to coral reefs and seagrass communities, fish stocks, protected areas and protected species;
- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Temporary sediment dispersal in water column (turbidity at site related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on employment and income, potential for local people to have (temporary or long term) job opportunities (and what kind) in the execution of the works;
- Disturbance to local natural resource users such as fishing areas, other tourism ventures;

Construction related hazards and risks

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

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 4.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 financial 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 5. Alternatives to proposed project – Alternatives including the *"no action option"*should be presented. Determine the best practical environmental option. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include but not limited to alternative coastal protection measures, locations, alternative designs, materials and methods. The report should highlight how the best options were determined. All alternatives must be compared according to accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Development of monitoring plan – If there are additional monitoring requirements for the proposed components of the projects, identify the critical issues requiring monitoring and present a monitoring plan. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring programme including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring programme must be provided.

The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring programme including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring programme must be provided.

Presentation- TheEnvironmental Empact 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

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.

ENVIRONMENTAL PROTECTION AGENCY Male', Rep of Maldives

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20th July 2016

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Website: www.epa.gov.mv

بسم الله الرحمن الرحيم

ދިވެހިން ދިވެހިންގެ ގޮތުގައި – މިނިވަންކަމުގައި އަބަދަށް

"Dhivehin" – Always Maldivian, Forever Independent

އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

Environmental Protection Agency

ނަންބަރު: 203-EIARES/438/2015/87

މިނިސްޓަރ އޮފް އެންވަޔަރަމަންޓް އެންޑް އެނަރޖީ އަލްފާޟިލް ތޯރިގް އިބްރާހިމް،

ވެދުން ސަލާމަށްފަހު ދަންނަވަމެވެ.

ކ. ވިލިމާފުށީގެ ހުޅަނގު ފަރާތުގެ ގޮނޑުދޮށް ހިމާޔަތްކުރުމާއި ގުޅޭގޮތުން ހުށަހަޅައިފައިވާ އީ.އައި.އޭ ރިޕޯޓުގެ ނިންމުމުގެ ލިޔުން

ކ. ވިލިމާފުށީގެ ހުޅަނގު ފަރާތުގެ ގޮނޑުދޮށް ހިމާޔަތްކުރުމާއި ގުޅޭގޮތުން ހުށަހަޅައިފައިވާ އެންވަޔަރަމަންޓަލް އިމްޕެކްޓް އެސެސްމަންޓްގެ (އީ.އައި.އޭ) ރިޕޯޓުގެ ރިވިއުކުރުމުން ނިންމުމުގެ ލިޔުމާއި ހުށަހެޅުއްވި ރިޕޯޓް މި ސިޓީއާއެކު ފޮނުވީމެވެ.

އަދި ދަންނަވަމެވެ. މި މަޝްރޫޢުގެ މަސައްކަތް ފެއްޓުމުގެ ކުރިން، ފެއްޓޭ ތާރީޚް މި އެޖެންސީއަށް ލިޔުމުން އަންގަވައިދެއްވުން އެދެމެވެ.

ރިޕޯޓުގައި ހުށަހަޅާފައިވާ މަޝްރޫޢު ބަދަލުވެ ރިޕޯޓް ހުށަހެޅުމުގެ ގަވާއިދުގެ 2 ވަނަ އިސްލާހުގެ 14 ވަނަ މާއްދާގެ (ރ) ވާގޮތުގެ މަތިން ޕްރޮޖެކްޓުގެ ނިންމުމުގެ ލިޔުން ދޫކުރި ތާރީޚުން ފެށިގެން 1 (އެކެއް) އަހަރުދުވަހުގެ ތެރޭގައި މަސައްކަތް ނުފަށައި އަދި މުއްދަތު އިތުރު ނުކޮށްދިނަމަ ޕްރޮޖެކްޓުގެ ނިންމުމުގެ ލިޔުން ބާޠިލުވާނެއެވެ. އަދި ނިންމުމުގެ ލިޔުމުގެ މުއްދަތު އިތުރުކުރުމަށް އެދެވޭނީ މި މާއްދާގެ (ބ)ގައި ބަޔާންކޮށްފައިވާ ގޮތުގެ މަތިންނެވެ.

