ENVIRONMENTAL IMPACT ASSESSMENT

Proposed 1394 Social Housing Units Development Project in Hulhumale’ Phase II

Proponent:
Housing Development Corporation (HDC)

Consultant:
Amir Musthafa (EIA01/13)
Nafha Aujaaz (T02/16)

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# Table of Contents

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>II</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>V</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>VI</td>
</tr>
<tr>
<td>CONSULTANTS DECLARATION</td>
<td>VII</td>
</tr>
<tr>
<td>PROONENTS DECLARATION</td>
<td>VIII</td>
</tr>
<tr>
<td>NON TECHNICAL SUMMARY</td>
<td>X</td>
</tr>
</tbody>
</table>

## 1. INTRODUCTION

1.1 BACKGROUND ............................................. 1  
1.2 AIMS AND OBJECTIVES OF THE EIA .......................... 1  
1.3 METHODOLOGIES ........................................... 2  
1.4 METHODS OF DATA COLLECTION ............................ 2  
1.4.1 GROUNDWATER QUALITY ................................ 3  
1.4.2 NOISE POLLUTION ....................................... 3  
1.4.3 STAKEHOLDER CONSULTATIONS ........................... 3  
1.4.4 BUILT ENVIRONMENT ................................... 4  
1.5 LITERATURE REVIEW ....................................... 4  
1.6 THE PROONENT .............................................. 5  
1.7 THE PROJECT LOCATION .................................... 6  
1.8 NEED AND JUSTIFICATION .................................. 8  

## 3. PROJECT DESCRIPTION

3.1 SITE SETUP ............................................... 12  
3.2 EXCAVATION AND DEWATERING ............................ 13  
3.3 FOUNDATION CONSTRUCTION .............................. 14  
3.4 CONSTRUCTION MATERIALS AND MACHINERY .......... 15  
3.5 ELECTRICITY ............................................. 15  
3.6 WATER AND SEWERAGE .................................... 16  
3.7 PROJECT MANAGEMENT ..................................... 17  
3.8 WASTE MANAGEMENT ....................................... 17  
3.9 WORK SCHEDULE .......................................... 18  
3.10 SAFETY ON SITE .......................................... 18  
3.10.1 FIRE PREVENTION ...................................... 19  
3.10.2 HOT WORKS ........................................... 20
3.10.3 LIFTING WORKS ...........................................................................................................21
3.10.4 ELECTRICITY .............................................................................................................23
3.10.5 SCAFFOLDING ...........................................................................................................23
3.10.6 OPERATING MACHINERY OR EQUIPMENT ..............................................................26
3.10.7 INSPECTION TOURS ..................................................................................................26
3.10.8 OVERALL SITE MAINTENANCE ................................................................................27
3.10.9 OVERALL SITE MANAGEMENT PROCEDURES .........................................................28
3.10.10 ENSURING COMPLIANCE TO HEALTH AND SAFETY STANDARDS ....................28
3.11 ACCIDENT AND HAZARD SCENARIOS ........................................................................29
3.12 PROJECT INPUTS AND OUTPUTS ..................................................................................32

4 DESCRIPTION OF THE EXISTING ENVIRONMENT ..............................................................38
4.1 CLIMATE ........................................................................................................................38
4.1.1 WIND ..........................................................................................................................39
4.1.2 WAVES .......................................................................................................................41
4.1.3 RAINFALL ....................................................................................................................41
4.2 EXISTING STRUCTURES ..................................................................................................42
4.3 VEGETATION ...................................................................................................................42
4.4 TRAFFIC SURVEY ...........................................................................................................42
4.5 NOISE POLLUTION .........................................................................................................43
4.6 WATER QUALITY ...........................................................................................................43
4.7 SOCIO – ECONOMIC ENVIRONMENT ............................................................................44
4.7.1 POPULATION .............................................................................................................44
4.7.2 TRANSPORT ..............................................................................................................44
4.7.3 EDUCATION ...............................................................................................................45
4.7.4 HEALTH ......................................................................................................................45
4.7.5 UTILITIES ..................................................................................................................46
4.7.6 TOURISM ....................................................................................................................46
4.8 HAZARD VULNERABILITY ..............................................................................................46

5 LEGISLATIVE AND REGULATORY CONSIDERATIONS .......................................................49
5.1 ENVIRONMENTAL PROTECTION AND PRESERVATION ACT (LAW NO. 4/93) ................49
5.2 REGULATION ON AGGREGATE AND SAND MINING .....................................................50
5.3 EIA REGULATIONS .........................................................................................................50
5.4 MALDIVES NATIONAL BUILDING ACT .........................................................................52
5.5 MALDIVES NATIONAL BUILDING CODE 2008 DRAFT ..................................................53
5.6 ENVIRONMENTAL GUIDELINES FOR CONCRETE BATCHING PLANTS 2014 ..................53
5.7 WASTE MANAGEMENT REGULATION, 2013 .................................................................54
5.8 DEWATERING REGULATION, 2013 ..............................................................................56
5.9 MANAGEMENT, USE AND CONTROL OF HCFC SUBSTANCES REGULATION, 2010 ......56
5.10 MALDIVIAN LAND ACT, 2002 ....................................................................................57
5.11 LAND USE PLAN AND IMPLEMENTATION REGULATION ..........................................57
5.12 CONDOMINIUM LAW 2006 .........................................................................................58
5.13 PERMITS REQUIRED FOR THE PROJECT .....................................................................58
5.13.1 DESIGN APPROVAL ...................................................................................................58
5.13.2 DEWATERING PERMIT .............................................................................................58
6 IDENTIFICATION OF IMPACTS & SIGNIFICANCE ................................................................. 60

6.1 IDENTIFICATION OF IMPACTS AND THEIR SIGNIFICANCE ........................................ 60

6.2 DESCRIPTION OF IMPACTS ......................................................................................... 62

6.2.1 LOSS OF VISUAL AMENITY DURING DEMOLITION AND CONSTRUCTION .................. 62

6.2.2 LOSS OF VEGETATION AND IMPACT ON TERRESTRIAL HABITATS ............................ 62

6.2.3 GROUNDWATER DEGRADATION ............................................................................. 62

6.2.4 SEA WATER DEGRADATION .................................................................................. 62

6.2.5 MOSQUITO GROWTH ............................................................................................ 63

6.2.6 NOISE POLLUTION ............................................................................................... 63

6.2.7 AIR POLLUTION .................................................................................................... 64

6.2.8 LEAD BASED PAINTS ............................................................................................. 64

6.2.9 GENERATION OF BUILDING AND CONSTRUCTION WASTE ................................. 64

6.2.10 HEALTH AND SAFETY OF WORKERS ................................................................ 65

6.2.11 SOCIAL ISSUES DUE TO POPULATION CONCENTRATION ..................................... 65

6.2.12 ALLEVIATING CONGESTION ISSUES IN MALE’ ..................................................... 65

6.2.13 FIRE HAZARDS AND IMPACTS ............................................................................ 66

6.3 IMPACT SIGNIFICANCE ASSESSMENT ...................................................................... 66

6.4 UNCERTAINTIES IN IMPACT PREDICTION ................................................................. 72

7 ENVIRONMENTAL MANAGEMENT AND MITIGATION MEASURES ................................. 73

7.1 MOSQUITO GROWTH .................................................................................................. 73

7.2 WATER QUALITY DEGRADATION ............................................................................. 73

7.3 NOISE POLLUTION .................................................................................................... 74

7.4 AIR POLLUTION ......................................................................................................... 74

7.5 LEAD BASED PAINTS .................................................................................................. 74

7.6 GENERATION OF BUILDING AND CONSTRUCTION WASTE ...................................... 74

7.7 HEALTH AND SAFETY OF WORKERS AND NEIGHBOURS .................................... 75

7.8 FIRE HAZARDS AND RISKS ..................................................................................... 75

7.9 SOCIAL ISSUES DUE TO POPULATION CONCENTRATION ....................................... 76

7.10 WASTE MANAGEMENT ............................................................................................ 76

8 ALTERNATIVES .............................................................................................................. 81

8.1 NO PROJECT OPTION .................................................................................................. 81

8.2 PROJECT ALTERNATIVES ............................................................................................ 82

8.2.1 PROJECT LOCATION .............................................................................................. 83

8.2.2 BUILDING HEIGHT .................................................................................................. 83

8.2.3 PROJECT DESIGN .................................................................................................... 83

8.2.4 BUILDING MAINTENANCE ...................................................................................... 84

8.2.5 FOUNDATION ......................................................................................................... 84

8.2.6 DEWATERING ......................................................................................................... 85

8.2.7 PARKING ................................................................................................................ 85

8.2.8 ADDITIONAL AMENITIES ....................................................................................... 86
9 STAKEHOLDER CONSULTATIONS
9.1 Consultations with the Developer
9.2 State Electric Company (STELCO)
9.3 Male’ Water and Sewerage Company (MWSC)
9.4 Health Protection Agency (HPA)
9.5 Waste Management Corporation Ltd. (WAMCO)
9.6 Maldives National Defence Force (MNDF)
9.7 Maldives Energy Authority (MEA)

10 ENVIRONMENTAL MONITORING
10.1 Monitoring Methodology and Costs
10.2 Recommended Monitoring Programme
10.3 Cost of Monitoring
10.4 Monitoring Report

11 CONCLUSION

12 ACKNOWLEDGEMENT

13 REFERENCES

ANNEX 1 – TERMS OF REFERENCE

ANNEX 2 – APPROVED CONCEPT DRAWINGS

ANNEX 3 – WATER TEST RESULTS

ANNEX 4 – PROJECT WORK SCHEDULE

ANNEX 5 – PROONENTS COMMITMENT FOR MONITORING AND MITIGATION

ANNEX 6 – EIA PARTICIPANTS

List of Figures

Figure 1 Location of proposed site in Hulhumale’ ................................................................. 6
Figure 2 Location of 1349 housing units in Hulhumale’ Phase II ........................................... 7
Figure 3 Impact Area and Study area for the project including the water and noise survey regions. 8
Figure 4 Percentage of people living in Male with respect to total population .......................... 10
Figure 5 Land Use Plan for Hulhumale’ Phase 2 .................................................................... 13
Figure 6 Dewatering methodology schematic ......................................................................... 14
Figure 7 Some safety signboards to be used on site ...................................................... 19
Figure 8 Wind rose diagram from Hulhule’ weather station for 2016 (MMS, 2016) .................. 40
Figure 9 Annual Seasonal rainfall variation in Hulhule’ .................................................... 42
Figure 10 Disaster risk profile of the Maldives (UNDP, 2006) ........................................... 48
Figure 11 Indicative image for recyclables and non recyclables (source: http://www.huonvalley.tas.gov.au/services/waste-2/) ............................................................... 77

List of Tables

Table 1 Accident and Hazard Risks ........................................................................... 29
Table 2 Main material input for the proposed project .................................................. 32
Table 3 Manpower input for the project .................................................................... 33
Table 4 Other inputs from the proposed project ........................................................ 34
Table 5 Major outputs from the proposed project ....................................................... 36
Table 6 Four Seasons of the Maldives ..................................................................... 39
Table 7 Groundwater quality ....................................................................................... 43
Table 8 Impact Evaluation Criteria ........................................................................... 68
Table 9 Analysis of potential impacts and their significance ...................................... 69
Table 10 Mitigation management plan summary ....................................................... 78
Table 11 Advantages and Disadvantages of the no project option .............................. 81
Table 12 Important stakeholders met during the consultation process ....................... 87
Table 13 Estimated costs of Stage 1 Monitoring Programme .................................. 97
Table 14 Estimated costs of Stage 2 Monitoring Programme .................................... 97
Consultants Declaration

This EIA 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.

Amir Musthafa (EIA 01/13)

4th December 2017
Proponents Declaration

(Attached in the following page)
Letter No.: HDC (161)-PM/203/2017/27

04 December 2017

Ibrahim Naeem
Director General
Environmental Protection Agency,
Ministry of Environment and Energy,
Male',
Republic of Maldives

Dear Sir,

PROJECT: HULHUMALÉ PHASE 2, 1394 SOCIAL HOUSING UNITS PROJECT - 2017
SUBJECT: PROPOUNENTS DECLARATION

As the proponent of the project, we guarantee that we have read this EIA report and to the best of our knowledge, all non-technical information provided here are accurate and complete. We are aware that this report has been prepared in accordance with the EIA regulations.

Thank You.

Yours faithfully,

Nawaz Shaugee.
Director
Non Technical Summary

This report is based on the proposed 1394 social housing units proposed for Hulhumale’ Phase II. Twelve buildings in total will be built as part of the project, each 14 storeys high. The project is being developed by Housing Development Corporation (HDC), and constructed by 23rd Metallurgical Construction Group Co. Ltd., which will oversee the development and project management including managing the EIA process.

An Environmental Impact Assessment was necessary for the works due to the large scale of the project with high rise buildings. In addition to meeting the regulatory requirements, the report would further assist the proponent and important stakeholders to make decisions based on favourable environmental conditions with the main focus on sustainability. The project also adheres to several other rules and regulations in the Maldives and has obtained permit from HDC to proceed. HDC is a 100% government entity, which also has the responsibility to set guidelines and oversee all developments in Hulhumale’.

The project is part of larger program by HDC to establish 15,000 social housing units in Hulhumale’. Therefore, other similar EIAs have been done recently, most notably for the 7000 housing units project and 2500 housing unit project. Apartments in these buildings can generally be regarded as being targeted towards lower class members of the community, who cannot afford commercial housings. The project will contribute to the grand plan by the government of reducing congestion in Male’ by providing a large number of housing opportunities in Hulhumale’. By 2019, it is projected that 15,000 such housing units will be built in Hulhumale’, which would accommodate approximately 80,000 people.

Similar to the other building EIA’s in Phase II, the existing environment at the project site does not consist of any significant vegetation and the water test result shows normal water quality. There are no residents living in Phase II yet and there is no other structure at the site as well. However, there are other similar developments previously stated projects. Other development in the land include shore protection and road construction, which is currently ongoing.

During the construction stage, health and safety standards of the workers at site, and waste generation is the major areas of concern as is the case for similar developments. With proper planning and project management, this can be easily mitigated. Impacts on water quality due
to dewatering as identified can be mitigated by dewatering inland. Waste is the main concern during the operational stage of the project, in addition to social issues. Since this will be developed as a condominium with multiple tenants owning the rights of the building, it has to be ensured that the tenants are held responsible to properly maintain the building. Impacts that may occur due to conflicts with other developments being undertaken simultaneously can be mitigated with proper communication and planning before project implementation. Long term social issues are envisaged due to a large population living in a concentrated area. Several social and legislative mitigation measures are proposed to counter this, including greater policing activities, larger public spaces, etc. Also concerns regarding fire safety exists. Proper fire safety measures are very important to be established as well as additional features such as sprinkler systems in each floor. In addition to fire safety, other impacts due to fuel storage at site and use and storage of chemicals are cause for concern. These can be mitigated by following the fuel and chemical storage standards and best practice methods.

Regarding alternatives, there are no viable alternatives available for the project with respect to location, as the most suitable location had been predetermined during the planning stage. The no project option is also not plausible at this stage and possibilities are outside the scope of this study. Other alternatives including material, foundation type, construction methodology are not necessarily recommended. Recommendations had been made to proceed with the project as planned. It is recommended to dewater inland to an empty land close to the project site after excavating the area to ensure that water is contained in the allocated area, and will not have any negative impact on the groundwater aquifer.

An environmental monitoring plan is proposed to be carried out with 2 phases; one for the construction stage, and one for 2 years post construction. Factors to investigate include surveying the amount of waste generation, noise pollution, traffic flow, health and safety at site and water quality.

The project in general has minimum impact as it is being undertaken in newly developing land, similar to the other current developments in the area. All project specific building related impacts highlighted in the study, including those related for fire risks, health and safety, and fuel and chemical storage and use can be mitigated. The socio-economic benefits to Greater Male’ City from projects such as these is very high. The project would go a long way in providing much needed additional housing opportunities, which would contribute to
alleviating the housing issues in Male’ City, and therefore mitigating the issues related to congestion. Thus, after consideration of all these perspectives, it is recommended that this project proceed as planned, after incorporating the mitigation measures given in this study with the commitment to implementing the monitoring plan given.

Furthermore, proper planning and stronger legislation is required to ensure sustainability of such projects and to ensure maximum benefits are reaped from them. Building maintenance legislation needs to be strengthened to ensure such projects provide the maximum benefits to the community with minimum risks over a long period.
EIA for the proposed 1394 social housing units development project in Hulhumale’ Phase II

Proponent: Housing Development Corporation
EIA for the proposed 1394 social housing units development project in Hulhumale' Phase II

Proponent: Housing Development Corporation
EIA for the proposed 1394 social housing units development project in Hulhumale’ Phase II

Proponent: Housing Development Corporation
1. Introduction

2.1 1.1 Background

This Environmental Impact Assessment (EIA) report has been prepared in order to meet the requirements of Clause 5 of the Environmental Protection and Preservation Act of the Maldives to assess the impacts of the proposed 1394 housing units in Hulhumale’ Phase II.

The report will look at the justifications for undertaking the proposed project components and it will identify and determine the significance of the potential impacts of the proposed works. Alternatives to proposed components or activities in terms of location, design and environmental considerations would be suggested along with measures to mitigate any negative impact on the environment. Environmental monitoring programme is vital in order to demonstrate the long-term sustainability of the proposed project as well as to undertake mitigation measures before any impact leads to long-term significant effects. Long term monitoring helps to understand uncertainties in impact analysis improving future impact predictions and project implementation. Therefore, a building monitoring and management plan would be suggested.

The major findings of this report are based on qualitative and quantitative assessments undertaken during site visits in November 2017. Available long-term data were collected from available sources, such as long-term data on meteorology and climate from local and global databases. Long-term data on the project site is lacking. However, to compensate for this, data collected recently in Hulhumale’ for similar projects will be used.

1.2 Aims and Objectives of the EIA

This report addresses the environmental concerns of the building construction works and also those that will occur during the operational stage of the development. The report attempts to achieve the following objectives.

- Describe the project components to the relevant authorities and to the public
- Allow better project planning and decision-making based on the sustainable development.
• Identify environmental impacts that will occur and gauge their significance for such a project undertaken in the particular location.

• Mitigating impacts caused due to the works outlined in the project

• Promote informed and environmentally sound decision making

• To demonstrate the commitment by the proponent on the importance of environmental protection and preservation.

1.3 Methodologies

This EIA has been prepared by Amir Musthafa, a registered permanent EIA consultant with years of experience in Environmental Impact Assessment in the Maldives and has been actively involved in numerous coastal protection projects and building construction projects in the country. The consultant was assisted by the developer’s staff throughout the project, most notably for water sample collection from the site.

Internationally recognized and accepted methods have been used in this environmental evaluation and assessment. This EIA is based mainly on data collected during field investigation missions in November 2017. The data collection methods are described in detail under the following Section.

1.4 Methods of data collection

Conditions of the existing environment of the study area were analysed by using various surveying techniques and scientific methods. Field surveys were carried out to get a further understanding of the existing conditions at the project location, and were carried out during to collect baseline data.

The following investigations were carried out on site:

• Groundwater quality parameters

• Existing noise levels on site

• Soil conditions at site

• Socio-economic conditions in the area
Due to the nature of the project and the proposed site for the works, there isn’t much baseline environmental conditions to be analyzed at the site. More important aspect of the project is the potential changes the relatively virgin environment will undergo during the lifetime of the project and beyond. As the area does not include any structures or vegetation of notes, vegetation and structural surveys were not required.

### 1.4.1 Groundwater quality

Groundwater quality was measured at the project location. Groundwater was collected by dipping into groundwater wells using 1500ml glass bottles. The containers were filled and taken for testing at the MWSC laboratory within 6 hours for sampling.

