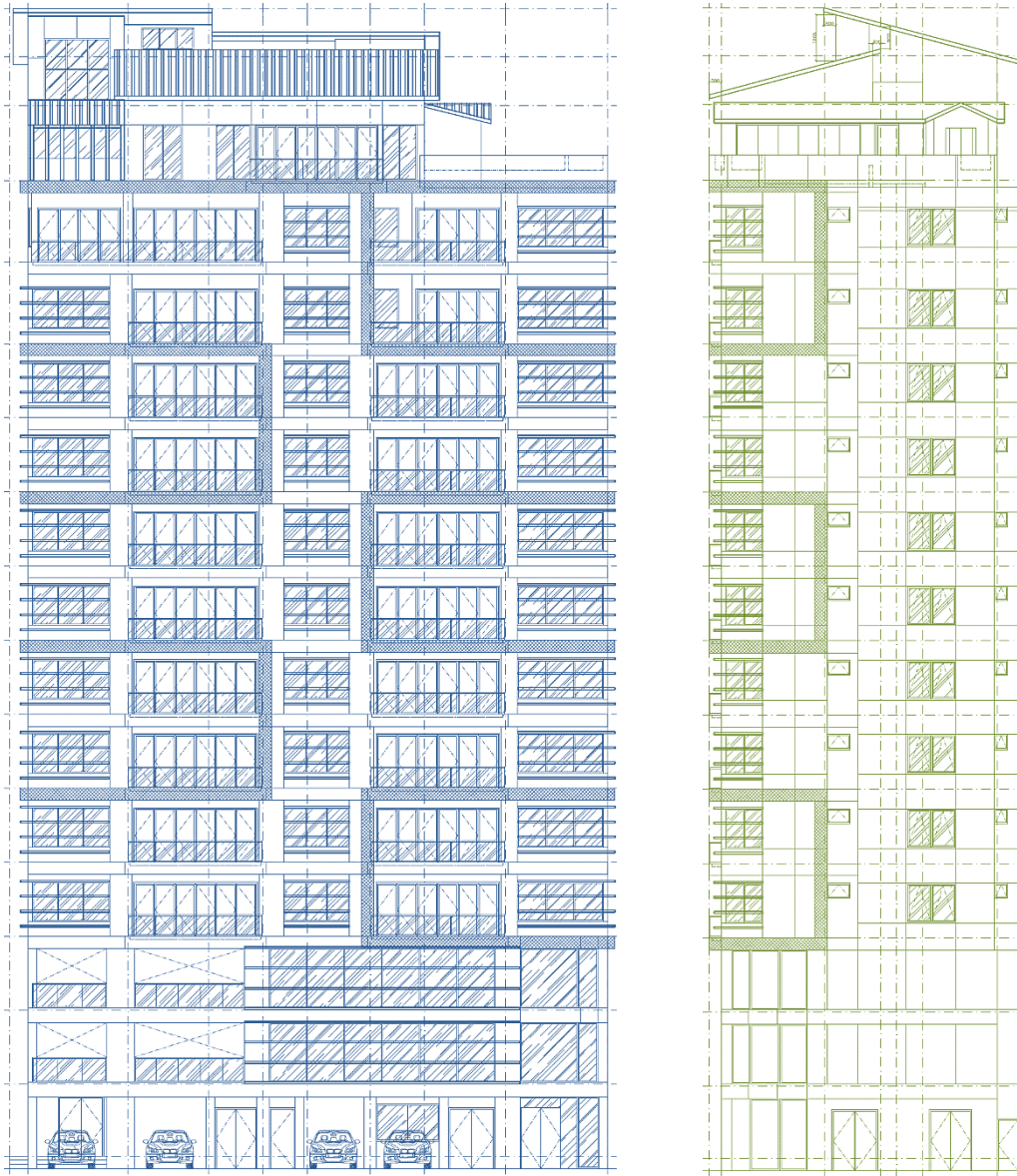


# ENVIRONMENTAL IMPACT ASSESSMENT

Proposed Development of 15-Storey Building with Basement  
at H. Dhoovehi  
Male'



May 2017

Prepared for:  
Prepared by:

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## CONSULTANT'S DECLARATION

I, Mohamed Zuhair, Registered EIA Consultant at the Ministry of Environment and Energy of Maldives with the Registration Number EIA 01/15, hereby declare that the statements in this Environment Impact Assessment (EIA) Report for Proposed Development of 15-Storey Building with Basement at H. Dhoovehi, Male' are true, complete and correct to the best of my knowledge and abilities.

The EIA Report has been prepared in accordance with EIA Regulation 2012, implemented by Environmental Protection Agency (EPA).

Name: Mohamed Zuhair (EIA01/15)

Signature:



Date: 21 May 2017

## PROPONENT'S DECLARATION

AMIN Construction Pvt. Ltd. hereby declare that the contents of this Environmental Impact Assessment (EIA) Report for the Proposed 15-Storey Building with Basement at H. Dhoovehi, Male' have been read and understood by us.

Also, we are aware that this EIA Report has been prepared to fulfill the requirements of EIA Regulation 2012 with regards to obtaining environmental clearance for the project from Environment Protection Agency (EPA).

Name: Ahmed Adham Abdulla

Designation: Chief Operating Officer (COO)

Signature: 

Date: 24-05-2017

Stamp:









# 1. EXECUTIVE SUMMARY

- i. The proposed 15 storey building at H. Dhoovehi will be developed by AMIN Construction Pvt. Ltd. Once completed, the basement area will have water tanks with storage area, the ground floor will be a private car park, generator room, water meter room, security room, waste collection, loading area; first and second floors will be a restaurant; third to thirteenth floor will be residential, fourteenth floor will be a suite. At the top level will be a rooftop mezzanine. The total area of the plot is 290m<sup>2</sup>.
- ii. The site will be excavated to a depth of 3.35m to lay the foundations and develop the basement area having 167sqm in floor area, which is 57% of the total plot area. The basement area will have 2 x 18cbm water tanks and a large storage area. The entire boundary will be sheet piled to depths of 5m with corrugated sheets supported by iron beams as a safety measure while preparing the site ready for construction.
- iii. The building will rest on a pile raft foundation. A total of 79 micropiles (200-300mm diameter) will be driven into the ground to depths ranging from 1 – 3.6m through boreholes done in 2 regions within the plot. The region 1 will have 31 such micropiles and region 2 will have 48 micropiles. The project requires 1,160m<sup>3</sup> of soil to be excavated and 783m<sup>3</sup> of groundwater to be dewatered to lay the foundation of the building. The project is scheduled to be completed in 18 months.
- iv. The EIA has been prepared as per the EIA Regulations 2012 developed directly under the Environmental Protection and Preservation Act and identifies that development of such buildings exceeding 31m in height and with basements or over 10 storeys with greater than 5ft foundation require an EIA to be undertaken and approved by EPA before commencement of construction.
- v. In addition to Environmental Protection and Preservation Act, EIA Regulations, the project has to comply with Dewatering Regulation, Waste Management Regulation, Male' Planning Regulation, Land Act as well as comply with Maldives National Building Code recommendations.

- vi. In order to understand existing environmental conditions of the proposed project area, assessments have been undertaken including ambient noise levels, traffic volume and movement, groundwater quality, soil and vegetation, physical condition of the surrounding buildings and roads.
- vii. The proposed development will take place in the eastern part of Male', Henveiru District on the north-eastern side of Block Number 9. Dhoovehi is located at the corner of Boduthakurufaanu Magu and Burevi Magu at 4°10'22.63"N and 73°31'3.39"E. The main connectivity will be from Boduthakurufaanu Magu. The block is located quite close to the Artificial Beach, proposed bridge and the open park space of Block Number 10.
- viii. Noise levels recorded from the sites were Site 1 47dB (day) and 56dB (night), Site 2 51dB (day) and 59dB (night), Site 3 49dB (day) and 57dB (night) and Site 4 42dB (day) and 47dB (night). Night time noise levels at all sites were found to be slightly increased than day time. This is mainly due to increased traffic in the area at the time of assessment at night.
- ix. The traffic volume was assessed to be quite high especially on Baduthakurufaanu Magu for both day and night times. The highest traffic volume was observed to be from motorcycle having 288 during day time and 420 during night time on Baduthakurufaanu Magu. On Burevi Magu number of cycles were greatly reduced having 56 during day time and 94 during night time. The volume of cars on Boduthakurufaanu Magu was observed to be 90 during day time and 121 during night time. On Burevi Magu number of cars were observed to be 22 during day time and 35 during night time.
- x. The results of the groundwater analysis show that the groundwater of the area is free from contamination. As the plot is located quite close to the sea, the results show some levels of salinity having 1.23<sup>0</sup>/<sub>00</sub>.
- xi. There is no vegetation present in the proposed plot hence, vegetation assessment was not undertaken.

- xii. On the western adjacent side of the plot, there are three buildings having 4 storey, 2 storey and 7 storey all of which belong to Noofaru house. Only the 7 storey building is found on Burevi Magu while others are inside of Noofaru house. On the southern adjacent side, a two storey storage and a labour building is found belonging to Sea Side house. No other adjacent buildings are found by the plot. On the western side of Noofaru house on Burevi Magu, a 5 storey building belonging to Rumania house and 10 storey building belonging to Sheereen Villa is found. All buildings are observed to be in good condition and no physical damages were identified. All buildings are believed to be 5 -7 years old.
- xiii. Dhoovehi plot is found on the corner of Boduthakurufaanu Magu and Burevi Magu, hence these two roads are found by the plot. Boduthakurufaanu Magu is the main road found around Male'. The condition of these roads are observed to be good. No cracks or physical damages were found.
- xiv. There are no significant environmental impacts from the proposed project, however, some of the environmental impacts from development activities such as excavation, dewatering, construction activities, operation of construction machinery, construction waste generating environmental impacts such as noise, dust and pollution are believed to occur. Social impacts such as traffic congestion, disturbance to nearby residents have been predicted as well as health problems as a result of dust have been identified. During operation period of the project, domestic waste and traffic are believed to increase.
- xv. As part of the proposed project, a number of mitigation measures have been proposed in the EIA Report including using corrugated sheets supported by iron beams as a safety measure for protecting the excavated area for foundation, dewatering will be undertaken upon approval from EPA, while preparing the site ready for construction, measures such as installation of safety and dust protection nets, appropriate signage will be placed to make aware people on the development. Also, important mitigation measures that will be implemented include complete elimination of waste disposal during construction and operation stages of the development into the project boundaries.

- xvi. Although the project has short-term environmental impacts from the proposed development, the project has more social and economic benefits, which is believed to tremendously contribute to the need for residential and commercial space in Male', create some employment opportunities and contribute to the local economy in Male' in the long-term.
  
- xvii. Although during construction of the project, negative environmental impacts from construction activities have been envisaged, with appropriate environmental management and mitigation measures, these impacts will be reduced to a considerable level. Also, with positive socio-economic outlook of the project and considering the overall importance of housing in Male', it is concluded that the project is an important development.

## **2. INTRODUCTION**

### **2.1 PROJECT BACKGROUND**

Amin Construction Pvt. Ltd., proposes to develop a 15-Storey Building with Basement at H. Dhoovehi found in the corner of Boduthakurufaanu Magu and Burevi Magu, Male' for mixed use and residential purpose. The total area of the plot is 290m<sup>2</sup>.

The site will be excavated to a depth of 3.35m to lay the foundations and develop the basement area having 167sqm in floor area, which is 57% of the total plot area. The basement area will have 2 x 18cbm water tanks and a large storage area. The entire boundary will be sheet piled to depths of 5m with corrugated sheets supported by iron beams as a safety measure while preparing the site ready for construction.

The building will rest on a pile raft foundation. The foundation thickness will be 500mm, depth will be 1,050mm, cover to foundation will be 50mm, cover to columns will be 40mm and the concrete mix ration for the foundation will be 1:2:3.

Once completed, the basement area will have water tanks with storage area, the ground floor will be a private car park, generator room, water meter room, security room, waste collection, loading area; first and second floors will be a restaurant; third to thirteenth floor will be residential, fourteenth floor will be a suite. At the top level will be a rooftop mezzanine.

The provision of main utility services of freshwater, electricity and sewerage will be from the main service providers including MWSC and STELCO.

### **2.2 AIMS AND OBJECTIVES OF THE PROJECT**

The key aims and objectives of the project are;

- To develop a mixed use building for commercial and residential purpose
- To maximize usable space available from the plot
- To contribute to housing and commercial space needs in Male'

- To develop a multi-purpose building in a prime location in Male' with state-of-the-art facilities including security and services

## **2.3 LEGAL REQUIREMENT**

This is the Environmental Impact Assessment (EIA) Report for the proposed 15-Storey Building at H. Dhoovehi, prepared in order to get environmental clearance from Environment Protection Agency (EPA) for the development.

The EIA has been undertaken as per the requirement of the EIA Regulation 2012 and its Amendments where the Schedule D of the Regulation, which enlists that EIAs shall be undertaken for development projects involving buildings exceeding 10 sheets without the raft foundation, buildings exceeding 31m in height, buildings exceeding 10 storeys with a foundation, buildings that have a basement and buildings that have a foundation deeper than 5ft.

The proposed project meeting with all of the above requirements, hence, requires an EIA to be undertaken and approved by EPA outlining the existing environmental conditions of the project site, key environmental concerns including likely environmental and social impacts that will be generated from the proposed project and measures to mitigate these environmental impacts and a monitoring programme to be undertaken during pre-construction and post-construction periods.

## **2.4 STATEMENT OF NEED AND RATIONALE**

Land is scarce in Male'. As a result, government, private and commercial purposes, land for residential, commercial and public uses are created through development of multi-storey buildings. Due to drastic increase in population as well as commercial activities and need for residential, commercial and economic use of land, there is tremendous pressure on land in Male', which has been on the rising demand for several years. Most evidently, Male' has been experiencing stress on housing and demand for housing has increased manifold over the last couple of years. Therefore, development of residential or mixed-use for residential and commercial purposes has become quite prominent.

Because of the scarcity of land, Male' has a history of development of high rise buildings in order to meet the land requirement for housing and commercial uses. There is a great influx of people to Male' from the Atolls for commercial, educational, medical and employment purposes, which creates a very high demand for both residential and commercial space.

The government has recently introduced policies regarding involvement of private sector in social and commercial housing development in order to reduce the housing stress especially in greater Male' region. Furthermore, government recently allowed for development of buildings up to 25 storey to assist with increasing demand for space needs.

The proposed building is currently located in a residential area, however this area is believed to become a prime location in Male' for multitude of uses due to close proximity to the proposed Male'-Hulhule-Hulhumale' linking bridge, which is scheduled to be completed in 2018.



*Figure 1: Location of the proposed building and proximity to the bridge*

The proposed project is designed as a commercial and residential development with a basement area allocated designated storage and emergency use water tanks. The proposed development is believed to contribute to addressing the housing and commercial space stress that currently exists in Male' in addition to creating indoor private parking space, which are becoming scarce in Male'. Furthermore, the area will become a prime location for both residential and commercial use in a near future due to the ongoing bridge development as well as presence of the artificial beach area, hence, there will be greater need for similar developments in the area.



*Figure 2: Increased development of buildings in Male' as a result of population pressure*

## **2.5 EIA APPROACH, SCOPE AND OBJECTIVE**

This EIA Report has been prepared based on information collected from the project site and the surrounding environment by use of established methodologies, desk research for obtaining relevant secondary data, information obtained from the project proponent, use of guidelines collected from relevant laws and regulations as well as information obtained from EIA studies carried out in the country for similar projects and experience of the EIA team engaged in preparing the report.

The primary objective of the EIA study is to safeguard the surrounding environment during planning, design, construction and operation of the proposed project activities by mitigating environmental and social impacts envisaged during various phases of the project and implementing an environmental monitoring programme to quantify the changes in the environmental components as a result of the development.

The specific objectives of the EIA study are;

- Determine the baseline environmental conditions of the project and surrounding area.
- Identify, predict and assess environmental impacts that might arise during pre-construction, construction and operation phases of the project.
- Suggest environmental impact mitigation measures to suit local conditions in order to eliminate or reduce the negative impact on the environment

- Enable the project proponent to comply with environmental laws and regulations.

The scope of the EIA study includes;

- Assessment of the present status of physical, biological and socio-economic components of the environment relevant for the proposed development.
- Identify environmental and social impacts due to the proposed project on environmental components (during the pre-construction, construction and operation phases).
- Evaluate these impacts to understand their magnitude.
- Propose environmental management and mitigation measures for the impacts identified.
- Propose an environmental monitoring programme to be pursued by the project proponent.

## **2.6 EIA METHODOLOGY**

The methodology adopted for the environmental impact study consists of the following stages:

- Identification of significant environmental components and assessment of their baseline (pre-project or existing) status within the study area. This is carried out by both qualitative and quantitative assessments.
- Prediction of impacts on various identified environmental and social parameters due to the proposed project. Data relating to the proposed construction activities, demolition (if any), construction and operation stage waste, as well as other activities causing environmental and social impacts through use of a descriptive impact matrices.
- Review of relevant EIAs carried out in similar environmental settings.
- Evaluation of significance of environmental impacts by use of significance analysis method
- Expert judgment and professional opinion have also been used throughout the impact assessment and evaluation process. These methods are described in detail at the relevant section of this EIA Report.

## 2.7 REVIEW OF RELEVANT STUDIES

As part of relevant literature review and preparation of the report, the following EIA studies have been reviewed to understand the effects of such development projects on the environment and social conditions in addition to personal experiences of the environmental consultant who have prepared this EIA Report. These are;

- EIA For the Development of a 14 Storey Building at H. Filigasdhoshuge, Malé, prepared by Water Solution Pvt. Ltd. in 2010, and
- EIA For Proposed 14-Storey Mixed-Use Residential Complexes in Hulhumale’ prepared by Mohamed Zuhair and Ibrahim Shakir in 2015
- EIA For Proposed Multi-Storey Building at H. Blue Heaven, Male’ prepared by Sandcays Pvt. Ltd. in 2016
- EIA For Proposed Construction of 25 Storey Building at Indhira Gandhi Memorial Hospital, Male’ prepared by CDE Consulting in 2016
- EIA For Proposed 20-Storey Rehendhi Building in Male’ prepared by Mohamed Zuhair and Ibrahim Shakir in 2016

All these EIAs focus development projects involving multi-storey buildings as an important part of the project, hence, have been used as reference material in order to understand the types, degrees and magnitudes of environmental and social impacts mostly from excavation, foundation development as well as construction activities. They also address how these impacts will be dealt with regards to reducing these impacts. Construction related impacts such as use of machinery, noise, dust, traffic congestion and short-term aesthetic issues have been identified as having both environmental and social implications.

## 2.8 EIA TEAM

**Mr. Mohamed Zuhair**, EIA Consultant (EIA01/15) is the team leader, who is a freelance Environment Consultant who has many years of experience in the field of environmental management, assessment and monitoring, implementation of environmental laws and regulations and has involved as lead consultant and a team member in preparing several EIAs in the Maldives including EIAs for tourist resort development, mariculture and agriculture

development, residential development, harbor development, coastal protection, land reclamation, etc.

**Mr. Ibrahim Shakir**, Registered Land and Hydrographic Surveyor, who is an experienced Land Survey Consultant who has undertaken a number of land surveys for the purpose of land registration and development, undertaken many hydrographic surveys for development of important facilities such as jetties, harbours, water villas, as well as other water-associated facilities in many islands in the Maldives.

Curriculum Vitae of the Consultants have been annexed to this report.

## **2.9 EIA TERMS OF REFERENCE (TOR)**

The Terms of Reference (TOR) outlining the scope of this EIA has been approved on 2 May 2017 based on the discussions undertaken in the EIA Scoping Meeting held at EPA on 27 April 2017.

The approved Terms of Reference is attached in **Appendix 1**.

### **3. STUDY AREA**

The information for the EIA was collected from the proposed project area and the surrounding environment.

The following figures show the location of the project region, project location where the development will be undertaken as well as the study area boundary.

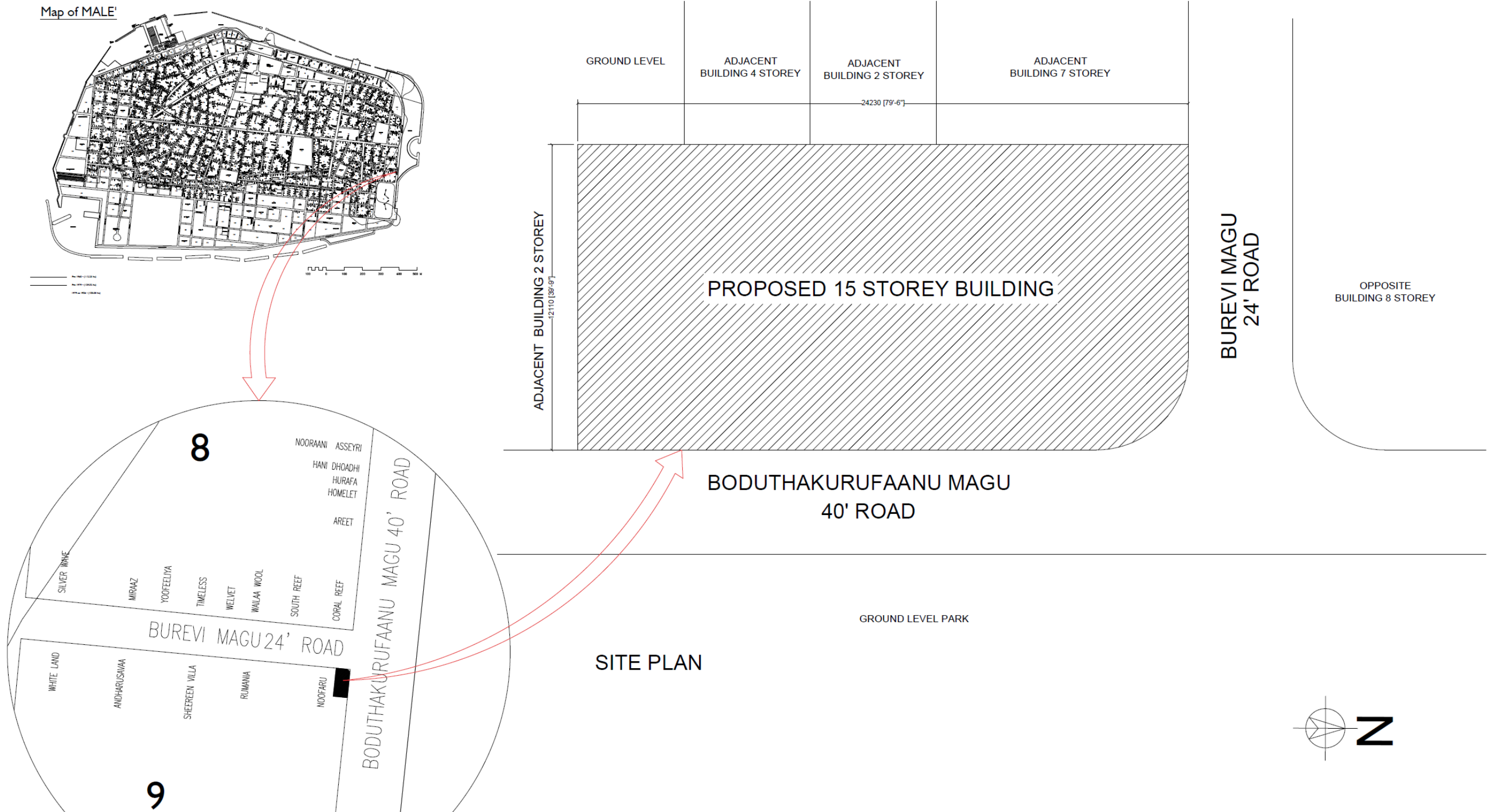


Figure 3: Location of the proposed development plot



Figure 4: Aerial view and location of the proposed development plot



*Figure 5: Study area*

## **4. PROJECT DESCRIPTION**

### **4.1 PROJECT LOCATION, SIZE AND TYPE OF DEVELOPMENT**

The proposed development will take place in the eastern part of Male', Henveiru District on the north-eastern side of Block Number 9. Dhoovehi is located at the corner of Boduthakurufaanu Magu and Burevi Magu. The main connectivity will be from Boduthakurufaanu Magu. The block is located quite close to the Artificial Beach, proposed bridge and the open park space of Block Number 10.

The land plot is located at 4°10'22.63"N and 73°31'3.39"E. The proposed development area will be 290m<sup>2</sup> (3,103ft<sup>2</sup>). A total of 15 storeys will be developed including a basement, for commercial, residential and private use.

### **4.2 PROJECT PROPONENT**

AMIN Construction Pvt. Ltd. previously known as Amin Carpentry Maldives Pvt. Ltd, was established in the year 1984 and is registered as a limited liability company for civil construction, carpentry work and wholesale trading business.

Major civil and construction projects started in the year 1987, named as Felivaru upgrading project, consisting of factory buildings.

Since then the company has undertaken numerous multi-million Rufiya projects in civil engineering, residential, institutions and commercial projects in both private and public sectors. Recent projects undertaken locally have brought our total contract value to be amongst the top five Maldives construction companies (ranking by contracts awarded) for the years 1997, 1998, 1999 and 2000.

Today the company have a large workforce of over 450 employees, amongst them includes specialists in many diverse field of construction industry. In addition to being fully equipped

with modern technological machinery, all the projects are well planned and handled by experienced professionals.

Amin is committed to improving its standard, quality and is resourcing new developments in the building industry globally.

The contact detail of the proponent is;

**AMIN Construction Pvt Ltd**  
52 Boduthakurufaanu Magu  
Male' 20-01  
Rep. of Maldives  
Tel: 332 4369  
Fax: 332 8424  
Email: [iru@amin.com.mv](mailto:iru@amin.com.mv) ; [nihad@amin.com.mv](mailto:nihad@amin.com.mv)

### **4.3 JUSTIFICATION**

Male' City is the Capital, commercial and business hub of Maldives, which only has a size of 5.8 km<sup>2</sup> and a population of 133,412 (Census 2014) making it the most densely populated island in the Maldives that exceeds 23,000 persons per km<sup>2</sup>. This population density is higher than Macau (20,000 person per km<sup>2</sup>) and Monaco (15,000 person per km<sup>2</sup>).

Development of buildings for both residential and commercial use in Male' is rapidly growing in order to cater for the increasing population. As the island is relatively small, the only option available in order to meet with the rapid population growth and demand for space is by developing multi-storey buildings.

One good example is development of 14-storey government office complex at Velaanaage, which is housing a number of government offices including some ministries and offices at the building. The building was opened in 2010.



*Figure 6: The 14 Storey Velaanaage Office Complex*

Construction of high rise buildings in Male' for both residential and commercial use has increased manifold over the last years to address the increasing demand for spaces for various uses, especially residential. Construction and real estate businesses are now quite well established.

Also, in order to address the land issues in Male', Hulhumale' Villimale' and Gulhifalhu are targeted for social and commercial development, which although has brought some leverage to the issue, however, the demand continues to grow rapidly. This is primarily because adequate spaces for commercial and residential needs are not created in accordance with the increasing population in greater Male' region.

Recently, the Government of Maldives has announced provision for allowing development of larger plots of land having 25 storeys as maximum, which are 10 floors more than that is usually allowed in the country. This is also to increase space supply in order to meet with the growing demand for space for residential and commercial needs.

As part of the proposed project, the building will be used for commercial, residential purpose as well as private use with 15 floors and a basement.

## 4.4 PROJECT OUTLINE

### 4.4.1 Project Scope

The following aspects form the general scope of the proposed project,

- Design – designing of concept, architectural, engineering, structural and services schemes of the project
- Approval of the design from Ministry of Housing and Infrastructure
- Preparation of EIA and approval from Environment Protection Agency (EPA)
- Project Mobilization and management
- Site clearance and setting up
- Construction and development of the project
- Completion of the project
- Provision of operational, management and maintenance services

### 4.4.2 Project Master Plan

#### 4.4.2.1 *Development Concept*

The proposed 15-storey building and the basement will be developed as a commercial and residential building with all facilities and services provisions.

The conceptual design of the project has been approved by Ministry of Housing and Infrastructure by the letter number 138-LBS2/PRIV/2017/397 dated 13 April 2017.

A copy of the approval letter from Ministry of Housing and Infrastructure is attached in **Appendix 2**.

The design concept of the project is attached in **Appendix 3**.

The residential units developed from 4<sup>th</sup> floor above will be comfortable and modern in design with state-of-the-art facilities and services. The basement will have a large storage area and emergency use 2x 18m<sup>3</sup> water tanks and grease trap. Ground floor is dedicated for private car parking, access to water and electric meters, standby generator and access to waste collection area. The 2<sup>nd</sup> and 3<sup>rd</sup> floors are dedicated for a restaurant. Effective use of space of the land plot has been greatly integrated with the development.

The building design has integrated cross-ventilation and natural lighting as an important aspect for energy saving. The eastern side of the building, which is the main building façade will have open park space, hence ventilation and lighting will be greatly enhanced. Both lifts and staircases will be installed as per the requirements.

#### 4.4.2.2 Parking Capacity and Access

The ground floor will have 4 car parking spaces, which will be developed for private use. Access to these car parking areas will be from the main entrance on the eastern side of the building at Boduthakurufaanu Magu. This road is 40ft wide.

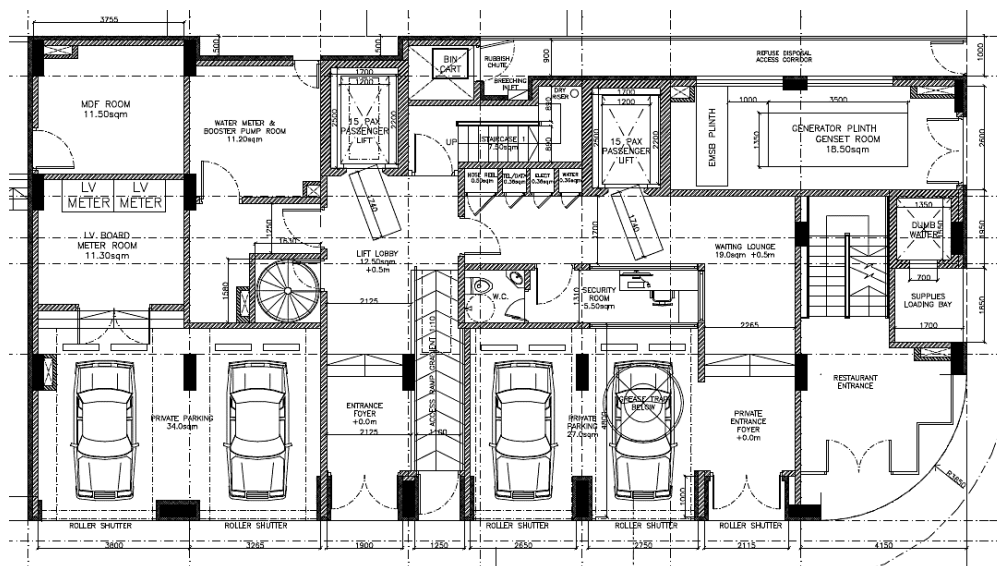


Figure 7: Parking plots and access points from Boduthakurufaanu Magu

## 4.5 PROJECT DEVELOPMENT

### 4.5.1 Project Schedule

The proposed project is expected to be completed in 1.55 years (567 days). A detailed project schedule is attached in **Appendix 4**.

### 4.5.2 Key Activities to Date

Prior to undertaking the design of the building, a geotechnical assessment was carried out in order to understand soil and ground condition against the load bearing capacity of the building as well as to assist in designing the foundation of the building based on the assessments carried

out. The geotechnical assessment was carried out by drilling 3 boreholes within the plot to a depth of 15.45m.

The geotechnical investigation report is attached in **Appendix 5**.

The building concept was then designed and developed and approved by Ministry of Housing and Infrastructure.

Baseline assessments for collecting environmental and social data from the site and surrounding environment has been completed after approval of the EIA Terms of Reference on 2 May 2017.

### **4.5.3 Key Uncertainty Factors on Project Schedule**

The key uncertainty factor that may affect the project schedule or the work plan of the project is extreme weather conditions and flooding in the area due to heavy rain where work such as excavations, foundation and lead time for sheets cannot be completed.