އިޖުރާއާތު ފުރިހަމަ ކުރެއްވުން އެދެމެވެ.

16 ޛުލްޙިއްޖާ 1436

30 ސެޕްޓެމްބަރ 2015

ޚާދިމުކުމް

ޢަބްދުﷲ މަޖީދު

ޑިރެކްޓަރ އެންވަޔަރަންމަންޓް އެސެސްމަންޓް

މިނިސްޓްރީ އޮފް އެންވަޔަރަމަންޓް އެންޑް އެނަރޖީ،

މާލެ، ދިވެހިރާއްޖެ

ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓު ގަބޫލުކުރުން

ދޫކުރި ތާރީޚް: 30 ސެޕްޓެމްބަރ 2015

ތިމާވެރިޔާގެ ބޯޑުން ނިންމުމުގެ ލިޔުން ދޫކުރި ވިލިމާލޭގެ ހުޅަނގު ފަރާތުގެ ގޮނޑުދޮށް ހިމާޔަތްކުރުމުގެ މަޝްރޫޢުގެ މަސައްކަތްކުރުމާއި ގުޅޭ ގޮތުން ތައްޔާރުކޮށް 14 ސެޕްޓެމްބަރ 2015 ގައި މުރާޖަޢާކުރުމަށް ހުށަހަޅުއްވާފައިވާ ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓާއި ބެހޭގޮތުން ނިންމިގޮތް އެންގުމަކީ މިއެވެ.

1. ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓު ހެދުމާއިބެހޭ ގަވާއިދު 2012 ގެ ދަށުން (މި ލިޔުމުގައި މީގެ ފަހުން މިނިސްޓްރީ ކަމަށް ބަޔާން ކޮށްފައިވާ) މިގަވާއިދުގެ ތަންފީޒީ އިދާރާ، އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީގެ ފަރާތުން މި ތިމާވެރިޔާގެ ބޯޑުން ނިންމުމުގެ ލިޔުން ދެއްވިގެން މަތީގައި ބަޔާންކޮށްފައިވާ ތަފްސީލާއި މަޝްރޫޢު ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓުގައި ބަޔާންކޮށްފައިވާ ގޮތަށް ކުރިއަށް ގެންދިއުމުގެ ހުއްދަ ދީފީމެވެ.

2. މި ހުއްދަ މިނިސްޓްރީން ދޫކުރައްވަނީ ތިރީގައި މިވާ ޝަރުތުތަކުގެ މަތިންނެވެ:

I. ތިމާވެރިޔާގެ ނިންމުމުގެ ލިޔުން ދޫކުރި ތާރީޚުން ފެށިގެން 1 (އެކެއް) އަހަރުދުވަހުގެ ތެރޭގައި މަސައްކަތް ނުފަށައި އަދި މުއްދަތު އިތުރު ނުކޮށްފިނަމަ ތިމާވެރިޔާގެ ނިންމުމުގެ ލިޔުން ބާޠިލުވާނެއެވެ.

II. ތިރީގައި މިބަޔާންކުރާފަދަ ކަމެއް ދިމާވެއްޖެނަމަ، މިނިސްޓްރީއަށް ނުވަތަ އެޖެންސީއަށް ކުރާފަދަ ކަމެއްކަން، ހިނގަމުންދާ މަސައްކަތުގެ މަޝްރޫޢު ކުރިއަށް ގެންދާ ބަދަލުތައް އަދި މަސައްކަތް ފަށައިގަތުމުން އެންގުމަކީ ހުށަހަޅަންވާނެއެވެ.

ހ. މި ތިމާވެރިޔާގެ ބޯޑުން ނިންމުމުގެ ލިޔުން ބާޠިލުކުރުން ނުވަތަ

ށ. މި ތިމާވެރިޔާގެ ބޯޑުން ނިންމުމުގެ ލިޔުމުގެ ޝަރުތުތަކަށް ޒިޔާދަކުރުން

III. މަޝްރޫޢު ހިންގުމުގައި ގެނެވެންހުރި، ތިމާވެށީގެ ބަދަލުތަކާއި ގުޅިގެން ކުރަންޖެހޭ މަސައްކަތްތައް ކުރިއަށް ގެންދިއުމަކީ މަސައްކަތް ކުރުން ގެންދިއުމަށް އެދިއެވޭ ޖަވާބުދާރީވާނެއެވެ.