### 1.4.2 Noise Pollution

Noise pollution at the project area was measured using a handheld noise measurement device using ‘Science Journal’ software. Noise measurements were undertaken for 60 seconds at the locations shown under Existing Environment section.

### 1.4.3 Stakeholder consultations

Stakeholder consultations was initially carried out in the EIA scoping meeting. The EIA scoping meeting gave the opportunity to consult with the Environmental Protection Agency, STELCO, project contractor 23rd MCC and developer Housing Development Corporation (HDC) in one sitting. Additionally, consultation with the Maldives National Defence Force, MWSC, and HPA, were carried out before this particular study was commenced. As required by the approved TOR, consultation was also undertaken with Maldives Energy Authority. General concerns of these parties with respect to similar projects were discussed. It was also agreed that project specific information will be shared with these agencies for each project to determine if they have any specific concerns with respect to this project and as such information was given and clarified if there were any specific concerns related to this project.
1.4.4 Built Environment

An overview of the built environment around the project site was undertaken by visual inspection with the aid of site and drone photography. A structural defect inspection study is not necessary as the proposed site is bare land and there are no structures in the vicinity.

Once the EIA has been submitted, it is expected that the review process will not take more than 2-3 weeks. The review process may result in the request for additional information before issuing a Decision Statement. However, all efforts have been made to ensure that adequate information has been provided with specific attention paid to meet all requirements of the Terms of Reference (TOR). The TOR for this EIA is given in Annex 1.

1.5 Literature Review

As there have been several multi-storey building projects undertaken in Male’ City, and especially in Hulhumale’ recently by various consultants, several of them were studied. These include the following:

- EIA for Hulhumale’ mixed use residence, 2015 (Zuhair 2015)
- EIA for the proposed 10-storey building in Plot No. D6-2C, Hulhumale’ – Renaatus Ithaamuuiy (Musthafa 2016)
- EIA for the proposed mixed residential building development at Hulhumale’ – Rainbow Oceanfront (Musthafa 2016)
- EIA for the proposed luxury apartment complex at Hulhumale’ – Sandhura Residencies (Musthafa 2017)
- EIA for the proposed mixed residential building development at Hulhumale’, Plot No. D1 – 1 (Musthafa 2017)
- EIA for the proposed 7000 housing units development project in Hulhumale’ Phase II (CDE 2016)
- EIA for the proposed 2500 housing unit development project in Hulhumale’ Phase II (Musthafa 2017)
From among these, the EIA for the 7000 and 2500 housing unit projects were most relevant to this study as they were also proposed to be undertaken in Hulhumale’ Phase II land, and was regarding social housing. The main difference between the proposed project and 7000 units project is with respect to building height. While the proposed buildings are all 14 storeys high, the 7000 housing unit project includes buildings of 25 storeys high.

The 7000 housing unit project consist of 16 buildings over 7 plots. Each building will have 25-storeys and the total area allocated for the project is 35,604 sqm. Out of the 16 buildings, 10 buildings will have 16 apartments on every floor and the remaining 6 buildings will have 20 apartments on every floor. A total of 7,000 residential units will be developed. Each building will consist of two bedroom apartments units, parking space and waste collection point in the ground floor. The target population is estimated between 21,000 to 28,000 persons at 3 to 4 persons per apartment.

Not much significant impact was noted for the construction stage of either the 7000 and 2500 housing units as significant receptors are non existent in the virtually vacant land. Much negative impacts were not declared for the operational stage either apart from demand for additional parking space, impact on traffic flow and exerting pressure on existing utilities and facilities in Hulhumale’. The main positive impact identified includes the project providing greater housing opportunities for the population living in Greater Male’ area.

As a mitigation, fire prevention had been emphasised, while it was recommended to setup a community police establishment in the area. No alternatives to the proposed project were recommended, while an environmental management framework was given.

1.6 The Proponent

The project is being proposed by Housing Development Corporation (HDC). HDC is a 100% state owned enterprise formed by a presidential decree, initially established in 2001 to oversee the development of Hulhumale’. HDC functions as the master developer of Hulhumale’ island. HDC had been involved in other housing development projects in other islands as well, although its responsibilities are not as far reaching in other islands.

The project design consultant and contractor is Chinese group, 23rd Metallurgical Construction Group Co. Ltd. (23rd MCC)
1.7 The Project Location

The project is based in Hulhumale’ in the newly reclaimed Phase II. The project area is located on the central eastern area of Phase II. Location coordinates are at around 4°13’28.58”N, 73°32’31.38”E

Hulhumale’ Phase II is bare land as of yet, with several building construction projects proposed. The only infrastructure project completed is the revetment works as protection to the shoreline against erosion. Road works are also ongoing. There are no residents living in Phase II yet. However, HDC office and few construction staff, including a team from the Maldives China Friendship Bridge project is based in Phase II, away from the proposed project area.

There are other similar developments proposed in the neighbourhood. Most notably, the 7000 housing units proposed in 25 storey structures.

The precise location is illustrated in the following images.

Figure 1 Location of proposed site in Hulhumaale’
Figure 2 Location of 1349 housing units in Hulhumale' Phase II
1.8 Need and Justification

The main justification for the project is the alleviation of the poor congested living conditions in Male’ through these projects.

Hulhumale’ has been regarded as the main residential area in the Greater Male’ region’s future and as such all upcoming housing projects are being proposed to be developed in Hulhumale’.

Figure 3 Impact Area and Study area for the project including the water and noise survey regions.
Hulhumale’ is currently a hub for development and is very much intended to play an integral role to drive the housing industry forward. There are additional housing projects being proposed, while a yacht marina, IT city, tourism zones, and others are also within the plan. All these developments are believed to generate several employment opportunities and therefore will attract additional migration to the area. Furthermore, it is widely anticipated a large influx of people will migrate towards Hulhumale’ once the China Maldives Friendship Bridge between Hulhumale’ and Male’ finishes construction in 2018.

With the development of Hulhumale’ Phase 2 a large number of residential buildings have been proposed for this area. The completion of these buildings would greatly alleviate the housing issues in the region, and also provide a much needed relief to the congestion in Male’. The need for such a relief has never been greater, as the living conditions in Male’ have deteriorated with each passing year.

The population in Male’ has steadily increased with respect to the total population in the Maldives. In 1985, data shows about ¼ of the total population was residing in Male’, which increased to 1/3 of the total population according to 2006 census. Moreover, this includes a large percentage of immigrants living in the capital city. The percentage of people living in Male’ area compared to the rest of the country is illustrated in the following graph. The data has been provided up to 2006. However, the trend has continued up to the present year.
In 2006 there were 14,107 households in Male’ compared to just 9,700 in 2000. The average household size was 7.4 persons per household. The increase in number of households over the 6 year period is regarded as a result of subdivision of housing plots and families sharing a single housing unit.

It has been common for a 2-3 bedroom houses in Male’ to have 15 to 20 people. The proportion of people living in houses with 40 square feet or few of housing area per person has increased from 17 to 22 and percentage of houses without compounds has decreased from 52 to 39 percent. Large households combined with relatively small size of houses create morbid living conditions, with people often sleeping in shifts. It is common to find whole families living in single rooms, which doubles as kitchen and living room. Such living conditions place great strain on families, sometimes leading to social issues including break up of families, above average drug usage among the youth, behavioural problems in children and young adults, etc. (Faisal, n/a)

In order to alleviate the issues, a major housing scheme was underway for the past 2 years titled ‘Gedhoruverikurun’, to provide housing opportunities to residents in Male’. As it is a social housing scheme, the target recipients of the scheme are those that are in need of government
subsidised housing. Other bigger housing opportunities such as purchasing own land plots, row houses, luxury condominiums have been quite expensive, and the price is projected to escalate with each passing year.

Developments such as proposed 1394 housing units provides these opportunities to the working class. Therefore, the developments are intended to alleviate the housing issues and the many other indirect consequences of it as state above for Maldivians living in Male’ City.
3 Project Description

The project is part of the government scheme for providing affordable housing units to the residents living in Greater Male’ area.

Twelve buildings in total will be built as part of the project, each 14 storeys high. The housing units will be all 2 room apartments with attached toilets. Each unit will be 550 sqft. The project is proposed to take place in Hulhumale’ Phase 2 in the area designated for Social housing development, towards the channel separating Phase 1 and Phase 2.

Ground and First floor will be dedicated for commercial areas. A single motorbike parking will be available for each unit. Each floor shall be accommodated with a designated enclosed area for garbage collection. The terrace area of the buildings is planned to be utilized for rainwater collection to be utilized during the operational stage (after construction and handover) of the development. Actively ongoing projects in Hulhumale’ phase 2, including MOFT 25-Storey Office Complex and the Design and Construction of 7000 Social Housing Units also integrates rainwater collection and utilization feature and the proponent is giving special consideration to integrate it into the currently planned projects in order to optimize the rainwater resource utilization. Details of each building are given in the Annex.

During the operation phase of the project, under the management of HDC, the building shall be maintained according to a maintenance agreement which shall be termed and agreed between HDC and the tenants or concerned body.

Major equipment and machinery will be engaged for the project including tower cranes, batching plants, excavators, bull dozers, dump trucks, loaders, etc.

The entire area from N3-36, N3-37, N3-38, to N3-39 will be a construction site for the full duration of the project, which is scheduled to be 2 years.

The temporary site for the construction will be in Phase 2 as well.
3.1 Site setup

A plot near the project site of the 1394 housing unit development shall be designated for the temporary site setup. Material storage, as well as construction staff accommodation shall be addressed within a demarcated land approved by HDC.

Total area allocated for the site shall be about 15,000 sqm. 4950 sqm will be allocated for batching plant, material stock and other such activities. 9000 sqm will be used for accommodation and office use.

However, a specific location has not yet been decided by HDC for the purpose.

3.2 Excavation and Dewatering

It has been established that the depth of foundation will be over 1.1m below the existing ground level. The estimated depth of water table in the area is 1.50m from ground level., dewatering must be continuous until casting of the foundation. Excavation will be undertaken
with a backhoe excavator. Total excavation quantity is approximately 4,000.00 cbm. Part of this will be used for back filling.

Dewatering is the localized lowering of the ground water table from its natural level, in order to create a dry environment for construction works. This is a critical process for creating the correct working conditions to establish the building substructures. Dewatering will be a continuous process and will be on-going simultaneously while excavation is being undertaken.

The process will be continued throughout until casting of the foundation. It is envisaged that 5 or 6 pumps each with the flow rate of 30 litres per second will be located at specific locations to pump out the water to the sea, north of the site. The dewatering works will be done entirely by the contractor. If the dewatering pipe has to cross any road under any circumstances, a ramp will be placed and this will function as a speed breaker.

Excavation of about 1 – 2 metres would occur, and the sand will be transferred to a site designated by HDC within Phase II. Water will be initially directed towards a catchpit right before the sea, to minimise sedimentation as only the overflow will get deposited in the lagoon. A schematic of the methodology is given below.

![Dewatering methodology schematic](image)

**Figure 6 Dewatering methodology schematic**

### 3.3 Foundation construction

For the foundation works, a raft foundation is expected to be used. This is currently the most commonly adopted method of construction in Maldives. It enables to spread the load from a structure over a large area, minimizing the pressure exerted on the base. Beams will then be incorporated into the structure to strengthen the foundation.
Excavation in loose sand requires continuous support, and therefore supports will be placed immediately as excavation commences. Sheets would be closely spaced and horizontal support bracings provided as excavation progresses. Supports and bracings will be placed concurrently with excavation, moving along the periphery of the plot successively. The concrete works for the raft foundation will be done using C30 Grade concrete.

However, this methodology would lead to excavating a larger and deeper area. This will result in excess sand which will need to be disposed. This will not be a major issue in a vast empty area as Hulhumale’ Phase 2. However, deep excavation would also lead to larger quantity of water to be dewatered.

### 3.4 Construction materials and machinery

The heavy construction materials to be used are

- Excavators
- Concrete Mixers
- Dump Trucks
- Concrete pump
- Cranes
- Tower crane

All the materials such as cement, aggregate and sand will be delivered to site based on consumption. Steel and Plywood will be stored at the temporary site. Barb bending and carpentry work will also be undertaken at the site.

Concrete will be mixed on site using a 1,000 m³/hour batching plant. The batching plant will have a total footprint of approximately 4950 sqm and will be operated daily during construction peak period. The batching plant will be placed at the construction site.

Details of the material and equipment used are provided under Project Input and Outputs. As the proposed project site is very close to the temporary site, delivery of materials will be very convenient and will not obstruct or cause hindrance to any activities.

### 3.5 Electricity
All utilities will be arranged by the contractor on a temporary basis for the construction stage. During the construction stage, it has been reported that the main utility companies, MWSC and STELCO will not be providing their services at the project location.

For electricity, a 400 kW power genset will be established at the site to cater for all power needs. The genset will be housed within a powerhouse with attenuator, chimney and insulated walls. It is anticipated that the site will consume 1200 litres. Therefore, 3 day tanks of 400 litres each will be established. The main fuel storage reservoir is calculated on 60 days of storage. A total of 70,000 litres diesel will therefore be stored at site. Fuel will be stored in steel tanks, while the tanks will be enclosed by a concrete bund with a capacity 110% of the fuel volume. Fuel will be transported to site on oil tanks after receiving fuel from the Phase II jetty area.

Once construction is completed, STELCO services will be operational in Phase II, and the entire 1394 housing unit power requirements will be fulfilled by the STELCO main grid.

### 3.6 Water and sewerage

Usually, temporary lines for water will be connected by HDC for the construction and if the connections are not available at the time of construction, an RO plant set up at the project site shall cater to the water needs during the construction period.

In the case that RO plant set up is required, all necessary components of the plant will be situated at site including RO filter membranes, sand filter, cartridge filter, chlorine dosage, sedimentation tank and water storage tanks along with distribution points. It is envisaged that two RO plants, with the capacity of 200 tons/day shall be installed in such case, with which the overall setup would approximately take up an area of 360 sqm.

The water intake will be from the ground by constructing boreholes 20-30m deep. Boreholes will be constructed using a drilling rig with bentonite. Excess and by products will be buried at the project site above the ground water level. Water outlet will be towards the lagoon on the eastern side facing the project site. The water will be discharged out about 50m away from the shoreline and about 150m inwards from the reef line. Therefore, it will avoid any sensitive area, including live corals.
It is estimated that 400 litre/day will be required per person for common usage, while 400 tons of water will be required at the peak of construction for concreting and other such construction purposes. 450 – 500 ton steel water storage tanks will be setup at the site to cater for this demand.

It is assumed that the main sewer connected by HDC shall be used for the site sewage management.

### 3.7 Project Management

The project is managed by the developer Housing Development Corporation (HDC). Laborers will mostly consist of expatriates from China, who are already established with the contractor for previous construction projects. All labourers will be accommodated at company labour quarters at the allocated temporary site in Phase II. There will be a consulting engineer hired in addition to an in-house site engineer and site supervisor to manage the project.

All operations, work planning for the on-going construction work will be done at Site Office; Major operations will be done at company head office. Heavy machinery such as excavator, dump truck, tower crane, batching plant, cement mixer, concrete pump, and crane will be used during excavation and casting. Most of the machineries are expected to be owned by the contractor while some heavy duty machinery may be rented.

### 3.8 Waste Management

Sand excavated during foundation work will be stockpiled at the site or transferred to a location within Hulhumale’ Phase 2. Upon completion of foundation works, some amount of sand may be reused for back filling. Excess sand can be transported to a stockpile as instructed by HDC, within Phase II land area.

It is estimated that during the construction phase, the project will generate waste around 50 tons per day which will be collected on site, and stockpiled at the site. Organic household type waste will be transported to Hulhumale’ Waste Management Center. The contractor will arrange the transportation of waste outside of Hulhumale’ to Thilafushi on a weekly or fortnightly basis. None of the waste will be placed outside the project boundary at any time. Temporary waste storage will be within the project-demarcated area.
All waste generated during concrete works phase and finishing phase will be collected at the end of each work day and temporarily at the site. Hazardous waste such as empty oil-cans (lube-oil), paint cans or strainers will be kept separate and disposed according to the standards established by relevant government authority. They will also be transported to Thilafushi in separate containers as is the case for all similar projects in Hulhumale’.

For waste generated during operations, an enclosed waste collection area shall be designated in each floor. About 90 sqft area is expected to be dedicated for waste collection and sorting in the ground floor in each building. Waste will be transported to the ground floor waste collection area from all the other floors in covered bins via lift or staircase. The waste will be collected by WAMCO vehicles daily and transported to the waste management site in Hulhumale’, to be eventually transported to Thilafushi.

### 3.9 Work Schedule

The project is expected to take about 2 years to complete. The project is expected to commence soon after the approval of this EIA report, which should take approximately 1 week from submission. Dewatering permit will then be obtained.

Initially the architectural and structural design works had been completed and approved before undertaking the EIA. This is already cleared by HDC. Dewatering is scheduled to commence next, which will be carried out by contractor. Upon completion of dewatering, foundation works will begin and soon thereafter structural works will be carried out. Masonry work and interior works will commence afterwards. The work schedule is given in the Annex.

### 3.10 Safety on site

The contractor has an extensive health and safety plan established and will be strictly adhered to for this project. The safety place strives to fully comply with the domestic and foreign relevant laws, regulations and standard of the industry requirements.

The main objective of the health and safety plan for the project shall be to achieve: Zero Fatalities, Zero Environmental Mishaps, and Zero Fires.

All precautions will be taken for safety of workers during the construction stage. Barricades, warning signs or devices will be placed on the road during casting or road works (connection of water lines and sewer lines) for safety of pedestrians and vehicles.
All workers are given instructions about the health and safety at Site. The Site Engineers and Supervisors will give a brief on daily basis before the work starts to all workers and all proper health and safety precautions will be implemented on site. Safety signs will be used on site, some of which are shown in the following Figure 7.

Personal protective equipment for protection from falling objects, hazardous dust or chemicals, or high working areas will be available for all the workers. Emergency first aid kit will be at site for minor injuries. First aid kit will be provided in the temporary office on the ground floor, after completion of ground and first floor slab where all safety clothing and equipment will be held. All workers and personnel entering the premises will be given hard hats and safety shoes.

Safety measures at site will adhere to Clause F of the draft National Building Code.

![Some safety signboards to be used on site](image)

Figure 7 Some safety signboards to be used on site

### 3.10.1 Fire prevention
Fire prevention steps will be taken when dealing with hot works as stated below. In addition to this, general fire prevention precautions will be setup at the site. These include fire extinguishers being available at the site at all times, training staff on the use of fire safety equipment, availability of fire safe clothing and first aid at site.

Upon completion of the buildings, they will comply to the fire safety requirements of Maldives National Defence Force.

3.10.2 Hot works

Managing hot work is one of the most essential areas of maintaining health and safety during construction. The following types of work consists of hot work.

A. Various welding, cutting and sandblasting work
B. Proofing and lining work
C. Chemical washing and degreasing work
D. Heat-treatment and chemical testing work
E. Flame pipe cutting and asphalt heating work
F. Motorized vehicles access into worksite

Construction team chief will be responsible for hot work control. HSE control group will inspect and supervise the hot work control.

The following standards and guidelines are followed for undertaking hot works.

- Performing hot work which will produce open fire or sparks should apply for hot work permit in advance
- Before work, the worker who conduct hot work should accept hot work safety training and have a good command of hot work safety basics. He should learn how to use firefighting apparatus and make clear the surrounding conditions and evacuation route.
- Provide firefighting apparatus within the scope of hot work area and keep the fire road clean and smooth.
• If there are inflammable and explosive materials around the hot work area, hot work cannot be started until they are cleared away or safety protective measures are taken.