Also, certain delays in preconstruction activities such as obtaining permit for dewatering and construction may affect the overall project schedule.

### **4.5.4 Project Mobilization**

Mobilization of the project will be undertaken once EIA is approved from EPA. A temporary security hut is currently developed within the plot. As the project has very tight deadlines, an early mobilization and getting ready for construction in order to meet with the key project milestones are an important aspect of the overall project implementation.

### **4.5.5 Temporary Setup**

In order to make site ready, the road area of the plot has been appropriately fenced as some of the initial construction materials and machinery will be kept at the site.



*Figure 8: Temporary security hut and fencing within the plot*

Other important activity during the initial phase will be development of temporary storages for materials within the plot. Plastering works for the adjacent buildings will be undertaken once the temporary storages are completed.

In addition to setting up of temporary storages, temporary arrangements for electricity and water supply for construction works will be arranged from STELCO and MWSC. The requirements for the arrangements have already been communicated to the service providers and approved by them.

#### **4.5.6 Site Clearance and Preparation**

As there are no existing buildings at the plot, there will be no requirement for any demolition work. Ground leveling and preparation works will be undertaken immediately upon approval of the EIA. Excavation areas for basement and foundation will temporarily marked in order to make the site ready to initiate the activities.

#### **4.5.7 Excavation Works**

A total area of 290m<sup>2</sup> from the plot will require to be excavated to a depth of 4m, which will be done by using excavators. It is estimated that around 1,160m<sup>3</sup> of sand from the entire plot will be excavated for laying the foundation as well as basement of the building.

The excavated material will be immediately transported to approved locations in Male' by Ministry of Housing and Infrastructure. At present a site or a location for disposing the material has not yet been confirmed. The excavated sand will not be used for construction purpose.

#### **4.5.8 Site Protection**

As there are existing buildings on the southern and western sides of the plot as well as roadside on the eastern and northern sides, the entire boundary will be shored with corrugated 6mm sheets supported by 1.1/2" angle iron beams at 1.2m – 1.5m distance for bracing as a safety measure while preparing the site ready for laying the foundation and construction works. The sheets will be laid to a depth of 5m.

Before excavation works begin, plastering of the walls of the adjacent buildings will be undertaken to ensure further protection of the buildings.



*Figure 9: Existing adjacent buildings on the west (left) and south (right)*

#### **4.5.9 Dewatering**

It is estimated that around 783m<sup>3</sup> of groundwater will require to be dewatered from the plot. Prior to dewatering, permit will be obtained from Environment Protection Agency (EPA) and will use machinery of Male' Water and Sewerage Company (MWSC) for all dewatering needs. However, considering limited time factor for the proposed development, use of contractor own machinery will be mobilized for dewatering purpose in case where MWSC machinery are occupied at the time.

It is estimated that around 45 days will be required to complete the dewatering works with approximately 17.5m<sup>3</sup> dewatered on a daily basis.

During the operation of dewatering, necessary signboards will be placed as per the requirement of Dewatering Regulation.

The proponent has proposed to lay an own dewatering pipeline by using own equipment and machinery as the volume required to be dewatered is quite large and will not be allowed to use sewer pipeline. The following pipeline route has been proposed as part of this option. Prior approval for the route will be obtained from Ministry of Housing and Infrastructure.



*Figure 10: Proposed dewatering pipeline route*

## **4.5.10 Foundation Works**

### ***4.5.10.1 Type of Foundation and Details***

A piled raft foundation will be laid for the proposed building.

A piled raft foundation is a spread of concrete slabs further supported by incorporating concrete beams into the foundation, which will be laid covering the whole building area and supported by several piles driven into the ground. The entire building will be supported by the raft foundation. Raft foundation is normally undertaken in loose soils with low bearing capacity in order to support the loads over a large area.

The depth of the foundation will be 3.35m except for the lift area, where the depth will be 5m with foundation thickness of 300mm. All exposed surfaces of foundation will be applied with bituminous based protection coating and all main bars will have U bends.

A concrete mix ratio of 1:2:3 has been considered for the foundation.

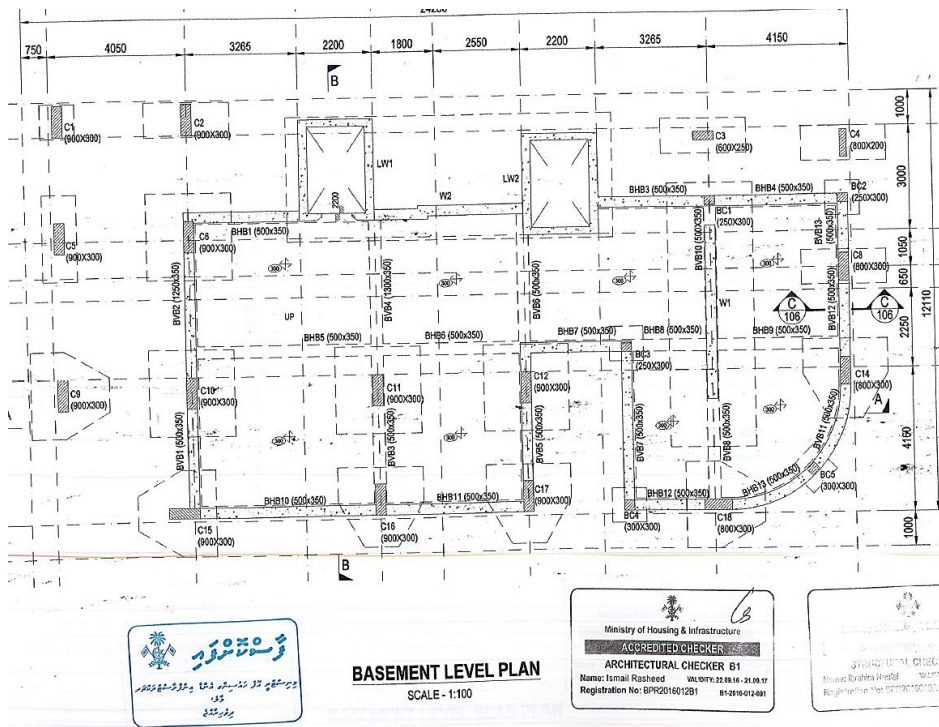
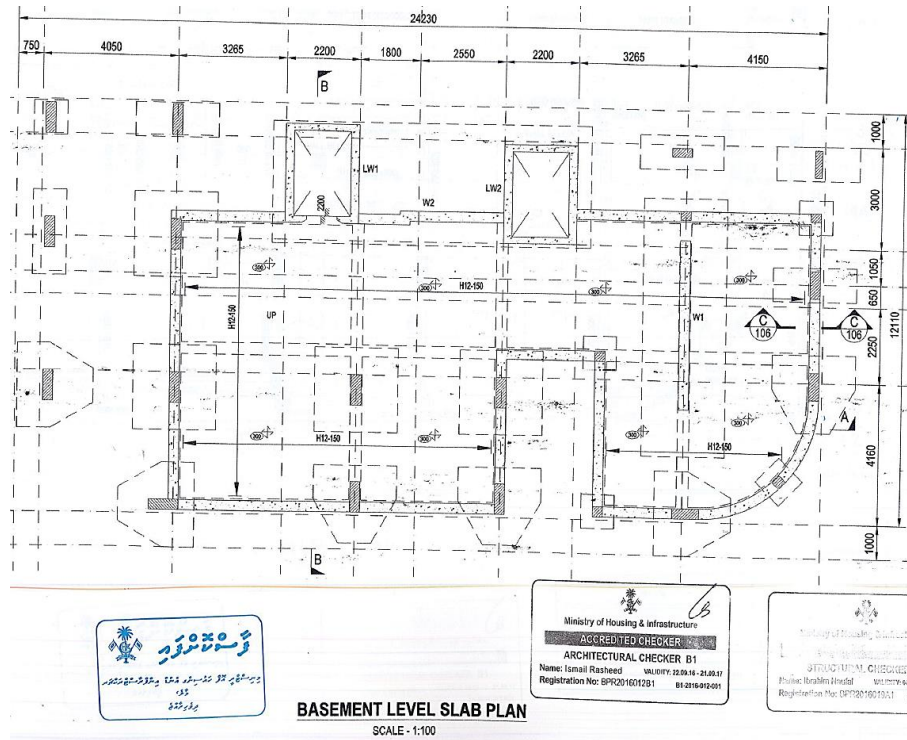


Figure 11: Foundation plan of the proposed building

The details of the foundation are attached in **Appendix 6**.

### 4.5.10.2 Micropiling

A total of 79 micropiles (200-300mm diameter) will be driven into the ground to depths ranging from 1 – 3.6m through boreholes done in 2 regions within the plot. The region 1 will have 31 such micropiles and region 2 will have 48 micropiles.

The below figure shows the piling plan.

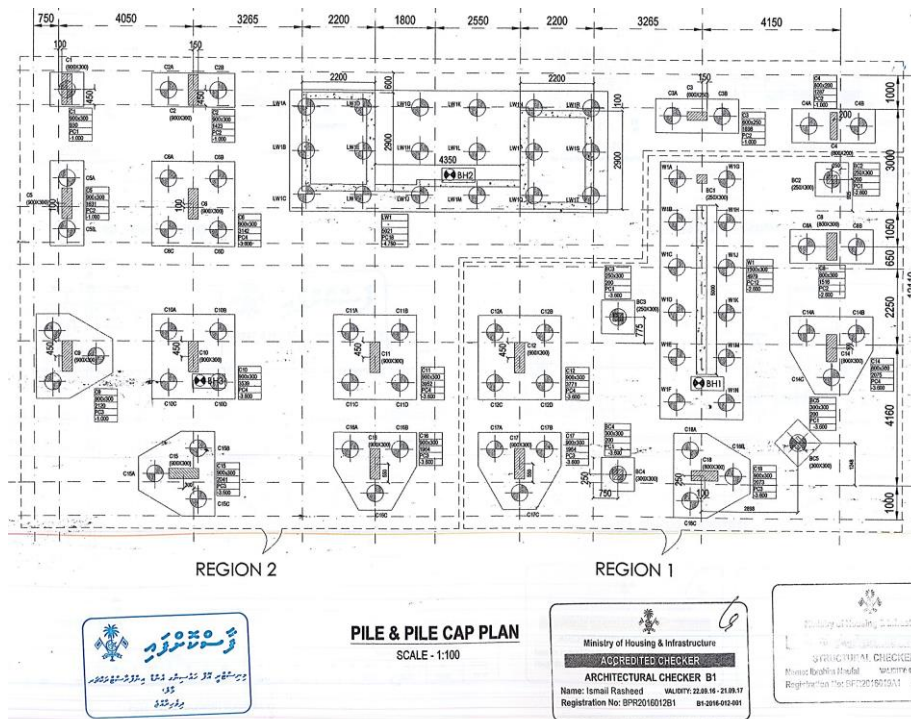


Figure 12: Piling plan

The details of piling are attached in **Appendix 7**.

### 4.5.10.3 Carrying Capacity of Foundation

According to the Geotechnical calculation, the approximate design load of the building has been recommended to be 125kPa for an allowable settlement of 100mm.

## 4.5.11 Construction Works

All construction works including structure development with concrete floor sheets, reinforced beams and slaps will be developed as the structural building frame upon completion of the foundation works. All construction works will be undertaken within a building safety framework and adequate lead time will be allowed in between the structural work requirements.

Light-weight concrete blocks will be used in all walls plastered with cement on either side of the wall. Electricity and telecommunication cable networks, water and wastewater pipe networks required for the overall building, floors and each apartment as well as grease trap for the restaurant will be laid upon completion of the structural works. All finishing works including wall sealing, painting and electric and water fixing works will be undertaken at the last stages of the construction.

#### **4.5.12 Electricity Requirements**

The energy requirements during the construction phase of the project will be obtained from STELCO sources in Male'. Initial discussions and finalization of machinery requirements have already been undertaken. It is estimated that between 100 - 150kW of electricity per day will be required during the construction phase of the project mainly to operate construction machinery, tools, lighting, lifting, etc.

STELCO power box is found for the plot, where temporary requirements for electricity can be easily obtained.

#### **4.5.13 Freshwater Requirements**

Only desalinated water will be used for all construction water requirements during the construction phase, which will be sourced from MWSC sources in Male'. Temporary arrangements for connecting freshwater to the project site has already been undertaken with MWSC. It is estimated that around 10 - 15m<sup>3</sup> of desalinated water per day will be required for all the construction operations.

Drinking water for labour workers will be fresh bottled water supplied from shops found nearby. No groundwater will be used during construction.

#### **4.5.14 Construction Waste Management Plan**

Large amounts of construction waste are believed to generate from the proposed project during the process of building development. During construction, construction waste from concrete, empty cement bags, wood and wood pallets, iron, steel, broken pieces of concrete blocks, nets, rods, cardboards, etc will form the bulk of construction waste.

Some of the construction waste generated at the site will be re-used, while disposable waste will be disposed off from the site.

Also, construction waste will be regularly transported to the waste management area in Male'. Two options will be looked at for managing construction waste. In this regard, construction waste will be transported to designated waste collection area in Male' by the contractor by using own vehicles. The other option will be to contact Waste Management Corporation (WMC) for their services of transporting construction waste on a regular basis.

In any option, handling and transportation of construction waste will be done as per the requirements of Waste Management Regulation implemented by EPA. If the project decides to transport waste by own means, a license will be obtained from EPA. If waste management will be given to WMC, they already have license and their transporting vehicles are according to the requirements of the regulation.

Wastewater during construction phase will not be disposed into the sewer network as construction wastewater contains large quantities of cement and other elements which may block the sewer. This wastewater will be either disposed into the ground by using soil pits or collected by using containers, where it will be transported to designated areas.

#### **4.5.15 Traffic Management**

Currently the roadside on the western (Boduthakurufaanu Magu) and northern (Burevi Magu) sides of the plot are designated parking areas. Parking from these areas will require to be temporarily closed at the time of building construction for safety reasons.

Managing traffic around the block will be an important aspect during construction phase of the building.

This requirement will be formally communicated to Ministry of Housing and Infrastructure and arrangements for vehicle access as well as temporarily moving parking areas will be undertaken before initiating construction work at the site.



*Figure 13: Vehicles parked on Baduthakurufaanu Magu (left) and Burevi Magu (right) by the plot*

#### **4.5.16 Compensation Plan for Dewatering and Construction Related Damages**

During the process dewatering, a seepage from the surrounding areas to the excavated area is believed to occur, however, will be minimized to a great extent due to proposed shoring methodology for site protection by use of sheets surrounding the entire excavated area. Damages to the surrounding areas due to dewatering will be temporary, hence long-term damages are unlikely. Care will be taken to reduce discharges into surrounding area during dewatering.

There are residential buildings on the immediate adjacent on the western side of the proposed building and there is believed to be a storage building on the southern side of the plot. On the other side of Burevi Magu, most of the buildings are residential. The boundary for the compensation plan has been considered for buildings within a 30m radius of the plot.

If there are any complaint from neighbors during dewatering and construction operations, the work will be immediately stopped and the extent of damage will be assessed and verified before it will be rectified. Monetary and physical compensation means in close collaboration with regulatory authorities will be considered depending on the magnitude of the damage. In case of any water shortages in the surrounding areas due to dewatering, water will be provided by the proponent until the issue is rectified.

#### **4.5.17 Waterproofing of Basement Area**

A number of measures have been considered for waterproofing of the basement area. In this regard, the new ground level will be at 500mm higher than normal ground level in order to stop potential flooding from outside. Entrance to the foyer will be elevated to 500mm.

All the walls of the basement will be concealed with a waterproofer and a water sealer. The waterproofer expands as it dries to become part of the wall. The water sealer will act as waterproof concrete as it take moisture of the wall to form its waterproof crystalline structure.

Additionally, sump pit room with a pump will be installed at the basement area to regularly pump water out from the sump. The sump will be connected with a perforated drainage pipe to collect water and then pumped out from a sump well. This will keep the basement dry at all times.

#### **4.5.18 Occupational Health and Safety**

Occupational health and safety issues will be dealt with at all times during the construction process of the proposed project. Health and safety briefings will be undertaken on a regular basis. All required equipment will be made available. In this regard, all construction workers will wear safety clothing including overalls, gloves, safety helmets, masks and safety boots during work at all times. Construction safety measures such as safety nets all around the building framework will be placed at all times. Other safety measures such as use of welding masks and use of safety belts will be made mandatory.

The site engineer will regularly supervise safety measures during construction period of the project.

Areas that accumulate water will be regularly cleaned to avoid mosquito breeding.

First aid kits will be made available on site for treating smaller wounds and cuts onsite. For serious and emergency issues, injured will be immediately taken to IGMH or ADK Hospitals for treatment.

Fire extinguishers and blankets will be made available at the project site in case of potential fire accidents.

#### **4.5.19 Demobilization and Inspection**

Towards the end of the construction period of the project, the demobilization process will be initiated. Demobilization will be undertaken after completing required construction works and finalization of the project. Upon demobilization of equipment and site inspection by the concerned agencies such as Ministry of Housing and Infrastructure, EPA, Maldives Energy Authority (MEA), Maldives Food and Drug Authority (MFDA), etc will be requested.

### **4.6 OPERATIONAL PHASE**

Following are the aspects that will be covered during the operational phase of the project.

#### **4.6.1 Provision of Electricity**

All electricity requirements during the operational phase will be obtained from STELCO. It is estimated that around 200-300kW of electricity per day will be required during the operation. There are no issues with STELCO to have the required electricity capacity during the operation of the proposed project.

They are currently upgrading their systems in selected zones in Male' especially in areas where there are major development projects.

As per the requirements of STELCO, electricity services areas will be developed on the ground floor including LV switch room, transformer and LV meters.

Additionally, a standby generator will be installed at the ground floor only for emergency use in a genset room. The generator as well as EMSB will rest on a plinth. A separate entrance will be developed for the genset room in the ground floor.

#### **4.6.2 Provision of Freshwater and Discharge of Wastewater**

All freshwater requirements for the building will be desalinated water obtained from MWSC. It is estimated that around 68 - 75m<sup>3</sup> of desalinated water per day will be required for the building (including restaurant), which can be met from the existing MWSC production capacity. For the purpose of discharging all wastewater from toilets, kitchens, laundries, etc

will use the main sewerage network of MWSC. A grease trap will be installed for the restaurant to ensure oils are trapped within the wastewater from the restaurant kitchen.

Water meter and booster pump room will be developed on the ground floor, which will have easy access to these facilities.

MWSC has recently introduced hydraulic booster pumps to pump water to high-rise building at high pressure. These hydraulic booster pumps will be used to pump freshwater to all floors of the building.

Wastewater from the building will be collected by two tanks installed on Boduthakurufaanu Magu and Burevi Magu to reduce loads on the main sewer line.

### **4.6.3 Waste Management**

Large amounts of waste, mainly household waste will be generated from the building once it starts operation. It is estimated that around 160 - 250kg of waste per day from the building including commercial (restaurant) and residential areas will be generated.

Each floor will have a designated waste chute and a designated landing and collection point at ground level. The area at the ground level will also have bin cart for collecting waste, with a separate access to the area. Waste transportation service will be provided by the proponent for waste generated from the building, which will be transported to the designated waste collection yard in Male'. In this regard, handling and transportation of waste will be undertaken by EPA Licensed parties to meet with regulatory requirements of waste management regulation. Also, transportation arrangements for waste will meet with all guidelines required under the Waste Management Regulation of 2013.

### **4.6.4 Management and Maintenance**

The building will be managed and maintenance services will be provided by the project proponent. These include regularly checking for damages and undertake repair works, undertake services requirements such as cleaning, security and servicing to the building.

Also, oversee the management of commercial area and parking area established at ground and first floors including maintaining cleanliness of the areas at all times. Maintaining a good and healthier environment outside of the building will be ensured.

### 4.6.5 Fire Fighting Measures

Necessary fire fighting equipment will be installed in all floors of the building. Additionally, sprinkler water tank having 36t (2 x 18t) capacity will be developed at the basement area with wet raiser pumps, sprinkler pumps and hose reel pumps.

Furthermore, 2 x 15-pax lifts will be developed in the building one of which can be designated for services and emergencies.

A staircase for the building will also be available to be used in case of fire and emergencies.

## 4.7 PROJECT INPUTS AND OUTPUTS

Following are the key project inputs and outputs.

Key Project Inputs during construction and operation phases.

Project Input	Project Phase	Type	Source
Construction Labor	Construction	Foreign / local	Contractor (140/100 persons)
Permanent staff	Operation	Foreign / local	Proponent (10/20 persons)
Technical personnel	Construction	Foreign / local	Contractor (5/5persons)
Material	Construction	Steel bars, iron, river sand, cement, aggregate, timber, wood, electrical and telephone, cables, pvc pipes, building blocks, tiles, plywood, gypsum board, lysaght roofing material, paint, varnish, chemicals, thinner, nets, etc	Import, local suppliers and contractor's material
Machinery	Construction	Excavator, pickup, trucks, tools	Contractor's machinery
Spare parts	Construction	Spare parts for all machineries	Contractor and local suppliers
Water supply	Construction	For construction needs 15m <sup>3</sup> per day	From MWSC
Water supply	Operation	For operation needs 75m <sup>3</sup> per day	From MWSC
Electricity Supply	Construction	150kW of electricity per day	From STELCO
Electricity supply	Operation	300kW of electricity per day	From STELCO
Fuel supply	Construction	Diesel, petrol, lubricants	Locally purchased from Male'

Food and accommodation	Construction	During construction	Contractor labour quarters
Health and safety	Construction/operation	Fire extinguishers, first aid, safety equipment	Contractor equipment during construction and proponent equipment during operation

Table 1: Key project inputs

#### Key Project outputs during construction and operation phases

Project Output	Project Phase	Quantity	Disposal Method
15-storey building	Operation	1	Contract management
Construction waste	Construction	100kg - 200kg per day	Transported to waste collection yard in Male'
Operation waste	Operation	160kg – 250kg per day	Transported to waste collection yard in Male'
Wastewater	Operation	30t per day	Use MWSC Male' sewerage network
Oil and lubricant waste	Construction	Small	Re-used or stocked to transfer for final disposal in Thilafushi
Dust and Noise Pollution	Construction	Small	Fixed working hours

Table 2: Key project outputs

## 4.8 AFFECTED BOUNDARIES

The proposed project is likely to generate some environmental impacts that may be carried to the surrounding areas especially during construction stages. An impact boundary within 30m radius especially buildings on the northern, western and southern sides are estimated. These impacts are mostly envisaged to be relating to noise and dust. As most of the buildings are multistorey residential buildings where people currently reside, the impacts will be immediately felt by the people residing in these buildings. However, these impacts will be temporary and will be mostly felt during early stages of the development.

Also, depending on the prevailing wind, especially during SW monsoon where winds are predominantly north-eastwards, implications of noise and dust may be felt on the building on the northern side. During the NE monsoon, similar effects will be seen for the buildings found on the southern side of the plot.

There are no noise-sensitive sites such as Mosques, Schools, Hospitals in the vicinity of the proposed building.

With regards to minimizing these impacts, appropriate measures will be taken including restricted working hours and use of nets around the building area will be undertaken.



*Figure 14: Expected impacts boundary (red) in relation to project area (orange)*

Most direct impacts such as construction waste and visual impacts are believed to be confined to the project site while indirect impacts of public nuisance from construction noise and dust is believed to occur in the surrounding environment as shown in the figure.

As this is a high traffic area, especially during afternoon and evening hours, impacts on traffic movement will occur during the initial stages of the development. However, with appropriate traffic control measures, the impacts on traffic will be minimal.

During the operation phase the main environmental impact will be from generation of solid waste at the premise as well as increased traffic as a result of residents and presence of restaurant at the premises.

## **5. LEGAL FRAMEWORK**

The following section looks into relevant laws and regulations as well as key government policies that have a direct bearing to the proposed development in terms of environmental management and protection in the country.

### **5.1 APPLICABLE LAWS AND REGULATIONS**

There are a number of laws and regulations relating to environmental protection and management in the country. Only relevant laws and regulations in relation to the proposed building development have been outlined in this section.

#### **5.1.1 Environmental Protection and Preservation Act (Law No. 4/93)**

The Environmental Protection and Preservation Act of the Maldives, EPPA (Law No. 4/93) provides the basic framework for environmental management including Environmental Impact Assessment (EIA) process in the Maldives, which is currently being implemented by Environmental Protection Agency (EPA) on behalf of Ministry of Environment and Energy (MEE).

Clause 2 of the EPPA mandates the Ministry of Environment and Energy to formulate policies, rules and regulations regarding the environment.

Clause 5 of this Act specifically provides for environmental impact assessment (EIA), a tool implemented to attempt to integrate environmental issues into development decisions. According to the Clause, environmental impact assessments are a mandatory requirement for all economic development projects.

Clause 6 of the EPPA gives the Ministry of Environment and Energy the authority to terminate any project that has an undesirable impact on the environment.

Clause 7 of the EPPA refers to the disposal of oil, wastes and poisonous substances in to the Maldivian territory. According to this clause, any type of waste, oil, toxic gas or any substance

that may have harmful effects on the environment should not be disposed within the Maldivian territory. If, however, the disposals of such substances become absolutely necessary, the clause states that they should be disposed only within the areas designated for that purpose and if incinerated, appropriate precautions should be taken to avoid harm to the health of the population.

The Environmental Act or Law 4/93 is the single most important legal instrument with regards to environmental management and it gives very high prominence towards safeguarding the environment with regard to all the development activities. Under this Act, the Ministry of Environment and Energy have developed regulations and guidelines concerning the environmental protection through implementation of EIA procedures.

### Applicability

The EIA has been prepared as per the EIA Regulations 2012 developed directly under the Environmental Protection and Preservation Act and identifies that development of such buildings exceeding 31m in height and with basements or over 10 storeys with greater than 5ft foundation require an EIA to be undertaken and approved by EPA before commencement of construction. This EIA is mandatory as the project exceeds all requirements.

### **5.1.2 Maldives EIA Regulation, 2012**

The most important regulation concerning the proposed development is Environment Impact Regulations, 2007, which was amended in 2012 is enforced under Environment Protection and Preservation Act (Law No. 4/93) by EPA.

The Schedule D of the EIA Regulation prescribes that all major housing development project shall undertake an EIA prior to commencement of the project if the building exceeds 31m in height, have more than 10 sheets, the foundation exceeds 5ft, have basements or have more than 10 storeys. As the proposed project is a residential development, hence, preparation and approval of an EIA is mandatory.

The EIA regulation further explains implementation of mainstream EIA process in the Maldives and provides guidelines for preparing relevant EIA to environmental clearance in the form of an Environmental Decision Statement.

### Applicability

The EIA has been done as per the requirements prescribed in Schedule D, which enlists that development of buildings exceeding 31m in height, have more than 10 sheets, have foundation exceeding 5ft, have more than 10 storeys and have basements shall prepare and approved an EIA before commencement of construction. This EIA is mandatory as the project exceeds all requirements.

### **5.1.3 Environmental Damage Liabilities Regulation, 2011**

Under the Environmental Protection and Preservation Act (No. 4/93), the Ministry of Environment and Energy formulated the Environmental Damage Liabilities Regulation in February 2011, which encompasses the basis to avoid environmental deterioration, extinction of biological resources, environmental degradation and avoid wastage of natural resources.

The main purpose of this regulation is to stop unlawful activities on environment and adequately implement a fining procedure for violations as well as implement a compensation mechanism on environmental damages. Its Schedules form the basis for levying fines on various environmental components and activities. Hence, the proposed project will be subject to this Regulation for any activity outside of the EIA scope and Environmental Decision Statement.

### Applicability

If the proposed project have an irreparable damage to the environment outside of its boundary, the provisions of the regulation can be applied in terms of compensating the damages caused.

### **5.1.4 Waste Management Regulation, 2013**

Waste Management Regulation (No. 2013/R-58) is more recent coming into effect on 6 February 2014. The Regulation was gazetted on 05 August 2013. The regulation is provides set of comprehensive guidelines and on collecting, storing, transporting and managing waste as well as management of hazardous waste. The waste management regulation identifies the following areas prohibited from dumping of waste; protected areas under the Environmental Protection and Preservation Act, mangroves, lagoons of islands, coral reefs, sand banks, beaches of islands, coastal vegetated areas of islands, harbors, parks and roads.

With regards to handling and transport of waste on land and sea, the following guidelines have been established. For those who are collecting, handling, transporting, storing, landfilling waste, a permit shall be obtained from EPA. During transport of waste on land and sea, the waste shall be completely covered to prevent odour and spilling. Also, the regulation prohibits importing and burning of hazardous waste. Similar to other waste, hazardous waste shall also be transported in sealed containers.

For all economic development projects, an appropriate site shall be identified for managing waste and waste shall be sorted and clearly labeled.

The entire provisions outline in the regulation will be strictly followed by the project proponent.

An annual waste management report by the licensed party shall be submitted to the Ministry of Environment and Energy.

#### Applicability

Waste handling, transportation and disposal as a result of the proposed development and operation of the proposed project must comply with the provisions of the regulation.

As part of the proposed project development and operation, the proponent proposes to transport disposable waste to designated area in Male', hence the above regulation and its components will be complied.

### **5.1.5 Dewatering Regulation, 2013**

A Dewatering Regulation (No. 2013/1697) under the Maldives Environmental Protection and Preservation Act came into force 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. Further, 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.

### Applicability

A dewatering permit will need to be issued by EPA prior to any dewatering operation and as prescribed in the regulation, the required dewatering signage will need to be placed at the project site during dewatering operation.

## **5.1.6 Management, Use and Control of HCFC Substances Regulation, 2010**

The HCFC Regulation is 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.

### Applicability

This is an obligation that has to be met by the Maldives, hence the provisions in this regulation will be adhered to. All air-conditioning and cooling done for the building will consider HCFC free equipment in order to support the efforts of the country to eliminate HCFC by 2020.

## **5.1.7 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.

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

### Applicability

The proposed development conforms to the provision set out in (a) outlined above as the plot has been designated for construction of household and building for residential purpose.

### **5.1.8 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 be 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.

### Applicability

There is no direct relevance of the proposed project with the Land Use Plan Regulation as the development will be undertaken as a residential development in a privately owned land.

### **5.1.9 Male' Planning Regulation, 2015**

The regulation was initially developed in 2008 and realigned to the Maldives Land Act 2002 in 2015 as 2015/R-192. The regulation is annexed to clause 6.3 of the Land Use Planning Regulation and is divided into two parts. Part One deals with regulatory planning requirements for Henveiru, Galholhu, Machchangolhi and Maafannu wards and Part Two deals with regulatory planning requirements in Villingili ward. The regulation is implemented by Ministry of Housing and Infrastructure.

The main requirement of the regulation under Part One includes; approving the development concept and obtaining a construction permit prior to undertaking any construction activity.

The regulation outlines the following;

- The construction permit shall be displayed at the project site.
- A foundation protection method shall be approved and all foundation works shall be undertaken in accordance with the approved foundation protection plan.

- Any demolition work of an existing building shall be undertaken after consulting with utility service providers including water and sanitation, electricity, etc.
- All construction activities shall be undertaken by taking into appropriate measures to protect surrounding buildings
- The height of the building shall be determined by taking into consideration the size of the plot, length and width of the plot as well as the width of the road/street in which the plot is found
- Also, the height of the building can be determined by taking into consideration its area
- In this regard, if the area of the plot exceeds 9.291 sqm, a building can be developed and if the width of the road/street exceeds 3.048m, a building having a height of 30.48m can be developed.
- If the area of the plot is less than 4,000 sqft (371.612 sqm), than the maximum height allowed under the regulation can be developed.
- The maximum allowable height of a building in Male' is 45m, which is only allowed for plots having an area exceeding 6,000 sqft.
- Extending the building to the roadside (for sun shading, balcony, etc) is only allowed from 9ft above to a limit of 1.49ft.
- A 10% area from each floor shall be left as opening space for ventilation
- The balconies of the building shall be at 1m height
- A parking area of 15% of the plot shall be allocated if the area of the plot is between 1,000 – 2,000 sqft.
- A fine between 1,000 MVR to 75,000 MVR will be imposed under the regulation depending on the magnitude of an illegal activity.

### Applicability

The design of the building and foundation protection plan has already been approved by Ministry of Housing and Infrastructure given that they are in conformity to the requirements of the regulation.