IV. މި ތިމާވެރިޔާގެ ބޯޑުން ނިންމުމުގެ ލިޔުމުގެ VII ވަނަ ޖަދުވަލުގައިވާ ފޯމާއި އެއްގޮތަށް ބަދަލުތައް ދަންނަވާ ރިޕޯޓު އެރުވުމަކީ ހުށަހަޅަން ވާނެއެވެ.

V. ދިވެހިރާއްޖޭގެ ތިމާވެށި ރައްކާތެރިކުރުމާއި ދެމެހެއްޓުމުގެ ޤާނޫނު (ނަންބަރު 4/93) އާއި ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަލައިދެނެގަތުމާ ގުޅޭ ހަދާފައިވާ ގަވާއިދު 2012 ގެ ދަށުން ރާއްޖޭގެ ތިމާވެށްޓަށް އަނބުރާ އިޢާދަ ނުކުރެވޭ ފަދަ ބަދަލެއް އަތުވެދާނެ ކަމެއް ކުރިން ބަޔާންކޮށްފައި ކުރިއަށްގެންދާ މަސައްކަތްތަކުގެ ބަދަލެއް ދިނުމަށް ނުވަތަ މަސައްކަތް ހުއްޓާލާ މަޝްރޫޢު ކުރިއަށް ގެންދިއުމަށް ދޫކޮށްފައިވާ ހުއްދަ ބާޠިލުކުރުމުގެ ބާރު އިދާރާއަށް އޮންނާނެއެވެ.

VI. ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބެލުމުގެ ރިޕޯޓުގައި ހިމެނިފައިވާ ފިޔަވަޅުގައި ނުވަތަ މަޝްރޫޢު ހިންގުމަށް ފިޔަވަޅުގައި ތިމާވެށްޓަށް ކުރާނެ އަސަރުތައް ކުޑަކުރުމަށް އަޅަންޖެހޭ ފިޔަވަޅުތައް ހިމެނޭގޮތަށް ބަލައިދެނެގަތުމުގެ ރިޕޯޓުގައި ބަޔާންކޮށްފައިވާ ގޮތަށް އަޅަންވާނެއެވެ.

VII. ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަލައިދެނެގަތުމުގެ ރިޕޯޓުގައި ފޯރަމް އެންސަރޝިޕް ބަދަލުކޮށް ދޫކުރެވިފައިވާ ހުއްދައިގައި ބަޔާންކުރާ ކަންތައްތަކާ ޚިލާފަށް، ފޯރަމް އެންސަރޝިޕް ބަދަލުކޮށް ދޫކުރެވޭ ހުއްދަ، ރިޕޯޓުގައި ބަޔާންކުރެވިފައިވާ ގޮތުގެ މަތިން މި އޭޖެންސީއަށް ހުށަހަޅަންވާނެއެވެ.

VIII. މި ފޯމްގައި ދެންނެވިފައިވާ ދިރާސާގައި މުއްދަތު ހަމަވާ ތާރީޚް ކުރިން ބަލައިދެނެގަތުމުގެ މުޤައްރަރު ތާރީޚުގެ ކުރިން މަސައްކަތް ފެށުމަށް ދޭ މުހުލަތެވެ.

އެންވަޔަރަމަންޓް ޕްރޮޓެކްޝަން އޭޖެންސީގެ ފަރާތުން މި ލިޔުމަށް ހުއްދަ ދިނީ:

ނަން: ޢަޖީދު އަޙުމަދު

ހުއްދަދިން ސިޓީ ނަންބަރު: 203-EIARES/438/2015/87

މަޤާމު: ޑިރެކްޓަރ، އެންވަޔަރަމަންޓަލް އެސެސްމަންޓް

ދޫކުރި ތާރީޚް: 30 ސެޕްޓެމްބަރ 2015

ސޮއި:

މުއްދަތު ހަމަވާ ތާރީޚް: 30 ސެޕްޓެމްބަރ 2016