• No hot work is allowed where there is open flame work.

• When doing blasting and hammering work at inflammable gas area, make analysis on the flammable and explosive gas contents. Only afterwards hot work can be started.

• When doing hot work at elevated area, set up spark preventive facility and take reliable protective measures to the inflammable materials, equipment, cables and gas cylinders below. Otherwise, hot work will not be allowed.

• When working at elevated area, work will not be allowed without proofing work simultaneously in the vertical line.

• Workers for welding and arc welding at elevated area should not turn on power source before they reach work place.

• When hot working at elevated area crosswise, appoint full-time people to monitor fire incidents.

• No hot work at elevated area is allowed when wind force is determined to be strong by the construction manager.

3.10.3 Lifting works

Lifting work in another major health and safety hazard concerning type of work.

It is compulsory to strengthen safety control during lifting work in order to prevent personal injury and equipment accident.

• Following are the standards and guidelines to be followed when operating crane.

• No operation of any types of cranes or tower cranes shall be allowed without prior notice to the contract superintendent.

• Before the use of lifting equipment, effective quality certificate of performance test and inspection should be submitted to the Employer. Crane operators should obtain relative certificate through HSE training.

• Cranes cannot be put into operation at the site without prior inspection and
approval by the representative from Employer.

- All the crane, hoister and other lifting equipment should be supported by relative legal certificate, registration documents and other updated information for the sake of inspection by Employer at any time.

- The crane operating cabin should be provided with the comparison table between safety load and turning radius. The hanger should be provided with safety spring device to avoid the movement of rigging or load.

In addition to cranes, standards for other lifting equipment and tools are below:

- Steel wire rope, hanger, hoop and sliding wheel and wheel coupler, relief clamp, rope clamp and hoister should be supported by quality certificate and operation instruction. Undertake full inspection when equipment initially arrives to site and after they are used every time, and establish record table.

- Operation, removal and movement of the lifting equipment and tools should be in accordance with the regulation in the operation instruction and operation procedure.

- Lifting equipment and tools should be inspected, maintained and repaired regularly during operation, if the equipment is found damaged, twisted or weakened which reach the discard standard, force to give a discard treatment and put into discard warehouse to undergo repair.

- Lifting workers, riggers and lifting mechanical operators should accept special learning and safety technical training, get special work permit after qualified test and license issued by the relevant authority.

- All the lifting workers should carry work permit with them. If Employer considers the workers are with lack experience or unqualified training, such staff will be dismissed.

- For the lifting work of the equipment with a weight over 3 tons, parts or small-sized equipment under special condition, it is necessary to prepare construction plan and measures. Submit it to relevant department for approval according to extent. Such lifting plan should be prepared at least 7 days ahead of time and submitted to the contract superintendent from Employer for review and
approval

- Give technical presentation to the lifting and erection technicians before lifting work. The operators should understand lifting plan, commanding signal, safety technical requirement and lifting equipment operational method.
- Conduct inspection work step by step for the lifting of the equipment with a weight over 3 tons, parts or small-sized equipment under special condition before lifting work.
- If problems are found during inspection, the project head will organize to make rectification till work is deemed approved.
- HSE control group will supervise the above lifting work and rectification work for approval.

3.10.4 Electricity

Work related to electricity are also regarded as sensitive with respect to health and safety. The following standards shall be followed.

- When the temporary electrical equipment is more than 5 gensets, or equipment capacity within 50KW, prepare electricity construction organization design.
- Temporary electrical consumption at site shall adopt three-phase five-wire system, carry out three-pole electric distribution, two-pole protection with ‘one machine one switch one protection’
- Weatherproof shelter should be provided for the electrical facilities such as distribution panel and box located outdoors at site.
- Electrical team shall be responsible for application of construction electrical facilities and equipment, repair and maintenance.

3.10.5 Scaffolding

Erection of scaffolding shall have direct influence on operator's safety. Collapse of scaffolding shall cause tremendous injury to the operators. Therefore, it is a must to standardize scaffolding work and prevent collapse and drop accident to protect worker's personal safety. Following are the standards that shall be followed when undertaking scaffolding work.
• Use steel tube as scaffolding post.
• Before scaffolding work, the scaffoldor should check and inspect the materials to see if they are approved.
• Scaffold board should be no less than 50mm in thickness, 250-300mm in width, 4m in length. Railing shall be adopted to support scaffold board every other 1.3 meters. Defected board cannot be used as scaffold board.
• Skirts shall be necessary for the gangway, slanted stair and working plane on all scaffolds. Skirts shall have a height of 100mm at least and be tied on the vertical poles at every corner.
• The scaffolders must have qualification certificate and they shall fulfil elevated work requirement.
• Before scaffolding work, everything should be ready and approved to ensure working condition and protective equipment are safe and reliable. For large and special scaffolding work, prepare scaffolding plan and set up scaffold according to it.
• Scaffolders shall carry out work by use of the upper and lower special gangway and work on the scaffolding boards. A safety harness of buffer type double hook shall be applied for working on the scaffold with a gap of excessive 1.8 meters.
• Operators shall go up and down the scaffold by way of stairs. Going up and down the scaffold through handrails, mid-rails or brace shall not be permitted. A rest platform shall be provided every other 8 meters on the stair or a continuous falling protective device be provided.
• All scaffolds shall be established on a sturdy foundation and keep level and vertical. Every vertical pole shall be underlaid with steel plate, under which shall be packed with scaffold board or channel steel.
• Distance between vertical poles shall not exceed 2 meters with a step of not exceeding 1.8 meters. If otherwise calculated or noted in construction plan, any exceeding shall not be allowed. From the second layer, scaffolding shall be tied up and so for every other layer afterward. Every other 5.4 meters in horizontal direction shall be necessarily tied up.
- Platform gang-board shall be fixed at its location. Extruded portion at the terminal of scaffolding board shall be parted from steel tube with a gap of at least 15 cm, but no larger than 30 cm.

- At the access port on the working platform shall be provided with a door to avoid directly going up and down the scaffolding from the railings.

- At the place for personal access under scaffolding shall be provided with a protective shelter, between skirts and handrails shall be set up a fine mesh safety net or the equivalent.

- Scaffolding shall not be in excess of safe work load.

- During scaffolding work, the workers must follow operation regulation. Take adequate protective measures to keep safe. Hang up safety tags at the place where danger exists. No one can be allowed in without permission.

- It is not allowed to throw scaffold materials from the structure up and down. Use ropes, container or belts to convey materials.

- Scaffolding work such as scaffold board and post binding and release fasteners cannot be stopped in the middle of work.

- After scaffolding work, the work team will inspect it by themselves and have it repaired when necessary. It should be approved by construction head. After completion, carry out inspection and acceptance check formality.

- Before application of scaffolding, inspection should be performed by the contractor's safety officer. A repeated inspection should be done after the occurring of any influence on the structural safety. Only such scaffolding as qualified after inspection and attached with efficient inspection board can be employed.

- Divide the incomplete scaffolding at access point and use signing and tagging.

- Workers should go into the work layer from ramp or special ladder. It is not allowed to climb up along scaffolding.

- Inspect scaffold weekly and prepare a written report, list scaffolding defects and repair method. Make an overall inspection to the scaffolding after any extreme weather events such as storms. Immediately tighten or replace parts if loose or inclination found.

- When excavating near scaffolding, strengthen scaffolding first.
• It is not allowed to remove scaffolding post or board during application, even partial cutting and damage.

### 3.10.6 Operating machinery or equipment

Following standards should be maintained **when operating any significant machinery or equipment.**

- Unauthorized personnel must not operate, interfere or tamper with plant or equipment.
- Persons authorized to use machines must first check that guards are in position and that any other safety device e.g. emergency stops, are in normal working order.
- All plant or equipment brought onto client premises must be properly guarded to prevent injury.
- Security guards shall be employed to ensure the site is secure at all times.
- Personnel and vehicle in and out should accept the client inspection. No materials can be conveyed out of the site without client written permit.
- Personnel coming into the site should carry pass permit prepared by EMPLOYER with him.
- Visitors coming into and going out of the site should get approval and notice in advance.
- Vehicles coming into site should have pass permit.

### 3.10.7 Inspection Tours

**Inspection tours** at the site shall be strictly monitored. Following standards shall be maintained.

Inspection tours shall be divided into maximum four groups and shall be accompanied by a health and safety supervisor. Inspection tours shall be undertaken with three shifts in turn per day.

Provide required quantity of search lights to assure there are no blind area for inspection in foggy, rainy, snowy day and at night.
Inspectors should be equipped with corresponding walkie-talkie and guard equipment to assure smooth implement of inspection.

3.10.8 Overall site maintenance

1) Project civilization construction organization

This work shall be done by Health and safety team. Health and safety chief is responsible for overall maintenance of site. Detail work shall be coordinated and organized by the engineering group.

2) Project manager will make comprehensive arrangement for temporary facilities, transport road, work sequence according to general layout plan. Prepare “Work Layout plan” and submit to client for approval prior to work commencement.

3) Construction temporary facilities floor area should follow the general layout plan approved by Employer during work. Temporary facilities, equipment, materials should be put in a good order with tags to keep the site in reasonable arrangement and clean condition.

(2) Site Sanitary control

1) No asbestos materials and products shall be allowed to use at site.

2) Regular disposal of waste materials area and rubbish bin left at jobsite or office area controlled by project department. Keep worksite clean and tidy. Constructors shall be responsible for storing and periodically disposing of all waste. Burning of trash and other combustible waste materials shall not be permitted. Surplus material and other construction materials shall be disposed to the designated location according to client’s instruction.

3) Carry out high standard and strict requirement control work at site. Undertake site cleaning once a week.

Carry out equipment and material transportation and erection according to plan.
4) People appointed by the project department will clean site lavatory. Keep lavatory and drain system unblocked. No bowel movement and urination are allowed at site. Such actions shall be penalized.

**3.10.9 Overall site management procedures.**

1) Electric welding machine and air compressor should be covered with rain-proof shed and three sidings. Cable laying should be in good order.

3) Immediately retrieve surplus and waste materials. Such materials should be cleared away after work area to guarantee the site cleanliness, road smoothness and ensure that the drainage system is under good condition.

**Set up construction marking when working in the place where vehicles will pass.**

4) Put the acetylene cylinder, oxygen cylinder in a good order and capped

5) Site water pipe, cable, conductor, welding wire should be installed and used according to the regulation and safety rules and arranged according to construction organization design. The welding flexible cord, oxygen belt and welding rod should be retrieved after work every day.

6) Any excavated trench or ditch must be backfilled in time. Dispose of soil out of the plant. It is not allowed to cover the equipment with soil or materials.

7) Before commissioning work, all the materials and articles in the workshop and shop building should be placed in good order. There should be no dust on equipment and pipeline surface.

8) Various kinds of remaining supplies should be retrieved in time according to the regulation and transported out of the plant.

9) Strengthen site security and guard work to prevent any theft.

**3.10.10 Ensuring compliance to health and safety standards.**
Several systems are in place to ensure the safety standards are followed at site including regular supervision and providing incentives for compliance.

The safety manager and supervisor shall undertake inspection at site every day.

During the inspection, staff who demonstrated an outstanding performance in the implementation of HSE standards are recorded. Summary assessments are carried out every week and bonuses are given.

Staff who do not comply shall be penalized according to the level of non-compliance.

### 3.11 Accident and hazard scenarios

Assessment for accident and Hazard is given below.

The following hazard and accident assessment is based on the following 3 stages of the building lifecycle, including construction, use and maintenance of building. Risk levels & probability are qualitatively assessed based on the following parameters; High, Moderate and Low.

<table>
<thead>
<tr>
<th>Performance Consideration</th>
<th>Risk Level</th>
<th>Risk Probability</th>
<th>Responsible Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of hazardous substances, which impact on construction work e.g.: asbestos, SMF, hydrogen chloride, etc.</td>
<td>High</td>
<td>Low</td>
<td>Project manager, Site Supervisor</td>
</tr>
<tr>
<td>Accidental spill of diesel</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Site Supervisor</td>
</tr>
<tr>
<td>Sufficient access / space around new section or building for use of cranes, scaffolding during construction</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Construction workers will be protected from / proximity to HV electrical, high risk energy sources</td>
<td>High</td>
<td>Moderate</td>
<td>Site Supervisor</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Roof and balcony design will reduce /eliminate the risk of falls from height during construction</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Sufficient space is planned for access &amp; to install / major fixed plant or equipment or specialised equipment, plant rooms</td>
<td>Low</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Floor loading design has been assessed by engineer to be able to accommodate heavy equipment / plant to be installed in future</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Floor surfaces – even level with no sudden changes in levels – floor coverings non-slip, suitable for levels of traffic use and suitable for type of tasks to be done</td>
<td>Moderate</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Stairs and balcony – edge delineation, slip resistant (SR) stair nosing, construction / design suitable for intended use, handrails, non-horizontal railings in balcony</td>
<td>Moderate</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Window positioning and solar glare</td>
<td>Low</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Safe Access to lighting fixtures to change fitting, bulbs</td>
<td>Low</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Safe Access to plant rooms – locked, lighting.</td>
<td>Low</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Access to roof tops – safe access to within safety zone, minimised manual handling of material, equipment tools.</td>
<td>Low</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Accessible window cleaning methods</td>
<td>Low</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Accessible roof cleaning methods</td>
<td>Low</td>
<td>High</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Accessible dirt or rubbish collection points</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Project Engineer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintenance Officer</td>
<td></td>
</tr>
</tbody>
</table>

High risk scenarios provided by the above table, along with specific mitigation is given below.

- **Presence of hazardous substances, which impact on construction work eg: asbestos, SMF, hydrogen chloride, etc.** While the risk level is high, the risk probability is low as material including such substances are not be used. As a mitigation measure, this has to be ensured during material procurement. Moreover, hazardous substances should all be in sealed containers. It should be checked which substances can be stored together or not.

- **Accidental Spill of diesel.** Diesel spill may occur during fuel transfer, which may lead to a hazard. Diesel spills from the storage tank will already be mitigated due to the bund. Spills during transfer should immediately be brought to the attention of the project manager or site supervisor in charge. If spill is deemed to be significant, the area should be demarcated and spill cleared. No works concerning fire should be undertaken at anytime at or near the spill area.

- **Construction workers will be protected from / proximity to HV electrical, high risk energy sources** While the risk level is high, the probability is given as moderate. Proper insulator gloves and protective cloth are to be worn by workers in close proximity to high risk energy sources. Moreover, it has to be ensured that these are not exposed at any given time.
3.12 Project Inputs and Outputs

Each component of the project has inputs and outputs based on human resources, economics, and the environment. However, since the operation is carried out in-house, project inputs and outputs are greatly conserved and limited.

The major inputs and outputs associated with the project encompassing all the components, are tabulated below. Table 2 highlights the main material inputs, while Table 3 highlights manpower inputs and Table 4 is regarding other inputs. Table 5 demonstrates the major outputs of the project.

Table 2 Main material input for the proposed project

<table>
<thead>
<tr>
<th>Input Resource</th>
<th>Estimated quantity</th>
<th>Main source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>26000 t</td>
<td>India</td>
</tr>
<tr>
<td>Aggregate</td>
<td>30000 t</td>
<td>India</td>
</tr>
<tr>
<td>Cement</td>
<td>6000 t</td>
<td>India</td>
</tr>
<tr>
<td>Brick</td>
<td>17500 m3</td>
<td>India</td>
</tr>
<tr>
<td>Steel</td>
<td>7500 t</td>
<td>China</td>
</tr>
<tr>
<td>Wood</td>
<td>1500 m3</td>
<td>Malaysia/Sri Lanka</td>
</tr>
<tr>
<td>Concrete form</td>
<td>10000 piece</td>
<td>India/Sri Lanka</td>
</tr>
<tr>
<td>Insulation board</td>
<td>8500 m2</td>
<td>India</td>
</tr>
<tr>
<td>Waterproof</td>
<td>12500 m2</td>
<td>China</td>
</tr>
<tr>
<td>Waterproof painting</td>
<td>75000 kg</td>
<td>China</td>
</tr>
<tr>
<td>Aluminum windows and doors</td>
<td>22500 m2</td>
<td>China</td>
</tr>
<tr>
<td>Wood door</td>
<td>17500 m2</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>Water pipe</td>
<td>7500km</td>
<td>China</td>
</tr>
<tr>
<td>Electric cable</td>
<td>1250km</td>
<td>China</td>
</tr>
</tbody>
</table>

Table 3 Manpower input for the project

<table>
<thead>
<tr>
<th>No</th>
<th>Designation</th>
<th>According to the construction stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pile</td>
</tr>
<tr>
<td>1</td>
<td>Project management team</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Administrators &amp; office persons</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Civil engineer and electrical engineer</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Stakeman</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Carpenter</td>
<td>/</td>
</tr>
<tr>
<td>6</td>
<td>Bar setter</td>
<td>/</td>
</tr>
<tr>
<td>7</td>
<td>Cementer</td>
<td>/</td>
</tr>
<tr>
<td>8</td>
<td>Waterproof worker</td>
<td>/</td>
</tr>
<tr>
<td>9</td>
<td>Plasterer</td>
<td>/</td>
</tr>
<tr>
<td>10</td>
<td>Wall and floor tiler</td>
<td>/</td>
</tr>
<tr>
<td>11</td>
<td>Painter</td>
<td>/</td>
</tr>
<tr>
<td>12</td>
<td>Scaffolder</td>
<td>/</td>
</tr>
<tr>
<td>13</td>
<td>Craneman</td>
<td>/</td>
</tr>
<tr>
<td>14</td>
<td>Plumbers</td>
<td>/</td>
</tr>
<tr>
<td>15</td>
<td>Firefighting equipment assemble worker</td>
<td>/</td>
</tr>
<tr>
<td>16</td>
<td>Welder</td>
<td>/</td>
</tr>
<tr>
<td>17</td>
<td>Measure man</td>
<td>4</td>
</tr>
<tr>
<td>18</td>
<td>Electricians</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>Mechanist</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>Laborers</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Grand Total</td>
<td>54</td>
</tr>
</tbody>
</table>
Table 4 Other inputs from the proposed project

<table>
<thead>
<tr>
<th>Input resource(s)</th>
<th>Estimated Quantity</th>
<th>Main sources of resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery and equipment</td>
<td></td>
<td>Sourced from contractor’s own equipment/machinery. If new machinery required, sourced from local rentals.</td>
</tr>
<tr>
<td>Tower crane – 6nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavator – 20 tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batching plant – 1nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transit mixtures – 2nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dewatering pumps – as per the requirement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil boring machine – 1nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skid loader – 2nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 cube tipper 1nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane truck 1nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffoldings – as per the requirement about 400 sets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GI Pipes 50mm – 1000nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arco jacks and based (U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formwork system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete stationary pump with required length of pipe 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material and passenger hoist – 2nos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>Quantity</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Bar bending machine</td>
<td>4 nos</td>
<td></td>
</tr>
<tr>
<td>Pre stressing jacks</td>
<td>4 nos</td>
<td></td>
</tr>
<tr>
<td>Grout pumps</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Compressive testing machine</td>
<td>1 nos</td>
<td></td>
</tr>
<tr>
<td>CBR testing apparatus</td>
<td>1 nos</td>
<td></td>
</tr>
<tr>
<td>Rebound hammer</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Water proofing membrane welding</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc welding plants</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Lighting generators</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Silent hammer</td>
<td>1 nos</td>
<td></td>
</tr>
<tr>
<td>Mobile crane</td>
<td>1 nos</td>
<td></td>
</tr>
<tr>
<td>Backhoe loader</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Plastering Machine</td>
<td>2 nos</td>
<td></td>
</tr>
<tr>
<td>Small concrete mixture</td>
<td>4 nos</td>
<td></td>
</tr>
<tr>
<td>Mobile concrete pump (as per the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>requirement)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Energy supply (during construction)
- ~400kW
- From contractor generator at site

### Water supply (during construction)
- 250 tones/day
- From contractor own RO plant at site

### Hydraulics and Drainages
- All the UPVC pipes and fittings shall be used high pressure pipes.
- Procured from abroad

<table>
<thead>
<tr>
<th>Products and waste materials</th>
<th>Anticipated quantities</th>
<th>Method of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste generated during construction</td>
<td>10-15 tons per day</td>
<td>Collected and sorted at site, and taken to Thilafushi waste collection area.</td>
</tr>
<tr>
<td>Waste water</td>
<td>60 litres/second</td>
<td>Water flow towards the lagoon on the west of Hulhumale’ via established MWSC system</td>
</tr>
<tr>
<td>Waste oil and grease</td>
<td>Minute quantities</td>
<td>Collected in used containers and transported to waste site</td>
</tr>
<tr>
<td>Air pollution</td>
<td>Debris in minute quantities</td>
<td>External influence minimised by site demarcation temporary boundary walls.</td>
</tr>
<tr>
<td>Noise pollution</td>
<td>&gt;75 db(A)</td>
<td>Minimised by site demarcation barriers. Ear muffs and safety equipment for workers on site.</td>
</tr>
<tr>
<td>Waste generated during operations</td>
<td>50 tons per day</td>
<td>Collected on site and transported to waste collection site in Hulhumale’</td>
</tr>
</tbody>
</table>
Waste water generated during operations | 3000 tons per day | Via MWSC sewerage network
4 Description of the Existing Environment

This section covers the existing environmental conditions of the project site. Since this is a housing project, the key components with respect to housing projects are described below.