### **5.1.10 Maldives National Building Code, 2008**

The Maldives National Building Code 2008 is a performance based code which is aimed to provide flexibility in design with the possibility for regular change to the compliance

documents and standards it refers to, depending on development in the construction industry. The advantage of a performance based Building Code is the flexibility. It contains no prescriptive requirements stipulating that certain products or designs must be used. This flexibility allows developments and innovation in building design, technology and systems. The purpose is to create the enabling environment to achieve a safe and usable building design rather than aiming for the best building design.

The Maldives building code does not consist of sets of “prescriptive” technical specifications but instead consist only of sets of “performance requirements” that each building has to meet. Hence the code is a “performance-based code” which means the code does not prescribe how work should be done, but states how completed building work and its parts must perform.

The code consists of two general clauses outlining classified building uses and interpretations and 35 technical clauses which cover aspects such as structural stability and durability, fire safety, access, moisture control, safety of users, services and facilities and energy efficiency.

The key aspects and requirements outlined in the building code are;

- Stability
  - Structure – Buildings, building elements and sitework shall withstand the combination of loads that they are likely to experience during construction or alteration and throughout their lives.
  - Durability - Building materials, components and construction methods shall be sufficiently durable to ensure that the building, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the building.
- Fire Safety
  - Means of escape - Give people adequate time to reach a safe place without being overcome by the effects of fire, and give fire service personnel adequate time to undertake rescue operation.
  - Spread of fire - Buildings shall be provided with safeguards against fire including means of protecting adjacent buildings.
  - Structural stability during fire - Buildings shall be constructed to maintain structural stability during fire to allow people adequate time to evacuate safely, allow fire service personnel adequate time to undertake rescue and firefighting

operations and avoid collapse and consequential damage to adjacent household units or other property.

- Access and facilities for the fire services - Buildings shall be designed and constructed so as to provide reasonable facilities to assist fire fighters in the protection of life.
- Access
  - Access routes - Where a building is provided with loading or parking spaces, they shall be constructed to permit safe and easy unloading and movement of vehicles, and to avoid conflict between vehicles and pedestrians.
  - Mechanical installations for access - Mechanical installations for access into, within and out of buildings shall provide for the safe and easy movement of people, and for the safety of maintenance personnel.
- Moisture
  - Surface water - Buildings and sitework shall be constructed in a way that protects people and other property from the adverse effects of surface water.
  - External moisture - Buildings shall be constructed to provide adequate resistance to penetration by, and the accumulation of, moisture from the outside.
  - Internal moisture - Buildings shall be constructed to avoid the likelihood of: Fungal growth or the accumulation of contaminants on linings and other building elements, free water overflow penetrating to an adjoining household unit, and damage to building elements being caused by presence of moisture.
- Safety of Users
  - Hazardous agents on site - Buildings shall be constructed to avoid the likelihood of people within the building being adversely affected by hazardous agents or contaminants on the site.
  - Hazardous building materials - Building materials which are potentially hazardous, shall be used in ways that avoid undue risk to people.
  - Hazardous substances and processes - Buildings where hazardous substances are stored and hazardous processes undertaken, shall be constructed to provide adequate protection to people and to other property.
  - Safety from falling - Buildings shall be constructed to reduce the likelihood of accidental fall.

- Construction and demolition hazards - Construction and demolition work on buildings shall be performed in a manner that avoids the likelihood of objects falling onto people on or off the site, objects falling on property off the site, other hazards arising on the site affecting people off the site and other property, and unauthorised entry of children to hazards on the site.
- Lighting for emergency - Buildings shall be provided with adequate lighting within all escape routes in an emergency.
- Warning system - Buildings shall be provided with appropriate means of warning people to escape to a safe place in an emergency.
- Signs - Signs shall be provided in and about buildings to identify escape routes, emergency related safety features, potential hazards, and accessible routes and facilities for people with disabilities.
- Services and Facilities
  - Personal hygiene - Buildings shall be provided with appropriate spaces and facilities for personal hygiene.
  - Laundering - Buildings shall be provided with adequate space and facilities for laundering.
  - Food preparation and prevention of contamination - Buildings shall be provided with space and facilities for the hygienic storage, preparation and cooking of food, that are adequate for the intended use of the building.
  - Ventilation - Spaces within buildings shall be provided with adequate ventilation consistent with their maximum occupancy.
  - Interior environment - Buildings shall be constructed to provide an adequate, controlled interior temperature, adequate activity space for the intended use, and accessible spaces and facilities.
  - Airborne and impact sound - Building elements which are common between occupancies shall be constructed to prevent undue noise transmission from other occupancies or common spaces, to the habitable spaces of household units.
  - Natural light - Habitable spaces shall provide adequate openings for natural light.
  - Artificial light - Spaces within buildings used by people, shall be provided with adequate artificial lighting which, when activated in the absence of sufficient natural light, will enable safe movement and activity.

- Electricity - Where provided in a building, electrical installations shall be safe for their intended use.
- Piped services - In buildings provided with potentially hazardous services containing hot, cold, flammable, corrosive or toxic fluids, the installations shall be constructed to provide adequate safety for people.
- Gas as an energy source - In buildings where gas is used as an energy source, the supply system shall be safe and adequate for its intended use.
- Water supplies - Buildings, provided with drinking water outlets, sanitary fixtures or sanitary appliances, shall have a safe and adequate piped water supply.
- Foul water - Buildings, in which sanitary fixtures and sanitary appliances using water-borne waste disposal are installed, shall be provided with an adequate plumbing and drainage system to carry foul water to appropriate outfalls.
- Industrial liquid waste - Buildings, in which industrial liquid waste is generated shall be provided with adequate spaces and facilities for the safe and hygienic collection, holding, treatment and disposal of the waste.
- Solid waste - Buildings shall be provided with space and facilities for the collection, and safe hygienic holding prior to disposal, of solid waste arising from the intended use of the buildings.
- Energy Efficiency
  - Energy efficiency - Buildings, throughout their lives, shall have provision for ensuring efficient energy use in controlling indoor temperature when that energy is sourced from a public electricity supply, or any other depletable energy resource.

### Applicability

The recommendations prescribed in the Building Code will be met throughout the development and operation of the proposed project.

## 5.2 RELEVANT POLICIES

### 5.2.1 National Framework for Development, 2009-2013

One of the most important environmental policy guidance is given in the Strategic Action Plan (SAP) of the National Development Framework for 2009-2013. Due to the fragile nature of the country's environment, all the development activities must ensure that appropriate care is taken to protect the environment. Environmental sustainability is the basis for socio-economic development, hence, the SAP outlines the key environmental policies that will be implemented in the country for environmental protection and sustainability, while one of the key environmental goals of the country is to protect and preserve the natural environment to ensure prosperous economic development. The environmental policies outlined in the SAP include;

- Policy 1: Strengthen EIA process with an emphasis on EIA monitoring*
- Policy 2: Conserve and sustainably use biological diversity and ensure maximum ecosystem benefits*
- Policy 3: Develop resilient communities addressing impacts of climate change, disaster mitigation and coastal protection*
- Policy 4: Strengthen adaptation and mitigation responses for beach erosion and develop a system to assist communities where livelihood and property are affected by beach erosion*
- Policy 5: Ensure management of solid waste to prevent impact on human health and environment through approaches that are economically viable and locally appropriate*
- Policy 6: Ensure protection of people and the environment from hazardous waste and chemicals*
- Policy 7: Improve air quality to safeguard human health*
- Policy 8: Enable a fully functional decentralized environmental governance system*
- Policy 9: Develop a low carbon economy to achieve Carbon Neutrality by 2019*
- Policy 10: Inculcate environmental values in the society and enable environmentally friendly lifestyle*

The Ministry of Environment and Energy and Environment Protection Agency takes the lead role in implementing the above national policies through various strategies and regulatory measures.

### **5.2.2 3rd National Environmental Action Plan, 2009-2013**

NEAP 3 sets out the agenda for environmental protection and management in the Maldives for the five year period 2009 – 2013. This plan is targeted to achieve measurable environmental results that matter to the people of the Maldives.

The aim of developing NEAP 3 is to protect and preserve country's environment and properly manage natural resources for sustainable development of the country and encompasses ten principles, six strategic results with targeted goals to be achieved under each result.

The key principles of the NEAP 3 are;

*Principle 1: Environmental protection is the responsibility of every individual*

*Principle 2: Achieve results*

*Principle 3: Promote and practice sustainable development*

*Principle 4: Ensure local democracy*

*Principle 5: Inter-sectoral co-ordination and co-operation*

*Principle 6: Informed decision making*

*Principle 7: Precaution first*

*Principle 8: Continuous learning and improvement*

*Principle 9: Right to information and participation*

*Principle 10: Environmental protection complements development*

The six strategic results of NEAP3 are: resilient islands; rich ecosystems; healthy communities; safe water; environmental stewardship; and a carbon neutral nation with 30 result oriented environmental goals that will be achieved in the span of the NEAP 3.

### **5.2.3 Maldives National Strategy for Sustainable Development, 2009**

The Maldives National Strategy for Sustainable Development (NSSD) outlines the key objectives, principles and goals that the country will embark toward achieving sustainable development. Hence, the overall direction of the NSSD is to build a nation which appreciates the true value of the natural environment, utilizes its natural resources in a sustainable manner for national development, conserves its limited natural resources, has built the capacity to learn about its natural environment and leaves a healthy natural environment for future generations.

The guiding principles outlined in the NSSD are;

*Principle 1: Promotion and protection of fundamental human rights*

*Principle 2: Equity within and between generations*

*Principle 3: Democratic and open society*

*Principle 4: Full participation of businesses and civil society*

*Principle 5: Policy coherence and coordination*

*Principle 6: Use best available knowledge*

*Principle 7: Precaution first*

*Principle 8: Make polluters pay*

While the country will be steered in accordance with the underlying principles of NSSD, the country aims to achieve very important environmental goals, including; adapting to climate change, protecting coral reefs, achieving carbon-neutrality in energy, ensuring food security, establishing a carbon neutral transport system, protecting public health and achieving full employment and ensuring social security.

### **5.2.4 National Solid Waste Management Policy, 2007**

As waste management has been identified as a key environmental issue in the Maldives, a National Solid Waste Management for the Republic of Maldives was developed in 2007 as an important step towards mainstreaming waste management in the country. The key strategic principles outlined in the document include; establishing polluter pay principles, integrated solid waste management, best practice environmental option (BPEO), best available

technology not entailing excessive costs (BATNEEC), proximity principle and private sector participation. It is an important priority of the Government of Maldives as identified in the policy document to setup regional waste management facilities and island waste management centers and decentralizing waste management administration. Hence, the key policies relevant to this project include;

*Policy 1: Establish a governance structure for solid waste management which will distribute clearly delineated roles and responsibilities for solid waste management at island, regional and national levels*

*Policy 2: All waste producers have a duty to manage the waste they generate*

*Policy 3: Waste will be management and disposed as close as possible to the place of their generation*

*Policy 8: Private sector participation (PSP) will be facilitated where it is financially for both government and private sector.*

Establishing a proper mechanism of waste management and disposal will be vital for the overall operation of the project and the waste management practices both during construction and operation of the project will closely adhere to the policies and principles taken as a priority of the government.

### **5.2.5 Maldives National Housing Policy, 2008**

The first ever housing policy in the Maldives was developed in 2008 by the then Ministry of Housing and Urban Development. The key aspects covered in the housing policy include;

- a. Develop strategic goals/targets for housing and urban development and give priority to these goals in national development*
- b. Formulate effective laws and regulations on reclamation, development and ownership of land and under an effective framework, on shelter*
- c. Provide access to safe drinking water, sewerage and other basic amenities for all*
- d. Promote low-cost, effective, safe, environmentally friendly, energy saving and healthy means in housing construction*
- e. Support and promote the role of private sector in the housing delivery mechanism to facilitate affordable housing*

- f. Establish an appropriate housing finance mechanism with joint effort by the public and private sector*
- g. Facilitate easy access to services and facilities for all households under an effective mechanism and facilitate upgrading of substandard housing*

## **5.3 RELEVANT AUTHORITIES AND SERVICES PROVISIONS**

### **5.3.1 Ministry of Environment and Energy, MEE**

The primary environmental institution in the Maldives is MEE. It is mandated with formulating policies, strategies, laws and regulations concerning environmental management, protection, conservation and sustainable development. The Minister of Environment or a designate gives the environmental approval or clearance to EIA by an Environmental Decision Statement. Additionally, MEE is responsible for formulating relevant laws and regulations, policies and strategies concerning energy, water and sanitation as well as waste management.

### **5.3.2 Environment Protection Agency, EPA**

EPA is the key regulatory body on environment, which is an autonomous body formed under the umbrella of MEE. It is mandated with implementing the EIA process in the Maldives, implementing the Environment Act and subsequent regulations on behalf of MEE, regulating water and sanitation, biodiversity conservation, waste management and coastal zone management. Also, it is responsible for developing environmental standards and guidelines in the country.

### **5.3.3 Ministry of Housing and Infrastructure, MHI**

MHI has the broad mandate for planning, developing, implementing as well as regulating housing and infrastructure development in the Maldives. In this regards, land use plans for each inhabited island and various development areas are approved by the Ministry. Additionally, the Ministry has developed a draft Building Code where it sets standards and controls for various building development in the country including guidelines for construction and safety measures that needs to be implemented.

The Ministry of Housing and Infrastructure approves all engineering and detailed designs of buildings developed in the country mainly for housing, residential and commercial purposes.

### **5.3.4 Maldives Land and Survey Authority, MLSA**

Maldives Land Survey Authority was established to realize the need for a separate agency to conduct surveys and collect and update information on the most beneficial use of lands, lagoons and reefs of the Maldives. The Land and Survey Authority approve all the land surveys undertaken in the islands for various development purposes. This authority is administered by Ministry of Housing and Infrastructure.

### **5.3.5 Ministry of Defense and National Security, MDNS**

Certain aspects of the buildings and operations are quite relevant for the work of the Ministry of Defense and National Security. The Ministry is responsible for implementing fuel handling and storing regulation as well as ensuring implementation of fire safety measures in the resorts and in buildings as per the requirement of Building Code.

### **5.3.6 Maldives Energy Authority, MEA**

The MEA is part of Ministry of Environment and Energy and it regulates the standards for energy in the country. The electricity wiring and networking shall be undertaken by MEA licensed electricians.

### **5.3.7 Health Protection Agency, HPA**

Public health and occupation health and safety issues are regulated by HPA. A Public Health Act is currently drafted. HPA has developed a set of guidelines and recommendations that needs to be followed with regards to protecting public health and occupational safety issues.

### **5.3.8 Maldives Food and Drug Authority, MFDA**

MFADA regulates all food processing and preparing requirements as well as import of pharmaceuticals to the country. Health and hygiene requirements for cafes and restaurants are maintained by MFDA. A regular inspection by MFDA is undertaken for monitoring of all food preparation and outlets to ensure that the requirements are met.

### **5.3.9 Male' Water and Sewerage Company, MWSC**

Freshwater intake pipelines and wastewater outflow pipeline has to be done in accordance with the requirement of MWSC and these services will be connected with the building by MWSC.

### **5.3.10 State Electric Company, STELCO**

The required electricity for the building during construction and operation phases of the project will be provided by STELCO. They will inspect the site prior to providing the service and recommends certain measures for appropriate use of electricity.

## **5.4 PERMITS OBTAINED AND REQUIRED**

The following permits as per the laws and regulations addressed in this section are required in order for the project to start implementation. These include;

### **5.4.1 Project Development Concept**

The project development concept of the building has already been approved by Ministry of Housing and Infrastructure and attached to this EIA report.

### **5.4.2 EIA Approval**

The most important environmental permit to initiate the proposed building project in Male' would be a decision regarding this EIA from the EPA. The EIA Decision Statement, as it is referred to, shall govern the manner in which the project activities must be undertaken. It is the final environmental clearance granted by the EPA for the proposed project.

### **5.4.3 Construction Permit**

Prior to commencement of all the construction activities on site, a Construction permit shall be obtained from Ministry of Housing and Infrastructure. This will be done upon issuance of EIA Decision Statement to the EIA.

### **5.4.4 Dewatering Permit**

A Dewatering Permit shall be obtained from EPA prior to undertaking any dewatering activities within the plot. This will be done upon issuance of EIA Decision Statement to the EIA.

### **5.4.5 Café/Restaurant Operation Permit**

An operating permit for the proposed café/restaurant will be required from MFDA prior to operation of the entity.

## **6. EXISTING ENVIRONMENT**

This section outlines the key existing environmental conditions of the project site, especially boundaries where the project is believed to impact the environment.

### **6.1 DATA COLLECTION METHODS**

This EIA is based on both qualitative and quantitative data collected from the proposed project area. Also, the report addresses major information requirements as outlined in the Terms of Reference (TOR) for preparing this EIA Report.

Following are the key environmental components and the ways and methods used to gather relevant data for the project.

#### **6.1.1 Climate Environment**

The climate information was collected from secondary sources, mainly from published information from Maldives Meteorological Services (MMS), which is used in the general description of the climate environment.

#### **6.1.2 Physical and Biological Environment**

In order to obtain physical and biological environment information as required in the TOR, the following methods have been undertaken on environmental various components. These include obtaining noise levels in and around the project site by using a sound meter (two periods); traffic flow and direction was obtained by undertaking a traffic survey for a period of 1 hour for two peak periods (12:00-13:00hrs and 21:00-22:00hrs); general water quality of the plot was analysed from MWSC laboratory; air quality information was also obtained from published information. No information on vegetation and other biological components were included as the plot is empty.

#### **6.1.3 Structural Environment**

Structural environmental information was obtained from general observations and photographic analysis of nearby buildings, surrounding roads and existing structures.

### **6.1.4 Socio-economic Environment**

Relevant socio-economic data from Male' was collected from published information, which is referenced.

### **6.1.5 Uncertainties in Data Collection Methods**

Some of the environmental assessments undertaken for the EIA are done on general observations such as structural environment of the adjacent buildings. Thus the degree of structural complexity that exists within these buildings will be difficult to understand. Also, some of the quantitative assessments undertaken are time bound such as assessment of traffic volume, which may differ from time-to-time and day-to-day. Thus, there is some degree of uncertainties that can exist on the data collected.

## **6.2 CLIMATE ENVIRONMENT**

### **6.2.1 Climatic Setting**

Maldives is located on the equator and therefore experiences monsoonal climate. There are two distinct seasons, dry season (Northeast Monsoon) and wet season (Southwest Monsoon). In these two seasons the temperature varies hardly. Northeast monsoon extends from January to March. Since Maldives consists of small islands and are surrounded by sea, hot days are often tempered by cooling sea breezes and balmy evening temperatures.

### **6.2.2 Monsoons**

Maldives is in the Monsoonal Belt in the North Indian Ocean. Therefore, climate in the Maldives is dominated by south-west (Hulhangu) and north-east (Iruvai) monsoons. The southwest monsoon is the rainy season which lasts from May to September and the north-east monsoon is the dry season that occurs from December to February. The transition period of the south-west monsoon occurs between March and April while that of the northeast monsoon occurs from October to November. These monsoons are relatively mild due to the country's location on the equator and strong winds and gales are infrequent in the Maldives. However, storms and line squalls can occur, typically in the period May to July. The winds usually get stronger in the south west monsoon especially during June and July.

### 6.2.3 Temperature

Throughout the year, temperature remains almost same in the Maldives. However, daily temperature ranges from around 31o in daytime to 23° Celsius in night time. The highest temperature ever recorded in the Maldives was 36.8°C, recorded on 19 May 1991 at Kadhdhoo Meteorological Office. Likewise, the minimum temperature ever recorded in the Maldives was 17.2°C, recorded at the National Meteorological Centre on 11th April 1978.

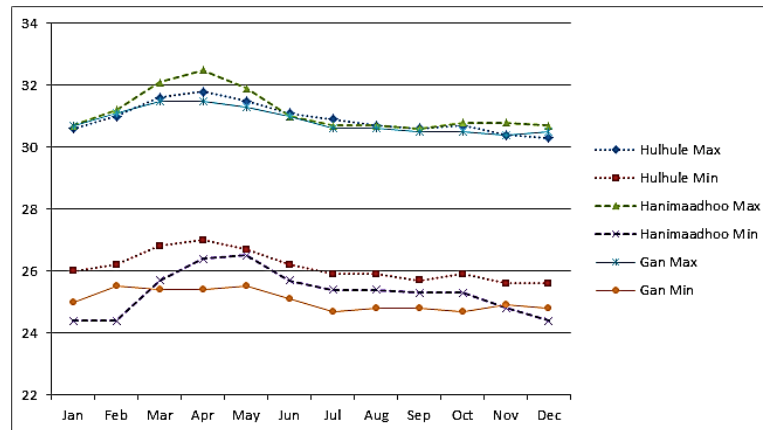


Figure 15: Average maximum and minimum temperatures (from 2000 – 2015) in the Maldives (Source: [www.meteorology.mv](http://www.meteorology.mv))

As can be seen from the above figure, there is very little temperature variation throughout the country. The maximum temperature is between the ranges of 30 - 32°C and minimum temperature is between the ranges of 24 - 27°C.

Assessments in the surrounding environment of the plot was undertaken in May 2017 and as climate data for May 2017 were unavailable, temperature comparison for 2015 and 2016 for the month of May recorded from the nearest weather station, which is Hulhule Met Center was obtained from Maldives Meteorological Service (MMS).

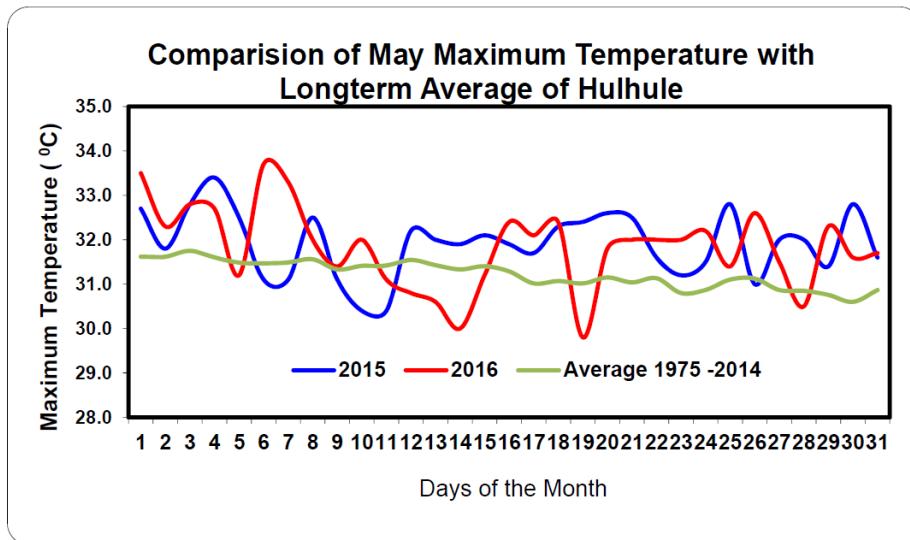


Figure 16: Comparison of max temperature for May 2015 and 2016 (Source: www.meteorology.mv)

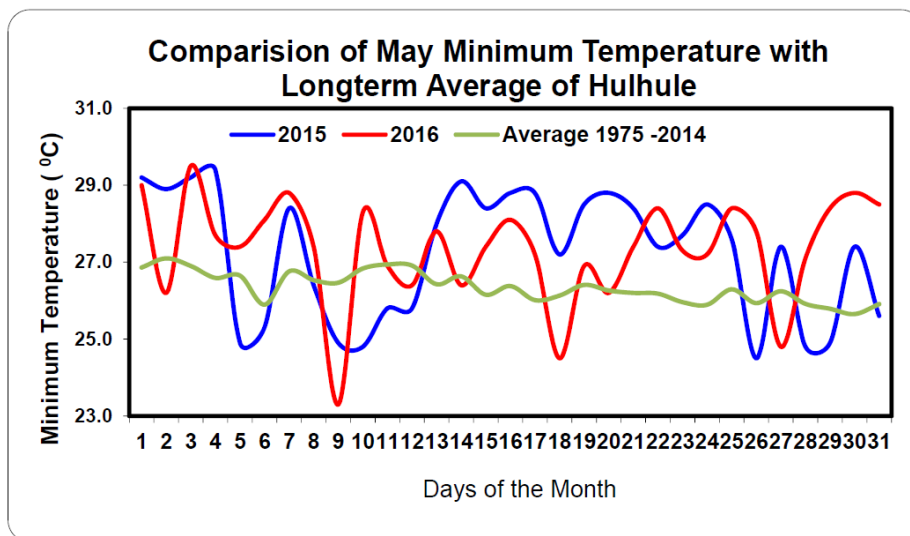


Figure 17: Comparison of min temperature for May 2015 and 2016 (Source: www.meteorology.mv)

The highest temperature recorded in central part of the Maldives in May 2016 was 34 degree Celsius, which was recorded on the 06th. The minimum temperature recorded in the same area for the last month was 23 degree Celsius and was recorded on the 09th of May. On the other hand, the highest temperature recorded in May 2015 in central part of the country was 34 degree Celsius, which was recorded on the 04th. Furthermore, the minimum temperature recorded in the central part in May 2015 was 25 degree Celsius, recorded on the 26th. Figure above shows daily maximum and minimum temperature (2015 and 2016) and average maximum and minimum temperature for the Month of May for central part of Maldives.

## 6.2.4 Rainfall

The wet season; southwest monsoon runs from mid-May to November. In this season Maldives experiences torrential rain. The highest rainfall ever recorded in the Maldives with in a 24 hour period was recorded on 9th July 2002 at Kaadedhdhoo Meteorological Office and amounts to 219.8mm of rainfall.

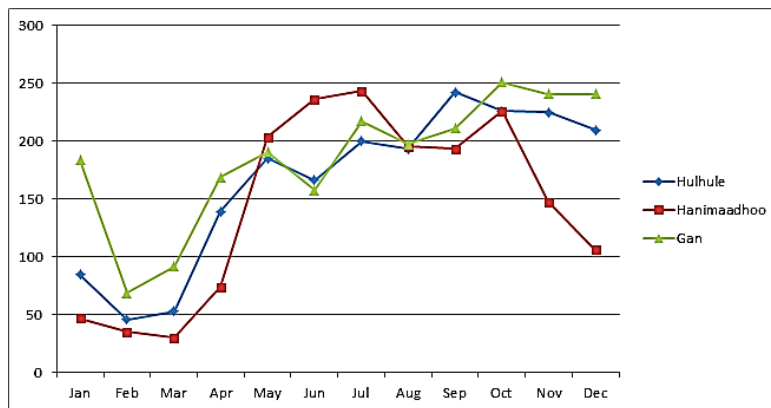


Figure 18: Average rainfall (from 2000 – 2015) in the Maldives (Source: [www.meteorology.mv](http://www.meteorology.mv))

As can be seen from the average for the past 15 years, the latter half of the year experiences more rain in the country.

Comparison of rainfall for the month of May 2015 and 2016 was also undertaken in order to understand the general rain pattern of the region during the field assessment period.

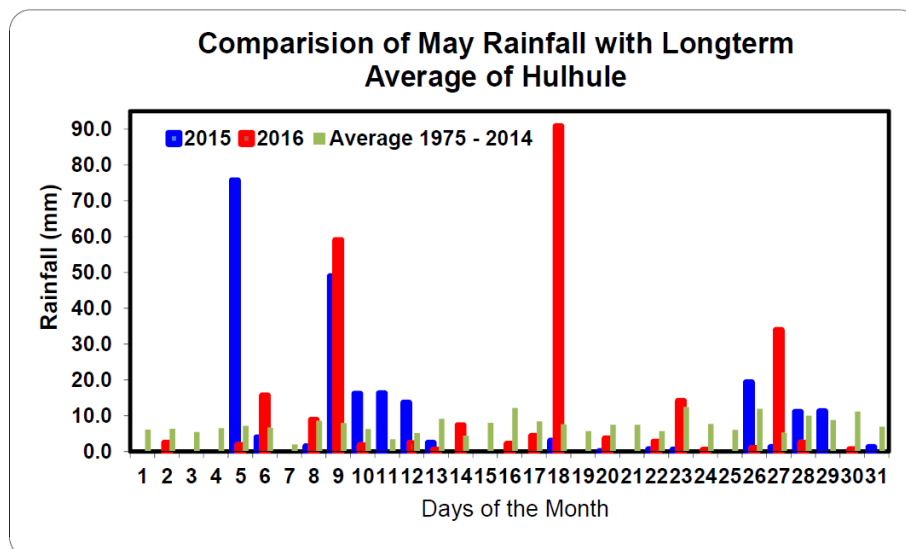


Figure 19: Comparison of rain for May 2015 and 2016 (Source: [www.meteorology.mv](http://www.meteorology.mv))

May 2016, central part of the country received a total rainfall of 255mm. The highest rainfall within 24 hours was recorded on the 18th and amounts to 91mm of rainfall. The rainfall received in May 2015 was 29mm less than that of May 2016. Figure above shows daily total rainfall (2015 and 2016) and daily average rainfall for the Month of May for central part of Maldives.

### 6.2.5 Wind

The average wind speed for the sum of the years (2002-2015) is 9 knots for the entire country and the predominant wind directions are W, WSW and WNW, which is the main feature during the SW monsoon. During the NE monsoon, predominant wind occurs from ENE direction with an average wind speed of 6-7 knots. Thus, strong winds are associated with the southwest monsoon season. Gales are uncommon, and cyclones are very rare in the Maldives.

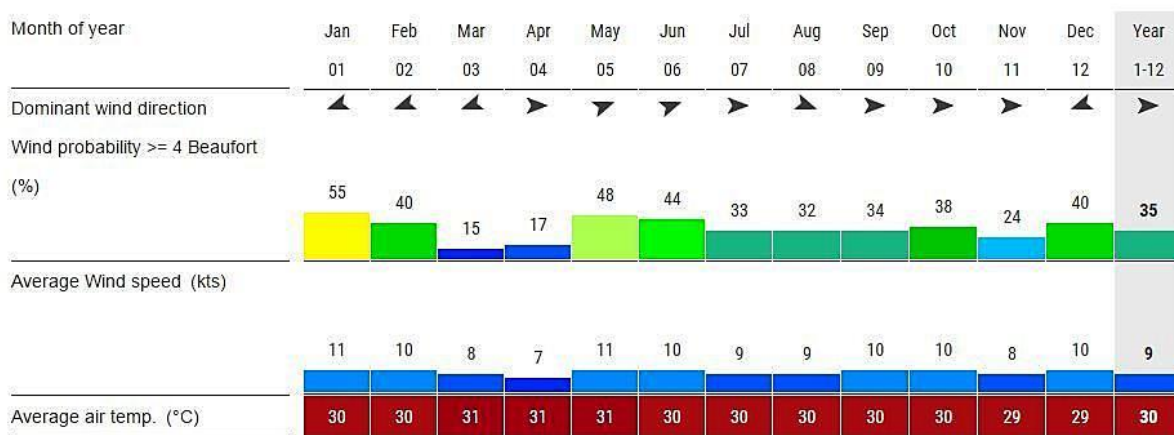


Figure 20: Monthly wind speed and direction (www.windfinder.com)

May 2016, the maximum wind speed in Central part of the country was experienced on the 17th at 17:20 hours from north-west and 27th at 15:30 hours from west-south-west at a speed of 40 mph. However, the maximum wind speed in central part in May 2015 was recorded on the 12th at 02:39 hours at a speed of 40 mph from west. Figure below shows daily maximum wind speed (2015 and 2016) for the month of May for the central parts of Maldives.

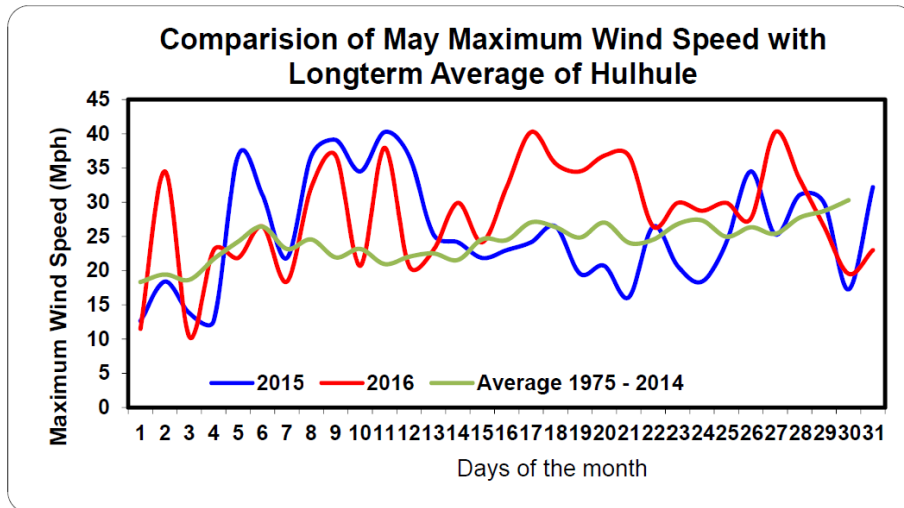


Figure 21: Comparison of winds for May 2015 and 2016 (Source: www.meteorology.mv)

Following is a wind frequency chart (wind rose) for Hulhule for May 2016. The field assessments at the plot was carried out in May 2017, hence wind data for May 2016 from Hulhule, which is the closest weather station was used as reference.

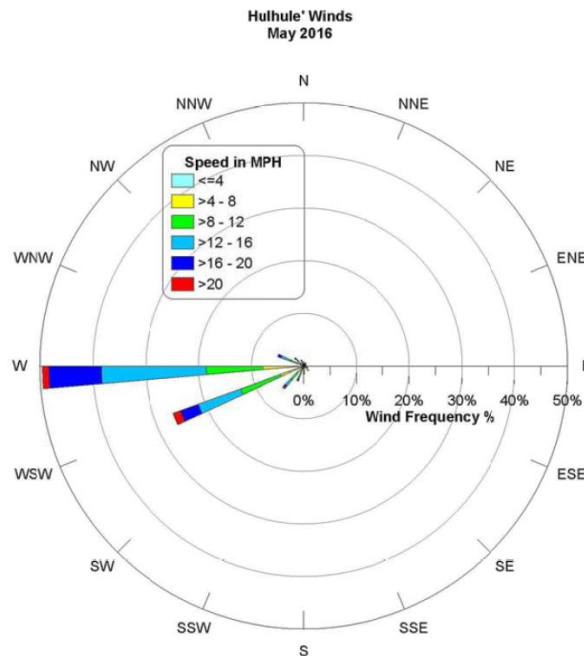


Figure 22: Wind frequency chart of Hulhule for May 2016 (Source: www.meteorology.mv)

This is the wind rose for Hulhule based on hourly wind data of the month May 2016. This rose shows that the winds at Hulhule during the period blow from the west-south-west and west much of the time. This also shows that the wind rarely blows from other directions.

## 6.2.6 Waves and Swells

The south-eastern side of Male' (close to the proposed plot) has the famous surf break area known Varunulaa Ralhugandu, where a number of surfers used to surf in this area due to occurrence of seasonal waves. However, as a result of ongoing construction works of the linking bridge, the waves have been observed to be fairly smaller. This may be as a result of piles of the bridge construction deck, where SE swells are believed to be greatly affected.

Information obtained from secondary sources indicate that the south-eastern side of Male' Atoll generated swells of 0.9m high during the month of April. The swells reduce in height to 0.5m as it enters the atoll, where the reefs play a major role in reducing the heights of the swells. According to the information, swells ranging 0.5m – 1.3m will be experienced in 94% of the time.

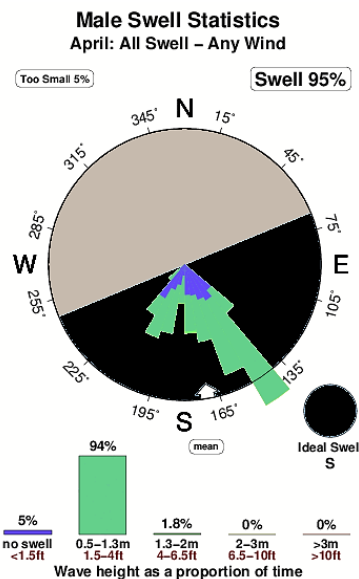


Figure 23: Swells map for North Male Atoll ([www.surf-forecast.com](http://www.surf-forecast.com))

## 6.3 PHYSICAL AND BIOLOGICAL ENVIRONMENT

### 6.3.1 Ambient Noise Levels

Average noise levels were recorded by using a digital sound meter on four different locations in the vicinity of the proposed site. Noise level readings in decibels (dB) were taken in the afternoon (12:30hrs) and at night (20:30hrs) on 18 May 2017, which coincides with the peak traffic periods in the area. Only average noise levels recorded were taken as baseline.

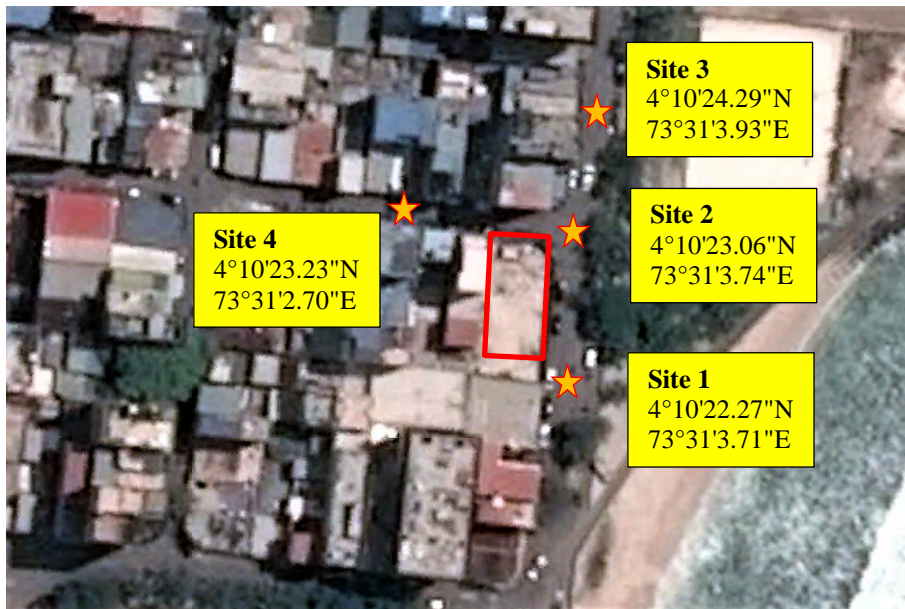


Figure 24: Noise level recorded locations

Following figure shows the noise levels recorded in the vicinity of the proposed plot.

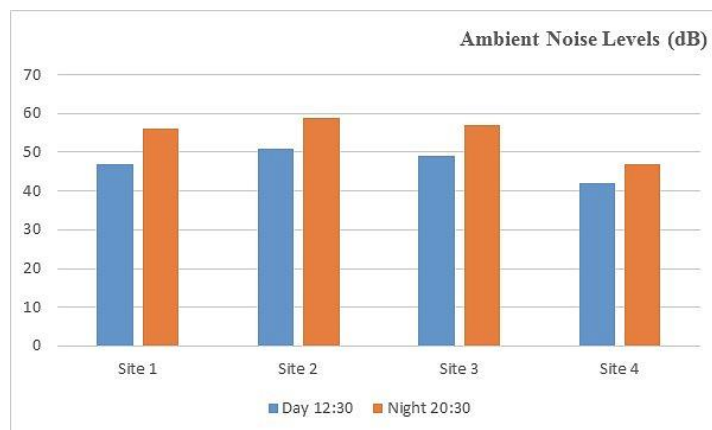


Figure 25: Noise levels recorded from the sites

Noise levels recorded from the sites were Site 1 47dB (day) and 56dB (night), Site 2 51dB (day) and 59dB (night), Site 3 49dB (day) and 57dB (night) and Site 4 42dB (day) and 47dB (night). Night time noise levels at all sites were found to be slightly increased than day time. This is mainly due to increased traffic in the area at the time of assessment at night. Noise levels recorded on Boduthakurufaanu Magu was above than Burevi Magu as Boduthakurufaanu Magu is a main road and has two-way traffic movement unlike Burevi Magu which has one-way traffic from east to west.

There are no noise sensitive sites such as School, Mosque or Hospital in the vicinity of the project site except for residential buildings nearby.

### 6.3.2 Traffic Flow and Volume



Figure 26: Traffic flow on Baduthakurufaanu Magu

An hourly traffic volume and flow direction during day time (12:00-13:00hrs) and night time (20:00-21:00hrs) on 18 May 2017) was observed on Boduthakurufaanu Magu and Burevi Magu in order to understand the general traffic pattern around the project site.

The following figure outlines the traffic volume on the two roads during day and night.

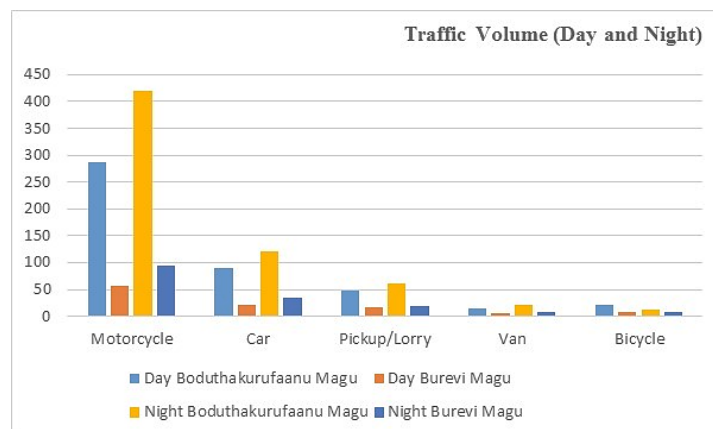


Figure 27: Traffic volume on Boduthakurufaanu Magu and Burevi Magu (Day and Night)

The traffic volume was assessed to be quite high especially on Baduthakurufaanu Magu for both day and night times. The highest traffic volume was observed to be from motorcycle having 288 during day time and 420 during night time on Baduthakurufaanu Magu. On Burevi Magu number of cycles were greatly reduced having 56 during day time and 94 during night time. The volume of cars on Boduthakurufaanu Magu was observed to be 90 during day time and 121 during night time. On Burevi Magu number of cars were observed to be 22 during day time and 35 during night time.

Night time traffic volume was observed to be greater than the day time. Increased traffic volume on Boduthakurufaanu Magu was due to two-way traffic movement as well as presence of a number of public gathering places such as political party gatherings as well as presence of a number of food outlets on the road and on Artificial Beach in addition to presence of BOM ATMs further north of the plot. Compared to Boduthakurufaanu Magu, traffic volume on Burevi Magu was observed to be greatly reduced as the road is a small one-way traffic road as well as there are no major food outlets except for Cibo, which is found on the opposite corner of Dhoovehi.

The traffic volume observed from the area is believed to be fairly high at the time of the survey, as it coincides with the peak traffic hours on the road.



*Figure 28: Traffic flow by the project site*

The traffic flow by the project site is from south to north and from north to south on Boduthakurufaanu Magu, hence two-way traffic movement is observed. On Burevi Magu traffic flow is from east to west, as it is a one-way traffic road.

### **6.3.3 Soil Investigation**

A geotechnical investigation on the soil of the proposed project area was undertaken separately, prior to designing of the proposed building in order to understand general soil conditions of the area. The condition of the soil plays a key role in determining the type and depth of the foundation proposed for the building.

Soil condition was assessed by drilling 3 boreholes within the project site as shown below.

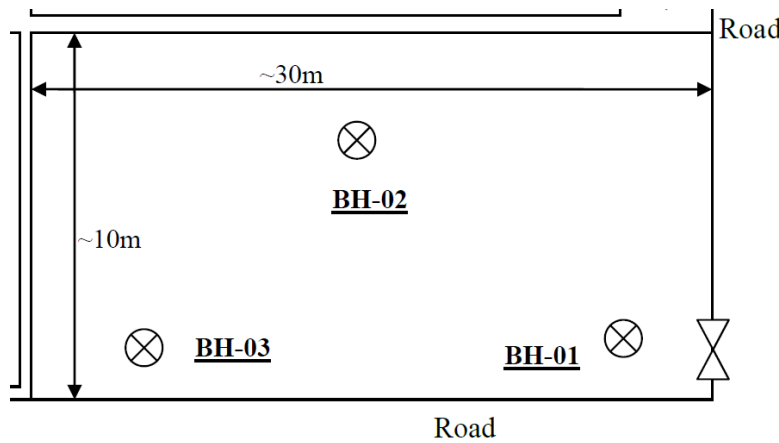


Figure 29: Locations of boreholes

The boreholes were advanced by means of rotary drilling machine and the drilling was carried out with overburden cutting tools and the wash boring process was adopted to remove the cuttings from the bottom of the borehole. During the drilling operation the walls of the boreholes were supported by 82 mm dia. NX type flush coupling casings. In order to achieve better alignment of borehole NWY flush coupling drill rods were used.

Details of the depths of drilling are indicated in the following table.

Borehole No.	Ground water level (m)	Overburden/Soil Drilling (m)	Rock/Boulder Drilling (m)	Total Depth(m)
BH-01	1.30	13.45	2.00	15.45
BH-02		15.45	-	15.45
BH-03		12.45	3.00	15.45

Table 3: Details of boreholes

The subsurface profile consists mainly of the following layers.

- Layer 1 – Loose coral sand with rare coral rock and hard zones
- Layer 2 – Medium dense coral sand
- Layer 3 – Highly weathered coral rock/highly weathered coral rock with coral sand only in BH 3
- Layer 4 – dense coral sand

Groundwater is found at a depth of 1.3m.

The geotechnical assessment report is attached in **Appendix 5**.

### 6.3.4 Groundwater Quality

A groundwater sample was collected from the building and was tested for parameters such as conductivity, salinity, nitrate, sulphate, TDS and pH. The results of the groundwater analysis show that the groundwater of the area is free from contamination. As the plot is located quite close to the sea, the results show some levels of salinity having 1.23<sup>0</sup>/<sub>00</sub>.

The results of the groundwater test from MWSC are attached in **Appendix 8**.

### 6.3.5 Ambient Air Quality

Ambient air quality data was not obtained for the proposed project, however, general air quality of Male' was assessed in 2010 as part of the study conducted for airport development project at Hulhule (AECOM, 2010). An air quality monitoring station was set up at Hulhumale', Hulhule and Male' as part of this study. The objective of the ambient air quality monitoring is to assess background environment status and to check the conformity to the applicable standards of ambient air quality.

The air quality monitoring was carried out using PM10, PM2.5, Sulphur dioxide (SO<sub>2</sub>), Oxides of nitrogen (NO<sub>x</sub>), Carbon Monoxide (CO) as the parameters by sampling continuously during the sampling period.

The ambient air quality results obtained from the monitoring undertaken indicate that all parameters were within the WHO guidelines for ambient air quality.

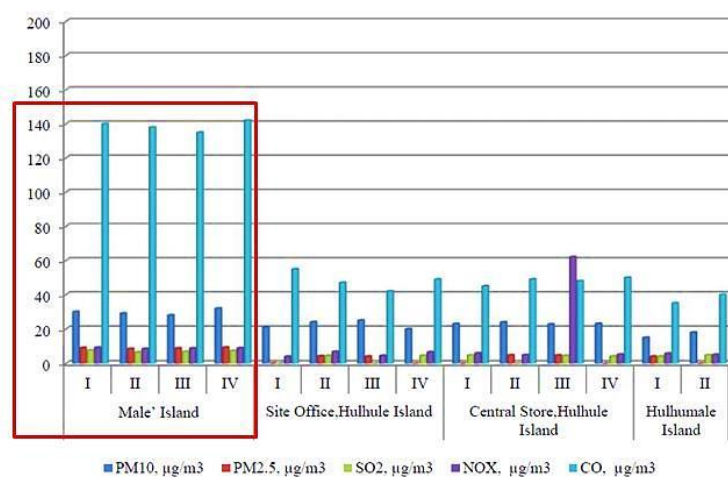


Figure 30: The ambient air quality for Male' (inside red box) taken from EIA for INIA Reclamation and Expansion by Water Solutions Pvt. Ltd., July 2014

Except for CO levels, the particulate matters and NOx and SO2 are found to be generally low in Male'. The CO levels were observed to be highest for Male' compared to Hulhule and Hulhumale', which is believed to be due to the presence of increased vehicles in Male'.

It will be difficult to establish air quality baseline as part of the project since there are a number of ongoing construction projects nearby as well as within the region where the ambient air may contain high levels of PM.

### **6.3.6 Vegetation**

There are no vegetation or mature trees found within the plot. Hence, no vegetation assessment was undertaken.



*Figure 31: Bare land of the plot*

## **6.4 STRUCTURAL ENVIRONMENT**

### **6.4.1 Condition and Uses of Nearby Buildings**

On the western adjacent side of the plot, there are three buildings having 4 storey, 2 storey and 7 storey all of which belong to Noofaru house. Only the 7 storey building is found on Burevi Magu while others are inside of Noofaru house. On the southern adjacent side, a two storey storage and a labour building is found belonging to Sea Side house. No other adjacent buildings are found by the plot. On the western side of Noofaru house on Burevi Magu, a 5 storey building belonging to Rumania house and 10 storey building belonging to Sheereen Villa is found.

On the opposite side of the plot on Burevi Magu, a 7 storey building is found, which belongs to Coral Reef house. Also, a 6 storey building of Wailaa Wool is located on the west of Coral Reef.

Except for the ground floor of these buildings found on Burevi Magu, most are residential flats and apartments. The ground floor is developed either as a shop, market and or an office space. All these building stated above are in good conditions without any physical damages. All buildings are believed to be 5 -7 years old.



*Figure 32: Condition of the buildings by the plot and opposite*

### **6.4.2 Condition of Roads**

Dhoovehi plot is found on the corner of Boduthakurufaanu Magu and Burevi Magu, hence these two roads are found by the plot. Boduthakurufaanu Magu is the main road found around Male'. The condition of these roads are observed to be good. No cracks or physical damages were found.



*Figure 33: Condition of Boduthakurufaanu Magu (left) and Burevi Magu (right).*

### 6.4.3 Existing Uses of the Site

Currently the project site is not used for any purpose.

## 6.5 SOCIO-ECONOMIC ENVIRONMENT

### 6.5.1 Population of Male'

According to the Preliminary Results of the Population and Housing Census of 2014, the total population of Male' is 153,379 divided into 83,429 males and 69,950 females. A large population of foreigners are also living in Male' and included in the total population, a total of 20,360 persons divided into 17,274 males and 3,086 females currently reside in Male'. According to the Census 2014, 38.98% of the country's population now reside in Male' (DNP, 2014).

The population has rapidly grown in Male'. In 2006 Census, the total population of Male' was 103,693 persons divided into 51,992 males and 51,701 females. Hence, over the last 9 years, the population of Male' has grown by 32%. The rapid growth of population in Male' is believed to be for various reasons including employment, education, health as well as for various economic activities, given that Male' is the business hub of the country.



Figure 34: Transformation of Male': in 1930s (from [www.maldivesroyalfamily.com](http://www.maldivesroyalfamily.com)) (left), and in 1960s (from [www.flickr.com](http://www.flickr.com)) (right)



Figure 35: Male' in 2014: where 38.98% of the country's population live ([www.earthporn.com](http://www.earthporn.com))

## 6.5.2 Population of Adjacent Buildings

The proposed building at Dhoovehi is located in a highly urbanised residential area. Almost all buildings within a radius of 30m are multi storied having between 2 – 10 floors. A total of 12 such buildings exist within this range. Almost all ground floors in these buildings are used for commercial purpose such as shops, offices, cafes and markets.

As it was difficult to get access to most of the residential units in these buildings, the exact number of population residing in these buildings are unknown. Hence, only estimation was done taking into consideration the average household size in Male'. In this regard, the population within the plot region is estimated to be between 320 – 500 persons.

## 6.5.3 General Socio-economic Environment of Male'

### 6.5.3.1 Education

Education in Male' is provided by 36 schools, which comprises of 13 government schools, 4 community schools and 19 private schools (Ministry of Education, 2013).

The student population in Male' is amongst the highest in the country having a total of 27,204 in all schools from 86,096 total student population in the country, which is 31.5% of all the student population (Ministry of Education, 2013). The total number of teachers in Male' schools are 1,878, hence, the student-teacher ratio is 14.48 students per teacher (Ministry of Education, 2013).

### 6.5.3.2 Health

There are two major hospitals in Male' namely Indhira Gandhi Memorial Hospital (IGMH), which is the government owned hospital and ADK, which is the private owned hospital, who provide major health services to the residents of Male' and for those who come to Male' from

the Atolls. In addition to these two major hospitals, there are number of specialist clinics established in Male' who provide specialist health services in Male'. Also, Dhamana Veshi (Male' Health Centre) provides health monitoring, vaccination and family planning services.

The in-patients in IGMH in 2013 were 13,058 and the average occupancy ratio was 71.4% for the same year (DNP, 2014). The average duration of stay was 5.5 days in 2013 (DNP, 2014). No statistics for ADK Hospital was available at the time EIA preparation.

Male' is believed to receive the highest number of in-patient and out-patients given that the major hospitals are located in the Male' with modern facilities and services.

In addition to major hospitals in Male' there are a number of private clinics providing general and specialist health services. Pharmacies, who play a major role in providing medicines and pharmaceuticals are also found in great numbers and are mostly located by the hospitals and clinics in Male'.

### **6.5.3.3 Utilities**

Utility services are supplied by the existing utility service providers in Male', namely State Electric Company (STECLO), who provide electricity services and Male' Water and Sewerage Company (MWSC), who engage in providing water and sanitation services in Male'. Recently, Waste Management Corporation (WAMCO) is created for providing waste management services in Male' and Greater Male' region in addition to Addu City and Fuahmulah City.

STELCO has its largest operation in Male', with an installed capacity of 61.42MW, and a 26 km underground 11kV distribution network feeding power to 99 distribution transformers to provide electricity to 33,341 customers ([www.stelco.com.mv](http://www.stelco.com.mv)). In 2013, the electricity use in Male' reached over 232,023 kWh (DNP, 2014).

Established on the 1st of April 1995, MWSC is the pioneer organization in the Maldives to institute a water production and wastewater management system to counter the issue of water shortages and a lack of an appropriate sewer system in the capital island Male'. Since then, the Company has worked diligently to provide the people of Male' with potable water and managing wastewater sustainably. The company has 29,278 customers in Male' (DNP, 2014). In 2013, over 4,509 MT of desalinated water was used in Male' of which majority 81% were used for residential purposes (DNP, 2014).

WAMCO currently provides household waste collection, transportation and disposal services based on a tipping fee. WAMCO is licensed by EPA to handle and transport waste in the country.

#### **6.5.3.4 Transport**

No specific data of vehicles in Male' were available at the time of EIA Report preparation. However, with increased population in Male', subsequently increases total number of vehicles in Male', hence has been experiencing traffic issues as a result. Traffic lights have been installed in major traffic movement areas as a safety and traffic control measure.

It is believed that Male' has the highest number of vehicles imported to the country. In 2013, over 61,413 vehicles were registered including motorcycles, cars, pickups, lorries, vans, trucks, etc, out of which motorcycles are amongst the highest having 50,777 cycles registered (DNP, 2014). Also, in 2013, over 4,878 vehicles have been registered, most of which were motorcycles, having 4,341 registrations (DNP, 2014). Increased vehicles in Male' are experiencing major traffic issues, including increased road accidents and increased traffic congestions. In order to reduce traffic related issues in Male', the majority of the roads have been made one-way roads.

#### **6.5.3.5 Unemployment**

Currently Male' has an unemployment rate of 9.2% out of the working population above 15 years of age of 82,289 (DNP, 2014).

#### **6.5.3.6 Waste**

Over 211,579 tonnes of solid waste including industrial and domestic waste from Male' were transported to Thilafushi Island in 2013 (DNP, 2014). Increased population also means increased solid waste. The waste generated in Male' is transported to Thilafushi for final disposal as land is scarce in Male'. However, a waste collection yard has been designated in the southern side of Male' before it is transported to Thilafushi.

#### **6.5.3.7 Economic Activities**

Male' is the major economic and commercial centre of the country, hence a number of economic activities are undertaken which contribute to the local economy. The construction sector in Male' is believed to be the largest economic activity as well as real estate development and management also plays a key role in the economy. Public and private sector employment is also believed to be a key economic activity in Male'. Additionally, tourist-related services

including operation of travel agencies, guest houses and hotels, operation of supermarkets and daily goods shops, garments shops, pharmacies as well as operation of cafés and restaurants are also important economic activities in Male'. Most of the imported goods arrive to Male' and gets distributed to the islands.

#### **6.5.4 Main Economic Activities in the Surrounding Area**

As the proposed building is found in a major area in Male', there are a number of economic activities in the region. The proposed building is found in close proximity to the proposed linking bridge between Male'/Hulhule/Hulhumale', hence the area will become a prime area in Male' for a number of economic activities as well as for residential purpose.

Most important economic activity observed from the region is café/restaurant, small shops and mini markets as well as offices. As Artificial Beach is located in close proximity to the proposed building where there are a number of restaurants as well as public gathering areas, this area is identified to have economic importance.

The first and second floors of the proposed building will also be developed as a large restaurant, the area will be an important area for both commercial and residential purposes.

#### **6.5.5 Plans for Evacuation in the Case of an Accident and Fire**

In order to cover potential accidents, each floor will have access to a first aid kit installed in the common areas including basement, car park, restaurant and residential units. For serious injuries, prompt attention will be given to transfer the injured by use of one of the lifts in the building.

With regards to addressing potential fire accidents, the basement area will have 2 x 18t sprinkler tanks as well as the ground floor will be installed with hose reel, wet raiser and sprinkler pumps. In case of fire, only staircases will be advised for use.

Additionally, the sea is in close proximity to the proposed building, hence access to seawater will also be option in case of such emergencies.

## 6.6 HAZARD VULNERABILITY

The following information on the vulnerability of the islands in the Maldives are taken from published literature such as Natural Hazard and Physical Vulnerability Assessment Report by UNDP (2008) as site –specific information on vulnerability of the proposed plot or the surrounding area was not available. According to the UNDP (2008) the natural vulnerability of the islands and atolls of the country to potential environmental hazards have been modeled to understand the risk factors of the country.

### 6.6.1 Major Natural Hazards

According to the UNDP assessment report, the natural hazards prevailing in the Maldives can be classified into 4 categories. These are;

- Geological hazards i.e. earthquakes and coastal erosion;
- Meteorological hazard i.e. tropical cyclones and storms, thunder storms, waterspouts, heavy rainfall, and drought;
- Hydrological hazards i.e. floods induced by heavy rainfall, storm surges, swell waves, udha, and tsunamis;
- Climate-related hazards i.e. accelerated sea level rise, sea surface temperature rise, changes in monsoon pattern.

Among those listed above, floods (induced by tsunamis, abnormal swell waves, and heavy rainfall), windstorms, droughts, and earthquake are counted as major natural hazards prevailing in the Maldives.

The general patterns of the major natural hazards prevailing in the Maldives can be well summarised in Figure 35.

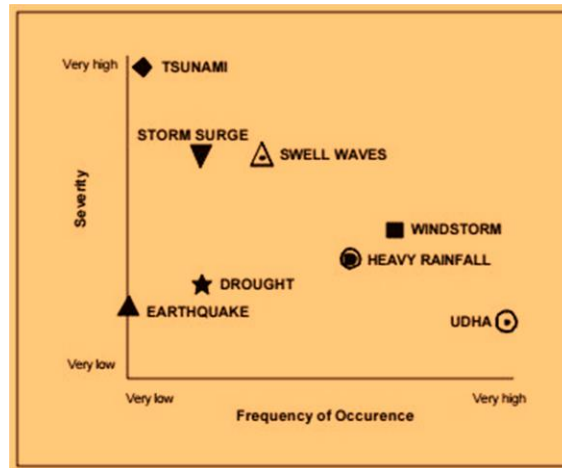


Figure 36: Relationship between hazard intensity and frequency of major natural hazards in the Maldives (UNDP, 2008)

### 6.6.2 Distribution Pattern of Natural Hazards

The major natural hazards in the Maldives are strictly controlled by their geophysical and climatic settings and show quite different patterns in their distribution, as shown in Figures 36 and 37. Tropical cyclones and correspondingly storm surges and droughts predominantly prevail in the north of the Maldives. In contrast, swell waves and heavy rainfalls are more prominent in the southern and western islands of the Maldives. The southern islands of the Maldives are threatened earthquakes from the seismic zone of Carlsberg Ridge.

There are also longitudinal variations in hazard distribution. The most notable is the occurrence of tsunami waves and their impacts. The eastern rim islands are subject to tsunamis and waves of a higher intensity due to their direct exposure to these hazards, whereas the western rim and atoll lagoon islands are protected by the atoll formation patterns. Impacts of swell waves and udha events are also expected to be highest on the western rim island due to the south westerly and westerly approach of these events. However, their impacts aren't totally reduced on the eastern rim islands due to the propagation of swell waves through reef passes and fetch within atoll lagoon.

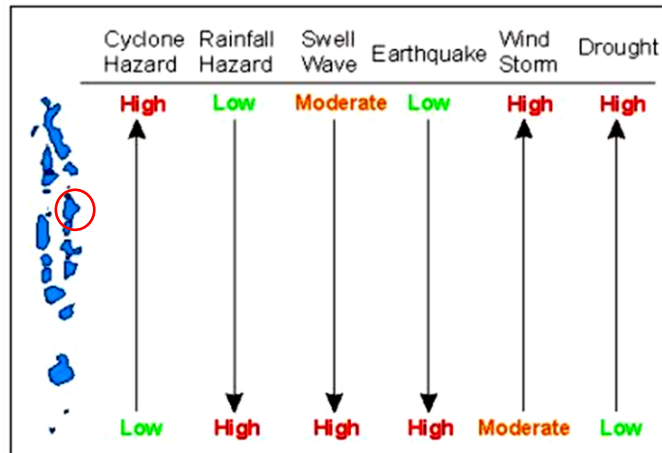


Figure 37: Latitudinal variations of major natural hazards across the Maldives (UNDP, 2008).

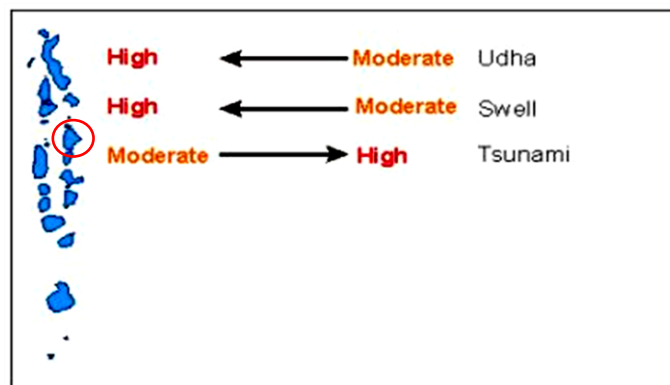


Figure 38: Longitudinal variations of major natural hazards across the Maldives (UNDP, 2008)

Based on the above analysis, it can be said that Male' is relatively in a safe zone from major natural disasters due to its location in the central parts of the country (Figure 36).

However, there is moderate potential for Udha and swells generated from the western side in between the western and eastern atoll and high potential for Tsunami from the eastern side that may directly affect Male' Atoll. Furthermore, flooding risks in heavy rain in the central parts of the country has been identified to be moderate.

## **7. ENVIRONMENTAL IMPACTS**

The following section predicts potential environmental impacts from the proposed 15-storey building to be developed at H. Dhoovehi, Male'. Once the potential environmental impacts are identified, the impacts are evaluated to identify their significance. In order to identify and analyze environmental impacts, the following methods have been used.

### **7.1 METHODS**

#### **7.1.1 Impact Prediction**

First of all, most of the environmental impacts that may be generated as a result of the project is predicted and is distinguished from construction and operation phases of the project. The impacts for both phases have been predicted by using a descriptive checklist. The prediction of environmental impacts also to a great extent incorporated expert judgment and professional opinion of the EIA consultant involved in the preparation of the report as well as information reviewed from other relevant EIAs outlined in this EIA Report.