- Climate
- Existing structures
- Vegetation
- Traffic flow
- Noise pollution
- Water quality
- Hazard vulnerability
- Data was collected using methods discussed in Section 1.4.

However, as the project is to be undertaken on barren newly reclaimed land, there are few components among these that are not relevant for this project. These include status of existing structures, vegetation, traffic flow as there are no structures or vegetation or traffic in the area currently.

4.1 Climate

This section deals with the regional and local climate of the study area. These are general information and the same is provided for all similar projects.

Data has been taken from the weather station at Hulhule’, the island which accommodates the International Airport and adjacent to Hulhumale’. Long-term meteorological data for Hulhulé is available and being less than a kilometre away from the project location, the station is at an ideal location.

The Maldives has a warm and humid tropical climate with average temperatures ranging between 25°C to 30°C and relative humidity ranging from 73 percent to 85 percent. The
country receives an annual average rainfall of 1,924.7 mm in the central parts, where Male’ is located. (Department of Meteorology, 2012).

The climate of the Maldives is dependent upon the Indian Ocean Monsoons. Monsoon wind reversal plays a significant role in weather patterns.

The two monsoon seasons observed in the Maldives include the Northeast (Iruvai) and the Southwest (Hulhangu) monsoon. The northeast monsoon is the dry season that occurs from December to February and the southwest monsoon is the rainy season, which lasts from May to September. The transition period of northeast monsoon occurs from October to November while that of southwest monsoon occurs between March and April. The ‘four seasons’ of the Maldives is highlighted in the following Table 6.

Table 6 Four Seasons of the Maldives

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>South West Transition</td>
<td>March to April</td>
</tr>
<tr>
<td>South West</td>
<td>May to September</td>
</tr>
<tr>
<td>North East Transition</td>
<td>October to November</td>
</tr>
<tr>
<td>South West Transition</td>
<td>December to February</td>
</tr>
</tbody>
</table>

4.1.1 Wind

Wind is an important indirect factor affecting formation, development and seasonal dynamics in the Maldives. Winds often help to regenerate waves that have been weakened by travelling across the reef and they also cause locally generated waves in lagoons. Therefore, winds are an important factor, as being the dominant influence on the hydrodynamics in most coastal areas.

The two monsoon seasons have a dominant influence on winds experienced across Maldives. Since Maldivian islands are spread across the equator, monsoons are relatively moderate while strong winds and gales are rare. However, during South West monsoon gusts of up to
60 knots (30m/s) have been recorded at Male’. Reversal of winds in the Maldives means change of seasons from North East monsoon to South West or vice versa.

Wind is also important with respect to such large construction projects, especially during heavy wind. In general wind is expected to be within 5m/s – 12m/s during the project. During heavy winds exceeding these amounts, special care must be taken to ensure loose materials are not at project site and/or all loose equipment and materials are tied down.

General wind surface wind pattern over the country during North East monsoon is north-easterly direction whereas during South West monsoon mean wind flow is westerly. Based on the project schedule, the project will encounter heavy westerly winds twice during the project cycle.

Figure 8 Wind rose diagram from Hulhule’ weather station for 2016 (MMS, 2016)
4.1.2 Waves

Wave climate is not as important for a structure situated at the coast. Therefore, for the purpose of the EIA, there were no measurements carried out for the wave generation on a local scale. However, regional data has been studied and visual observation on site was used to analyse the environment, as even though there is low probability that direct wave impact will occur at the project site, inundation due to larger swells is possible for the area.

Two major types of waves are formed on the Maldives coasts: wave generated by local monsoon wind and swells generated by distance storms. The local monsoon predominantly generates wind waves, which are typically strongest during May-July in the aforementioned southwest monsoon period. During this period, swells generated north of the equator with heights of 2-3 m with periods of 18-20 seconds have been reported in the region. Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves.

Since the project site is at the eastern parts of the island, probably of impact due to easterly waves are there during north east monsoon. However, the area will be well protected via a buffer area in between the shoreline and the project site in addition to the shoreline being heavily protected using rock armour revetment.

4.1.3 Rainfall

The average annual rainfall for the archipelago is 1,937mm. There are regional variations in average annual rainfall. Southern atolls receive more rain compared to the northern atolls (MEC, 2004). Mean monthly rainfall also varies substantially throughout the year with the dry season getting considerably less rainfall. The north-east monsoon is known as the dry season and the south west monsoon the rainy season. It is not expected that the project team will have to endure heavy rainfall during the excavation and foundation works based on the current schedule.
4.2 Existing structures

There are no other existing buildings on the same area as proposed for this project. There are upcoming buildings proposed in Phase 2. However, no building has been constructed yet.

4.3 Vegetation

As Phase 2 is largely barren land, there was no vegetation survey required as part of the project.

4.4 Traffic Survey

As there are no developments currently established in Hulhumale’ Phase 2, and no public vehicles are allowed into the Phase 2 area, a traffic survey was not required as part of the project.
4.5 Noise Pollution

Noise pollution can be an environmental and health hazard. However, there are no currently no guidelines for noise levels at residential areas in general. Examples of guidelines with regard to noise for residential areas as set World Bank Environmental Health and Safety guidelines for noise at residential areas are:

Daytime reference value for noise as set by the bank is 55 dBA while night time value is set at 45 dBA. For industrial area the noise reference level is set at 70dBA.

The background noise levels at the project site is very low due to lack of activities in the area. The baseline Noise levels are at 45 dBA. This coincides with the finding in the 7000 housing unit development EIA in the same region and of the 2500 housing units project study, where the minimum noise level was at 44 dBA, while in general the maximum was at 59 dBA.

4.6 Water quality

Ground water in the location was sampled and sent for testing to MWSC in November 2017. Results of this test are shown in the Table 7 below (see Annex 3 for results sheet).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>1394 Housing Unit, Hulhumale’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>µS/cm</td>
<td>825</td>
</tr>
<tr>
<td>pH</td>
<td>-</td>
<td>8.03</td>
</tr>
<tr>
<td>Salinity</td>
<td>‰</td>
<td>0.40</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>23.5</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/L</td>
<td>412</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>587</td>
</tr>
<tr>
<td>Nitrogen Ammonia</td>
<td>mg/L</td>
<td>4.98</td>
</tr>
</tbody>
</table>
Marine water quality is generally good. However, there are no significant marine life in the area that dewatering and brine discharge is proposed for as was highlighted in the 7000 housing units EIA. A separate marine assessment for this project was not required by the TOR for this study.

### 4.7 Socio–economic Environment

| 4.7.1 Population |

The population of Hulhumale’ based on most recent official results is 15,769 divided to 8,175 males and 7,594 females. Total no. of foreigners residing in Hulhumale’ is about 1200. However, HDC data shows current residential population in Hulhumale as 65,520 people.

Hulhumale’ population is growing rapidly and is the fastest growing in the country. In 2006 census the total population of Hulhumale was only 2866 people. Therefore, the exponential growth is set to continue. The population is projected to rise up to about 100,000 in 2020. There are many housing projects proposed in the island, and migration from Male’ and even from other islands is anticipated to increase at a greater rate. Moreover, Male’-Hulhumale’ bridge project is currently ongoing and will complete in 2018. This gives incentives to residents in Male’ to move away from the congestion in the capital island.

| 4.7.2 Transport |

Access to Hulhumale’ is currently by ferry operated by the Maldives Transport and Contracting Company Plc Ltd (MTCC). Ferry is available throughout the day except between 3am to 5am. The average carrying capacity of the ferries are about 100 people per boat. Regular bus is available to travel from the Ferry terminal to several locations in the residential areas.

There is also a regular bus traveling between Hulhumale’ and Hulhule’ every 30 minutes. There are more options to travel between Hulhumale’ and Hulhule’ currently; by private vehicles of guest houses operating in Hulhule’. The vehicles, usually vans provide taxi services to locals.
Traveling within Hulhumale’ is by taxi services and also private motorcycles. Currently bicycles are also getting increasingly popular. The island is designed in a pedestrian friendly manner with big pavements available through the island, especially in the main roads.

With the expected completion of the proposed China Maldives Friendship Bridge, it is expected that this will be the main mode of transport for the majority of residents living in Male’ and Hulhumale’.

### 4.7.3 Education

Hulhumale’ currently has 3 secondary and higher secondary schools, namely; Ghaazee School, Rehendhi School and Gateway International School.

Pre-schooling options in Hulhumale’ currently consists of Little Gems Preschool and Gateway International School. A new preschool is currently being built and is anticipated to be operational sometime during 2017. While most of the local residents obtain schooling from the local schools, some do travel to Male’ daily. There are fewer occasions where students from Male’ come to Hulhumale’ schools.

By the time the housing units as proposed are constructed, there will be more schooling opportunities in Hulhumale’. Currently, there are 2 significant school projects being undertaken. It is expected 1 additional secondary school and 1 additional preschool will be open within the next 2 years. There are more proposed educational institutes proposed for Phase 2 area.

### 4.7.4 Health

There is a main public hospital in Hulhumale’ on the main road. It is the central health care provider in the island. The hospital was previously run by the Ministry of Health and recently management has been shifted to Medical Insurance Provider ‘Aasandha’. Due the relatively less congestion at the site relative the Male’, the hospital does get patients from Male’ in addition to Hulhumale’ residents. Currently, there are some major renovation works being undertaken at the hospital.

A multi-speciality international hospital has been proposed for Hulhumale’ and is nearing completion. The hospital is expected to be operational very soon. When fully developed, the hospital will have a capacity of 600 beds and will have private access to emergency facilities.
Additionally, there are few clinics currently being opened in Hulhumale’, including dental clinics and general clinics.

### 4.7.5 Utilities

Utility services are provided by the biggest utilities in the Maldives; STELCO and MWSC. Both companies inform they have the capacity to deal with the current developments in Hulhumale’ and are poised for expansion as new developments come in. Current power generating capacity at STELCO, Hulhumale’ is 12MW, while there are plans to upgrade to an additional 3MW in the coming months. Both MWSC and STELCO’s scale of operation will be significantly upgraded with the development of Phase 2.

Regarding waste management, HDC has recently signed the contract with WAMCO to undertake all waste management in Hulhumale’, including waste pick up and transport from households, management of the waste site, transporting waste to Thilafushi. Currently WAMCO is in the process of establishing their waste management system to Hulhumale’ Phase 2 as well. However, phase 2 operations have not commenced yet.

### 4.7.6 Tourism

Hulhumale’ has been a hub for budget tourism and guest house development. Currently it is estimated there are about 100 guest houses in the island, with the total capacity to cater for about 2000 guests at any one time. International visitors numbers provided by HDC states that in 2016 alone over 126,385 guests visited the island and is projected to rise exponentially to over 650,000 guests in 2020.

Hulhumale’ is also a popular destination for local tourism with many locals travelling to the island on weekends and on holidays, mainly from Male’. In 2016, about 820,144 locals visits are accounted for and the number is projected to rise to over 1,200,000 in 2020. However, this could be a gross over estimate.

A significant land is allocated for tourism purposes in Phase 2. Therefore, with the development of Phase 2, more tourism operations will be in place.

### 4.8 Hazard Vulnerability
Maldives in general does not experience natural disasters and hazards on a frequent basis. The major natural hazards are due to swells and/or due to storm surges. However, the Indian Ocean Tsunami in 2004 was a historic reminder on potential hazardous threats the country faces. The islands across Maldives face similar type of threats and hazards to varying degrees and magnitude depending on several factors.

The vulnerability of islands to natural hazards depends on geological and more importantly geographic aspects of the island. As such, the location of the island, with respect to the country and atoll is quite important. Likewise, the level of protection the island is offered from neighbouring islands, the house reef, shape and orientation of the island are also important factors.

Based on the UNDP Disaster Risk Assessment Report of Maldives in 2006, Hulhumale’ is located in an area that has been designated as a low-risk hazard zone. However, as stated in the report, sea level rise due to climate change is a uniform hazard throughout the country, and will have high impact on Hulhumale’ as well. Figure profiling the Maldives based on the hazard zones are given in the following Figure 10.

The proposed buildings located south of the Phase II area, and virtually center of the entire Hulhumale’ land area. There may be flooding at the project site in the event of a Tsunami or major swell surges, which would be the case for majority of the island. As there is no residential area in the ground floor, impact to residents will be minimal under such circumstances.
Figure 10 Disaster risk profile of the Maldives (UNDP, 2006)
5 Legislative and Regulatory Considerations

The legislative and regulatory consideration the project adheres to is mostly at a national level, since it takes place on a local scale within the Maldivian environment. The extent to which the project conforms to existing plans, policies, guidelines, regulations and laws of the Maldives are considered in this Section. Some of the more important regulations are stated within the context of this project scope. The regulatory context in which the project activities take place and the legal and policy aspects relevant to those activities will be discussed in the Section.

5.1 Environmental Protection and Preservation Act (Law No. 4/93)

The major legal instrument relating to environmental protection is the Environmental Protection and Preservation Act (Law No. 4/93) of the Maldives passed by the Citizen’s Majlis in April 1993. This Act provides the Ministry of Environment with wide statutory powers of environmental regulation and enforcement. This umbrella law covers issues such as environmental impact assessment, protected areas management and pollution prevention. The following clauses of the Environmental Protection and Preservation Act (Law No. 4/93) are relevant to the project:

Clause 5a: An impact assessment study shall be submitted to the Ministry of Environment, and Energy before implementing any development project that may have a potentially detrimental impact on the environment.

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

Clause 6: The Ministry of Environment, and Energy has the authority to terminate any project that has an undesirable impact on the environment. A project so terminated shall not receive any compensation.

Clause 9a: The penalty for minor offences in breach of this law or any regulations made under this law, shall be a fine ranging between Rf5.00 (five Rufiyaa) and Rf500.00 (five hundred Rufiyaa), depending on the actual gravity of the offence. The fine shall be levied by the Ministry of Environment, and Energy or by any other government authority designated by that Ministry.
**Clause 9b:** Except for those offences that are stated in (a) of this clause, all major offences under this law shall carry a fine of not more than Rf100,000,000.00 (one hundred million Rufiyaa), depending on the seriousness of the offence. The fine shall be levied by the Ministry of Environment, Energy and Water.

**Clause 10:** The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment. This includes all activities mentioned in Clause No. 7 of this law as well as those activities that take place outside the projects that are identified here as environmentally damaging.

### 5.2 Regulation on Aggregate and Sand mining

This regulation addresses sand mining from uninhabited islands that have been leased; sand mining from the coastal zone of other uninhabited islands; and aggregate mining from uninhabited islands that have been leased and from the coastal zone of other uninhabited islands.

Coral mining from the house reef and the atoll rim has been banned through a directive from the President’s Office dated 26th September 1990. Under Article 7 (c) of the Regulation on Sand and Coral Mining issued by the Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) on the 13th of March 2000, it is an offence to mine sand or coral from the beach, lagoon or reef of any inhabited island and islands leased for the purpose of building a tourist resort.

This regulation would not have any implication on the project, as manufactured sand and imported sand will be used for the construction works.

### 5.3 EIA Regulations

The EIA Regulations, which initially came into force in May 2007 has been amended and republished in May 2012 based on the Environmental Protection and Preservation Act. The EIA Regulations have been the basis for Environmental Impact Assessment in the Maldives and since its inception; it had helped to improve the quality of EIAs undertaken in the country. Today, registered consultants are required to sign EIAs and the reports are subsequently reviewed by two independent reviewers and a final decision is made by EPA based on the
reviews. Likewise, this EIA report would also be subject to these requirements and review criteria.

‘Jadhuvalu Raa’ of the new EIA Regulations lists the different environmental projects that require an Environmental Impact Assessment study. High rise building construction works is among this list and thus a full Environmental Impact Assessment was needed to be carried out for this project. It is specifically stated that buildings with foundation deeper than 5ft / 1.5m will require Environment Impact Assessments to be carried out. This project proposes a foundation 2.77m deep.

The EIA Regulations sets out the requirements for the contents of Environmental Impact Assessment reports in ‘Jadhuvalu Baa’ and format for monitoring reports have been given in ‘Jadhuvalu Laamu’. Therefore, these requirements have been taken into consideration in preparing this EIA report.

On 9th April 2013, a further amendment to the EIA Regulation 2012 has been published, which deals with repeated offenders of the regulation. Under Clause 20 of the regulation, the amendment proposes a new Schedule. ‘Jadhuvalu Taviyani, which lists penalties for repeated offenders. Under ‘Jadhuvalu Taviyani’, repeated offenders of the regulation will be fined based on the following criteria

- For Initial offence: 20,000 MVR
- If an offence is repeated for the 2nd time: 60,000 MVR
- If an offence is repeated for the 3rd time: 120,000 MVR
- If an offence is repeated for more than 3 times: 200,000 MVR for each offence.

On 11th August 2016, a third amendment was published, which mainly deals with revised criteria for EIA evaluators, environmental consultants and their performance evaluations.

On 19th January 2017, a 4th amendment to the EIA regulation was published. The amendment lists additional types of project which can be implemented without the need of an EIA, with only a confirmation/assurance from the developer/proponent affirming that mitigation measures required for the project will be undertaken during project implementation. These types of projects include the following

1. Harbour and entrance channel maintenance dredging.

2. Removal of vegetation in plots allocated for housing development by the owner of the plot
3. Removal of vegetation from roads in areas allocated for housing development.

4. Making boreholes for water intake

5. Projects which are undertaken within 3 years in newly reclaimed areas in which the reclamation has been alongside existing natural island.

6. Projects which are undertaken within 5 years in newly reclaimed areas in which the reclamation has been in a lagoon separate from existing island.

The amendment gives an exemption to the types of projects mentioned in 5 and 6, if the project has the following characteristics

1. use of hazardous chemicals
2. any type of fuel storage
3. use of an incinerator
4. release of poisonous emissions
5. involves fibre work

Moreover, it states that if a residential population is established in the reclaimed land, then the exemptions granted for the type of projects as stated in Clause 5 will not be applicable. As fuel storage activities will be undertaken as part of the project, and to fulfil financing requirements of the contractor, an EIA has been undertaken for the project.

**5.4 Maldives National Building Act**

The Maldives National Building Act (4/2017) has been published in the gazette on 23rd April 2017. The building Act discusses compliances issues and procedures, providing disability access, details of procedures for building consent, supervision of buildings, roles and duties of all parties concerned with developments including the regulatory authority, building owners, developers and contractors, occupation of the buildings, licensing of building practitioners, and refers to the Building Code for more detailed guidance on construction procedures and best practice.

The Act also establishes the “Maldives Building and Construction Board” which is responsible for advising the Minister and other relevant actors on matters specified in the Act. The Board is comprised of 7 appointees, from both private and, public sector, who can sit on the board for 2 consecutive 2-year terms.
Some other key areas covered by the Act include the creation of a standardised building code, a fine regime for persons who do not comply with the Act and subsequent Regulations, giving priority to Maldivian workers in the construction sector and, guaranteeing compensation for services rendered. The Act also provides a dispute resolution mechanism for parties who seek to contest fines and other actions taken against them under this Act. The dispute must be lodged within 14 days of the action and a response to the disputed action must be given within 1 month.

The Act also stresses on the importance of engaging locals in building construction projects and also highlights fines for non-compliance of the various clauses given within the Act.

### 5.5 Maldives National Building Code 2008 draft

Maldives National Building Code is also still at a draft stage, and is awaiting the Building Act to be fully implemented. The Code intends to regulates on the duties of the contractors, It recommends best practices, in addition to regulations to be adhered to during construction work. It covers aspects such as structural stability, fire safety, access, moisture control, durability, services and facilities, and energy efficiency. Once the building act is published, the Coder will be enforced and all contractors will need to adhere to the regulations provided. Currently the contents are followed as a guideline. The proposed development will conform to the guidelines provided in the Building Code draft.

### 5.6 Environmental Guidelines for Concrete Batching plants 2014

The guideline has been prepared by EPA as a guide for developers/contractors regarding installation and operation of batching plants. It is proposed to ensure that the operations are environmentally friendly and has minimum impact on neighbouring communities. Some of the key points outlined in the guideline are as follows:

Generation of wastewater from the plant must be minimised and measures to re-use wastewater should be in place such that it mitigates potential groundwater impacts.

Materials used for the plan such as cement, sand and aggregates should be stored in such a way that they are covered and not exposed to rain or excessive sunshine.

Material dispersal to the natural environment should be minimised during transportation.
Noise reduction measures should be in place during plant operations

The plant should be located at the site in a such a way as to reduce spread of dust and/or debris by incorporating existing trees, or constructing fences and landforms to maintain a minimum of 100m buffer distance from other sensitive areas.

5.7 Waste Management Regulation, 2013

Waste Management Regulation (No. 2013/R-58) came into effect on 6 February 2014. The Regulation was gazetted on 05 August 2013. The regulation provides a set of comprehensive guidelines and on collecting, storing, transporting and managing waste as well as management of hazardous waste. The waste management regulation prohibits dumping of waste on to parks and roads; protected areas under the Environmental Protection and Preservation Act. Moreover, waste management regulation states that those involved in waste management must be permitted by the Environmental Protection Agency.

Clause 11 of the regulation deals with terrestrial wastes and states that waste should be deposited and managed only at sites allocated by the relevant authority.

Clause 26 of the regulation deals with the transportation of wastes.

Clause 34 of the regulation states the procedure for penalties for those that do not abide by the regulation.

Jadhuvalu (annex) Haa 1.1 states the regulation applicable to household wastes.

- Waste should be stored within the household in a container with a lid, such that there is no opening for any leakage. This is the responsibility of the household dwellers.
- There should not be any leakage of waste from waste storage to waste transport vehicle
- Any waste that can potentially leak out liquid should be properly sealed
- Waste should be sealed such that no insect or animal will be able to access the contents of the stored wastes

Jadhuvalu (annex) Haa 1.4 of the regulation states the conditions applicable to building and construction waste. From the clause, the notable points are as given below:
- Construction projects should be planned and managed in such a way to ensure minimum amount of waste is produced.
- Steps should be in place to ensure minimum waste generation during building and construction
- Building and construction waste generated from demolition should be reused as much as possible
- Building and construction waste should be within the site boundary of the project and should not cause any disturbance to the public
- All building and demolition works shall be arranged in such a way to ensure that during the course of the project, there shouldn’t be any disturbances to the neighbouring entities and public due to the generation of wastes

It should be noted that demolition is not part of this project, as there is no structure in the area currently. Moreover, the way the site is setup, it is virtually guaranteed that waste will be contained within the site and will not pose any nuisance to the public or any potential neighbour.

Jadhuvalu (annex) Haa 2.1 states the conditions applicable to land transport of waste.

- Waste should be properly concealed during transportation such that any waste or smell of waste will not be exposed to the surrounding environment
- Waste transporting vehicle should be properly washed and cleaned regularly
- If waste is to be transported on a wheel burrow, it has to still be ensured that the burrow is able to handle the entire content of the waste and that there is no chance for waste to spill out
- If waste is transported by individuals personally, still the condition as stated in this clause is applicable.

During the operational stage of the project, under the management of HDC, the building will be maintained according to a maintenance agreement which will be termed and agreed between HDC and the tenants or concerned body. In any case, waste management within the building will be outsourced to a third party and waste transfer to transfer station or landfill will be undertaken by WAMCO.
5.8 Dewatering Regulation, 2013

A Dewatering Regulation (No. 2013/1697) came into effect in December 2013. The main purpose of the regulation is to protect groundwater resources found in the islands from impacts of dewatering, pollution and protect the environment from release of groundwater by dewatering. As per the regulation, a dewatering permit shall be obtained from EPA prior to any dewatering operations required for all development projects.

Furthermore, the regulation states that 30m radius boundary shall be considered as impact area from all dewatering operations and any entities within the boundary shall be informed 24hrs before the dewatering operation. EPA approved dewatering signage must be placed during the process of dewatering. There are no structures or any development within a 30m radius from the project site.

Dewatering can only be to be carried out, after gaining approval by submitting “the dewatering approval form” in the annex 1 of the Regulation to the enforcing body for approval with all the required documents expressed and with an administrative fee of 500 MVR. Water quality tests results also have to be submitted as one of the required component.

The regulation also guides on where and how the extracted water shall be disposed of, and how it has to be handled. According to the regulation, permission can be granted for dewatering at a stretch for a maximum of 28 days, for which a sum of 500 MVR should be paid per day. This amount can be increased with the increase in number of days.

5.9 Management, Use and Control of HCFC Substances Regulation, 2010

The HCFC Regulation was developed under the Environmental Protection and Preservation Act (4/93) towards regulating phasing out of import, use, selling of HCFC substances by 2011 and completely eliminating use of HCFC substances in the Maldives by 2020 through controlling importers, registering importers, establishment of a quota system, control mechanisms for selling, maintenance of import, selling, purchase and service providers statistics. This regulation is more relevant to the operational stage of the project.
5.10 Maldivian Land Act, 2002

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

In accordance with section 3 of this Act, land shall be allocated for the following purposes and uses: for the construction of households and buildings for residential purposes, for commercial use, for social use, for environmental protection and for government use.

Clause 38 of the Act states the conditions for articles discovered during the excavation of land. Sub-clause A states that except for coconut palms owned by the person, all other natural resources and gold, silver, jewellery, money, utensils, historical artefacts and metals that do not have a legal owner shall be a property of the government. Sub-clause B states Any jewellery, vessel or money or artefacts or metal as mentioned in subsection (a) of this section, if found in the soil of Maldives then the party who found the articles. As the project is being undertaken in Hulhumale’, an artificially reclaimed land, it is highly unlikely the clause will come into effect.

5.11 Land Use Plan and Implementation Regulation

Under the Maldivian Land Act of 2002, all lands in the islands under the lands development policy, a Land Use Plan shall be developed and approved from Ministry of Housing and Infrastructure prior to use of the lands. The regulation outlines key aspects that need to considered while preparing land use plans as well as describes guidelines on developing and allocating lands for various purposes. In this regard, various categories of lands are identified under which a government agency shall implement the land use plan.

The project falls under Category D, which are described as islands reclaimed as special projects. The land use plan will be made for such islands by the developer as stated in the regulation, which in this case is HDC.
5.12 Condominium Law 2006

Condominium Law or ‘Emmedhu Imaaraathaa behey Qavaaidhu’ came into effect on 21st May 2006. The law states that a Condominium is defined by buildings in which in different tenants own floor areas/apartments in the same building, as would be the case in this project.

Clause 18 of the law states that Public Spaces and Services in Condominiums will have to be maintained by the tenants.

Clause 19 of the law states that It has to be stated in the contract on how Public Spaces and Services in Condominiums will be monitored and maintained.

Clause 20 of the law states that apartments in condominiums can only be owned by local citizens of the Maldives.

The tenants would need to be contractually obliged to maintain the building.

The law is very brief and is in need up revision considering the many upcoming condominiums projects such as these.

There should be elaboration on the penalties upon tenants if they do not oblige with the predefined maintenance setup, which is unanimously agreed among the tenants, or is predetermined by the developer. This is to ensure that the buildings are maintained properly and is not subject to decisions made by individual tenants. Proper maintenance of the building is key for the project to be sustainable and to ensure the building area is liveable for the long term.

5.13 Permits required for the Project

5.13.1 Design Approval

The floor plans and design has to be currently approved by Housing Development Corporation (HDC). The approval is attached in the Annex 3. There need not be any approvals required from the Ministry of Housing Infrastructure to implement the project. However, detail design would still need to be certified by an Engineer approved by the Ministry.

5.13.2 Dewatering Permit
A dewatering permit shall be obtained from EPA prior to undertaking any dewatering works. Before dewatering approval is given, an EIA would need to be done if the project falls under ‘Jadhuvalu R’ of the EIA regulations.

5.13.3 EIA Decision Statement

A decision regarding this EIA from the Environmental Protection Agency (EPA) need to be obtained before construction commences. The EIA Decision Statement, as it is referred to, shall govern the manner in which the project activities must be undertaken. This EIA report assists decision makers in understanding the existing environment and potential impacts of the project. Therefore, the Decision Statement may only be given to the Proponent after a review of this document following which EPA may request for further information or provide a decision if further information is not required.

5.13.4 Building Use Permit

A building use permit is required to be obtained from HDC upon completion of the proposed building. HDC projects and/or engineering team will undertake a final inspection of the development to determine if there are any defects and if the building conforms to the development guidelines as provided by HDC.

Prior to commencing living in the apartment units, water connection approval would need to be obtained from MWSC and electricity connection approvals would need to be obtained from STELCO.
6 Identification of Impacts & Significance

This section is based on the potential environmental impacts due to the project components including:

- Excavation and Dewatering
- Material sourcing, transport and storage
- Site setup and establishment of utilities
- Operation of own gensets and RO plants at site
- Fuel handling and storage
- Construction of the foundation
- Super structure construction and masonry works
- Waste management
- Building operation
- Building maintenance
- Long term social issues

The section describes the mitigation measures for each identified impact. Since the components are all building related some impacts are general to all the components of the project, and some are specific. Likewise, the same applies for the mitigation measures. Methods of identification of potential impacts and assessing the significance of the impacts are described in the following sections.

6.1 Identification of Impacts and their Significance

Impacts on the environment from various activities of the proposed project have been identified through:

- Public consultation with important stakeholders. Including during the scoping of the project and formulation of the Terms of Reference for the EIA.
- Using decision frameworks for assigning significance to impacts
- Existing environmental studies carried out similar developments in other similar environments, especially that 7000 and 2500 housings units project.
- Research data that has been accumulated specific to the Maldivian context.
- Baseline environmental conditions collected.
- Experience of the consultants with similar projects.
Possible negative impacts on the environment have been considered in worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in the implementation phase.

The impacts highlighted in the TOR for this EIA has been used as a guideline in identifying important impacts. However, this was not used as a strict instruction for the identification. Once new impacts not highlighted in the TOR were foreseen, they were given equal importance.

Following are the major types of negative impacts that commonly occur due to the implementation of building construction projects in Greater Male’ City.

- Loss of visual amenity during demolition and construction
- Loss of vegetation and impact on terrestrial habitats
- Groundwater degradation
- Mosquito growth
- Noise Pollution
- Air Pollution
- Traffic disruption leading to congestion
- Generation of building and construction waste
- Impact on adjacent structures
- Health and safety of workers and neighbours
- Generation of household waste during operational phase
- Building maintenance issue
- Fire risk hazards

Among these, several impacts do not apply to this project due to the barren undeveloped area this project is proposed to be undertaken.

As such, there is virtually no visual impact during construction, negligible noise pollution, no traffic disruption, no impact on vegetation and no impact on adjacent structures.

The project impact area is the project site as shown in the Figure 2 showing the study area, with no significant impact anticipated beyond the area.
6.2 Description of Impacts

6.2.1 Loss of visual amenity during demolition and construction

There is no existing building at the site and therefore there is no impact from demolition. There are no other receptors near the project site as well. The visual impact would be short in nature and receptors will only be other construction staff. The magnitude of impact will be very low and can be regarded as negligible.

6.2.2 Loss of vegetation and impact on terrestrial habitats

As this project is to be undertaken on a newly reclaimed land, there is no impact on vegetation.

6.2.3 Groundwater degradation

The major cause for concern with regards to groundwater is the water extraction process, dewatering, to lay the foundation. Dewatering would remove a moderate volume of water from the project site. Although the depth is not significant, a large area will be excavated and need to be dewatered to an extent. This water will be disposed towards the lagoon. The impacts of the operation are short term.

The short-term impacts due to dewatering is mainly the impact on the groundwater lens due to saline intrusion resulting from coning and the impact of such sudden increase in salinity on the freshwater lens near the site. As stated previously, there are no mature trees that will undergo an impact from this. The sudden increase in salinity in the area will not have any impact.

Further impacts on ground water may occur due to contamination from spills, mishandling of chemicals, paint and fuel.

Considering the cumulative impact from many other similar developments in the area, it can already be observed that the ground water quality has somewhat deteriorated. However, the freshwater lens will likely regain its shape once the dewatering phase for all the projects are completed.

6.2.4 Seawater degradation

The dewatered water is proposed to be discharged out to the lagoon east of the project site.
There will be sedimentation impacts on the lagoon resulting in poor water quality in the immediate area for the duration of dewatering. However, this impact will be minor especially if only overflow water from a trench made nearby is allowed to be discharged into the sea. Further impact on seawater may occur from brine discharge. However, this will be a very short term and insignificant impact.

6.2.5 Mosquito growth

Mosquito growth has become a significant issue at all major construction sites, due to potential spreading of dengue among other diseases. Mosquito growth at construction sites mostly occur due to negligence. After foundation is laid, and construction takes place at ground floor and beyond, the elevator pit is usually left without any such construction. More significantly, after excavation, if the fresh water lens is left exposed mosquito growth occurs at dewatering sites as well, especially when the dewatering operation is suspended for some reason after commencement. Any area that water is left to accumulate and left without intervention provides a favourable environment for mosquito growth.

6.2.6 Noise Pollution

As stated previously under Description of the Environment, ambient noise pollution in the area is low due to lack of consistent activity in the area. However, once all the constructions work commences, noise emission will be high. Even though noise emissions are expected to be high, there will not be any significant receptor of the noise in the barren land. Construction activities will increase the amount of noise, especially during the concrete mixing operations. Also, there will be consistent noise emitted from Stationary equipment such as air compressors, cranes, and generators. They generally run continuously at relatively constant power and speed, although sound levels may vary according to the work cycle (e.g., loading). These types of noises are temporary and are relatively intermittent. As there aren’t much receptors at site, the significance is negligible to minor. As there are not any notable receptors near the project area, the impact will be very low.

There will be a cumulative impact with other similar developments nearby. It is likely that at the peak of construction, the area will emit noise in excess of 65-70 dbA. The main receptors of this impact will be construction staff. If they follow safety standards, impacts will be low.
6.2.7 Air Pollution

Air pollution is an issue during construction when debris maybe seen accumulating in the project area. Impact of debris on human health is significant. Pollutants will include dust from demolition, excavation, movement of transportation vehicles, loading and unloading of materials, earthwork and during concrete mixing work. Dusts may also be transported to surrounding areas by wind, affecting residents and workers of surrounding areas. The most significant activity would be the operation of the batching plant.

In addition to dusts and debris, harmful gases released by heavy machineries and vehicles and other construction work include carbon monoxide, carbon dioxide, hydrocarbons, and nitrogen oxides. Other harmful gases can be released from vapors of oils, glues, thinners, paints and wood treatment during construction and interior finishing. These are all atmospheric pollutants and can also cause respiratory problems and other detrimental health issues upon repeated inhalation.

The diesel generator at site will emit greenhouse gases to the atmosphere. However, a more notable issue would be if incomplete combustion regularly occurs. Emissions will include carbon dioxide, carbon monoxide, nitrous oxides, of fine particulate matter.

Considering cumulative impact, the area will have higher amount of dust and debris compared to background amounts. However, the only receptors would be construction staff.

6.2.8 Lead based paints

Using lead based paints could have very serious cumulative long-term impacts on the residents of the apartment building during operation stage. Children and Pregnant woman are especially vulnerable to the effects of lead. This is important to consider as families will be occupying the building after construction is completed. Prolonged exposure to lead based solvents also lead to high blood pressure, hypertension, issues with the kidney and reproductive system in healthy adults. Furthermore, the impact on children include mental and growth issues.

6.2.9 Generation of building and construction waste

There will be a significant volume of building and construction waste generated from the construction area. This would result in a negative input to the environment and can be a nuisance to the surrounding areas. Construction waste such as wood, concrete, metals, bricks, plastic and domestic waste will be generated in addition to excavated waste and municipal
waste. The impact of the waste will be localised as waste should not be placed outside the site under any circumstances.

### 6.2.10 Health and Safety of workers

Health and safety of workers have been discussed to some extent under noise pollution and air pollution. As stated in the preceding sections, the construction site will indeed be a health hazard and care must be taken always while at or near the site. Moreover, in addition to impacts arising from noise and air pollution, there is also the significant possibility of direct impact from accidents from the work area. This has already been discussed under Section 2.4 and Section 2.5. Further accidents could occur due to falling objects, misplaced equipment and materials, temporary structures not properly fixed, etc.

### 6.2.11 Social Issues due to population concentration

Numerous social issues are envisaged due to the concentration of population in one area. Similar points were highlighted in the 7000 housing units project. Issues ranging from indecent behaviour, intolerance among community members, conflicts in between to full fledged crime are real concerns. Similar social housing based condominium type projects in Male’ (most notably Senahiya and Male’ hiya) has resulted in such issues getting repeated time and time again. This will have an impact on virtually all the residents living in the apartments once fully operational. The impact will be cumulative and will increase in magnitude with time unless proper intervention is not in place.

### 6.2.12 Alleviating congestion issues in Male’

Male’ is already among the most densely populated island cities in the world. Based on the 2006 census, the population density of Male’ is 18,000/km². Currently over one third of the total population lives in Male’. It is a widely held belief that projects of these types in Male’ contribute to alleviating the ever increasing population in Male’. More housing has traditionally resulted in more migration to the Male’, and the process has continued to grow exponentially.

Decentralisation is a key policy for all the major government stakeholders and policy makers and this has resulted in reducing the increase in the population density. One of the key actions for this has been the development of Hulhumale’, which has resulted in people moving to the island away from Male’.