#### **7.1.2 Impact Evaluation**

The environmental impacts are assessed in terms of significance. Significance is the function of magnitude of the impact and the likelihood of the impact occurring and the impact magnitude is a function of the extent, duration and intensity of the impact. The criteria used to determine impact significance are summarized in the following table (adapted from Environmental Resource Management, 2008).

IMPACT MAGNITUDE		
<b>Extent</b>	On-Site	Impacts that are limited to the boundaries of the development site
	Local	Impacts that affect an area in a radius of 1km around the development site
	Regional	Impacts that affect regionally important environmental resources, administrative boundaries determined by regional scale
	National	Impacts that affect nationally important environmental resources or have macro-economic consequences
<b>Duration</b>	Temporary	Impacts are predicted to be of short duration and intermittent / occasional
	Short-term	Impacts that are predicted to last only for the duration of the construction period
	Long-term	Impacts that will continue for the life of the project, but stops when the project ceases operation
	Permanent	Impacts that cause a permanent change in the affected receptor or resource
<b>Intensity</b>	<i>BIOPHYSICAL ENVIRONMENT</i>	
	Negligible	Impact on the environment is not detectable
	Low	Impact affects the environment in such a way that the natural functions and processes are not affected
	Medium	Where the affected environment is altered but natural functions and processes continue
	High	Where natural functions or processes are altered to the extent that they will temporarily or permanently cease
	<i>SOCIOECONOMIC ENVIRONMENT</i>	
	Negligible	There is no perceptible change to people's livelihood
	Low	People/communities are able to adapt with relative ease and maintain pre-impact case
Medium	People/communities are able to adapt with some difficulty and maintain pre-impact case but only with a degree of support	
High	People/communities will not be able to adapt to changes or continue to maintain pre-impact case	
<b>Likelihood</b>	Unlikely	The impact is unlikely to occur
	Likely	The impact is likely to occur in most conditions
	Definite	The impact will occur

Table 4: Impact significance criteria

Once a rating has been determined for magnitude and likelihood, the following matrix has been used to determine the impact significance.

		SIGNIFICANCE		
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 5: Significance rating matrix

The different ratings of impact significance are then given a colour scale for easily understanding the overall magnitude of the impact. The following colour scale has been used.

Negative Ratings	Positive Ratings
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table 6: Significance colour scale

### **7.1.3 Limitations and Uncertainties**

The potential environmental impacts from the proposed project are all predicted and assumed, hence there may be variables affecting the accuracy of these impacts due to natural variations and unforeseen events.

Although there are buildings having 25 floors proposed to be developed in Male' region (IGHM Building in Male; and Ministry of Finance and Treasury Building in Hulhumale'), no buildings exceeding 15 floors have been completed yet, hence, there is difficulty in understanding the type and magnitude of environmental and social impacts that may be associated with proposed development.

EIA studies undertaken in similar environmental settings and technical experience as well as professional judgment of the EIA team have been used as support while predicting and evaluating these environmental impacts.

### **7.1.4 Justification of Methods Used**

There are many ways and a number of methods in which environmental impacts that arise from development projects can be assessed and evaluated. The methods used for the purpose of predicting and evaluating the significance of environmental impacts is an accepted and internationally recognized as well as widely used methods throughout the world in a number of development projects. Although it is adapted for the condition of the project by the EIA consultant from Environmental Resource Management, 2008 literature, the approach as well as intended outcomes still remain same.

EIA is a decision-making tool, hence, needs to be understood by both technical and non-technical people. The use of colour codes for determining the significance of impacts in the methods used has been demonstrated to be quite effective, especially with non-technical people.

## **7.2 IMPACT PREDICTION**

The environmental impacts that may be associated with the proposed 15-storey building project are predicted in this section by using a simple descriptive matrix. The following matrix distinguishes the types of environmental impacts that may be associated with various project

actions on key environmental components and distinguishes whether these impacts occur during construction period or during post-construction and operations period.

PROJECT ACTIONS	ENVIRONMENTAL COMPONENTS AND ENVIRONMENTAL IMPACTS					IMPLICATION PERIOD
	Physical and biological	Structural	Air quality	Ground water	Social	
<b>Excavations</b>	Potential impact to soil environment	Potential threat to nearby buildings and roads				During construction
<b>Dewatering</b>		Potential threat to nearby buildings and roads		Short-term loss of ground water within boundary and vicinity	Potential to increase in induration of saltwater within neighbour areas	During construction
<b>Construction activities</b>	Potential physical damages to adjacent buildings	Potential threat to nearby buildings and roads	Short-term exposure to dust	Impacts due to wastewater disposal from concretion and washing	Exposure to noise and road blocking	During construction
<b>Operation of construction machinery and vehicles</b>	Disturbance to residents and physical damages to adjacent buildings	Potential to damage roads from heavy machinery	Short-term exposure to dust, CO and PM	Impacts due to wastewater disposal from concretion and washing	Exposure to noise and road blocking	During construction
<b>Construction waste</b>	Land degradation and aesthetic impact			Potential to pollute ground water	Potential health issues and nuisance Potential mosquito breeding	During construction
<b>Increased traffic</b>			Exposure to CO and PM		Potential health issues and nuisance and increased noise levels	During operation
<b>Solid waste</b>	Aesthetic impacts due to improper management				Potential health risks	During operation

Table 7: Impact prediction table

The above table shows the main project activities and the main components upon which the environmental and social impacts will occur. The environmental impacts on various environmental components during the construction phase of the proposed project seem greater than those of the operation phase.

## **7.3 CONSTRUCTION PHASE IMPACTS**

### **7.3.1 Excavation**

It is estimated that around 1,160m<sup>3</sup> of sand from the plot will be excavated for laying the foundation and development of basement of the 15-storey building. Sand from the proposed building boundaries will be excavated by using excavators. Although there are no major environmental impacts from sand excavation due to absence of significant habitats and vegetation, very low levels of impacts to the soil environment is believed to occur including displacement of some soil organisms.

There will be no impact on terrestrial flora and fauna due to absence of such within the proposed plot.

Also, structural impacts to the nearby buildings and roads are unlikely, however, it has been identified as having potential implications, if excavation works are not undertaken carefully.

### **7.3.2 Dewatering**

It is estimated that around 783m<sup>3</sup> of groundwater will require to be dewatered from the proposed area. The environmental impacts associated with dewatering will be short-term in nature, including loss of groundwater from the project boundary and immediate surrounding. It is unlikely that the quality of groundwater will be severely affected, however, slight changes to certain water parameters may occur. These include increased salinity, turbidity and dissolved solids during dewatering operation within the vicinity areas for short period of time. As a result of dewatering, there is also potential for physical and structural damage to adjacent buildings as a large volume of groundwater will be dewatered in the process.

If the activity is mismanaged, there is potential of flooding within the excavated plot and the surrounding environment from dewatering.

### **7.3.3 Construction Activities**

As a relatively large building will be constructed at the plot, a number of construction activities will occur including cladding, concrete mixing, safety framework development, site preparation, transport of excavated material, transport of construction material, welding, woodworks, transport of construction waste, etc. These construction activities are believed to generate a number of environment and social impacts. Most of these environmental impacts include potential structural damages to the roads and adjacent buildings due to careless operations, decreased air quality from increased dust and particulate matter and some social impacts such as exposure to increased noise levels as well as nuisance from road blocking and traffic congestion.

During laying of the foundation, including piling works, some disturbances may occur to the pedestrians and traffic due to regular movement of material and equipment during assembling work. Of particular concern will be impacts to traffic and pedestrian movement in the area.

However, large-scale impacts to pedestrians and traffic from construction activities are unlikely as all construction operations including foundation development and piling will be undertaken in a closed boundary.

### **7.3.4 Operation of Construction Machinery and Vehicles**

As part of the proposed project, construction machinery such as concrete machine, welding machine, lifting machine and vehicles such as excavators and trucks will be used in the construction operations. During the operation of these vehicles and machinery, impacts from higher noise levels, presence of CO, PM and dust are envisaged. Noise and dust pollution may have health implications to the people living nearby areas. Also, occasional road blocking may occur at the time of operations which may be a nuisance to nearby people and to the traffic movement in the area.

As the area was observed to have a fairly large population, increased traffic as well as public gathering places such as cafes and restaurants, impacts from vehicles and machinery as well as general construction activities may be quite notable.

### **7.3.5 Construction Waste**

Any project that involves construction generates large amount of solid waste particularly construction waste. Construction waste involving packaging waste such as cement bags and

cardboards, concrete waste, iron, timber, aluminum, nets, wastewater, etc that are generated from construction activities if inappropriately disposed have the potential to degrade environmental conditions in disposed areas. Also, as a result, aesthetic conditions of the surrounding environment will be lost in addition to health risks and nuisances for nearby residents. Additionally, waste oil and lubricants if disposed at site will contaminate and pollute the groundwater.

Construction wastewater and washing wastewater that have high cement content as well as oils if disposed into the main sewer may have the potential to block the sewerage system, which may affect the entire region.

Also, as water will be released into the concrete sheets on a regular basis as well as maintaining water in containers, there will be potential for mosquito breeding in these areas. As a result of mosquito breeding, there is potential health risks and disease outbreaks which may affect the population of the surrounding areas.

### **7.3.6 Pedestrian and Traffic Issues**

During construction, due to partial blocking of the roadside and due to frequent parking of vehicles bringing in construction material, the pedestrian and traffic may have to face difficulties, however, will only be limited to the time of material delivery.

As Boduthakurufaanu Magu region of the plot has heavy traffic during midafternoon and early nigh hours, difficulty for pedestrian and traffic movement is believed to be encountered.

## **7.4 CONSTRUCTION RELATED HAZARDS AND RISKS**

### **7.4.1 Pollution of Natural Environment**

Pollution of natural environment of the surrounding area is believed to occur as a result of wastewater disposal mostly from concrete works and washing of machinery and vehicles. This

may have some negative impacts on the groundwater of the area and there may be some public complaints regarding the issue.

#### **7.4.2 Dust and Emissions**

During construction stages, increased dust from and emission from vehicles are likely to cause some public concern, which may also have some potential health implications. As the area has fairly large resident population as well as public places such as cafes and restaurants, increased risks on public health may be a concern from noise and dust.

#### **7.4.3 Weather Related Hazards and Risks**

Extreme weather events such as heavy rain and heavy wind may have the potential to flood the plot area and bring about some physical damages to the site and work that is being carried out. Also, some serious damages to construction material such as cement due to rain and falling off of objects due to heavy wind from the construction site are potential risks.

#### **7.4.4 Risk of Accidents to Workers**

Potential risks to workers during construction of the proposed building include accidents due to negligence and risks due to avoiding use of required safety equipment during work. Mandatory use of safety equipment by all workers at all times will be ensured. All construction activities will be carefully monitored and supervised to reduce accidents to workers from construction activities.

#### **7.4.5 General Public Health and Safety Issues**

As described earlier, there are some public health and safety issues especially from construction sites undertaken in residential areas. These issues include health risks from dust, noise and emissions emanating from construction activities as well as potential injury and property damage as a result of carelessness and mismanagement during construction activities.

As the proposed project is within a residential area as well as having a number of public places, there is regular movement of people within the project area, hence, the project is not free from such issues. With careful planning and proper management, such issues can be minimized.

#### **7.4.6 Fire Risks**

Potential for during construction phase will be unlikely as the site will not have any storage facilities such as fuel shed. The required fuel for vehicles will be loaded outside as most of the machinery used will be electrical. Nonetheless, if there may be incidence of an accidental fire, the site will have adequate facilities such as fire blankets and extinguishers in case of a need.

### **7.5 SOCIO-ECONOMIC IMPACTS**

There are both positive and negative socio-economic impacts from the proposed project. The positive impacts will be outlined later. Most of the negative impacts have been outlined previously including noise and dust issues, potential health risks as well as impacts to traffic movement in the area have been identified to be major negative impacts on socio-economic environment.

Additionally, physical and structural risks to adjacent buildings during excavation and dewatering process as well as regional impacts to groundwater from dewatering have been identified to have some social implications.

### **7.6 OPERATION PHASE IMPACTS**

#### **7.6.1 Household Solid Waste**

During the operational phase of the project, the largest environmental impact will be from generation of household and domestic waste from the residential units as well as the restaurant. Household waste mostly includes food waste and other household items. Piling of household waste by the project area is believed to generate serious environmental implications including decreased aesthetics and higher risks of disease outbreaks. Additionally, it will be a nuisance for people who are living in nearby premises and aesthetically very unattractive.

Piling of such waste by the area will not only affect people living in the premises but will to a large extent impact others living in the vicinity.

### **7.6.2 Increased Traffic**

Upon completion of the project, it is believed that the total population within the building is expected to be around 200 including users of the restaurant. Some traffic is believed to be diverted to the area mostly for use of the residents and as well as café visitors, hence the traffic is deemed to be slightly increased as result of the proposed development. Major environmental impacts from increased traffic to a certain area include increased dust, CO and PM levels in the area, which may have some health implication on a longer term.

## **7.7 POSITIVE IMACTS**

The proposed development of 15-storey building will bring numerous social and economic benefits. The building in full occupancy can accommodate between 120 – 160 persons, hence will contribute towards alleviating housing stress in Male' region. As part of the proposed development, it is expected that some new job opportunities will be created including building management and services, café and restaurant, security, etc.

Additionally, as the building will have large commercial areas, economic opportunities as well as indirect opportunities for employment is expected to be high.

Male' has heavy traffic and limited parking space. The proposed building with private car parking areas will contribute to eliminating some traffic stress in the region.

Overall, the proposed project for developing the 15-storey building will bring numerous social and economic benefits, hence the project has a very positive outlook.

## **7.8 CUMULATIVE IMPACTS**

Male' is seen rapid development especially a number of construction projects of multistorey buildings. Similarly there some buildings in the vicinity of the proposed building and as a result of these developments, similar environmental impacts such as increased dust and emissions, increased traffic, generation of construction waste around the area is believed to happen simultaneously. Thus, in general the magnitude of these impacts may be higher on a collective basis.

## 7.9 INDIRECT IMPACTS

As this is a large construction project, there will be some unforeseen impacts which are believed to occur as a result of unforeseen events such as natural disasters and accidents which may affect the overall project schedule.

Additionally, due to the location of the proposed building in close proximity to the proposed linking bridge and the eastern sea side of Male', the land value of the building may be drastically increased.

## 7.10 IMPACT ANALYSIS AND EVALUATION

The following section analyses and evaluates the previously described environmental impacts during construction and operation in order to identify their significance.

ACTIVITY/IMPACT	IMPACT MAGNITUDE					
	EXTENT	DURATION	INTENSITY	LIKELIHOOD	MAGNITUDE	COLOUR SCALE
Land excavation	Onsite	Temporary	Negligible	Likely	Negligible	
Dewatering	Onsite	Short-term	Low	Likely	Minor	Yellow
Construction activities	Onsite	Short-term	Medium	Likely	Moderate	Orange
Operation of construction machinery	Onsite	Short-term	Medium	Likely	Moderate	Orange
Construction waste disposal	Onsite	Short-term	Low	Likely	Minor	Yellow
Podestrian and traffic issue	Onsite	Short-term	Low	Likely	Minor	Yellow
General public health and safety	Local	Short-term	Medium	Likely	Moderate	Orange
Domestic solid waste disposal	Onsite	Long-term	Medium	Definite	Moderate	Orange
Increased traffic	Local	Long-term	Medium	Likely	Moderate	Orange
Creation of employment opportunities (Positive)	Local	Long-term	Medium	Definite	Moderate	Green
Contributing to local economy (Positive)	Local	Permanent	High	Likely	Major	Green
Cumulative impacts	Local	Long-term	Medium	Likely	Moderate	Orange
Indirect impacts	Local	Long-term	Low	Likely	Minor	Yellow

Table 8: Impact evaluation and analysis table

The above environmental impact analysis indicates the overall environmental impacts from the proposed development are moderate to minor. The moderate impacts that occur during the construction phase are mostly associated with construction activities and operation of construction machinery at the project site, general public health and safety issues as well as cumulative impacts (both construction and operation) due to ongoing construction projects within the vicinity. Minor impacts during the construction stage are mainly from dewatering and construction waste as these are very short-term impacts. Although indirect impacts are minor, they will be felt on a long-term basis (mostly during operation). The geographic ranges

of the impacts are distributed mostly within the project boundary as well as most of the impacts are confined to the project site.

However, during the operation stage of the project, long-term impacts are believed to occur including generation of solid waste and increased traffic around the area. These impacts are observed to be moderate.

Some of the socio-economic impacts are believed to be negative such as public nuisance, noise and dust issues, potential physical and structural threats to nearby buildings. However, some social impacts have a positive outlook. Creation of employment opportunities have been identified to be moderate and contribution of the project to the local economy has been identified to have a major implication mainly envisaged due to the commercial aspects integrated as part of the proposed development.

## **8. MITIGATION MEASURES**

The following section outlines key environmental management and mitigation measures that will be undertaken and followed with regards to minimizing and reducing environmental impacts from the proposed project. Mitigation measures have been addressed for all environmental impacts identified in the previous section.

### **8.1 JUSTIFICATION FOR PREFERRED MITIGATION MEASURES**

The environmental management and mitigation measures outlined in this section have been selected by taking into consideration a number of factors. The most important factor considered in selecting these mitigation measures is that these are not just ‘paper mitigation measures’, it has been selected based on its practicality. Other factors such as economic aspects, technical know-how as well as adequacy and appropriate timing of certain project activities played a key role in determining these environmental management and mitigation measures.

### **8.2 LIMITATIONS OF MITIGATION MEASURES**

The key limitations of the mitigation measures depend on how accurate the predicted environmental impacts are for the proposed project. This includes for instance, the severity and magnitude of environmental impacts from proposed construction and development activities where impact have been predicted. Even with implementation of mitigation measures, the impact boundary could either extend or minimize or the impact magnitude could either increase or decrease. Also, the nature of impacts even from similar project activities undertaken in a different location in the country could behave in a totally different manner.

## 8.3 CONSTRUCTION PHASE

### 8.3.1 Mitigation Measures for Excavation Impacts

Excavation of the area to lay the foundation of the building and development of the basement is an important aspect of the proposed development. Excavation has the potential to impact structural environment of the surrounding area.

The following measures will be used to reduce impacts from excavation and reducing threats to structural environment of the surrounding.

- Only excavate required area and complete the work as soon as possible.
- Undertake excavation in sections and install protection and then move on to the next section to reduce physical and structural damages to adjacent buildings.
- The entire boundary will be shored with corrugated sheets supported by iron beams as a safety measure while preparing the site ready for construction. This will also be used for foundation protection.
- The excavated material will be immediately transported out of the project boundary to an approved area.
- All excavation works will be done after appropriately fencing the project site so impacts on pedestrian and traffic will be greatly reduced.

Key considerations;

Consideration	Detail
Cost	MVR 300,000 – 450,000
Expected benefits	Protection of adjacent buildings
Expertise	Engineer
Required Manpower	5 - 10
Responsibility	Contractor
Equipment/Technology	Corrugated sheets and iron beams
Timing	Pre-construction

### 8.3.2 Mitigation Measures for Dewatering Impacts

Most of the impacts from dewatering are short-term, however occurs quite immediately. The following measures will be undertaken for reducing dewatering impacts;

- All dewatering operations will be undertaken after obtaining necessary permits from EPA and will be undertaken in accordance with planned schedule.

- During the process of dewatering, the EPA approved sign board will be placed in order to inform public that dewatering is ongoing.
- Dewatering operations will be undertaken quickly in order to reduce exposure of prolonged environmental effect in the surrounding environment.
- Dewatering pipeline will be regularly monitored for physical damage and immediately rectify the issue. This will be done if dewatering will be undertaken by contractor's equipment and machinery.
- Regularly check with neighbours if dewatering is affecting groundwater of the surrounding areas.
- Avoid peak traffic hours during dewatering to reduce impacts on traffic
- Establish compensation mechanisms if there are complaints from neighbors. Designate a key person for receiving all complaints.
- If there are complaints, immediately stop dewatering and rectify the issue including compensation before dewatering works restart.

Key considerations;

Consideration	Detail
Cost	MVR 150,000
Expected benefits	Reduce potential flooding
Expertise	Environmental protection
Required Manpower	5 - 10
Responsibility	Contractor
Equipment/Technology	Management, Pipeline, Machinery
Timing	Pre-construction

### 8.3.3 Mitigation Measures for Construction Activities Impacts

Most of the environmental impacts are believed to occur during undertaking of construction activities as outlined previously. Therefore, a number of mitigation measures will be implemented throughout the construction period of the project. These include;

- Placement of construction work sign boards and fencing
- Drive piles into designated location where boreholes are done in order to reduce noise and vibration impacts
- Complete the foundation works including framing and concreting in the shortest possible time
- Placement of safety and dust protection nets all around the building frameworks

- Regularly clean concrete sheets from water accumulation to reduce potential risks of mosquito breeding
- All activities generating dust will be undertaken within and inside of dust protection nets
- Do not leave objects free that have potential to fall during heavy winds
- Implementation of mandatory use of safety equipment and gear at all times
- All construction activities to be undertaken within the boundaries of the proposed project to avoid nuisances to nearby people from construction-related activities
- All construction activities will be time bound, hence impacts from excessive noise at night time will be avoided.
- All road blocking will be released soonest possible time upon completion of the work in order to reduce nuisance for nearby people. Ensure road blockings are done only when required.
- Do not allow pedestrian to move by the construction site during operation of construction machinery to avoid potential injuries.
- All construction activities will be halted during prayer times.
- First aid kits will be maintained on site at all times

Key considerations;

Consideration	Detail
Cost	MVR 250,000 – 350,000
Expected benefits	Reduce public health and safety and accidents
Expertise	Environmental protection and project management
Required Manpower	100 - 150
Responsibility	Contractor
Equipment/Technology	Safety equipment, sign board and proper management
Timing	Construction

### 8.3.4 Minimizing Impacts from Construction Machinery and Vehicles

Construction machinery and vehicles such as concrete machine, excavator and trucks will be largely used during the construction of the buildings. Excessive noise and dust as outlined in the impacts section are expected during the operations of these machinery and vehicles. The following measures will be undertaken to reduce impacts related with operation of construction machinery and vehicles;

- Concrete mixing will be done by using vehicles that drive while mixing so that impacts from noise and dust from the site will be greatly reduced
- The movement of vehicles used for supplying of materials will not be coincided with peak traffic hours found within and around the project site
- Required materials will be supplied bulk in order to reduce the need for frequent transportation, hence reduce impacts from noise and dust
- Operate construction machinery within the project site and only in areas approved by Ministry of Housing and Infrastructure to reduce nuisance to nearby people and avoid frequent road blockades.
- Do not park construction vehicles outside of the project boundary as it will affect traffic movement of the area
- Set times for movement of such vehicles and avoid use of these vehicles at night reduce disturbance to neighbours.

Key considerations;

Consideration	Detail
Cost	0
Expected benefits	Reduce dust and emissions and impacts to traffic
Expertise	Environmental protection
Required Manpower	2 - 4
Responsibility	Contractor
Equipment/Technology	Site Supervisors
Timing	Construction

### 8.3.5 Avoiding Construction Waste Disposal

As outlined in the impacts section, large amounts of construction waste will be generated from the proposed project. In order to reduce impacts from solid waste disposal on the construction site and the surrounding environment, the following measures will be undertaken;

- Categorically pile all construction waste in an allocated location in the project site
- Reuse material from construction waste wherever possible in order to reduce waste required for disposal
- Regularly transport unusable construction waste to the waste collection yard in Male'
- Avoid transportation of waste during rainy periods
- Designate time slots for waste transportation to avoid peak traffic movement in the region

- Outsource waste management, handling and transportation to EPA licensed parties and comply with all regulatory requirements at all times
- Waste disposal onsite and within project boundaries will be avoided at all times
- Avoid waste piling in the surrounding areas at all times
- Regularly clean all area including surrounding environment to maintain a clean environment at all time

Key considerations;

Consideration	Detail
Cost	0
Expected benefits	Reduce solid waste onsite
Expertise	Environmental protection
Required Manpower	5 - 10
Responsibility	Contractor
Equipment/Technology	Management and staff
Timing	Construction

### 8.3.6 Minimize Pedestrian and Traffic Issues

As the area of the proposed building has a relatively large resident population, heavy traffic as well as a number of public gathering places such as cafes/restaurant and Artificial Beach. As a result of the proposed development, some disturbances to the residents, traffic and general public using the area may be experienced.

Care will be taken to reduce and minimize impacts to pedestrians, traffic movement and the general public. In this regard the following measures will be undertaken;

- Use sign boards to notify public that it is a construction site
- Schedule movement of construction vehicles by the project site to avoid traffic congestion in the area
- Restrict time periods for vehicle use to avoid excessive noise especially during night time and prayer times
- Avoid use of construction vehicles during peak traffic times
- Avoid use of construction vehicles when there are large public gatherings in the Artificial Beach area
- Avoid parking of construction vehicles by the project site
- Always keep pedestrians out of the construction site

Key considerations;

Consideration	Detail
Cost	0
Expected benefits	Minimize pedestrian and traffic issues
Expertise	Social protection
Required Manpower	2 - 4
Responsibility	Contractor
Equipment/Technology	Management and site supervisors
Timing	Construction

### 8.3.7 Minimize Public Health and Safety Issues

As the proposed development will happen in a large residential area, it has potential to raise some public health and safety issues such as exposure to noise and dust during construction, mosquito breeding at the site which may have some health implications, objects falling from the construction site which may injure public are some of the issues already identified.

In order to minimize public health and safety issues, the following measures will be implemented;

- Use sign boards to notify public that it is a construction site
- Regularly clean water accumulated in concrete sheets to avoid potential mosquito breeding
- Use safety nets all around the construction site to reduce spread of dust in the surrounding environment
- Do not leave objects that have potential to fall freely during heavy winds that may harm and injure the public
- Restrict use of construction vehicles to minimize excessive noise in the surrounding environment
- Immediate stop all construction activities if there are any public complaints and rectify the issue before works restart

Key considerations;

Consideration	Detail
Cost	MVR 150,000
Expected benefits	Minimize public health and safety issues
Expertise	Social protection
Required Manpower	2 - 4
Responsibility	Contractor
Equipment/Technology	Management and site supervisors, safety nets
Timing	Construction

## 8.4 OPERATION PHASE

### 8.4.1 Manage Domestic Waste

Importance has been given to manage household waste during the operational periods of the project. Following measures will be implemented;

- Piling of domestic waste in the floors and in the restaurant by the building will not be allowed
- The building and adjacent areas will be kept clean at all times, free from waste.
- Outsource waste management, handling and transportation to EPA licensed parties and comply with all regulatory requirements at all times
- Ensure that waste goes to waste collection yard in Male'
- Avoid waste transportation during rainy periods to avoid potential health risks
- Designate time slots for waste transportation to avoid peak traffic movement in the region
- Waste disposal onsite and within project boundaries will be avoided at all times
- Keep the restaurant clean and ensure proper hygienic is maintained at all times
- Regularly monitor waste chutes in each floor
- Keep the waste collection area in the ground floor dry and clean at all times

Key considerations;

Consideration	Detail
Cost	MVR 5,000 - 10,000 / month
Expected benefits	Reduce solid waste
Expertise	Environmental protection
Required Manpower	2 - 5
Responsibility	Proponent
Equipment/Technology	Outsourced
Timing	Operation

### 8.4.2 Minimize Traffic Issues

As large amounts of traffic will be diverted to the area during the operational phase of the project, the following measures will be undertaken;

- Parking of vehicles by the building will be prohibited to reduce traffic congestion in the area
- Residents are encouraged to use car parking available in the building

Key considerations;

Consideration	Detail
Cost	0
Expected benefits	Good traffic flow
Expertise	Environmental protection
Required Manpower	2 - 4
Responsibility	Proponent
Equipment/Technology	Management
Timing	Operation

## 8.5 COMMITMENT

The proponent is fully aware of and recognizes the importance of implementing environmental management and mitigation measures as the proposed project is deemed to have certain environmental and health impacts.

The commitment letter from the proponent is attached in **Appendix 9**.

## **9. ALTERNATIVES**

The following section outlines some alternatives to various project activities, which can be implemented as part of the proposed project.

### **9.1 NO-DEVELOPMENT OPTION**

Although there are some environmental and social impacts from the proposed project, a no development option has been looked at in order to understand the weight of the proposed development on environmental, social and economic aspects and the consequences that it will bring if the proposed project chooses no-development option.

As outline in the EIA Report, the main environmental and social impacts from the proposed development is generated during the construction period of the project, including generation of noise and dust from construction activities, potential health risks to neighbours, potential traffic issues, generation of construction waste and operation of construction machineries. Based on the impact significance evaluation undertaken in the EIA, all these impacts have been identified to have lesser magnitudes, given that most of the impacts are confined to the project boundary and their effects on the natural environment are minimal.

If the proposed project considers no-development option based on the grounds of environmental and social impacts, then opportunities of social and economic development that the proposed project will bring will be forgone. The key socio-economic benefits of the proposed include; development including development of residential units, commercial opportunities and creation of parking spaces, which are important requirements in Male' in addition to employment opportunities.

Considering the demand for space for residential and commercial purpose in Male' and ever increasing housing need, the proposed project will directly place some residential and commercial space in the market, which will have positive impact on the demand for land and space.

Involvement of private sector in real estate business is improving and proposed development by a local contractor directly contributes to strengthening construction industry in the country.

After careful evaluation of the environmental impacts and socio-economic opportunities and benefits of the proposed development, the No-Development Option has been considered not favourable for the proposed development.

## **9.2 ALTERNATIVE FOUNDATION OPTIONS**

### **9.2.1 Shallow Footing Foundation**

The shallow foundation options considered are square footings, strip or combined footings, and raft foundations.

As this is a 15-storey building, the ultimate carrying capacity and design load needs to be taken into serious consideration taking into account that loose soil layers at depths 0-3m are found in the proposed plot. The possibility of carrying a 15-storey building on individual and combined footings in such an environment is very low, hence, this option was not further evaluated.

### **9.2.2 Raft Foundation**

According to the geotechnical assessments undertaken on the soil of the plot area, the allowable carrying capacity of a raft foundation smaller than 30m x 10m placed at 1m depth has been estimated to exceed 125kPa for an allowable settlement of 100mm. It is believed that the proposed building will exceed 125kPa carrying capacity limit, hence it is likely that the raft may experience a higher settlement than the allowable settlement of the raft. In such a scenario, further measures need to be implemented to control settlement.

A pile raft foundation system has been proposed as a key measure to control settlement through raft-pile-soil integration.

The building cannot be supported on a raft foundation alone, hence requires further measures of which may be costly to implement. However, taking into consideration the load bearing capacity of the building and the soil condition of the site, the pile raft foundation system has identified to be more suitable for the proposed building.

### **9.2.3 Pile Raft Foundation**

Given that shallow foundations such as combined footings and raft foundation are not appropriate for the building, the available option is to go for deep foundation by using micropiles or bored piles, which will have greater load bearing and carrying capacity given the type of the building and soil conditions found within the plot.

The details of the foundation are given in the Project Description section.

## **9.3 ALTERNATIVE WASTE MANAGEMENT OPTION**

It is proposed that waste management during the operational phase of the proposed project will be outsourced to EPA Licensed parties to handle waste management in accordance with the Waste Management Regulation. The outsourced party's main responsibility will be to collect solid waste from the building and transfer to the waste collection yard in Male'.

As an alternative waste management option during the operational phase of the project, direct involvement of the project proponent, after obtaining the License from EPA to handle and transfer waste, employ dedicated waste management staff as well as use appropriate vehicles and boats to transfer waste to Thilafushi has been considered.

This alternative is believed to be costly as it requires dedicated staff and machinery to implement waste management operations, the outsourcing to a licensed party as proposed in the proposed has been considered more favourable to the alternative waste management option.

The option for engaging Waste Management Corporation (WAMCO) has been identified to be quite suitable as it has been created to manage, handle and transport waste from the country. WAMCO are already a licensed party from EPA for waste handling and transportation.

## **9.4 JUSTIFICATION FOR PREFERRED ALTERNATIVES**

The following statements justify the preferred options over the alternatives proposed that will be undertaken as part of the proposed 15-storey building at H. Dhoovehi.

- It is preferred that the proposed development should be implemented over the no-development option since the project has tremendous social and economic benefits in terms of adding residential and commercial space in Male' which is an important requirement. Although there are some environmental and social impacts from the project, these can be minimized by implementing proposed mitigation measures as outlined. The benefits of the project are believed to last for decades to come.
- With regards to the foundation method of the proposed high rise building, pile raft foundation has been considered given that shallow foundation methods such as footings and raft foundation have limitations considering the magnitude of the development and the existing condition of the soil. The load bearing of the building is expected to exceed 125kPa/m<sup>2</sup>, hence a combined pile and raft foundation has been selected.
- The waste management will be outsourced to a licensed party to handle and transfer waste to the dedicated waste collection sites in Male', which has been preferred as the option requires less physical and financial resources over the option of undertaking waste management by the project proponent during the operational phase. Also, by having the outsourced preference, the project proponent could monitor and advise to take necessary actions if the waste management operation is undertaken without regulatory requirements, hence could play a local regulatory role in the whole waste management process for the development. WANCO has been proposed as choice for outsourcing waste management.

## **10. STAKEHOLDER CONSULTATION**

In order to identify stakeholder concerns and interests with regards to the proposed project for developing 15-storey building at H. Dhoovehi, Male', consultation with the key stakeholders have been undertaken.

### **10.1 KEY STAKEHOLDERS**

As per the TOR, the identified key stakeholders relevant for the proposed development are;

1. Ministry of Housing and Infrastructure
2. Transport Authority of Maldives
3. STELCO
4. MWSC
5. Ministry of Environment and Energy
6. General public (within 30m radius)
7. Waste Management Corporation
8. HPA
9. MEA
10. Ministry of Defense

Although the TOR has not identified MFDA (Maldives Food and Drug Authority) as a key stakeholder, the EIA consultant feels that the stakeholder has an important role as the project has a restaurant on the first and second floors proposed as part of the development. Hence, MFDA was included in the stakeholder consultation.

### **10.2 MEANS OF CONSULTATION**

There is no formal method for undertaking stakeholder consultation with regards to addressing concerns and issues relating to the project, hence a number of methods have been used to collect information from key stakeholders identified above. These include; direct meetings and

telecommunications with stakeholders and direct on the spot interview with some residents around the project site.

## **10.3 KEY OUTCOMES**

### **10.3.1 Ministry of Housing and Infrastructure**

Ministry of Housing and Infrastructure has approved the concept of the proposed development on 13 April 2017. The approval letter from the ministry is annexed to this report. The approval from the ministry is indicative that they have no major concerns over the proposed development provided that the development shall be undertaken in conformity to relevant laws and regulations.

Additionally, the Ministry of Housing and Infrastructure has approved foundation plan of the building, which is also annexed to this report.

A detailed description of the relevant laws and regulations have been addressed in the Legal Framework section of the report.

A construction permit will be given to the project proponent upon approval of the EIA.

### **10.3.2 Transport Authority of Maldives**

Date: 4 May 2017  
Time: 10:00 hrs  
Type: Telephone conversation

Following are the summary of discussions;

- There is no direct involvement of Transport Authority of Maldives with regards to providing any permission such as parking and road blocking for the proposed project.
- TAM has the mandate to develop policies, regulations for Land and Sea Transport in the Country under the Maldives Transport Authority Act 3/2016
- TAM is also the lead agency for ensuring safety of sea and land transport in the country as well as providing necessary licenses for services providers in the sector.

- Under the Land Transportation Act 5/2009, a Regulation on Parking of Vehicles has been developed (2012/R-1), which states parking zones shall be determined by the City Council in Cities and Island Councils in the islands.

#### Participant

Name	Details	Contact Details
Mohamed Rafeeu	Director General, Transport Authority	778 5355

### 10.3.3 STELCO

Date: 7 May 2017

Time: 14:00 hrs

Venue: STELCO

Following are the summary of discussions;

- Initial discussions have already been undertaken with STELCO with regards to providing electricity to the project site during construction phase and as it is a resident area on a main road, electricity can be made available easily
- The design of the building to have easy access to the switchboard room, meters are located on the ground floor of the building.
- There is no issue of STELCO to have a standby genset for emergency use within the building.
- There will be no capacity issue to provide electricity to the building as there is ongoing upgrading works done at STELCO powerhouse.
- All meters need to be approved by STELCO as now an HV metering system is implemented

#### Participants

Name	Details	Contact Details
Mohamed Niyaz	Senior Engineer, STELCO	778 7021
Ali Niyaz	Engineer, STELCO	777 1520
Ibrahim Nihad	Amin Construction	777 6789

### 10.3.4 MWSC

Date: 7 May 2017  
Time: 10:00 hrs  
Type: Telephone conversation

Following are the summary of discussions;

- MWSC was communicated during the design stage of the building and their main requirements are addressed in the approved design of the project.
- MWSC will be able to supply required freshwater during project construction phase as the site is located on a main road
- Suggested to have two catch pits for wastewater on either side of the building, which will be connected to the main sewer network.
- MWSC is currently upgrading the main sewer in Male' in different sections as well as increasing the diameter of the freshwater pipeline in different sections in Male', hence there will be no capacity issue for managing wastewater and supplying freshwater to the proposed building
- Additionally, some of the pump stations for the main sewer are being upgraded to allow for more volume to be pumped out from the system
- For dewatering purpose some other measures need to be considered given that there are some limitation for continuously dewatering from large development projects
- New hydro system booster pumps are now available at MWSC, which can raise pressure up to 10 bars, hence there is no issue in lifting freshwater to top floors of the building.

Participants

Name	Details	Contact Details
Mohamed Naif	Senior Customer Service Officer, MWSC	996 3547

### 10.3.5 Ministry of Environment and Energy

Date: 10 May 2017  
Time: 9:10 hrs

Type: General telephone conversation

Following are the summary of discussions;

- No major requirement from MEE with regards to the proposed building except for the requirements of EPA, which is the enforcing agency for major environmental laws and regulations as well as providing necessary permits such as waste management, handling and transportation and dewatering.
- Terms of Reference approved by the EPA for the EIA shall be strictly followed and all information requirements shall be addressed in the report.

Participants

Name	Details	Contact Details
Abdulla Ziyad	State Minister, MEE	778 1502

### **10.3.6 Waste Management Corporation**

Date: 4 May 2017

Time: 10:30 hrs

Type: Telephone conversation

Following are the summary of discussions

- In addition to Male' City, WAMCO has started operations for waste management, handling and transportation in Hulhumale', Addu City and Fuahmulah City based on monthly tipping fee mechanism
- Door step monthly tipping fee in Male' is MVR 150
- Building services monthly tipping fee in Male' is MVR 100
- Monthly tipping fee per household in Addu and Fuahmulah is MVR 100
- Currently construction waste cannot be handled by WAMCO due to absence of specialized vehicles.
- Once construction waste are placed in the collection yards, WAMCO can transport these waste to Thilafushi
- The company is currently increasing its capacity in terms of vehicles for waste transportation for all service areas

- Waste is currently collected from MPL site

#### Participants

Name	Details	Contact Details
Ali Khalid	Chairman, WAMCO	778 4707

### 10.3.7 Health Protection Agency (HPA)

Date: 16 May 2017

Time: 11:00 hrs

Venue: HPA

Following are the summary of discussions;

- HPA is more engaged in creating public awareness on public health issues
- An Occupational Health Act has been drafted and waiting to be a law which covers most aspects of occupation health and safety
- Currently random checking of construction sites are undertaken by HPA to ensure occupational health and safety issues are undertaken by the contractors
- Difficult access to most of the construction sites have been raised by the HPA officers
- Mosquito breeding may become a potential health issue for the construction staff as well as for the neighbours, hence cleanliness of the sites need to be ensured
- Advises the contractors to take safety issues seriously including safety of construction staff as well as safety of pedestrians as there a number of large construction projects that are happening in Male'

#### Participants

Name	Details	Contact Details
Aminath Shaufa	PH Programme Coordinator	750 4075
Fathmath Shabana	Senior PH Programme Officer	983 2050

### 10.3.8 Maldives Energy Authority (MEA)

Date: 21 May 2017

Time: 13:00 hrs

Type: Telephone conversation

Following are the summary of discussions;

- MEA is engaged in developing the regulatory code and standards on the production of energy in the Maldives
- Shall obtain operating permit for the standby generator from MEA as it will be used for providing electricity for the use of the building
- All electrical wiring of the proposed building must be undertaken and approved by MEA licensed persons.
- MEA may monitor the site for compliance
- No other requirements in relation to the proposed project.

Participants

Name	Details	Contact Details
Muawiath Shujau	Director, MEA	778 7867

### 10.3.9 Ministry of Defense

Date: 21 May 2017

Time: 13:30 hrs

Type: Telephone conversation

Following are the summary of discussions;

- Ministry of Defence is engaged in checking the fire safety systems of buildings as well as approving the fire safety drawings of buildings.
- The Ministry also ensures that equipment imported to the country as fire safety systems meet with the requirements and standards maintained in the country.
- Additionally, the ministry provides permits to import dangerous chemicals to the country.

Participants;

Name	Details	Contact Details
Ibrahim Faiz	Assistant Director, MDNS	332 2601 Ext 3236

### **10.3.10 Maldives Food and Drug Authority, MFDA**

Date: 21 May 2017  
Time: 11:00 hrs  
Type: Telephone conversation

Following are the summary of discussions;

- General Regulation for Food Establishment and Services (2007/182/FS1) is the most applicable regulation for the proposed restaurant establishment in the building
- The establishment shall not be in environmentally polluted areas, close to waste management areas or areas that have potential for contamination of food
- Building shall be designed in a way to provide separation for various operations to avoid cross contamination, have adequate working space, and shall be designed to prevent the entrance and harboring of pests and contaminants, have adequate cleaning facilities and shall regularly supervise for good food hygiene.
- Establish good hygiene practices in the establishment
- The establishment shall have good lighting and ventilation mechanisms in place
- Any establishment violating the regulation are subject to fines ranging from MVR 5,000 to MVR 10,000 for the first time and MVR 10,000 to MVR 20,000 for the second time and revoking of the permit.
- Upon completion of the building, the establishment shall apply for operating permit from MFDA.

Participants;

<b>Name</b>	<b>Details</b>	<b>Contact Details</b>
Abdul Muhsin	Inspector Food Control Division, MFDA	301 4305

### **10.3.11 General Public Views**

Date: 10 - 11 May 2017  
Time: 15:00 – 21:30 hrs (between these hours)  
Type: On the spot and direct interviews

Following are the summary of major findings

- This is a high traffic area due to many cafes, restaurants, offices, artificial beach and a main road, the development may impact traffic movement in the area.
- Traffic is very high during night hours as it is a main road in Male' as well as there are number of visitors to the restaurants nearby.
- The only entrance to Burevi Magu is from Boduthakurufaanu Magu, and if there are frequent road blocking, it will be difficult for the residents and offices located in Burevi Magu
- Currently motorcycle parking by the proposed block is undertaken mostly by Cibo restaurant visitors and if parking is not allowed, it will be difficult for the restaurant visitors, however, there are other parking areas on the other side of Boduthakurufaanu Magu, which can be used.
- Most difficult problem as a result of the development will be parking in the area as the roadside of the plot is currently used for car and motorcycle parking.
- There will be no major issues from noise and dust as activities will happen inside a closed boundary and work will not be undertaken at night.
- A lot of multi-storey buildings have been developed on Burevi Magu and Boduthakurufaanu Magu by the plot area and some are under development that have completed structural works, there are major issues with dust and noise from these ongoing projects.
- Most problems to pedestrians and traffic as well as residents in the area are believed to occur during the initial stages of the development such as during dewatering and laying of foundation that may have an impact in the surrounding area as this is a large plot compared to many other plots in the surrounding area.
- If there are any problem or issues as a result of the proposed development that the neighbours may have to face, it is important to have a compensation mechanism by the developer.
- Once structural works are completed, no major problems are believed to occur as things will get normalized by then.

## Participants

<b>Name</b>	<b>Details</b>	<b>Contact Details</b>
Ahmed Mohamed	Resident, Noofaru Apartment, Burevi Magu	777 7732
Ahmed Rasheed	Resident, South Reef 2F, Burevi Magu	777 1285
Mohamed Irushad	Resident, Rumania Apartment, Burevi Magu	743 6666
Muaz Abdulla	Resident, Rumania Apartment, Burevi Magu	779 5288
Faheem Fathhee	Resident, South Reef 3F, Burevi Magu	790 4570
Ahmed Irfan	Resident, Velvet, Burevi Magu	798 0410
Hassan Mohamed	Resident, Sheereen Villa, Burevi Magu	777 1794
Ahmed Niyaz	Resident, Homelet, Boduthakurufaanu Magu	770 4020
Hussain Rasheed	Resident, Hurafa 6FL, Boduthakurufaanu Magu	795 6770
Ibrahim Waheed	Visitor, Cibo Restaurant, Boduthakurufaanu Magu	777 7075

# **11. ENVIRONMENTAL MONITORING**

## **11.1 BACKGROUND**

Environmental monitoring is important part of the whole EIA. It ensures that how the project has or is impacting the baseline environmental conditions that have been assessed as part of the EIA. It identifies the degrees and magnitudes of the predicted environmental impacts for the project are felt on the environment as a result of project implementation. Thus, it will help in implementing the mitigation measures that are already identified in this report or implement further measures if the impacts are identified to be bigger than anticipated.

### **11.1.1 Aim**

The primary aim of the monitoring is to provide information that will aid impact management, and secondarily to achieve a better understanding of cause-effect relationship and to improve impact prediction and mitigation methods.

### **11.1.2 Objective**

The following monitoring plan is used to measure impacts that occur during the proposed project activities and determine the accuracy of impacts that are predicted and the effectiveness of mitigation measures that are relevant for the proposed project. The objectives of the monitoring plan are to measure:

- Noise levels (EIA baseline)
- Traffic volume and flow (EIA baseline)
- Groundwater quality (EIA baseline)
- Solid waste (During construction and operation)
- Vibration (Foundation development)

The monitoring will also ensure that these measurements are kept within the baseline limits and predicted impacts are accurate and mitigation measures taken are effective.

Also, it assist in understanding whether there are any impacts relating to piling works through monitoring of vibration in nearby locations.

## **11.2 MONITORING REPORT**

A detailed environmental monitoring report will be compiled and submitted to the Environment Protection Agency during construction and post-construction periods of the project based on the data collected for monitoring the parameters included in the monitoring plan outlined for the project.

### **11.2.1 Report Format**

The Environment Monitoring Report will be developed in accordance with the following format;

- i) Introduction
- ii) Aims and Objectives
- iii) Existing Environmental Conditions
  - a. Ambient Noise Levels
  - b. Traffic Volume and Flow
  - c. Groundwater Quality
  - d. Solid Waste
  - e. Vibration
- iv) Comparison with EIA Baseline Data
- v) Conclusion and Recommendations

### **11.2.2 Reporting Schedule**

It is important to ensure that monitoring of the environmental parameters mentioned above will be initiated during construction periods, which will be continued throughout the operation life cycle of the project. In this regard, the following schedule will be followed.

- *During Construction Phase* – Three Monitoring Reports
- *During Operation Phase* – Annual Monitoring Report for 2 years

## **11.3 MONITORING PLAN AND COSTS**

The following Environmental Monitoring Plan will be followed during and after the construction phases of the proposed 15 Storey Building Development at H. Dhoovehi, Male’.

<b>Monitoring Requirements</b>	<b>Indicators</b>	<b>Baseline Reference Values</b>	<b>Technique</b>	<b>Frequency</b>	<b>Approx Cost (US\$)</b>
<b>Noise Levels</b>	Increase/decrease	Baseline EIA	Sound meter	Every 4 - 6 months	<b>200.00</b>
<b>Traffic flow and volume</b>	Increase/decrease	Baseline EIA	Visual Observations	Every 4- 6 months	<b>200.00</b>
<b>Groundwater quality</b>	Changes in levels of parameters tested	Baseline EIA	Lab analysis	Every 4 - 6 months	<b>100.00</b>
<b>Solid waste (construction and operation periods)</b>	Type and Volume	At the beginning of construction	Data Collection	Every 4 - 6 months	<b>300.00</b>
<b>Vibration</b>	Acceleration, Velocity, Displacement		Vibration Meter	During Foundation Development	<b>700.00</b>
<b>TOTAL COST</b>					<b>1,500.00</b>

*Table 9: Environmental monitoring plan*

## **11.4 COMMITMENT**

The proponent fully commits to implement the proposed environmental monitoring programme. The commitment letter is attached in **Appendix 9**.

## 12. CONCLUSIONS

Following are the main conclusions of the proposed 15 storey building to be developed at H. Dhoovehi, Male' based on the EIA undertaken for the project.

- a. The proposed 15 storey building at H. Dhoovehi will be developed by AMIN Construction Pvt. Ltd. and will be used for mixed use commercial and residential purpose with a basement, ground floor car park, 1<sup>st</sup> and 2<sup>nd</sup> floor restaurant. The rest of the floors will be used for residential and private residential purpose. The total area of the plot is 290m<sup>2</sup>.
- b. Once completed, the basement area will have water tanks with storage area, the ground floor will be a private car park, generator room, water meter room, security room, waste collection, loading area; first and second floors will be a restaurant; third to thirteenth floor will be residential, fourteenth floor will be a suite. At the top level will be a rooftop mezzanine.
- c. The site will be excavated to a depth of 3.35m to lay the foundations and develop the basement area having 167sqm in floor area, which is 57% of the total plot area. The basement area will have 2 x 18cbm water tanks and a large storage area. The entire boundary will be sheet piled to depths of 5m with corrugated sheets supported by iron beams as a safety measure while preparing the site ready for construction.
- d. The building will rest on a pile raft foundation. A total of 79 micropiles (200-300mm diameter) will be driven into the ground to depths ranging from 1 – 3.6m through boreholes done in 2 regions within the plot. The region 1 will have 31 such micropiles and region 2 will have 48 micropiles. The foundation thickness will be 500mm, depth will be 1,050mm, cover to foundation will be 50mm, cover to columns will be 40mm and the concrete mix ratio for the foundation will be 1:2:3.
- e. The project requires 1,160m<sup>3</sup> of soil to be excavated and 783m<sup>3</sup> of groundwater to be dewatered to lay the foundation of the building.

- f. The project has to comply with key laws and regulations implemented by Ministry of Housing and Infrastructure and EPA including Environmental Protection and Preservation Act, EIA Regulations, Dewatering Regulations, Male' Planning Regulation, Land Act as well as comply with Maldives National Building Code.
- g. The project will be executed in 18 months.
- h. There are no significant environmental impacts from the proposed project, however, some of the environmental impacts from development activities such as excavation, dewatering, construction activities, operation of construction machinery, construction waste generating environmental impacts such as noise, dust and pollution are believed to occur. Social impacts such as traffic congestion, disturbance to nearby residents have been predicted as well as health problems as a result of dust have been identified. During operation period of the project, domestic waste and traffic are believed to increase.
- i. With appropriate environmental management and mitigation measures as well as conformity to all the legal and regulatory requirements as outlined in the EIA Report, the project is believed to control or minimize most of the environmental and social impacts both during construction and operation phases of the development. Important considerations with regards to mitigating environmental impacts include closing the boundary of the project area, placing dust nets around the building, regularly transporting construction waste and avoiding material transport during peak traffic hours as well as designating proper time periods for construction works have been identified.
- j. Although the project has short-term environmental impacts from the proposed development, the project has more social and economic benefits, which is believed to tremendously contribute to the need for residential and commercial space in Male', create some employment opportunities and contribute to the local economy in Male' in the long-term.
- k. Although during construction of the project, negative environmental impacts from construction activities have been envisaged, with appropriate environmental

management and mitigation measures, these impacts will be reduced to a considerable level. Also, with positive socio-economic outlook of the project and considering the need for additional space in Male', it is concluded that the project is an important development.

## 13. REFERENCES

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ENVIRONMENTAL IMPACT ASSESSMENT For Proposed Multi-Storey Building at H. Blue Heaven, Male' prepared by Sandcays Pvt. Ltd. in 2016

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## 14. APPENDICES

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No: 203-EIARES/PRIV/2017/408

## Terms of Reference for Environmental Impact Assessment for the Proposed 15-Storey Building with Basement at H. Dhoovehi, Male'

The following is the Terms of Reference (ToR) following the scoping meeting held on 27 April 2017 for undertaking the EIA of the proposed 15 Storey Building with Basement at H. Dhoovehi, Male'. The Proponent of the Project is AMIN Construction Pvt. Ltd.

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

**1. Introduction and rationale** –Describe the purpose of the project and, if applicable, the background 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 projects executed by other consultants, and how coordination between other consultants, contractors, government institutions will be carried out. List the donors, and the institutions the consultant will be coordinating with and the methodologies used. This should include but should not be limited to the following;

- Name and contact details of the Proponent
- Rationale and background to the project
- Aims and objectives of the project

**2. Study area** – Submit a minimum A3-size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size of the facility. The study area should include adjacent buildings and related infrastructure, nearby environmentally sensitive sites (e.g. mosque). Justification for site selection is required. Relevant developments in the areas must also be considered including residential areas, all economic ventures and cultural sites

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

**Task 1. Description of the proposed project** – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. All inputs and outputs related to the proposed activities shall be justified. Provide the following details'



Master plan design concept

- a) Main master plan used for the project
- b) Master plan concepts in A3 format
- c) Parking capacity and access

Project development

Provide a schedule outlining the proposed phasing, sequencing and duration of components, including;

- a) Pre-construction, construction, operation and decommissioning
- b) The activities to date, including baseline assessments, modeling and geotechnical investigations
- c) Key factors controlling the schedule and uncertainties relating to the project

Excavation and dewatering

- a) Area, depth, volume required for excavation
- b) Excavated earth disposal method and location
- c) Estimated number of days required for dewatering
- d) Dewatered water disposal method and location(s)
- e) Shoring methods for particularly on sides with adjacent buildings

Foundation, Piling and Concrete Works

- a) Pile specifications, including type, dimensions and max driving length
- b) Pile driving method
- c) Type of foundation and foundation depth
- d) Geotechnical calculations regarding the building weight
- e) Concrete batching process and transportation method (if required)

Construction Management

- a) Construction waste management
- b) Traffic management
- c) Project site office and temporary storage area details

Utilities

- a) Description of the utility providers during construction and operation stage (Water, Electricity, Power)
- b) Sewerage connection plan to Male' main network
- c) Water connection plan and water storage tank(s) details
- d) Waste management plan during operation
- e) Fuel storage details and measures of leakage prevention



Temporary facilities

Describe construction methods, scheduling and operation of temporary facilities including power generation, oil storage, water supply, waste water treatment, accommodation facilities, waste management and decommissioning.

Revegetation

- a) Details of the source of trees that will be used for revegetation'
- b) If vegetation is to be supplied from inhabited islands, approvals from those island councils are required and details of the number of trees should be provided

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

**Task 2. Description of the environment** -- Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (eg: monsoon season). Identify baseline data gaps, and identify studies and level of detail to be carried out by the 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 data must be collected as per the requirements of the EPA Data Collection Guideline (published on [www.epa.gov.mv](http://www.epa.gov.mv)). The report should outline detailed methodology of data collection utilized.

All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, vegetation and noise levels for posterior data comparison. Information should be divided into the categories shown below:

Climate

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





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

Impacts on natural environment

- Impacts of noise, vibration and disturbance
- Impacts on terrestrial flora and fauna and from land preparation works, if any
- Impacts on groundwater table and quality as a result of dewatering and groundwater use
- Impacts on soil
- Contamination due fuel leakage
- Impacts on landscape integrity/scenery
- Mosquito growth

Impacts on the socio-economic environment

- Impacts on employment and income such as job opportunities in the constructional and operational phase;
- Disturbances to residents and cultural facilities/activities;
- Impacts on transportation/traffic.
- Impacts of increased demands on utility services especially water and energy and waste management
- Impacts on nearby buildings

Construction related hazards and risks

- Pollution of natural environment (e.g. oil spills, discharge of untreated waste water and solid waste including construction waster)
- Risk of accidents and pollution on workers and local populations, and
- Impacts on social values, norms and belief due to construction workers on local population
- Dust and emission
- Impacts due to foundation works
- General public health and safety issues
- Fire risk due to proximity of fuel shed

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





- c) STELCO
- d) MWSC
- e) Ministry of Environment and Energy
- f) General public within 30m radius
- g) HPA
- h) MEA
- i) Ministry of Defence

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

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

Date: 02nd May 2017











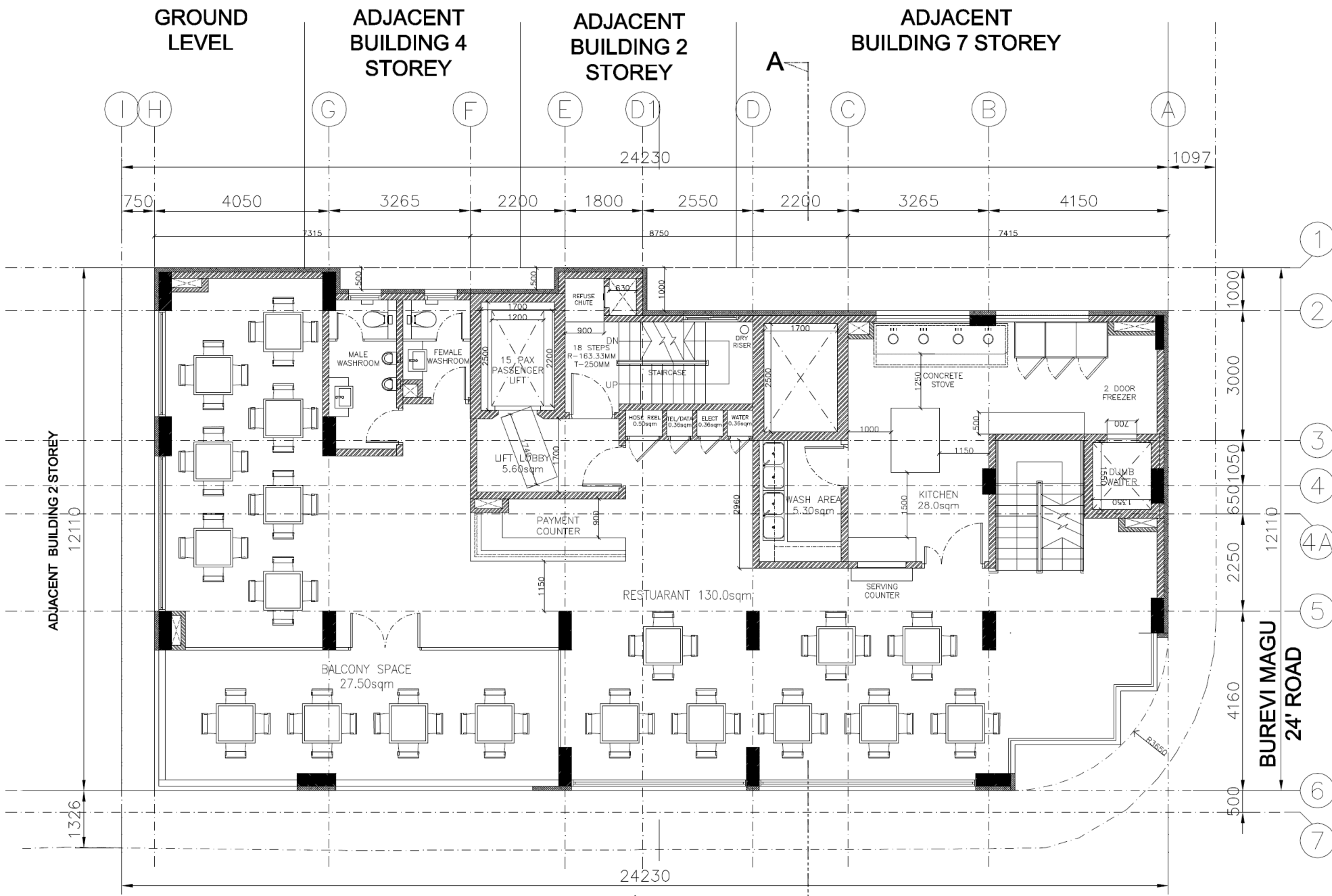


DESIGN SCHEME 03 MAR 17

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OPPOSITE BUILDING 8 STOREY



FLOOR LAYOUT PLAN - LEVEL 2 TO 3

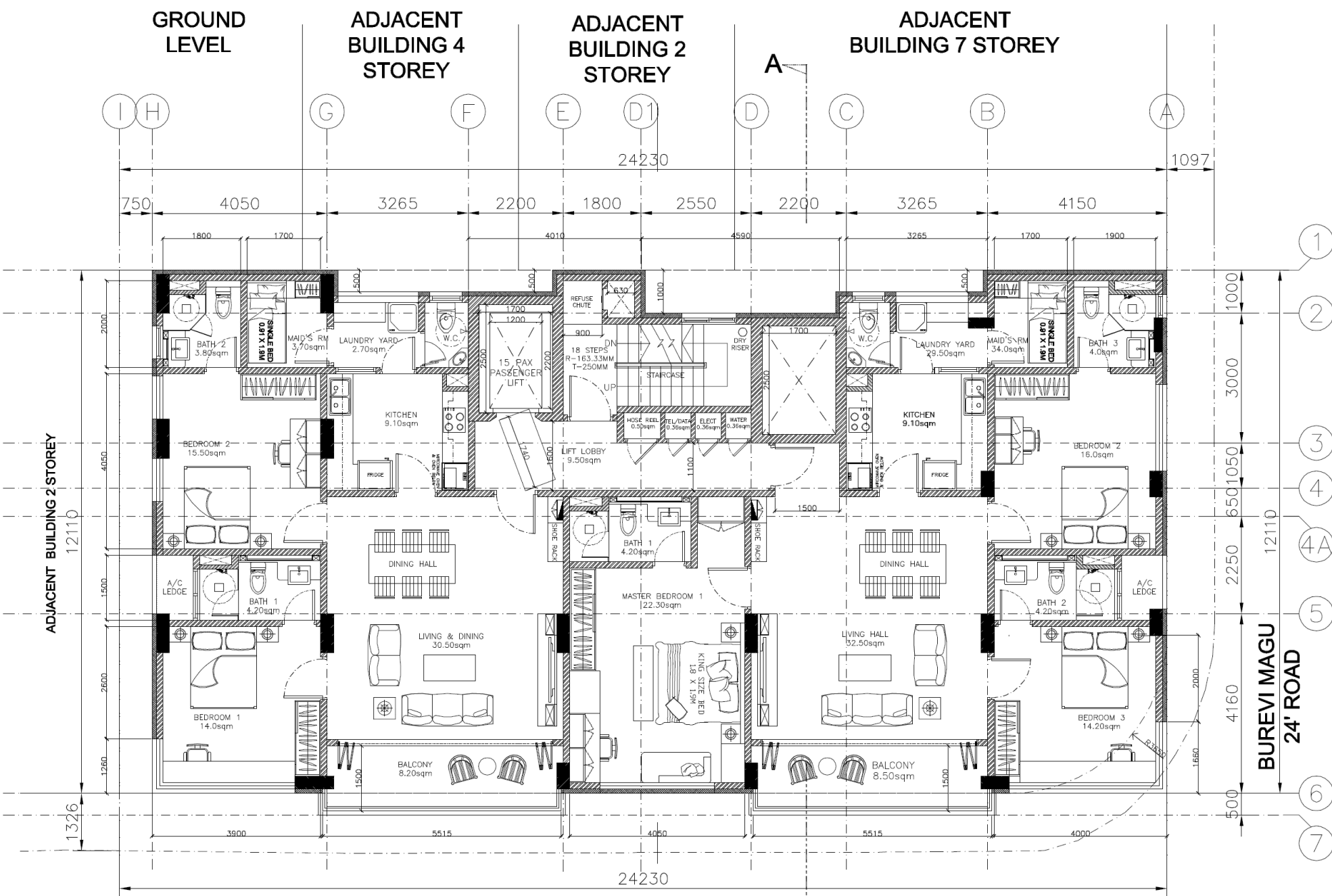
No.	Amendment	Date
Architect MEP & C&S		
 <b>JPL CONSULTANTS PTE LTD</b> <small>ARCHITECTS   PROFESSIONAL ENGINEERS   PROJECT MANAGERS   INTERIOR DESIGNERS</small>		
<small>352B KING GEORGE'S AVENUE,                  KING GEORGE'S BUILDING,                  SINGAPORE 208580                  TEL : 6396 0055                  FAX: 6396 0555</small>		
<small>Knowledge •• Innovation •• Vision</small>		
OWNER		
AMIN CONSTRUCTION PRIVATE LIMITED 52, BODUTHAKURUFAANU MAGU, MALE' 20-01, REPUBLIC OF MALDIVES TEL: +960 3324369 FAX: +960 3328424		
Tenure of Land		
FREEHOLD		
Project Title		
PROPOSED 15-STOUREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD		
Drawing Title		
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MARCH 2017		
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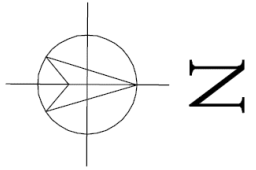
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OPPOSITE BUILDING 8 STOREY