Hulhumale’ offers more public spaces, better ventilation, and an overall better environment compared to Male’, and therefore it is a positive impact to offer more housing in the area,
albeit with some controls in place to preserve the current environment. From a planning perspective, there are important factors to consider as constructing large buildings in close proximity will lead to congestion issues.

### 6.2.13 Fire hazards and impacts

The dangers of fire risks and hazards increases with increasing congestion and poor urban planning and individual developments also largely contribute in the potential of fire incidents as well as risk minimization once a fire breaks out.

The risks posed by potential fires is great in terms of social, economic and environmental impacts. It is a huge threat to health, life, livelihood and possessions of the individuals and community. While there would be losses which are irrecoverable, financial burden associated in the recovery process would be heavy. Furthermore, environmental costs coupled with smoke and toxic fumes that would pollute the air, leachates that would contaminate the soil and water lens and also the loss of resources would be difficult to quantify.

The impacts need to be addressed through prevention, impact minimization measures and efficient responding mechanisms. Awareness and drills also plays a major role in determining the potentials impacts that can be avoided or minimized.

### 6.3 Impact Significance Assessment

This section provides a summation of the impacts of the project components discussed above. The impacts of the project have been evaluated as per the criteria proposed by Posford Haskoning (2004). The decision framework is given in the following figure.

In order to make the evaluation quantitative, the framework proposed by Haskoning has been modified. Spatial distribution of impact is also added in order to make the significance of the impacts more realistic. Scores are given for each impact once it is identified that the resource is vulnerable to the impact. Scores are based on the following factors.

- Sensitivity of Receptor
- Recoverability of Receptor
- Importance of Receptor
- Spatial Distribution of impact

The scales associated with the above criteria are given in the Table 8.
EIA for the proposed 1394 social housing units development project in Hulhumale’ Phase II

Proponent: Housing Development Corporation
Table 8 Impact Evaluation Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scale</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>How sensitive the receptor is to the impact</em></td>
<td>-1</td>
<td>Positive Effect</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Not sensitive</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>High</td>
</tr>
<tr>
<td>Recoverability</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>How long it would take for the receptor to recover from the impact</em></td>
<td>1</td>
<td>Short</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Non-recoverable</td>
</tr>
<tr>
<td>Importance</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The importance of the receptor to the environment</em></td>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>High</td>
</tr>
<tr>
<td>Spatial Distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Distribution of impact</em></td>
<td>1</td>
<td>local scale</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>regional scale</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>global scale</td>
</tr>
</tbody>
</table>

If the impact receives a -1, it deems the impact to have a positive effect on the receptor and the other criteria is then not applied. The impact is referred to as a Beneficial impact as is done by the Haskoning framework.

The significance of the negative impacts will be given based on the following range:

- 1 – 5: Minor Impact
- 6 – 9: Moderate Impact
- 10 – 12: Major Impact
Table 9 Analysis of potential impacts and their significance

<table>
<thead>
<tr>
<th>Potential Impact</th>
<th>Nature of Impact</th>
<th>Significance Evaluation Criteria</th>
<th>Spatial Distribution</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct/Indirect</td>
<td>Immediate &amp; Cumulative</td>
<td>Sensitivity</td>
<td>Recoverability</td>
</tr>
<tr>
<td>Loss of visual amenity during demolition and construction</td>
<td>Direct</td>
<td>Immediate &amp; Cumulative</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Air pollution during demolition and construction</td>
<td>Indirect</td>
<td>Cumulative</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Groundwater degradation during dewatering.</td>
<td>Direct</td>
<td>Immediate &amp; Cumulative</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Groundwater degradation due to mishandling of chemicals/paint/fuel</td>
<td>Direct</td>
<td>Immediate &amp; Cumulative</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Direct</td>
<td>Cumulative</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------</td>
<td>------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Mosquito growth during dewatering stage, and at locations where structural construction is scheduled at a later stage</td>
<td>Direct</td>
<td>Cumulative</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Noise pollution during construction.</td>
<td>Direct</td>
<td>Immediate</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Disruption of regular traffic and traffic congestion</td>
<td>Direct</td>
<td>Immediate</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Generation of waste oil and building and construction wastes</td>
<td>Direct</td>
<td>Cumulative</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Impact on residents due to use of lead based paints</td>
<td>Direct</td>
<td>Cumulative</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Health and safety of workers</td>
<td>Direct</td>
<td>Cumulative</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fire hazards and impacts</td>
<td>Direct</td>
<td>Immediate</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Indirect contribution to alleviating congestion in Male’</td>
<td>Indirect</td>
<td>Cumulative</td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>Social issues due to population concentration</td>
<td>Indirect</td>
<td>Cumulative</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>---------</td>
<td>-----------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Waste Generation during the operational stage of the project</td>
<td>Direct</td>
<td>Cumulative</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Indirect Economic impact on the community, by creating additional jobs for construction, landscaping and building maintenance</td>
<td>Indirect</td>
<td>Cumulative</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>
The potential impacts, their significance and mitigation measures to be undertaken are given in Section 6 for the construction and operation phase together since the components of the project are all continuous processes.

In conclusion, the project will have minor to moderate impacts on the environment.

Compared to similar other developments in Hulhumale’, the proposed construction is in a relatively remote area. Therefore, impacts during construction will be even less. While some moderate impacts are important, probability of these impacts occurring are rather low.

### 6.4 Uncertainties in Impact Prediction

The impact prediction has been carried out based on literature and tested methods. However, the prediction relies heavily on the judgement of the consultant, and would therefore lead to uncertainties. Alternatively, such projects as has been described in this report has been carried out on numerous occasions in Male’ and Hulhumale’. Therefore, observing past literature on a local context, the uncertainty would be reduced. However, the issue is that no long term monitoring exists for such developments, and therefore there are major unknowns as to the direct impact due to the project.

Based on this, the level of uncertainty in the case of the proposed project may be expected to be moderate as similar projects in similar settings is ongoing. The uncertainty can be further reduced once some of these projects are completed and a final assessment of the impacts that has occurred is made in a comprehensive monitoring stage.

Uncertainties will be significantly reduced by undertaking the monitoring program and re-analysing impacts, after comparing the monitoring data with the baseline data in this report and previous recent environmental studies done for Hulhumale’.
7 Environmental Management and Mitigation Measures

Mitigation measures are proposed where significant impacts are expected. Once an impact is identified to have ‘moderate’ or ‘major’ impact, appropriate mitigation measures are given for the project, if possible.

Successful implementation of the measures given would lead to a major reduction and/or nullification of the impacts on the environment and thereby ensuring that the project is environmentally sustainable.

7.1 Mosquito growth

As a mitigation measure, some project managers put an oil layer on top to make the area inaccessible for mosquito growth. However, this also leads to groundwater contamination. For small pockets of unavoidable open water areas, it is recommended to put a lid on top of the area. This practice is already carried out by some contractors. Alternatively, regular monitoring of any water-logged area at the site can be carried out and removed or lidded with immediate effect. Daily inspection of the project site is required and any open stagnated water area should be removed or covered.

Dewatering works should not be suspended, and once started, the area should be entirely dewatered and shoring works completed to ensure that open water will not be present in the area for a long term.

According to HDC, vegetated areas in Hulhumale’ phase 2 are fumigated on frequent intervals as a measure to control mosquitoes. It is recommended that the same is carried out for construction and temporary sites.

7.2 Water quality degradation

Short term groundwater quality impacts due to dewatering is unavoidable. However, the magnitude of the impact on the groundwater aquifer can be mitigated by dewatering inland rather than towards the lagoon. Likewise, this will mitigate the sedimentation impact on the lagoon due to dewatering as well. As recommended under the Alternatives section, dewatering should occur in land to a site close to the project area, and is not used currently.

Ensure fuel storage and handling areas are constructed in concrete and that any water in the area will not be drained to the ground.
7.3 Noise Pollution

Noise protection gears such as ear muffs are to be used by workers on site. Components that require heavy vehicles such as casting of the slabs and columns are scheduled to be undertaken on weekends. Works emitting noise at high decibels should not to be encouraged to be undertaken during night hours. Furthermore, the boundary wall should be able to contain some amount of noise within the project site. Noise barriers could be further used for noisy plants.

7.4 Air Pollution

For mitigation, dust screens and regular water spraying and dampening should also be practiced to reduce the spread of dust to surrounding areas. Dust screens should be erected to cover the scaffolding consistent with the increase in elevation of the structure.

All heavy machineries should be inspected and fine-tuned to make sure the harmful gases released to the atmosphere do not exceed allowed standards.

Building materials should be covered or contained during loading, unloading and storage. The boundary wall or fence should also be able to restrict the movement of dusts and debris within the project site.

Construction workers should wear dust masks during dust sensitive work always.

For the buildings, proper ventilation should be ensured for each housing unit and toilet/bathroom areas. Kitchen areas should be highly ventilated as well. Furthermore, building corridors should be ventilated either mechanically or naturally.

7.5 Lead based paints

Use of lead free paints is recommended. If under any circumstances, lead based paint is used, the tenants should be well informed and the painted surfaced in the housing units should be inspected and maintained regularly. It is recommended not to use lead based paints altogether.

7.6 Generation of building and construction waste

It is recommended to re-use as much construction waste as possible, although this may be difficult to manage. The reusable waste includes wood and blocks. Metals can be recycled, and a recycling group can be contacted to remove such materials. WAMCO will likely provide assistance on this. Reusing formwork material as much as possible
is another measure that can be taken to reduce waste. All such recyclable or reusable wastes should be segregated on site.

Waste that cannot be reused or recycled (which will be in the majority) are to be taken away from site for disposal. The contractor has to collect and store the waste at site. These include any waste oil and other hazardous type waste, which all should be collected separately. They are to be transported to Thilafushi on a regular basis; likely weekly, which would be facilitated by HDC.

### 7.7 Health and Safety of workers and neighbours

Awareness of the works on site is the first and foremost mitigation measure that can be taken to reduce any risk of accidents and other minor health impacts. For awareness, the commonly used method is to put up warning signs around the project area. These include:

‘Caution: Construction works in progress!’.

“Warning: No entry beyond this point!”.

“Wear Safety Hats at all times!”, etc.

Aside from awareness, second method is to encourage wearing safety cloths and equipment at the construction site always. This applies more to construction workers. As such, they should be instructed to wear safety helmets always, dust masks during sensitive work, conspicuous fluorescent cloths, earmuffs, safety shoes, etc.

All loose or semi loose component such as temporary roofing, scaffolding should be made tighter to prevent any harm in surrounding areas especially in an event of storms and strong wind.

The measures given under Safety on site section in this report should be followed.

### 7.8 Fire Hazards and Risks

Factors such as standard building setbacks, planned road networks and parking itself contribute as important features to minimize fire risks and also shall facilitate in the responding to emergency situations more efficiently to minimize the loss. Furthermore, fire hydrants are expected to be integrated into Hulhumale’ phase 2.

Moreover, individual developments also have a crucial role to play in ensuring the fire safety and risk minimization. It needs to be addressed in the planning, design,
construction and operation stages of the development. Building materials and design perform a central role in providing the optimum fire safety. However, it is also important that due care is taken not to either neglect sufficient and necessary features in the design for risk minimization or on the other hand grossly over design where neither would be sustainable. Risk assessments to determine the level necessary measures would contribute in reaching a balance in addressing the matter.

Some of the key measures include integration of dry riser and wet riser systems into the setup at each floor. It is important to ensure all firefighting equipment including fire alarms and fire extinguishers are present and in working condition in each apartment. It is also recommended to equip each floor with build in sprinkler systems. Fire drills are also recommended to be undertaken on a frequent basis.

7.9 Social issues due to population concentration

Interventions can be put in place from the start to prevent exasperating social issues. These ranges from legislative implementations, social interventions, to strict enforcement. As suggested in the 7000 housing units EIA study, it is recommended to have in place a community police setup within the project area. Also, CCTV should be in place to ensure security of all residents. Likewise, any alleyways or pathways in both inside the buildings and in the land area should be properly lit at all times.

Programs can be held frequently which involves the apartment blocks community, creating awareness to social issues and how to prevent them. Troubling tenants can be penalised, while good behaviour can be encouraged by various reward systems targeted for tenants. It is very important to have a corporate management system established specifically for the project area from the start, which will provide an outlet for tenants to reach out at all times. Moreover, and even more importantly, such a body shall ensure that the buildings are properly maintained at all times.

7.10 Waste Management
Waste management is the main issue during the operational stage of the project. A large number of wastes will be generated from 1394 apartments in a concentrated area. Currently the proponent has stated that this is a service that would be provided to the tenants free of additional costs, and assured that daily collection and disposal services will be offered by the developer and they will be fully overseeing operations. However, this may not be the case on a long-term basis.

In addition to the general waste management method, recyclables from non-recyclables should be segregated at the source. Tenants should be informed on the type of waste that are regarded as recyclables and non-recyclables. They should be informed on how the waste are to be collected in their units. The waste should be collected on a daily basis and transported to the waste management area in the ground floor, and placed in appropriately labelled bins for recyclables and non-recyclables. Images such as given in the Figure 11 below could be used. This will reduce the total no. of waste produced and the system will be easier to manage ensuring sustainability.

The enclosed garbage collection area in each floor of the buildings shall be closely maintained at a daily basis.

![Acceptable recycling items](http://www.huonvalley.tas.gov.au/services/waste-2/)

![Unacceptable recycling items](http://www.huonvalley.tas.gov.au/services/waste-2/)

Figure 11 Indicative image for recyclables and non recyclables (source: http://www.huonvalley.tas.gov.au/services/waste-2/)

Furthermore, it is recommended for the developer to put in place a system for hazardous wastes such as batteries and large waste collection. It is important to inform tenants to not dispose hazardous wastes including batteries along with normal household wastes.
It is recommended to collect large wastes on a quarterly basis and upon demand. The developer/operator would need to coordinate with WAMCO to schedule to remove such waste as per the generation volume.

Table 10 Mitigation management plan summary

<table>
<thead>
<tr>
<th>Mitigation measures</th>
<th>Implementing Responsibility</th>
<th>Implementing Stage</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ground water degradation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispose water to site as shown by HDC for ground water recharge</td>
<td>Project Engineer</td>
<td>Construction</td>
<td>65,000 MVR</td>
</tr>
<tr>
<td>Regular monitoring of groundwater condition on site</td>
<td>Project Engineer</td>
<td>Construction</td>
<td>750 MVR/test</td>
</tr>
<tr>
<td>Ensure concrete flooring in all areas where fuel storage and handling is practices</td>
<td>Project Engineer</td>
<td>Construction</td>
<td>Apprx. 45,000 MVR</td>
</tr>
<tr>
<td><strong>Mosquito Growth</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure still water does not remain on site</td>
<td>Site Supervisor</td>
<td>Construction</td>
<td>na</td>
</tr>
<tr>
<td>Put lids or pump out water from areas prone to water accumulation</td>
<td>Site Supervisor</td>
<td>Construction</td>
<td>10,000 MVR</td>
</tr>
<tr>
<td>Ensure dewatering process does not get suspended midway and fully complete dewatering</td>
<td>Project Manager</td>
<td>Construction</td>
<td>In project cost</td>
</tr>
<tr>
<td>Ensure daily fumigation of both construction site and temporary site</td>
<td>Site supervisor</td>
<td>Construction</td>
<td>8,000 MVR per month</td>
</tr>
<tr>
<td><strong>Noise Pollution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For workers, use of earmuffs at construction site.</td>
<td>Project Manager</td>
<td>Design</td>
<td>In project cost</td>
</tr>
<tr>
<td>Construction to be scheduled in such a way that noise pollution will be at a minimum to the public.</td>
<td>Project Manager &amp; Site supervisor</td>
<td>Design and Construction</td>
<td>In Project cost</td>
</tr>
<tr>
<td>Ensure proper site demarcation and boundary wall condition before commencing such work</td>
<td>Site supervisor</td>
<td>Construction</td>
<td>In Project cost</td>
</tr>
<tr>
<td>Place noise barriers around noisy plants</td>
<td>Site Supervisor</td>
<td>Construction</td>
<td>15,000 MVR</td>
</tr>
<tr>
<td><strong>Air Pollution</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers should be made to wear dust marks during dust sensitive work.</td>
<td>Project Manager</td>
<td>Construction</td>
<td>In Project cost</td>
</tr>
<tr>
<td>Place dust screens demarking the concrete mixer</td>
<td>Project Manager</td>
<td>Construction</td>
<td>In project cost</td>
</tr>
</tbody>
</table>
Daily water spraying and dampening to reduce spread of dust to surrounding areas.  | Site Supervisor  | Construction  | In Project cost  
---|---|---|---  
Inspect and fine-tune all machinery and vehicles before work commencement to ensure harmful gases released to atmosphere are at a minimum.  | Site Engineer  | Construction  | In Project cost  
Cover building materials such as cement and sand, and should be contained during loading, unloading and storage.  | Site Engineer  | Construction  | In project cost  
Surfaces in the housing units should be painted with lead free paints.  | Project Manager  | Construction  | In Project cost  
Ensure ventilation throughout each building, including common areas and corridors  | Project Engineer  | Design and Construction  | In project cost  

**Water quality degradation**  
Undertake all dewatering inland rather than towards the lagoon. Ensure water gets percolated to the ground  | Project Manager  | Construction  | In Project cost  

**Traffic Congestion**  
Schedule transport of heavy-duty vehicles to site during off peak hours such as the morning.  | Project Manager  | Construction  | 0  

**Generation of building and construction waste**  
Re-use construction waste where possible.  | Project Engineer  | Construction  | 0  
Metals are to be collected separately and handed over or sold to a metal recycling group.  | Site supervisor  | Construction  | 0  
All waste should be segregated on site.  | Site supervisor  | Construction  | 5,000  
During and straight after demolition works, all waste that cannot be recycled or reused, are to be transported daily to the waste disposal site in Thilafushi.  | Site supervisor  | Construction  | In Project cost  
Reusing formwork material as much as possible.  | Site supervisor  | Construction  | 0  

**Health and safety of workers and neighbors**  
Undertake health and safety training for workers before project commencement.  | Project Manager  | Pre-Construction  | In Project cost  
Put up warning signs around the project area including signs indicating ongoing works, and restricting entry into the project area, and signs reminding the use of safety gear at site.  | Project Manager  | Construction  | In Project cost  
Encourage use of safety cloths and equipment at the site at all times. These include safety helmets, dust masks, conspicuous fluorescent cloths, earmuffs, safety shoes, etc.  | Project Manager  | Construction  | In Project cost  
Ensure there are no loose materials or loose components of the temporary or permanent structure  | Site Supervisor  | Construction  | 0  

**Social issues due to population concentration**
### Ensure CCTV cameras in place to cover all areas within the area

| Ensure CCTV cameras in place to cover all areas within the area | Project Manager | Construction | n/a |

### Establish a community police setup

| Establish a community police setup | Project Manager | Operation | n/a |

### Ensure project area is properly lit at all times

| Ensure project area is properly lit at all times | Property Manager | Operation | n/a |

### Setup a property management body with the responsibility of maintaining the building quality

| Setup a property management body with the responsibility of maintaining the building quality | Project Manager | Operation | n/a |

### Setup a reward and penalizing system for tenants to encourage good behaviour

| Setup a reward and penalizing system for tenants to encourage good behaviour | Property Manager | Operation | n/a |

### Fire risks and hazards

<table>
<thead>
<tr>
<th>Ensure fire hydrants and alarm systems are present and in working condition</th>
<th>Project Manager</th>
<th>Construction &amp; Operation</th>
<th>In Project cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undertake fire drills</td>
<td>Project Manager</td>
<td>Operation</td>
<td>In Project cost</td>
</tr>
<tr>
<td>Implement sprinkler systems in each floor.</td>
<td>Project Manager</td>
<td>Construction</td>
<td>In Project cost</td>
</tr>
</tbody>
</table>

### Generation of household wastes

<table>
<thead>
<tr>
<th>Separate collection of recyclables and non-recyclables at the building and transport the waste</th>
<th>Maintenance officer</th>
<th>Operation</th>
<th>In Project cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect hazardous wastes in separate containers.</td>
<td>Maintenance officer</td>
<td>Operation</td>
<td>In Project cost</td>
</tr>
<tr>
<td>Have a quarterly large waste collection schedule in place</td>
<td>Maintenance officer</td>
<td>Operation</td>
<td>In Project cost</td>
</tr>
</tbody>
</table>
8 Alternatives

This section looks at different alternatives for the proposed project. The main alternative is the no project option. After discussion of this alternative, options for the project components are investigated. Alternatives are given for each component based on location and design. Each alternative is discussed based on economic, social, and environmental factors.