# FLOOR LAYOUT PLAN - LEVEL 4 TO 11

No.	Amendment	Date

Architect MEP & C&S



**JPL CONSULTANTS PTE LTD**  
ARCHITECTS | PROFESSIONAL ENGINEERS | PROJECT MANAGERS | INTERIOR DESIGNERS

352B KING GEORGE'S AVENUE,  
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 TEL : 6396 0055  
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Knowledge • Innovation • Vision

OWNER  
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 52, BODUTHAKURUFAANU MAGU,  
 MALE' 20-01, REPUBLIC OF MALDIVES  
 TEL: +960 3324369  
 FAX: +960 3328424

Tenure of Land  
 FREEHOLD

Project Title  
 PROPOSED 15-STOREYS H-DOOVEHI BUILDING  
 PROJECT DEVELOPMENT AT  
 BODUTHAKURUFAANU MAGU IN MALE',  
 MALDIVES FOR AMIN CONSTRUCTION PVT LTD

Drawing Title  
**FLOOR LAYOUT PLAN  
 - LEVEL 4 TO 11**

Scale A3-1:200 AS SHOWN

Date MARCH 2017

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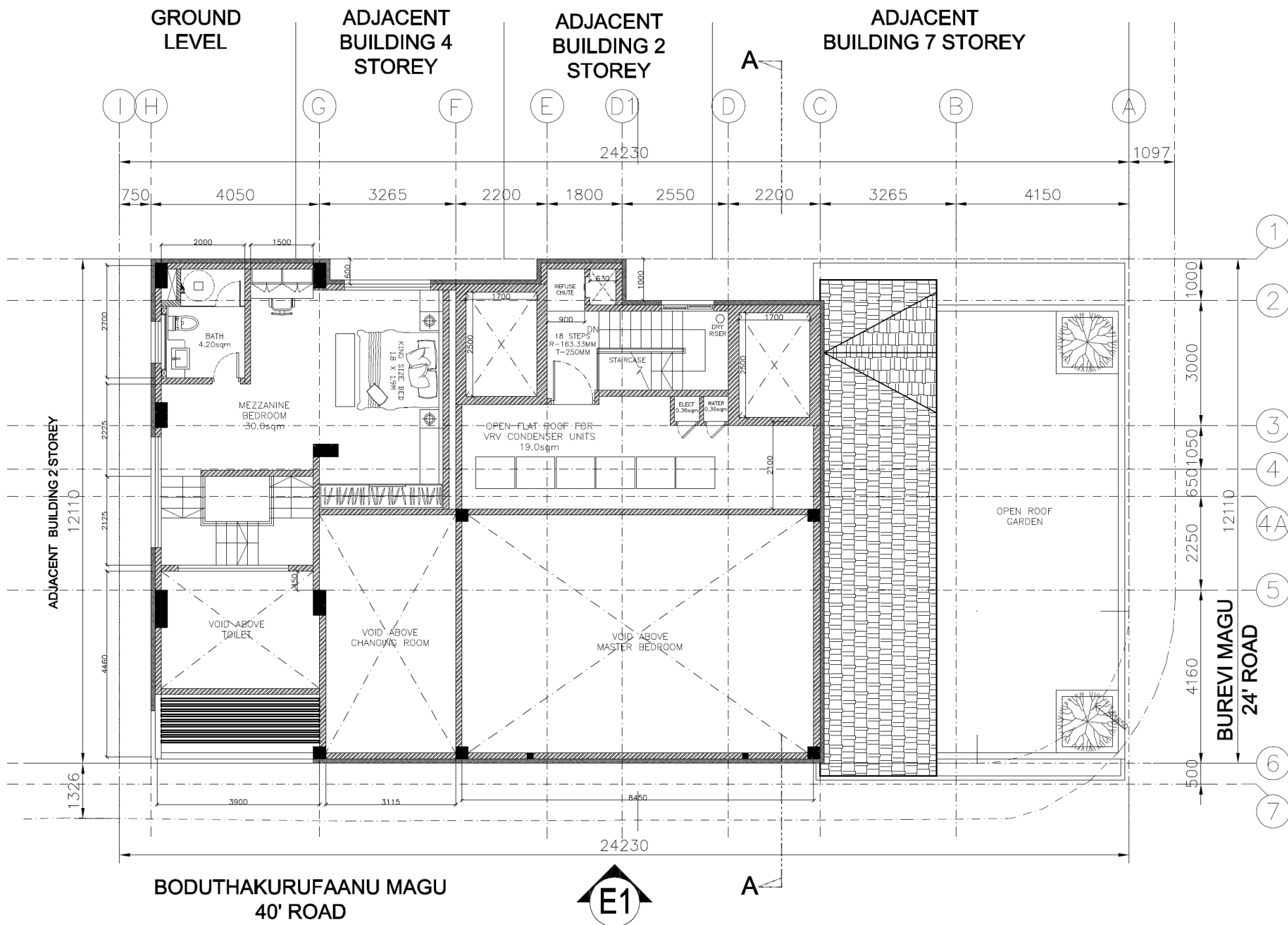


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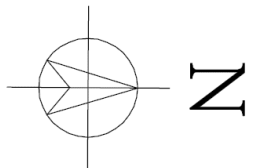
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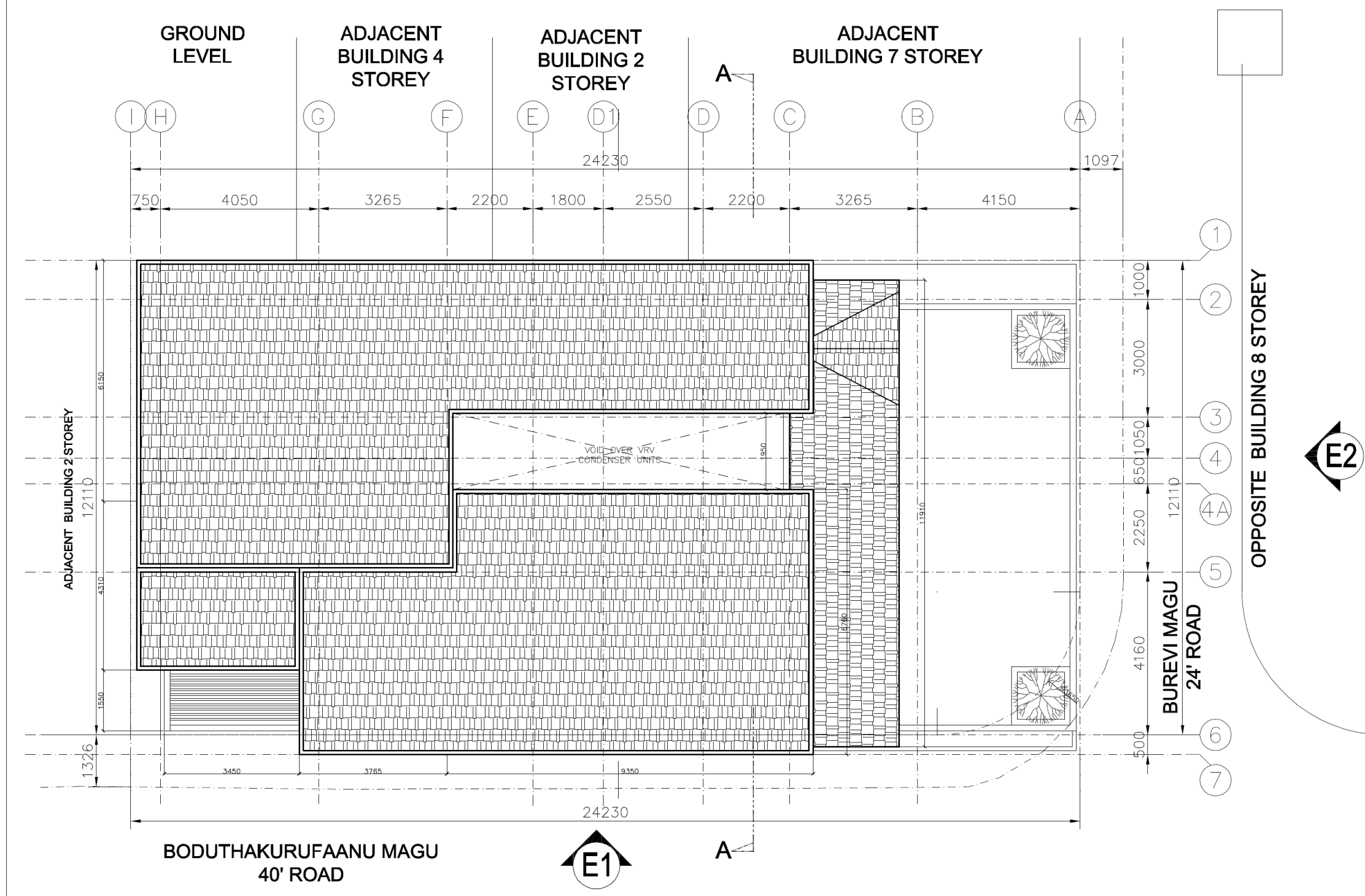
OPPOSITE BUILDING 8 STOREY



# FLOOR LAYOUT PLAN - LEVEL 15 (MEZZANINE)

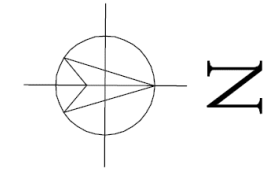
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OWNER		
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Tenure of Land		
FREEHOLD		
Project Title		
PROPOSED 15-STOREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD		
Drawing Title		
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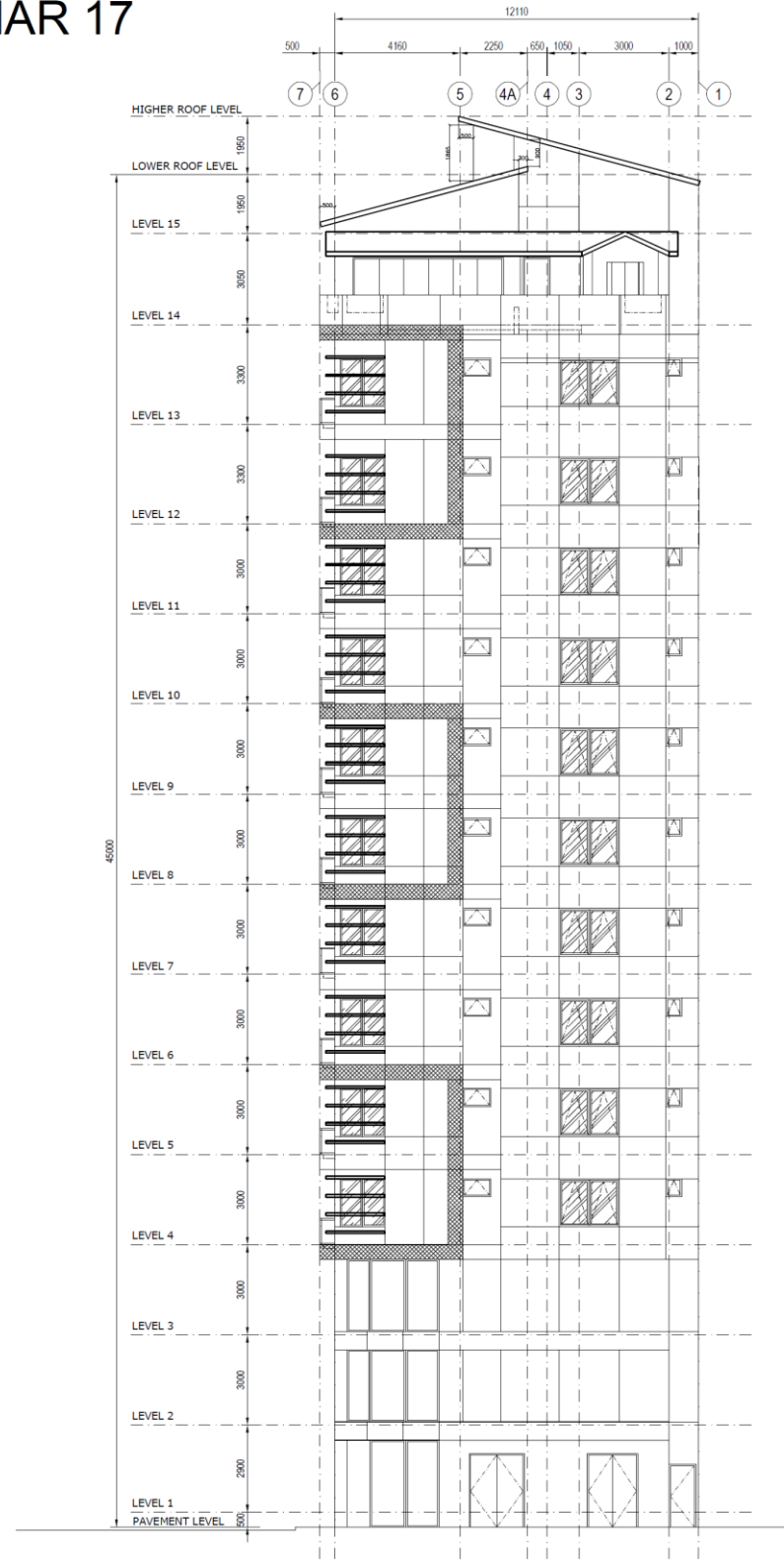
FLOOR LAYOUT PLAN - ROOF PLAN

OPPOSITE BUILDING 8 STOREY



No.	Amendment	Date
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Tenure of Land		
FREEHOLD		
Project Title		
PROPOSED 15-STOUREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD		
Drawing Title		
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Scale A3-1:200		AS SHOWN
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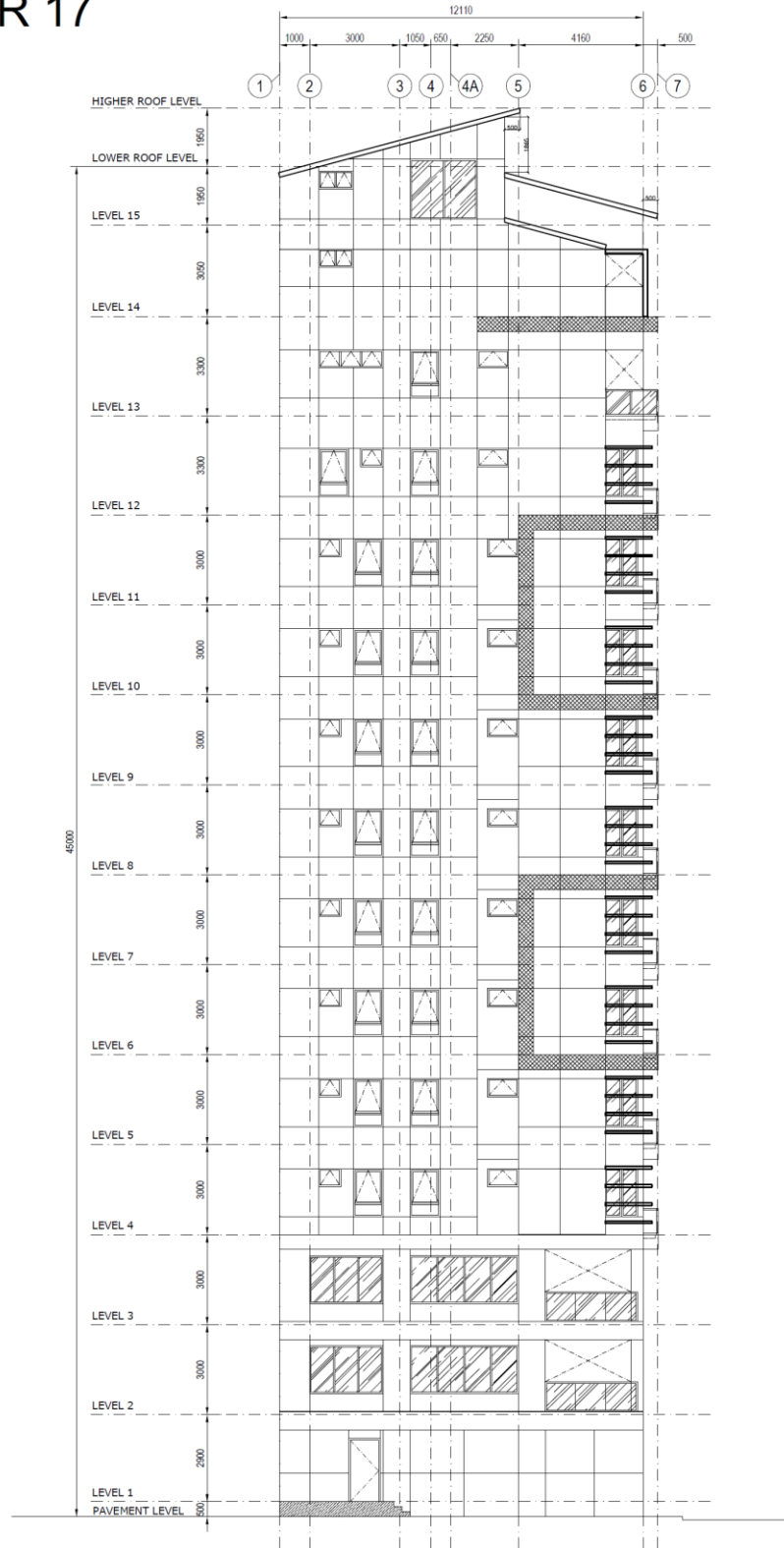
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ELEVATION E-1 (NORTH ELEV)

DESCRIPTION		PROJECT TITLE :	DRAWING TITLE :	OWNER / APPLICANT :
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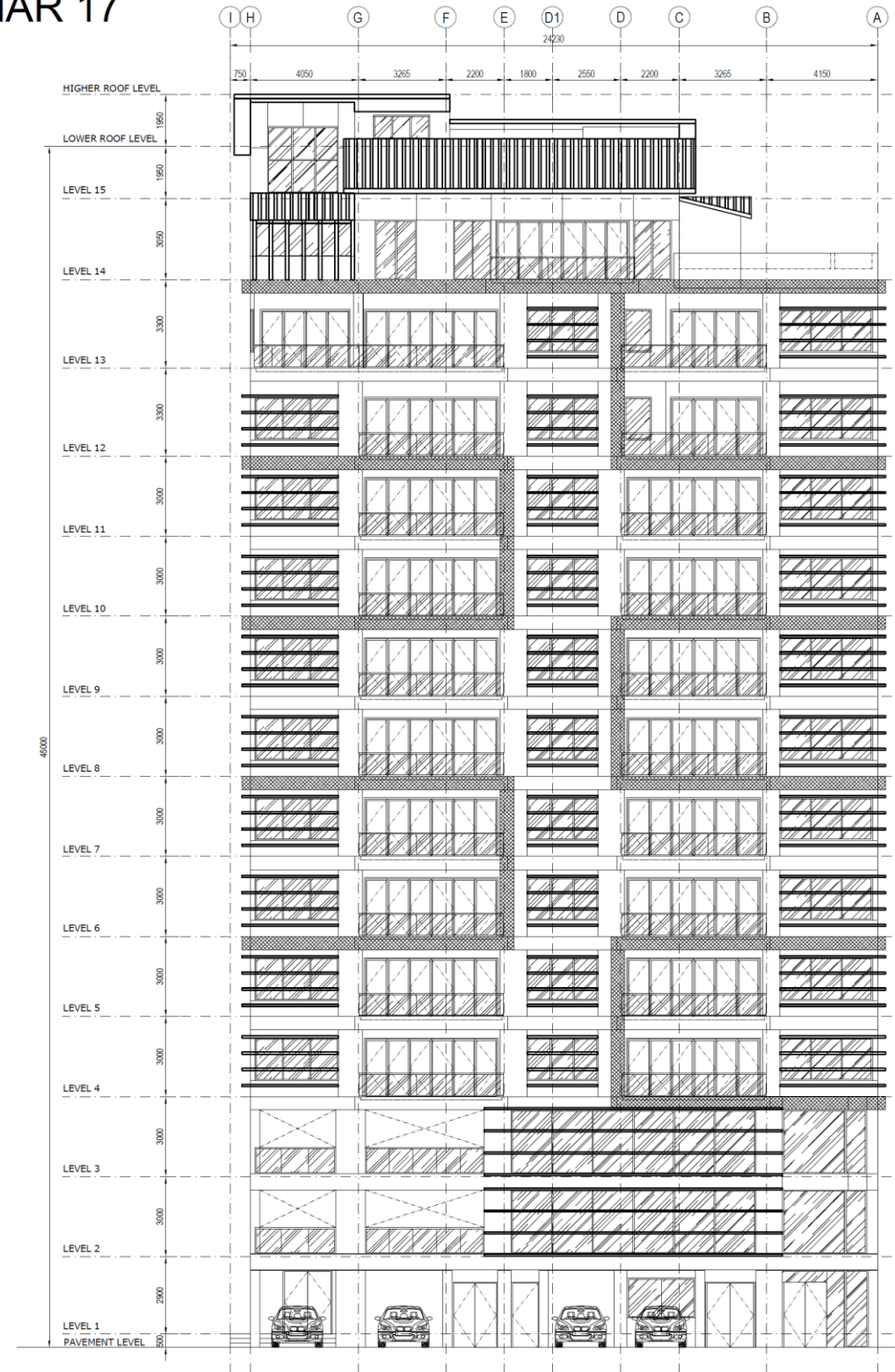
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ELEVATION E-3 (SOUTH ELEV)

DESCRIPTION		PROJECT TITLE :	DRAWING TITLE :	OWNER / APPLICANT :	
		PROPOSED 15-STORYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD	ELEVATION E-3 (SOUTH ELEV)	AMIN CONSTRUCTION PRIVATE LIMITED	
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				ARCHITECT : JPL CONSULTANTS PTE LTD 352B KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 238586 TEL : 6396 0555 FAX: 6396 0555	

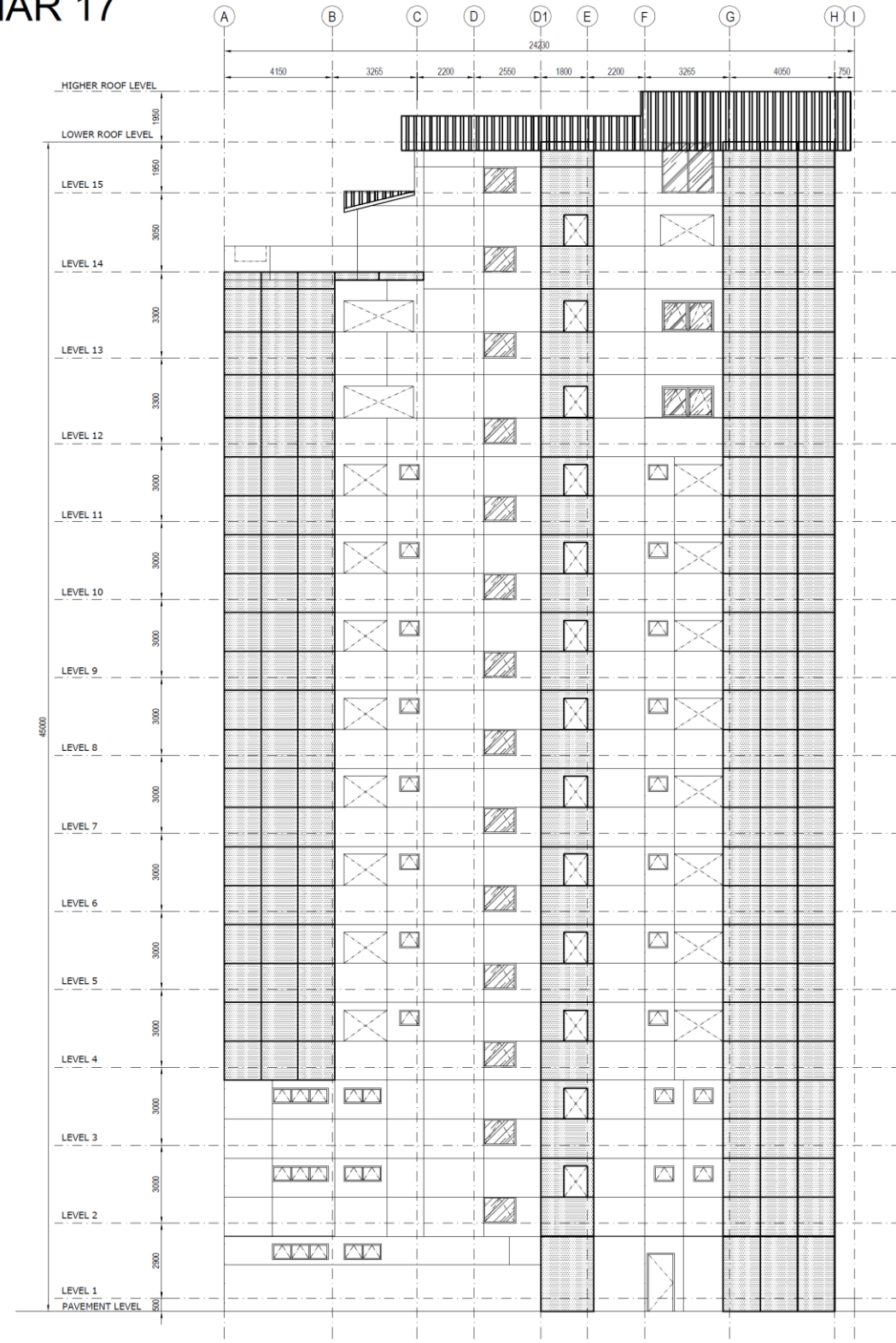
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ELEVATION E-2 (EAST ELEV)

DESCRIPTION		PROJECT TITLE :	DRAWING TITLE :	OWNER / APPLICANT :
		PROPOSED 15-STORYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD	ELEVATION E-2 (EAST ELEV)	AMIN CONSTRUCTION PRIVATE LIMITED SE. BODUTHAKURUFAANU MAGU, MALE', 20-01, REPUBLIC OF MALDIVES TEL: +960 3334500 FAX: +960 3334244
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		DRAWN : DF	CHECKED : DF	JPL CONSULTANTS PTE LTD 310B KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 200580 TEL : 6368 0535 FAX: 6368 0555
		DWG NO : 1207 / CD /	REV. :	

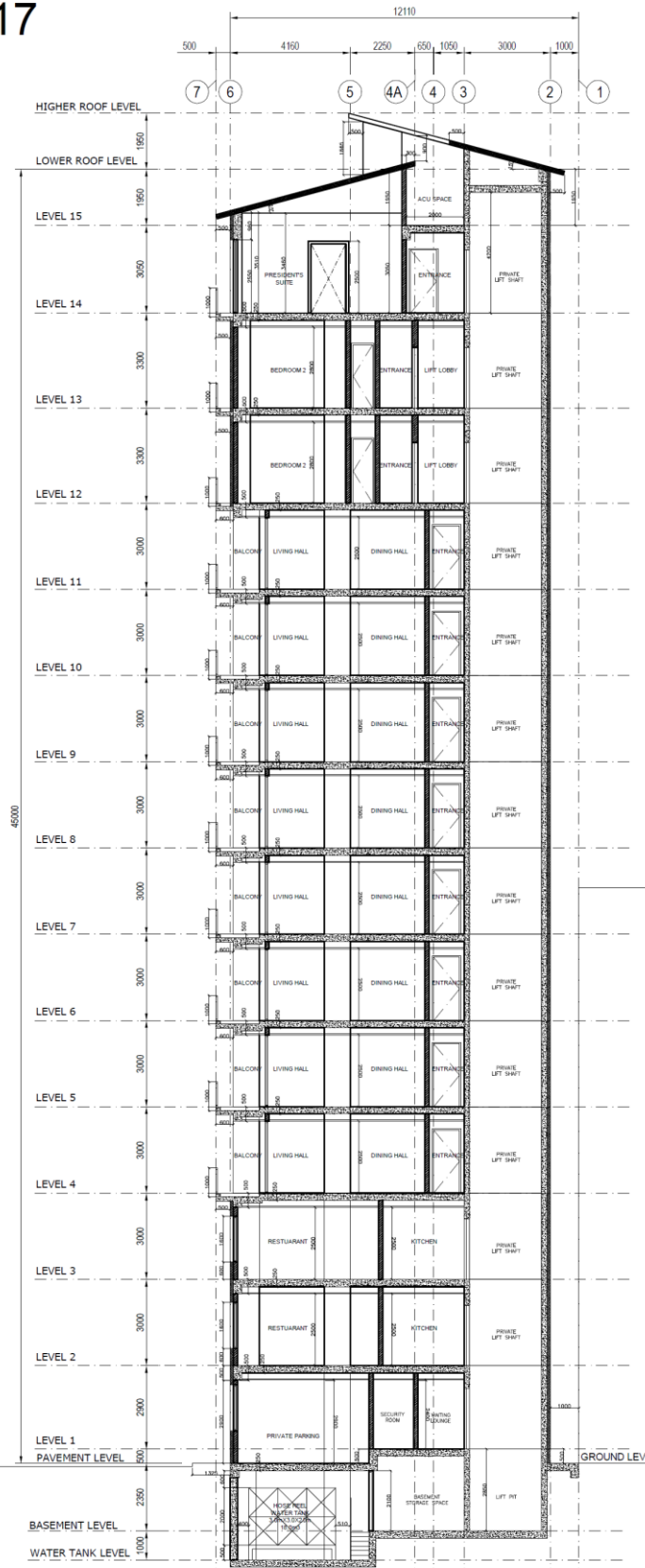
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ELEVATION E-4 (WEST ELEV)