These alternatives are not as intensively investigated as the original scope of the project. However, investigating and discussing alternatives is important so that it is ensured that the best available option(s) is/are chosen to solve particular project issues.

8.1 No project option

Initially the no project option is discussed to hypothesise whether the project should be taking place first of all. This is an important exercise to avoid such a scenario and to ensure that undertaking this project at this stage makes good socio-economic sense without any significant impact on the environment. The discussion on no project option is similar to all other similar developments in Hulhumale’, especially to the 2500 housing units development project.

The no project option is analysed on the basis that no such project is to take place in Male’ City, and not specifically for this development. As this development is part of a larger program, discussing no project option for this specific project alone will not make much sense. The no project option is therefore not very much applicable as the project has been given the go ahead in the planning stage, and the decision does not seem reversible at this stage.

Nevertheless, the advantages and disadvantages of not undertaking the project is given below.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will not lead to health and safety concerns at project site during construction</td>
<td>Will not be able to alleviate the issue of large number of people living in small crowded places in Male’</td>
</tr>
</tbody>
</table>
### 8.2 Project Alternatives

Alternative options; mainly based on design and methodology for the construction are given below.

<table>
<thead>
<tr>
<th>Will not cause any traffic issues and noise and air pollution at project location</th>
<th>Will decrease economic opportunities for construction companies and their employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>The land can be used for other alternative uses such as public open area, commercial area, or tourist areas, which will all result greater revenue for the developer.</td>
<td>Will leave a large area of land unutilized in a land scarce area. Other commercial uses of the land will deprive the opportunity to provide housing options to a large population living in Male’ who has been deprived of housing opportunities for generations.</td>
</tr>
<tr>
<td>Other commercial uses for the land will increase the economic activity of Hulhumale’, which is currently quite stagnant.</td>
<td>Will hinder the development of Hulhumale’, and especially Phase 2</td>
</tr>
<tr>
<td>Will not lead to production of waste at a concentrated site as the proposed area</td>
<td>Easier to collect waste from a single point source rather than housing units dispersed over a wide land area.</td>
</tr>
</tbody>
</table>

A comparison of the no project option with the project going ahead as proposed, indicate that the no-project option is possible, but involves losses to the developers if no other activity is undertaken in the land. If in the event, alternative uses are proposed and developed in the land, it may be a more profitable option for the developer. However, one of the key issues of the country which the project aims to resolve, will be left unresolved in such a case.

There are a few advantages of the no project option from an environmental perspective, although they are not strong as impact from the project is minor. Local environmental impact from this project is small in nature, and the advantages stated is not significant, since most of the environmental impacts can be properly mitigated.
8.2.1 Project Location

Alternative locations are not as important for this project, as the location cannot be changed under any circumstances. The plot had been decided by HDC at the planning stage. Even if location can be changed at this stage, there are no particularly better alternative locations.

8.2.2 Building Height

Building height has also been approved at the planning stage like all other similar developments. While it will lead to congestion of population at a point source, there are advantages such as easy management of housing units. As an example, waste management will be more convenient for the municipal service provider as collection from the point source would be easier than collecting waste from dispersed housing units. However, there are social issues that will arise from a large number of people living together as well. These will need to be properly managed by the developer.

8.2.3 Project design

Several components of the project design can be changed, taking the community more into consideration, such as:

Making space for a mini mall or office space for the first 4 or 5 floors so that it would provide activities in the area. Vertical development is important since it would encourage shop/office goers to get concentrated to particular areas, rather than spread out into the streets as the case in Male’ thereby making them crowded & disrupting traffic. Providing more of such amenities in the building will have further advantages.

Provide a larger parking space within the building. The current parking space proposed will likely be sufficient for the tenants of the building. But a larger public parking space or visitor parking space would alleviate potential parking issues for Hulhumale’. Providing such a space in the building will therefore be an important service to the community.

Design for a rooftop garden area and incorporate green walls, which will contribute to making the city greener, while improving the natural aesthetics of the area while also continuing with the infrastructure development in the given area.

Energy generation and usage is another important factor that can be considered in design. Currently it is proposed to only depend on power generated by STELCO. However, a more efficient system would to incorporate solar panels within the building.
The solar power generated can be used to power the utilities and appliances in the common areas at least. Furthermore, energy efficient lighting and water saving shower heads can be incorporated as part of the project to make the building more energy and water efficient.

These project designs are given as suggestions, the feasibility of which the developer should take into consideration before implementation.

### 8.2.4 Building maintenance

There does not seem to be a rigid building maintenance plan proposed specific for the project. However, considering the general convention followed by the developer for similar developments, the developer is in charge of building maintenance. It is also possible for a system to be followed such that a steering committee is chosen among the tenants, which in turn will have the responsibility of collecting fees and hiring maintenance teams.

For a social housing project such as this, it can be foreseen that some issues may arise if responsibility for collecting fees and undertaking maintenance is given to the tenants. It will be more efficient and more sustainable if a maintenance figure is ‘built into’ monthly payments by each tenant. As HDC is currently already undertaking such maintenance work, HDC can carry out the fee collecting and maintenance works. Alternatively, HDC can hire a property management company to oversee the process. It will be a more sustainable model if fee is collected by HDC and maintenance works are handed over to a property manager for a monthly fee.

### 8.2.5 Foundation

A deep pile foundation can be constructed, which will likely provide more stability to the structure in the long term. The issue with piling is generally vibration impacts at nearby areas leading to tremors and cracks in nearby buildings especially old ones. The methodology has endured negative reception in Male’, most notably that of the Traders building (formerly Holiday Inn) at Athireege Aage. For the structure, metal load bearing piles were driven to depths of 30 to 40 metres. The deep piling, lead to several neighbours complaining of tremors and cracks in their walls. Due to the close proximity of buildings structures, use of deep pile technology may not be ideal for high rise buildings in Male’, but the case can be different for Hulhumale’.
As there are no structures at the project area, this issue is virtually negligible for the proposed project. Furthermore, with only 14 storeys developed over a large enough land area, the impact shall be much moderated.

Moreover, using bored piles would expedite the foundation process and reduce the impacts that may occur due to the project getting prolonged. It will also reduce impacts due to prolonged dewatering processes such as facilitating a medium for mosquito growth in the area.

It is recommended to finalise foundation methodology after a geotechnical assessment is undertaken at the project location.

### 8.2.6 Dewatering

The project proposes to dewater to the channel south of the project site. This is very straightforward, and is easy to implement for the contractor and prevents any flooding issues that may occur in land. However, this also means that a large amount of water will be lost from the groundwater aquifer which has formed over months after reclamation. As Phase II is largely barren land, any potential flooding can be mitigated easily. It is therefore recommended to dewater inland to an empty land close to the project site after excavating the area about 1.0-2.0m deep. This will ensure that water is contained in the allocated area, and sufficient time should be given for the water to seep into the groundwater aquifer.

### 8.2.7 Parking

The project proposes to allocate one parking spot for each apartment. In the similar but larger 7,000 housing unit project, it was reported that 2 parking spots were allocated for each housing unit. Based on the average motorcycle use in the greater Male’ area, this is the bare minimum amount of parking that is recommended for such buildings. Allocating one spot will only lead to more cycles being parked on public roads creating both nuisance and traffic issues. Therefore, it is recommended that 2 parking spots are allocated for each unit and ensure the design is revised to accommodate this. Moreover, it is favourable to establish a limited number of car parking areas at the project site as well.
8.2.8 Additional amenities

The proposed buildings are within a social housing project and therefore bare minimum has been offered for future residents of the area. The building area does not consist of any sites allocated for recreational purposes and any significant public areas appear to be absent. The currently proposed design may lead to significant socio-economic issues with a large population being secluded in an area without sufficient space for entertainment and relaxation. It is important to ensure the socio economic environmental issues that we had faced in Male’ is not repeated in future projects. And as such congestion is one of the major issues in Male’ and to prevent it, additional open spaces are recommended.
9 Stakeholder Consultations

Stakeholder consultations were carried out with the developer, contractor, and EPA in one sitting during the scoping meeting.

Further consultations were carried out with the Project Manager for the project, and other stakeholders such as STELCO, WAMCO, MWSC, HPA, MEE and MNDF. General discussions relevant to all similar developments that are currently being undertaken in Hulhumale’ were discussed previously in face to face meetings and through phone consultations. The project specific information was also shared via email requesting for any specific concern or other relevant input from the stakeholders. Separate meetings were held with MNDF Fire personnel.

Table 12 Important stakeholders met during the consultation process

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
<th>Office</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aminath Shaufa</td>
<td>Public Health</td>
<td>HPA</td>
<td><a href="mailto:shaufa@health.gov.mv">shaufa@health.gov.mv</a></td>
</tr>
<tr>
<td></td>
<td>Program Cordinator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ahmed Asif</td>
<td>-</td>
<td>MWSC</td>
<td><a href="mailto:ahmed.asif@mwsc.com.mv">ahmed.asif@mwsc.com.mv</a>,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><a href="mailto:ahmed.rabeeu@mwsc.com.mv">ahmed.rabeeu@mwsc.com.mv</a>,</td>
</tr>
<tr>
<td>Ahmed Rabeeu</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azzam Ibrahim</td>
<td>Senior Engineer</td>
<td>STELCO</td>
<td>+960 7782574</td>
</tr>
<tr>
<td>Ismail Ubaid</td>
<td>Facilities Manager</td>
<td>WAMCO</td>
<td><a href="mailto:ismail.ubaid@wamco.com.mv">ismail.ubaid@wamco.com.mv</a></td>
</tr>
</tbody>
</table>
Col. Abdulla Zuhury  | Commander MNDF fire  | admin@defence.gov.mv

Warrant Officer 1 Muanmar  | Prevention Officer  |

Seargent Mohamed Ashraf  | Design and Enforcement Incharge  |

Muawiyath Shareef  | Director Maldives Energy Authority  | muawiyath.shareef@energy.gov.mv

**9.1 Consultations with the Developer**

Meeting with the developer was initially held in early November 2017 and regular collaboration had occurred since then.

The developer informed that the main need to undertake the project from the contractor’s perspective was to secure finance from the bank, for which an EIA approval was required. Additionally, they have the need to undertake the project as environmentally sustainable as possible.

The developer ensured that the project will adhere to all the local regulations in addition to strictly complying to all health and safety standards. The main objective of the developer is to initiate the project soon.

The developer discussed regarding fears of large number of people living in the same area. As such, they informed that commercial areas will be developed as part of the project. The distance between the buildings have also been increased to achieve this objective.

The developer further informed that they expect financing for all upcoming housing projects to settle soon and expect construction to commence early as well.
9.2 **State Electric Company (STELCO)**

STELCO was met during the EIA scoping meeting on 28th November 2017 and extensive discussions had been undertaken then. Project specific details were initially communicated and all required feedback from STELCO was received at the meeting.

STELCO was consulted as the main power supplier for Hulhumale’ for residential, industrial and commercial areas as well. The company had previously informed that they are not regularly updated on the upcoming projects, although they are aware of the proposed project.

STELCO had informed that they had currently suspended all works in Hulhumale’ Phase II. They informed that as things stand, all contractors in Phase II area will need to provide power themselves. HDC is undertaking all civil works to setup power infrastructure in Hulhumale’ Phase II currently. STELCO will be the service provider during the operational stage.

9.3 **Male’ Water and Sewerage Company (MWSC)**

Project specific details have been shared with MWSC on 3rd December 2017. Although any additional points were not brought up by MWSC for this specific project, general issues in relevance to similar developments have been recently consulted (via email on 24th September 2017 and on 12th October 2017) with the Company.

MWSC provides water and sewerage services to the whole of Hulhumale’. MWSC also provides dewatering services to similar developments in Male’. However, it was informed that for such developments based in Hulhumale’, currently MWSC does not provide any such services.

Furthermore, MWSC has not initiated operations in Hulhumale’ Phase II as of yet. They had informed that the project for provision of water and sewerage services in Hulhumale’ Phase II is ongoing as per the agreed timeline with HDC. The water and sewer services will be provided to the developers/tenants as per the Phase II development plan they had received from HDC.

MWSC also discussed the issues of providing water at high pressure to high rise buildings. Currently MWSC can provide water services to 4 storey buildings at the
normal pressure maintained by the company. If the buildings are 4 storey and above, developers are required to use booster pumps in order to obtain required water pressure level. Furthermore, they informed that MWSC is in a process of formulating a guideline for provision of water to high rise buildings and currently the guideline is in approving stage.

### 9.4 Health Protection Agency (HPA)

HPA was notified of the project on 29th November 2017 with project specific information provided.

HPA had previously informed that information regarding upcoming projects were not shared with them. The main concern from HPA side had been with respect to workers health and safety on site, and issues with respect to hygiene. However, they mentioned that there were no local regulations or guidelines currently specifying the standards for health and safety of workers.

The other main concern from HPA was regarding mosquito control at construction sites. They informed that a survey had been undertaken recently in Male’ and the condition was quite bad at most site and they had notified numerous developers on the issue of mosquito growth at their sites. Details of the survey has not been published at the time. HPA informed that they do carry out inspections at site, and that some work had already been undertaken in Hulhumale’ as well.

HPA had previously that they are currently in the process of making regulations and guidelines which would enforce certain standards within construction sites with respect to both mosquito control and worker health and safety. However, this has not been published up to this date.

HPA did not have any further recommendations or comments specific to this project.

### 9.5 Waste Management Corporation Ltd. (WAMCO)

WAMCO was met on 24th September 2017 regarding Hulhumale’ phase 2 projects. They informed that all waste management in greater Male’ area has been handed over to them starting from January 2017. This includes waste collection, pickup and sorting, management of the waste site, and transporting waste to Thilafushi. However, they
informed that specific arrangement related to waste management in Hulhumale’ Phase II has not been finalised yet. However, WAMCO has started operating in Phase II now.

Regarding waste generated post construction, WAMCO informed that they will likely have a good setup running in Hulhumale’ Phase II at that stage. They are currently planning to pick up waste from sites on a daily basis. However, the main issue noted by WAMCO is that a waste transfer site has not been designated in Hulhumale’ Phase II. Moreover, the transfer site given in Phase I is also not sufficient. Therefore, there is great need to expand the waste management area in Phase I or alternatively designate another area in Phase II.

For the proposed project, during the construction stage, it was reported that the contractor will transfer the waste to Thilafushi at their own costs. They will use their own quay wall in Hulhumale’ Phase II.

### 9.6 Maldives National Defence Force (MNDF)

Fire Department of Maldives National Defence Force was initially met with on 2\textsuperscript{nd} October 2017. The important points noted by the department in relevance to the high-rise buildings as proposed are summarised below.

MNDF fire highlighted that the more planned nature of Hulhumale' development in itself would contribute in the fire risk minimization. For example, the space left between buildings, parking spaces and planned roads shall influence the potential damage of the fire and speed of firefighting response.

It was also noted that fire hydrants were being integrated into the phase 2 of Hulhumale' in collaboration with HDC.

MNDF fire department conducts awareness every year regarding fire safety and risk minimization and this year so far, over 20,000 participants have been covered through various programmes.

While drills are conducted for public sectors such as the schools and offices, drills are also accommodated upon request.
While even residential buildings are targeted for conducting such drills, there are unique challenges to it. Most of the time the apartments are rented out which makes reaching to the owner difficult. Moreover, it is also hard to find a workable time for all residents.

It was recommended that it is very important to maintain compliance to regulations and best practice standards by all stakeholders especially at individual levels.

High-rise buildings need to pay additional attention to fire risks with special provisions incorporated in design for fire risk reduction and also facilitate internal response.

9.7 Maldives Energy Authority (MEA)

Project specific details were shared with MEA via email on 4th December 2017 and a brief phone consultation was provided on 5th December by the Authority.

According to MEA all electricity relevant works shall be carried out by a licensed power engineer. A list of power engineering licensees is available from the official website of the Authority.

Other than the mentioned, the Authority had no specific recommendations or concern regarding the proposed project.
10 Environmental Monitoring

This section deals with the Environmental Management and Monitoring plan for the proposed building construction project with respect to the developments proposed in this EIA. The proposed monitoring plan is for the construction and operation phase of the project. The data collected for this assessment will be used as baseline data while undertaking the monitoring plan. Undertaking environmental monitoring is essential for several reasons including:

- To ensure that potential impacts are minimized and to mitigate unanticipated impacts.
- To aid in impact management,
- To improve impact prediction for future projects
- To identify the effectiveness of the proposed mitigation measures
- To improve mitigation measures for the next phases of this project and for future projects
- To gather long term data to minimise uncertainty
- To ensure sustainable development

The proposed monitoring programme will yield beneficial results if it is undertaken for a long period. The monitoring is to take place during the construction phase once every 3 months until the end of the construction period, and then on an annual basis for 2 years. Further monitoring is recommended to ensure the building standards are maintained. However, this is not obligated by this EIA.

The proponent expressed their full commitment to carry out the monitoring program outlined in this report. The proponent’s commitment to undertake the environmental monitoring and mitigation measures is given in the Annex 4.

10.1 Monitoring Methodology and Costs

The methodology used for monitoring will be similar if not the same as those used in this environmental assessment. However, field water quality testing equipment can be employed to decrease the uncertainties of the results as they can be compared to those obtained from the Laboratory from MWSC.

The costs given in Table 13 and Table 14 are calculated for monitoring to be undertaken by hiring environmental consultants for each monitoring program. However, field data collected for the proposed environmental monitoring program can be carried out by an
in-house maintenance team since most of the parameters are to be investigated monthly and quarterly, and therefore hiring a consultant for each occasion may not be feasible. Moreover, majority of the monitoring, such as waste monitoring can be undertaken by an in-house team as being based at the site is important to get the required data. If the developer does not employ environmental experts among its staff, it is highly recommended that an arrangement is made with an environmental consultant on a long-term basis to carry out and supervise the execution of the monitoring program.

The waste generation data must be undertaken by the maintenance team setup at the site.

The parameters that are most relevant for monitoring the impacts that may arise from the project are included in the monitoring plan. Therefore, the monitoring programme will cover the following aspects of the project:

- Ground water quality
- Generation of wastes
- Noise pollution
- Health and safety issues
- Traffic congestion

### 10.2 Recommended Monitoring Programme

As instructed in the TOR, the monitoring programme will be divided into 2 stages.
Stage 1

Ground water quality for pH, temperature, electronic conductivity, total hydrocarbon, and total coliform at project site.

Determine number, type and respective quantity of waste produced within the past quarter. Data from the contractor’s project management team will be required. Project team is required to take a log of daily waste and give an estimate on quantities. Waste types and respective quantities present at site during inspection should be noted at each visit.

Observe and monitor any open water logged areas at the construction site and determine area.

Noise measurement. Measure noise at the locations as was studied in the EIA.

Survey the traffic within the same area as undertaken for this EIA.

Inspect the use of health and safety equipment on site. Take a head count on the number of staff at site not using proper health and safety equipment including safety shoes, fluorescent vest, safety helmets during monthly inspection. Record any accidents that had occurred during the past quarter.

Determine complaints or issues raised by any neighbouring development or from developer side.

Stage 2

Ground water quality for pH, temperature, electronic conductivity, total hydrocarbon, and total coliform at project site.
• Determine number, type and respective quantity of waste produced (on daily basis, extrapolated to monthly data). Long term data can be taken in coordination with the maintenance office set up at the building area. During monitoring, general inspection of the building common areas should take place to take note of any loose wastes in the common areas. Will have to depend on secondary data collected by building monitoring officers based at the site. Building monitoring office is required to maintain a log of daily waste generation at site.

• Noise measurement. Noise should be measures at the southern and northern end of the project area and at the center of the project area.

• Survey the traffic around the project area. Traffic survey was not undertaken for the project due to the area being vacant. However, once operation begins, this will be an important parameter and needs to be measured and assessed. Traffic survey should be undertaken at the southern, northern end, and at the center of the project site at 3 different times (09:00am – 10:00am, 04:00pm – 05:00pm, 0830pm – 0930pm) both on a weekday and a weekend.

• Record any major social issue or conflict that had occurred. This can be determined by randomly consulting with tenants and also by consultation with the management office or HDC.

• Record any significant accident that had occurred, including any fire related incidents. Data to be obtained by the management office or HDC.

### 10.3 Cost of monitoring

The following tables outline the cost estimate for each stage of the monitoring plan given. The costs are calculated assuming the monitoring will be undertaken by hiring environmental consultants on a project basis. Since this monitoring is in Hulhumale’ and does not involve expensive surveying equipment, and most are based on visual observation and consultation, the overall cost is low relative to most monitoring programs.
Table 13 Estimated costs of Stage 1 Monitoring Programme

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<th>Item No.</th>
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<th>Frequency</th>
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<td>400.00</td>
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<td>3</td>
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<td>8</td>
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<td>Compliance reporting (annual report)</td>
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<td><strong>Total</strong></td>
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<td><strong>7,430.00</strong></td>
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The monitoring is for a period of 2 years (duration of construction phase), where data is collected quarterly.

Table 14 Estimated costs of Stage 2 Monitoring Programme

<table>
<thead>
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<th>Details</th>
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<td><strong>Total for 5 years</strong></td>
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<td><strong>2620.00</strong></td>
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</table>
This monitoring is for a period of 2 years, where data is collected annually. Therefore, for each year the cost will be approximately USD 1310.00, not taking into account any effects of inflation and other such economic scenarios.

Considering the 2 stages of monitoring, monitoring costs in the construction stage would be approximately USD 7,430.00. The proponent has to endure the greatest cost during stage 1 monitoring, as frequency of monitoring is greater.

10.4 Monitoring Report

Monitoring report should be compiled based on the baseline data collected. This report should be submitted to the EPA and any other relevant government agencies for compliance annually or at a greater frequency, if requested. The report structure may include but not limited to:

- Introduction
- Details of the site at the time of investigation,
- Data collection and analysis,
- Details of methodologies and protocols followed
- Quality control measures,
- Sampling frequency and monitoring analysis
- Conclusion and recommendations
11 Conclusion

There have been numerous mixed residential projects based in Hulhumale’ recently of which the environmental impact assessments are quite similar. This project proposes mixed social residential buildings in Hulhumale’ Phase II, which is largely barren land and has not been populated yet. Therefore, in general the impacts are much less than those being undertaken in the populated Phase I. Due to the virgin nature of the land area, there is not much site investigations to be carried out. Additional impacts from the proposed project compared to a typical building project is due to the generating own power and water production at the site. There are regulations and best practice guidelines for these including fuel storage, which should be adhered to ensure sustainability.

More serious impacts are of planning nature, and is not project specific. These include social impacts due to large number of people living in close proximity in the same area. To mitigate this impact, it has been recommended to incorporate CCTVs and community police setup within the project area, in addition to providing more public open areas. Moreover, concerns regarding fire safety exits and standard fire safety measures are very important to be established as well as additional features such as sprinkler systems in each floor. Proper ventilation should be ensured in both housing units and in common areas.

The project can be regarded to complement the larger program by Housing Development Corporation to establish more residential buildings in Greater Male’ area. The project will contribute to the grand plan of reducing congestion in Male’ by providing more housing opportunities in Hulhumale’. With the proposed building providing opportunities for those seeking their first own housing options, it is intended that this will remove the low-income generators from the mid range market, thus allowing more competitive prices in the market. The eventual plan is to provide a wide range of accommodation option to all members of the community living in greater Male’ area.

The existing environment at the project site does not consist of any significant vegetation and the water test result shows normal water quality. There are no residents
living near the site and there is no other structure currently at the site as well. There are other buildings that are proposed to be developed in the area.

Regarding alternatives, there are no viable alternatives available for the project with respect to location. The no project option is also not plausible at this stage and possibilities are outside the scope of this study, as the non-development of this building is a question to be considered at the planning stage. The same applies to the height of the building. Other alternatives including material, foundation type, construction methodology are not necessarily recommended. Recommendations had been made to change dewatering methodology. It is recommended to dewater inland to an empty land close to the project site after excavating the area to ensure that water is contained in the allocated area, and will not have any negative impact on the groundwater aquifer. It is also recommended to proceed with piling as foundation type for the buildings.

In general, proper planning and stronger legislation is required to ensure sustainability of such projects and to ensure maximum benefits are reaped from them. Legislation needs to be strengthened to ensure such projects provide the maximum benefits to the community with minimum risks. As such building code needs to be strengthened and widely followed. Currently condominium law is very brief and is in need for revision considering the many upcoming similar projects. There should be elaboration on the penalties upon tenants if they do not oblige with the predefined maintenance setup, which is unanimously agreed among the tenants.

As there are not much impacts specific to this project alone, there is limited mitigation measures required apart from following proper site safety and waste management, adherence to standards for electricity generation and water production. Ensuring strong building maintenance legislation will ensure that the buildings are maintained properly and is not subject to decisions made by individual tenants. These in turn will ensure sustainability of projects such as these.
12 Acknowledgement

I would like to acknowledge all major contributors to this study, among them Nafha Aujaaz, who provided invaluable input especially with regards to fire safety and final compilation of the document. The proponent was supporting throughout the study, which is highly appreciated and made our work a lot easier. Technical information was provided by the contractor 23rd MCC, for which I am very grateful. I would also like to thank all stakeholders for the cooperation they gave throughout.
13 References

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Terms of Reference for Environmental Impact Assessment for Proposed Design and Construction of 1394 Social Housing Units in Hulhumale’ Phase II.

The following is the Terms of Reference (ToR) following the scoping meeting held on 28/11/2017 for undertaking the EIA of the Proposed Design and Construction of 1394 Social Housing Units in Hulhumale’ Phase II. The proponent of the Project is Housing Development Cooperation.

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

1. **Introduction to the project** – Describe the purpose of the project and, if applicable, the background of the project and the tasks already completed. Clearly identify the rationale and objectives to enable the formulation of alternatives. Define the arrangements required for the environmental assessment and if relevant, including how work carried out under this contract is linked and sequenced with other projects executed by other consultants, and how coordination between other consultants, contractors and government institutions will be carried out. List the donors and the institutions the consultant will be coordinating with and the methodologies used.

2. **Study area** – Submit an A3 size scaled plan with indications of all the proposed land infrastructures. Specify the boundaries of the study area for the environmental impact assessment highlighting the location and size of the proposed construction. The study area should include nearby environmentally sensitive areas. 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. Literature review:**
- Identify the existing literature regarding the vulnerability and the condition of the current environment for Hulhumale.
- Review similar EIAs and other research carried out for Hulhumale.
- The consultant shall also explain the mitigation measures proposed for any potential impacts from the proposed project related to the vulnerability discussed in the literature.

**Task 2. 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. All inputs and outputs related to the proposed activities shall be justified.

1. Provide a clearly labeled concept design and scaled site plan of the project boundary.
2. Submit a detailed description of the components of the project and how the project activities will be undertaken.
3. A project schedule should be included.
4. A matrix of inputs and outputs related to the proposed activities shall be included
5. Need and justification for the proposed project
6. Waste management during construction period including construction waste, and demolition waste.
7. Dewatering plan
8. Description of any underground structures such as basement or wells.
9. Plans for road closures during construction
10. Details of vegetation clearance if any
11. Use of any energy conserving utilities
12. Details of the backup generator to be installed, if any
13. Estimated consumption of water and electricity and their sources

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, power and fuel supply for backup generators;

Building design details

- Description of residential building designs including the type of accommodation and facilities offered
- Layout of various building floors
- Parking capacity and building access
- Description of office complex design

Site clearance

- Number and types of vegetation removal required
- Green waste disposal methods

Excavation and dewatering

- Area, depth and volume required for excavation
- Excavated earth disposal method and location
- Estimated no of days required for dewatering
- Dewatered water disposal method and location(s)
- Shoring methods for excavated particularly on sides with adjacent buildings
- Details of methodology used for dewatering including machinery specifications

Construction work

- Scheduling and workforce inclusive of workforce accommodation logistics
- Construction materials and machinery to be used (quantified)
- Construction methodology; inclusive of low energy ventures and concepts to be used during construction and operation phases

Foundation and piling works

- Pile specifications, including type, dimensions and max driving length
- Pile driving method
Foundations and concrete works

- Type of foundation and foundation depth;
- Geotechnical calculations regarding the building weight
- Concrete batching process and transportation method (if required)

Construction management

- Project site office and temporary storage area details

Utilities

- Type, number and capacity of backup power plant
- Capacity, construction method and binding details of any fuel storage tanks
- Sewage connection plan to Male’s main network
- Water connection plan and water storage tank(s) details
- Waste management plan during operations

Building operations

- Traffic management plan outline
- Revegetation plan outline

Task 3. 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 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 including water-sampling points.

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.

Climate
Temperature, rainfall, wind, waves

Physical and Biological Environment
Noise levels in the vicinity of the site including any noise sensitive location
Water quality of groundwater wells in project site. Following parameters are to be tested: Conductivity, pH, Salinity, Temperature, TDS, Turbidity

Built Environment
Nature of adjacent or upcoming buildings if any
Condition of the roads
Existing structure/uses of the proposed site
Proposed land use plan especially with a focus on the public facilities nearby
Socio-economic Environment
Demographic data for greater Male' area.
Brief description of social environment of Hulhumeale' in general and adjacent residential units in particular
Identify types of vehicles and peak traffic hours in or near the project site

Task 4. 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:
• Approval from the Housing Development Corporation

Task 5. Potential impacts (environmental and socio-cultural) of proposed project, incl. all stages – The
EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate
the magnitude and significance of each. Particular attention shall be given to impacts associated with the following:
• Loss of vegetation if any
• Loss of visual amenity
• Land preparation and piling works if any
• Impacts on ground water table and water quality
• Impacts related to construction works on land including materials sourcing, transport and storage,
building construction methodology and piling.
• Mosquito growth
• Impacts due to generation of waste
• Potential impacts of the development, post construction, on proposed residential areas, especially
sensitive areas like schools, pre-schools and mosques.
• Safety and security of the building
• Risk of accidents to workers and public
• Impacts on employment and income such as job opportunities
• Disturbances to residents and public facilities/activities nearby post construction

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 6. Alternatives to proposed project – Describe alternatives including the “no action option” should be
presented. Determine the best practical environmental options. Alternatives examined for the proposed
project that would achieve the same objective including the “no action alternative”. All alternatives must
be compared according to international standards and commonly accepted standards as much as possible.
The comparison should yield the preferred alternative for implementation. Mitigation options should be
specified for each component of the proposed project.

Task 7. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce
significant negative impacts to acceptable levels. These will include both environmental and socio-
economic mitigation measures. Measures for both construction and operation phase shall be identified.
Cost the mitigation measures, equipment and resources required to implement those measures. The
confirmation of commitment of the developer to implement the proposed mitigation measures shall also be
included. An Environmental management plan for the proposed project, identifying responsible persons,
their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to
compensate for the environmental effect shall be given.
Task 8. Development of monitoring plan (see appendix) – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for ground water as well as defects in neighbouring structures. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

Task 9. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, Housing Development Corporation, engineers/designers, development managers, staff and members of the general public. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes. Major stakeholder consultation shall include:
- STELCO
- MWSC
- MNDF Fire
- HPA
- Maldives Energy Authority
- EPA

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

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

28.11.2017
Annex 2 – Approved Concept Drawings
1394 HOUSING UNITS PROJECT
HULHUMALE' PHASE II
CONCEPTUAL DRAWINGS
Annex 3 – Water test results
**WATER QUALITY TEST REPORT**

**Report No.: 500177864**

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</table>

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ANALYSIS RESULT</th>
<th>TEST METHOD</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Appearance</td>
<td>Opaque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>825</td>
<td>Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)</td>
<td>μS/cm</td>
</tr>
<tr>
<td>pH</td>
<td>8.03</td>
<td>Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)</td>
<td>-</td>
</tr>
<tr>
<td>Salinity</td>
<td>0.40</td>
<td>Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)</td>
<td>%</td>
</tr>
<tr>
<td>Temperature</td>
<td>23.5</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>412</td>
<td></td>
<td>mg/L</td>
</tr>
<tr>
<td>Turbidity</td>
<td>597</td>
<td>HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)</td>
<td>NTU</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.7</td>
<td>Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)</td>
<td>mg/L</td>
</tr>
<tr>
<td>Nitrogen Ammonia</td>
<td>4.98</td>
<td>Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sulphide</td>
<td>5070</td>
<td>Method 8131 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)</td>
<td>μg/L</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.17</td>
<td>Method 6046 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)</td>
<td>μg/L</td>
</tr>
</tbody>
</table>

**Keys:** μS/cm: Micro Siemens per Centimeter, %: Parts Per Thousand, °C: Degree Celsius, mg/L: Milligram Per Liter, NTU: Nephelometric Turbidity Unit, μg/L: Microgram Per Liter, MPN/100ml: Most Probable Number

---

**Checked by**

Aminath Sofia  
Assistant Laboratory Executive

**Approved by**

Mohamed Eymon  
Assistant Manager, Quality

**Notes:** Sampling Authority: Sampling was not done by MWSC Laboratory  
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This test report is ONLY FOR THE SAMPLES TESTED.  
- Information provided by the customer
**WATER QUALITY TEST REPORT**

Report No: 500177864

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>1394 Housing Unit, Hulhumale</th>
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<tbody>
<tr>
<td>Sample Type</td>
<td>Ground Water</td>
</tr>
<tr>
<td>Sample No</td>
<td>83195184</td>
</tr>
<tr>
<td>Sample Date</td>
<td>20/11/2017</td>
</tr>
<tr>
<td>PARAMETER</td>
<td>ANALYSIS RESULT</td>
</tr>
<tr>
<td>Physical Appearance</td>
<td>Opaque</td>
</tr>
<tr>
<td>Faecal Coliforms</td>
<td>1</td>
</tr>
</tbody>
</table>

**TEST METHOD**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Appearance</td>
<td>Opaque</td>
</tr>
<tr>
<td>Faecal Coliforms</td>
<td>1 MPN/100ml</td>
</tr>
</tbody>
</table>

**UNIT**

MPN/100ml

**Keys:** µS/cm : Micro Siemens per Centimeter, % : Parts Per Thousand, °C : Degree Celsius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit, µg/L : Microgram Per Liter, MPN/100ml : Most Probable Number

**Checked by**

Aminath Sofia  
Assistant Laboratory Executive

**Approved by**

Mohamed Eyman  
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~ Information provided by the customer

------------------------- END OF REPORT -------------------------
Annex 4 – Project Work Schedule
The controlled schedule of 1394 units housing project in Hulhumale' Phase II

<table>
<thead>
<tr>
<th>Work Description</th>
<th>unit</th>
<th>period</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Financing and commencement</td>
<td>month</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Preliminary design</td>
<td>month</td>
<td>0.5</td>
<td>Including EIA and geological survey</td>
</tr>
<tr>
<td>Detailed design</td>
<td>month</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Site hand-over and mobilization</td>
<td>month</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Construction period</td>
<td>month</td>
<td>21</td>
<td></td>
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<tr>
<td>Inspection and take-over</td>
<td>month</td>
<td>0.5</td>
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</table>
The Initial Control Schedule of 1394 Units Housing Project in Hulhuamle’ Phase II

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Time (D)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720</td>
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<tr>
<td>1</td>
<td>Financing</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Preliminary Design</td>
<td>15</td>
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<td>3</td>
<td>Detailed Design</td>
<td>45</td>
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<tr>
<td>4</td>
<td>Mobilization</td>
<td>60</td>
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<td>5</td>
<td>Construction</td>
<td>630</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V.1</td>
<td>The 1st Batch (4 towers)</td>
<td>300</td>
</tr>
<tr>
<td>1</td>
<td>Foundation</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Structure</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Brick wall</td>
<td>75</td>
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<tr>
<td>4</td>
<td>Internal Plastering</td>
<td>80</td>
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<tr>
<td>5</td>
<td>External Plastering</td>
<td>40</td>
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<tr>
<td>6</td>
<td>Tiling</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Painting</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>Window &amp; Door</td>
<td>70</td>
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<tr>
<td>9</td>
<td>Electric &amp; Plumbing</td>
<td>350</td>
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<tr>
<td>10</td>
<td>Testing &amp; Repairing</td>
<td>30</td>
</tr>
<tr>
<td>V.2</td>
<td>The 2nd Batch (4 towers)</td>
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<td>Foundation</td>
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<tr>
<td>2</td>
<td>Structure</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Brick wall</td>
<td>75</td>
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<tr>
<td>4</td>
<td>Internal Plastering</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>External Plastering</td>
<td>40</td>
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<tr>
<td>6</td>
<td>Tiling</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Painting</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>Window &amp; Door</td>
<td>70</td>
</tr>
<tr>
<td>9</td>
<td>Electric &amp; Plumbing</td>
<td>360</td>
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<tr>
<td>10</td>
<td>Testing &amp; Repairing</td>
<td>30</td>
</tr>
<tr>
<td>V.3</td>
<td>The 3rd Batch (4 towers)</td>
<td>420</td>
</tr>
<tr>
<td>1</td>
<td>Foundation</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Structure</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Brick wall</td>
<td>75</td>
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<tr>
<td>4</td>
<td>Internal Plastering</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>External Plastering</td>
<td>40</td>
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<tr>
<td>6</td>
<td>Tiling</td>
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<tr>
<td>7</td>
<td>Painting</td>
<td>120</td>
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<tr>
<td>8</td>
<td>Window &amp; Door</td>
<td>70</td>
</tr>
<tr>
<td>9</td>
<td>Electric &amp; Plumbing</td>
<td>390</td>
</tr>
<tr>
<td>10</td>
<td>Testing &amp; Repairing</td>
<td>30</td>
</tr>
</tbody>
</table>
Annex 5 – Proponents Commitment for Monitoring and Mitigation
Letter No.: HDC(161)-PM/203/2017/28

Ibrahim Naeem
Director General
Environmental Protection Agency,
Ministry of Environment and Energy,
Male',
Republic of Maldives

Dear Sir,

PROJECT: HULHUMALÉ PHASE 2, 1394 SOCIAL HOUSING UNITS PROJECT - 2017
SUBJECT: PROPOUNENTS COMMITMENT FOR MONITORING AND MITIGATION

As the proponent of the project, we would like confirm our financial commitment to undertake all mitigation measures and give our commitment to finance the environmental monitoring program to the costs given and as outlined in this EIA.

Thank You.

Yours faithfully,

Nawaz Shaugee.
Director
Annex 6 – EIA Participants