	<p>PROJECT TITLE :</p> <p>PROPOSED 15-STOREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD</p>	<p>DRAWING TITLE :</p> <p>ELEVATION E-4 (WEST ELEV)</p>	<p>OWNER / APPLICANT :</p> <p>AMIN CONSTRUCTION PRIVATE LIMITED</p> <p>52, BOOTHAKURUFAANU MAGU, MALE', 20-01, REPUBLIC OF MALDIVES</p> <p>TEL: +993 3324369 FAX: +993 3324214</p>
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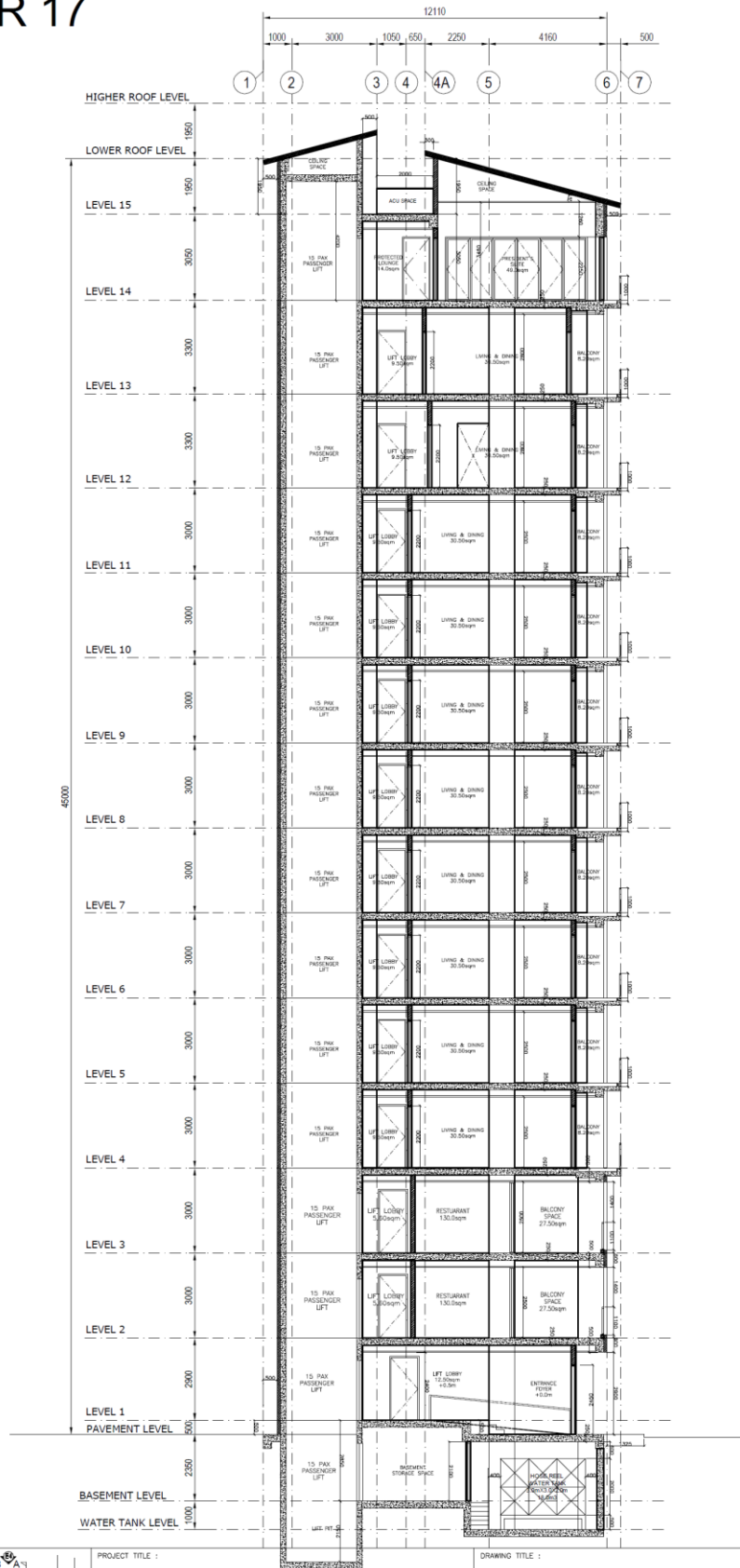
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SECTION A-A

PROJECT TITLE : PROPOSED 15-STOREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD	DRAWING TITLE : SECTION A-A	OWNER / APPLICANT : <b>AMIN CONSTRUCTION PRIVATE LIMITED</b> 02, BODUTHAKURUFANU MAGU, MALE', 20501, REPUBLIC OF MALDIVES TEL: +960 3324369 FAX: +960 3339424
	ARCHITECT : <b>JPL CONSULTANTS PTE LTD</b> 352B KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 238586 TEL: 6398 0555 FAX: 6398 0555	SCALE : A3 = 1 : 150 DATE : MARCH 2017 DRAWN : JF CHECKED : JF DWG NO : 1207 / CD / REV :

15 MAR 17



SECTION B-B

DESCRIPTION		PROJECT TITLE :	DRAWING TITLE :	OWNER / APPLICANT :	
		PROPOSED 15-STOREYS H-DOOVEHI BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFAANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD	SECTION B-B	AMIN CONSTRUCTION PRIVATE LIMITED 33, BOOTHAKURUFAANU MAGU, MALE', 20-01, REPUBLIC OF MALDIVES TEL: +960 3324369 FAX: +960 3328424	
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					JPL CONSULTANTS PTE LTD 352B KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 208660 TEL : 6396 0555 FAX : 6396 0555



Construction of Dhoovehi 15 storey Building at Male'

ID	Task Name	Duration	Start	Finish	Predecessors	2017						2018											
						Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	<b>Construction of 15 storey building - Working Schedule</b>	<b>567 days</b>	<b>Sat 10-06-17</b>	<b>Fri 28-12-18</b>		[Gantt bar spanning from Sat 10-06-17 to Fri 28-12-18]																	
2	<b>Mobilization</b>	<b>2 days</b>	<b>Sat 10-06-17</b>	<b>Sun 11-06-17</b>		[Gantt bar from Sat 10-06-17 to Sun 11-06-17]																	
3	Site Cleaning	2 days	Sat 10-06-17	Sun 11-06-17		[Gantt bar from Sat 10-06-17 to Sun 11-06-17]																	
4	<b>Construction work</b>	<b>565 days</b>	<b>Mon 12-06-17</b>	<b>Fri 28-12-18</b>		[Gantt bar spanning from Mon 12-06-17 to Fri 28-12-18]																	
5	<b>Sub structural works</b>	<b>82 days</b>	<b>Mon 12-06-17</b>	<b>Fri 01-09-17</b>		[Gantt bar from Mon 12-06-17 to Fri 01-09-17]																	
6	Excavation works	7 days	Sat 26-08-17	Fri 01-09-17	7	[Gantt bar from Sat 26-08-17 to Fri 01-09-17]																	
7	For Plie foundation	75 days	Mon 12-06-17	Fri 25-08-17	3	[Gantt bar from Mon 12-06-17 to Fri 25-08-17]																	
8	<b>Shoring works</b>	<b>30 days</b>	<b>Sat 26-08-17</b>	<b>Sun 24-09-17</b>	<b>7</b>	[Gantt bar from Sat 26-08-17 to Sun 24-09-17]																	
9	Shoring work at below ground level	30 days	Sat 26-08-17	Sun 24-09-17	7	[Gantt bar from Sat 26-08-17 to Sun 24-09-17]																	
10	<b>Pile cab &amp; Column stumps</b>	<b>43 days</b>	<b>Mon 25-09-17</b>	<b>Mon 06-11-17</b>		[Gantt bar from Mon 25-09-17 to Mon 06-11-17]																	
11	Binder reinforcement & Shuttering	10 days	Mon 25-09-17	Wed 04-10-17	9	[Gantt bar from Mon 25-09-17 to Wed 04-10-17]																	
12	Concrete works	6 days	Mon 02-10-17	Sat 07-10-17	11SS+7 days	[Gantt bar from Mon 02-10-17 to Sat 07-10-17]																	
13	Column stump (Reinforcement & Shuttering)	7 days	Sun 08-10-17	Sat 14-10-17	12	[Gantt bar from Sun 08-10-17 to Sat 14-10-17]																	
14	Concrete Works	5 days	Fri 13-10-17	Tue 17-10-17	13SS+5 days	[Gantt bar from Fri 13-10-17 to Tue 17-10-17]																	
15	Block Work with plastering	7 days	Wed 18-10-17	Tue 24-10-17	14	[Gantt bar from Wed 18-10-17 to Tue 24-10-17]																	
16	Back Filling & Compaction	7 days	Wed 18-10-17	Tue 24-10-17	14	[Gantt bar from Wed 18-10-17 to Tue 24-10-17]																	
17	Below Ground level RCC Wall	10 days	Wed 18-10-17	Fri 27-10-17	14	[Gantt bar from Wed 18-10-17 to Fri 27-10-17]																	
18	Basement slab	8 days	Mon 30-10-17	Mon 06-11-17	16FS+5 days	[Gantt bar from Mon 30-10-17 to Mon 06-11-17]																	
19	<b>Super Structural works</b>	<b>232 days</b>	<b>Tue 07-11-17</b>	<b>Tue 26-06-18</b>	<b>16</b>	[Gantt bar from Tue 07-11-17 to Tue 26-06-18]																	
20	<b>Ground Floor</b>	<b>7 days</b>	<b>Sat 16-06-18</b>	<b>Fri 22-06-18</b>		[Gantt bar from Sat 16-06-18 to Fri 22-06-18]																	
21	Grade Slab reinforcement	6 days	Sat 16-06-18	Thu 21-06-18	113	[Gantt bar from Sat 16-06-18 to Thu 21-06-18]																	
22	Grade slab concrete	1 day	Fri 22-06-18	Fri 22-06-18	21	[Gantt bar from Fri 22-06-18 to Fri 22-06-18]																	
23	<b>First Floor</b>	<b>17 days</b>	<b>Tue 07-11-17</b>	<b>Thu 23-11-17</b>		[Gantt bar from Tue 07-11-17 to Thu 23-11-17]																	
24	Column Reinforcement & shuttering	3 days	Tue 07-11-17	Thu 09-11-17	18	[Gantt bar from Tue 07-11-17 to Thu 09-11-17]																	
25	Column Concrete	2 days	Fri 10-11-17	Sat 11-11-17	24	[Gantt bar from Fri 10-11-17 to Sat 11-11-17]																	
26	Lift wall shuttering & concrete	2 days	Sun 12-11-17	Mon 13-11-17	25	[Gantt bar from Sun 12-11-17 to Mon 13-11-17]																	
27	Staircase shuttering & concrete	2 days	Tue 14-11-17	Wed 15-11-17	26	[Gantt bar from Tue 14-11-17 to Wed 15-11-17]																	
28	Slab & Beam shuttering and reinforcement	7 days	Thu 16-11-17	Wed 22-11-17	27	[Gantt bar from Thu 16-11-17 to Wed 22-11-17]																	
29	Slab & Beam Concrete	1 day	Thu 23-11-17	Thu 23-11-17	28	[Gantt bar from Thu 23-11-17 to Thu 23-11-17]																	
30	<b>Second Floor</b>	<b>17 days</b>	<b>Fri 24-11-17</b>	<b>Sun 10-12-17</b>		[Gantt bar from Fri 24-11-17 to Sun 10-12-17]																	
31	Column Reinforcement & shuttering	3 days	Fri 24-11-17	Sun 26-11-17	29	[Gantt bar from Fri 24-11-17 to Sun 26-11-17]																	
32	Column Concrete	2 days	Mon 27-11-17	Tue 28-11-17	31	[Gantt bar from Mon 27-11-17 to Tue 28-11-17]																	
33	Lift wall shuttering & concrete	2 days	Wed 29-11-17	Thu 30-11-17	32	[Gantt bar from Wed 29-11-17 to Thu 30-11-17]																	
34	Staircase shuttering & concrete	2 days	Fri 01-12-17	Sat 02-12-17	33	[Gantt bar from Fri 01-12-17 to Sat 02-12-17]																	
35	Slab & Beam shuttering and reinforcement	7 days	Sun 03-12-17	Sat 09-12-17	34	[Gantt bar from Sun 03-12-17 to Sat 09-12-17]																	
36	Slab & Beam Concrete	1 day	Sun 10-12-17	Sun 10-12-17	35	[Gantt bar from Sun 10-12-17 to Sun 10-12-17]																	
37	<b>Third Floor</b>	<b>17 days</b>	<b>Mon 11-12-17</b>	<b>Wed 27-12-17</b>		[Gantt bar from Mon 11-12-17 to Wed 27-12-17]																	
38	Column Reinforcement & shuttering	3 days	Mon 11-12-17	Wed 13-12-17	36	[Gantt bar from Mon 11-12-17 to Wed 13-12-17]																	
39	Column Concrete	2 days	Thu 14-12-17	Fri 15-12-17	38	[Gantt bar from Thu 14-12-17 to Fri 15-12-17]																	
40	Lift wall shuttering & concrete	2 days	Sat 16-12-17	Sun 17-12-17	39	[Gantt bar from Sat 16-12-17 to Sun 17-12-17]																	
41	Staircase shuttering & concrete	2 days	Mon 18-12-17	Tue 19-12-17	40	[Gantt bar from Mon 18-12-17 to Tue 19-12-17]																	
42	Slab & Beam shuttering and reinforcement	7 days	Wed 20-12-17	Tue 26-12-17	41	[Gantt bar from Wed 20-12-17 to Tue 26-12-17]																	
43	Slab & Beam Concrete	1 day	Wed 27-12-17	Wed 27-12-17	42	[Gantt bar from Wed 27-12-17 to Wed 27-12-17]																	



Project: Construction of Dhoovehi 15 Storey Building at male'	Task	[Blue bar]	External Tasks	[Grey bar]	Manual Task	[Blue bar with arrow]	Finish-only	[Square icon]
	Split	[Dotted line]	External Milestone	[Diamond icon]	Duration-only	[Blue bar with arrow]	Deadline	[Down arrow icon]
	Milestone	[Diamond icon]	Inactive Task	[White bar]	Manual Summary Rollup	[Blue bar with arrow]	Progress	[Horizontal line icon]
	Summary	[Arrow icon]	Inactive Milestone	[Diamond icon]	Manual Summary	[Arrow icon]		
	Project Summary	[Arrow icon]	Inactive Summary	[Diamond icon]	Start-only	[Square icon]		















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**Geotechnical Engineering Division**  
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## **GEOTECHNICAL INVESTIGATION REPORT**

**OVE 116**

### **PROJECT**

Geotechnical Investigation for H-Doovehi Building Project

### **CLIENT**

M/s.Amin Construction (Pvt) Ltd

December 21, 2016



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## GEOTECHNICAL INVESTIGATION FOR THE H DOOVEHI BUILDING PROJECT

### 1.0 Introduction

Geotechnical investigation phase of foundation engineering plays a vital role in the process of designing a foundation structure intelligently. This work includes borehole drilling, sampling of disturbed and un-disturbed materials, laboratory investigation of samples and in-situ testing. The scope of borehole drilling which means the number, location and depth of boreholes depend on the loads imposed by the structure, size of the structure and sub-soil conditions.

This report embodies the findings of the site investigation including, nature and depth of soil strata, ground water levels at the site, physical and mechanical properties of soils and other relevant details of the geotechnical investigation

### 2.0 Project Description

A comprehensive geotechnical assessment has been conducted by **M/s. ELS & AMIN International (Pvt) Limited** for **M/s. Amin Construction (Pvt) Ltd**, Maldives to determine the geotechnical conditions present within the investigated land. This report includes the work carried out by **ELS & AMIN International (Pvt) Limited** to determine the sub soil and ground water conditions at the site along with the foundation recommendation for the proposed fifteen storied building with semi basement at Male city.

The site area has approximate dimensions as 30m×10m. Land is flat, rectangular and bare at the time of investigation.

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### **3.0 General Geological and Sub Grade Characteristic of Site Area**

When the underneath geological formation of the site is considered, the coral reef formation is predominated at all the Maldivian islands, it may be stated that a classic atoll chain and the reef limestone, of which they are built, have accumulated on a volcanic ridge foundation associated with a transform fault on the floor of the Indian ocean which is now inactive. As mentioned above the Male Island also had been formed under volcanic ridge foundational phenomena.

When describing the soil conditions in the Maldives, it has been observed from previous investigations that the structure of the reef flats generally consists of either coral sand, soft or hard coral rock and is usually overlaid with a relatively thick layer of coral sand. On the lagoon side of the reef edge the reef is mostly covered with dead corals and a few colonies of live corals. The cavities between the coral heads are constantly being filled up with coral sand and pieces of broken and dead corals and will ultimately become a substantially hard cemented material.

When considering the climatic characteristics, Maldives experience a monsoonal climate, as the northeast monsoon is from January to March; hot days, cooler nights and relatively dry periods are common feature during this season. The wet, southwest monsoon prevails from mid-May to November. Gales and heavy rainfall occur during this season.

### **3.1 Formation of Coral in the Region**

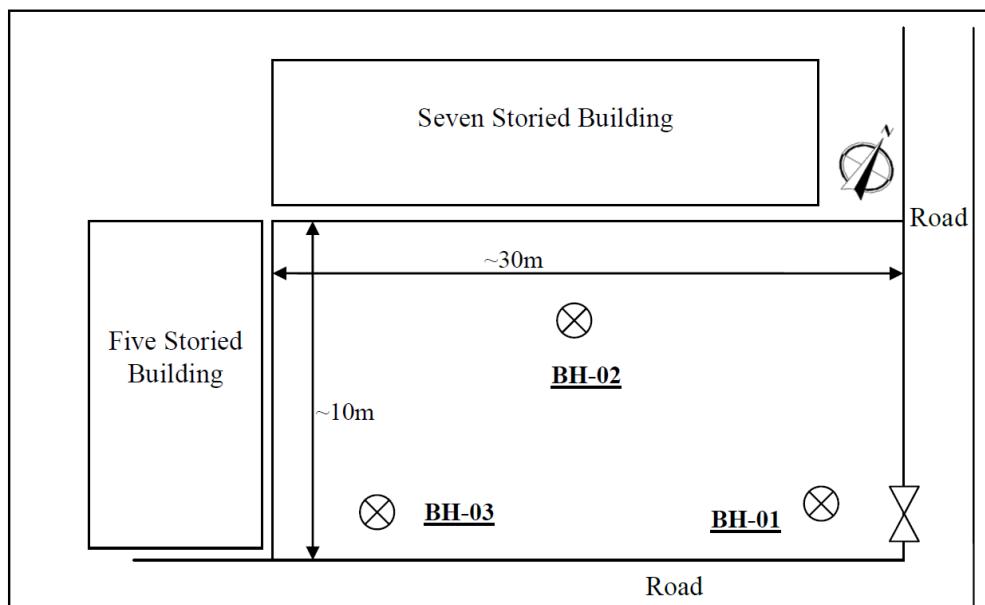
With respect to coral formation in general corals are preserved as calcareous skeletons, originally secreted by a simple animal known as polyps. Reef building polyps avoid deep water more than 25m deep and grow optimally at depths within 10m. The sea water

temperature should be between 25<sup>0</sup>C-29<sup>0</sup>C. Emersion or exposure above water could be tolerated only for short periods during tidal cycles. Salinity levels should generally be between 2.7% and 4.0%. The water turbulence is desirable in order to disperse carbon-dioxide to bring in plank tonic food and oxygen.

A moderate fall out of fine sediments from the water can be tolerated because corals have self cleansing mechanisms but burial beneath sediment for lengths of time could result in an asphyxiation and death. The polyp sack like body had an internal cavity which acted as its stomach. There was only a single opening to the out side, surrounded by tentacles. The polyp sat in a cup like depression on to pot its calcareous skeleton, or corallites, which is built upwards to form a support as it grew. Coral are classified according to this internal structure, which cannot often be observed directly.

### 3.2 Site Description

The Maldives is situated on the Central Indian Sill, running from the southern point of India via the Kerguelen – Gauberg – Ridge to the Antarctic continent.



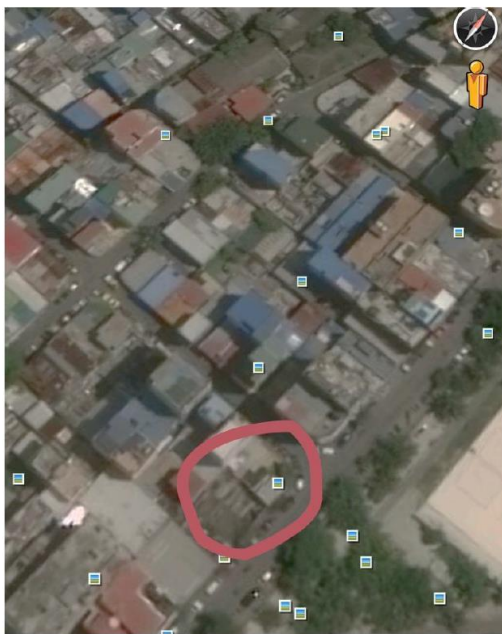
**Figure 1(a): Site Plan**

The investigated land is at Male city and it is rectangular shape land which showed no significant visible elevation differences.

Access to the site is from the eastern corner along a road in the north-eastern direction. There is another road parallel to the south-eastern site boundary.

A seven storey building and five storey could be seen at N-W direction and S-W direction respectively. The investigated land is in highly urbanized area.

When considering the climatic characteristics, Maldives experience a monsoonal climate, as the northeast monsoon is from January to March; hot days, cooler nights and relatively dry periods are common feature during this season. The wet, southwest monsoon prevails from mid-May to November. Gales and heavy rainfall occur during this season. As most of the equatorial cities, male' experiences relatively consistent temperatures through put the year with an average high and low of 30°C and 26.5°C.



**Figure 1(b): Investigated Area**

#### 4.0 Field Investigation

Field investigation consisted of advancing three boreholes at the locations marked in Figure 1(b). The field investigation was commenced on 15<sup>th</sup> November 2016 and completed on 25<sup>th</sup> November 2016. This factual report consisted of the detailed summary of the three boreholes.

#### 4.1 Borehole Investigation

The boreholes were advanced by means of rotary drilling machine and the drilling was carried out with overburden cutting tools and the wash boring process was adopted to remove the cuttings from the bottom of the borehole. During the drilling operation the walls of the boreholes were supported by 82 mm dia. NX type flush coupling casings. In order to achieve better alignment of borehole NWY flush coupling drill rods were used. Details of the depths of drilling are indicated in the Table 1.

**Table 1: Summary of the Borehole Investigation**

Borehole No.	Ground water level (m)	Overburden/Soil Drilling (m)	Rock/Boulder Drilling (m)	Total Depth(m)
BH-01	1.30	13.45	2.00	15.45
BH-02		15.45	-	15.45
BH-03		12.45	3.00	15.45

##### 4.1.1 Standard Penetration Test (SPT)

In this investigation the SPT was carried out in regular intervals in the overburden, at each of the borehole. The performance of this test is based on the test method specified in BS 1377. Disturbed samples of soil were collected from SPT tube.

---

#### 4.1.1.1 Test Procedure

- SPT sampler (Split spoon sampler) inserted in to the boring and it has been connected via steel rods to 63.5kg hammer.
- Using automatic safety hammer mechanism, hammer was raised a distance of 760mm and allowed it to fall freely and the energy drives the sampler in to the bottom of the boring. The process was repeated until the sampler has penetrated a distance of 450mm. The numbers of blows were recorded for first 150mm (Seating drive) and then two consecutive 150mm intervals (Test drives).
- The N value was computed by summing the blow counts for the two 150mm intervals of penetration. The blow count for the first 150mm is retained for reference purposes but not used to compute N value because the bottom of the boring is likely to be disturbed by drilling process and may be filled with loose soil that fell from the side of the boring.
- The SPT samples were extracted from the sampler and saved the obtained soil samples in appropriate manners.
- Boring to the depth of the next test been done with the above procedure.

#### 4.2 Ground water conditions

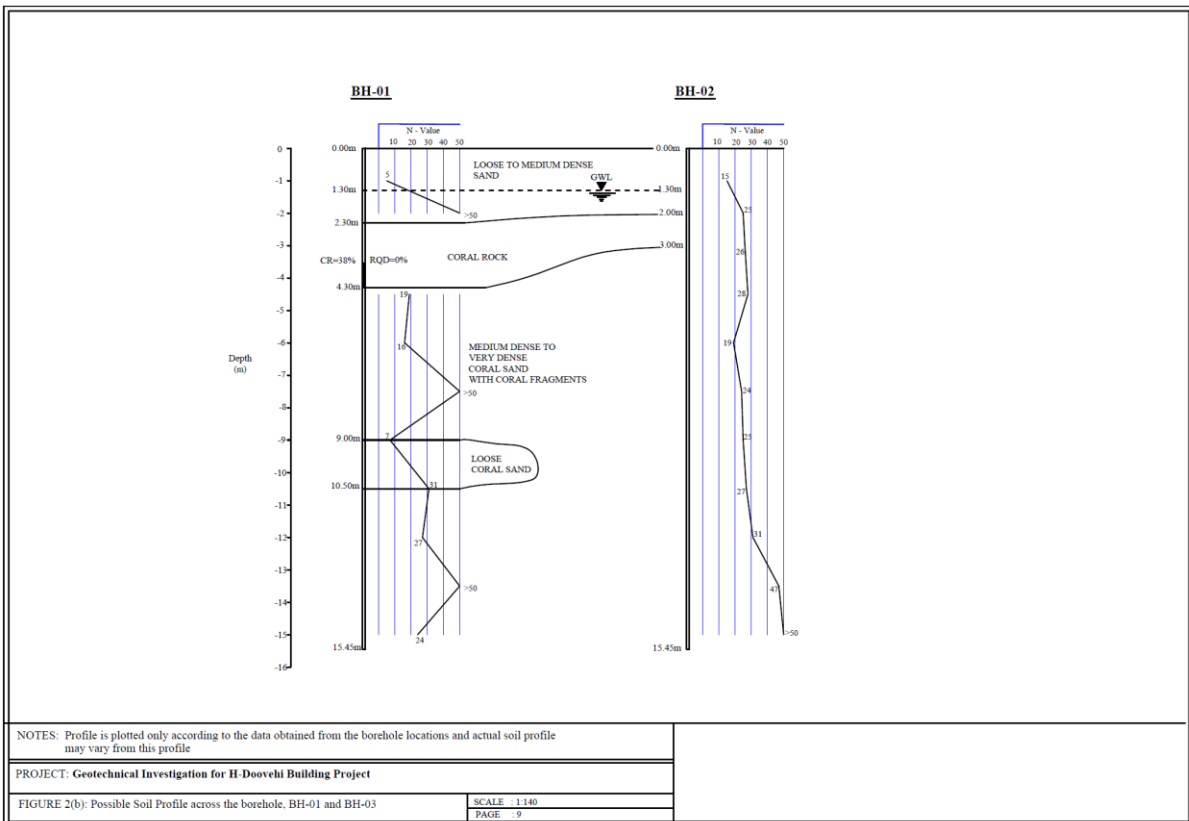
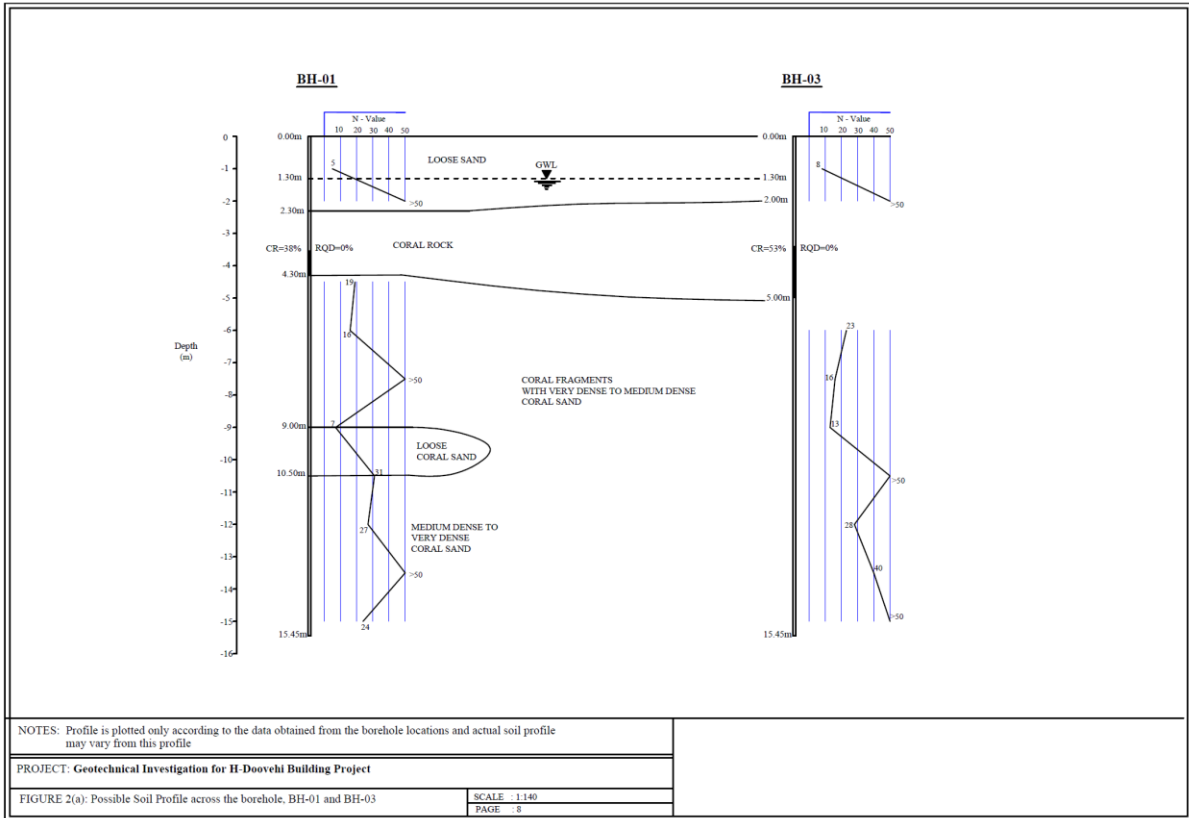
Ground water measurements were obtained from the open boreholes where the water levels were obtained after a considerable response time. The ground water levels obtained can fluctuate with the seasons, periods of precipitation and temperature.

---

## 5.0 Sub-Surface Conditions

The sub surface conditions encountered at the site are graphically presented in the borehole logs attached in Annex I. The soil horizons identified at the borehole locations are inferred from the samples taken from the borehole locations. Soil horizons/layers generally represent a transition from one soil type to another and that should not be assumed to be representing an exact plane of geological change.

Further, the conditions may vary between and beyond the borehole locations. A comprehensive detail about the sub soil conditions at /across the boreholes is graphically shown in the Figure 2(a) to Figure 2(c).



## 6.0 INTERPRETATION OF THE RESULTS OF THE SITE INVESTIGATIONS

### 6.1 Details of the structure and details of Investigation carried out

It is proposed to construct a 15 storied building with a semi basement within Male City. The area of land has been given as 30m x 15m. The drawing of the building or the loads are not available by the time of writing this recommendation.

A seven (07) storied building is located adjoin to one of the long edge of the proposed building and close to one of the short edges of the proposed land, a five (05) storied building is available. The other two boundaries are close to existing roads.

Three (03) bore holes have been carried out within the land proposed for construction. All the bore holes have been terminated at depth of 15.45m.

### 6.2 Sub surface profile

The field SPT values were corrected using the energy method (Bowles, 1996) and the corresponding soil strength parameters at each depth at each bore hole are summarized in Table 1 below. For highly weathered coral rock layer, field SPT was taken as 50 and corrected SPT values are reported in Table 1.

Table 1 Estimated soil strength parameters using SPT blow counts at borehole locations

Depth (m)	BH 01			BH 02			BH 3		
	N	$\phi$	State	N	$\phi$	State	N	$\phi$	State
1.30	5	24	Loose sand	15	30	Medium dense Sand	8	26	Loose sand
2.30	41	42	Highly weathered Coral	21	31	Medium dense Coral gravels	41	36	Highly weathered Coral
3.30	36	40	Highly weathered Coral	19	30	Medium dense Coral Sand	36	40	Coral
4.80	13	28	Medium dense Coral Sand	20	30	Medium dense Coral Sand	35	40	Coral
6.30	10	27	Medium dense Coral Sand	12	27	Medium dense Coral Sand	14	28	Medium dense Coral Sand
7.80	32	38	Dense Coral Sand	15	29	Medium dense Coral Sand	10	27	Medium dense Coral Sand
9.30	4	24	Loose Coral sand	15	29	Medium dense Coral Sand	8	26	Loose Coral Sand
10.80	18	30	Medium dense Coral Sand	15	29	Medium dense Coral Sand	29	33	Dense Coral Sand
12.30	15	29	Medium dense Coral Sand	17	30	Medium dense Coral Sand	15	29	Medium dense Coral Sand
13.80	26	31	Medium dense Coral Sand	24	31	Medium dense Coral Sand	20	30	Medium dense Coral Sand
15.30	12	27	Medium dense Coral Sand	24	31	Medium dense Coral Sand	24	31	Medium dense Coral Sand

The subsurface profile consists mainly of following layers:

- Layer 1- Loose coral SAND with rare coral rock and hard zones
- Layer 2 – Medium dense Coral SAND
- Layer 3 – Highly weathered Coral ROCK/ highly weathered coral ROCK with coral SAND  
Layers only in BH 3
- Layer 4 - Dense Coral SAND

The thicknesses of different layers in the subsurface and their properties are summarized in Table 2.

Table 2 – Thickness (H) of layers at the borehole locations, Corrected SPT N values

<b>BH 01</b>				<b>BH 02</b>			
Depth (m)		Layer	Average SPT	Depth (m)		Layer	Average SPT
From	To			From	To		
0.00	2.30	Layer 1	5	0.00	2.00	Layer 2	15
2.30	4.30	Layer 3**	41	2.00	3.00	Layer 3	21
4.30	7.80	Layer 2	16	3.00	15.45	Layer 2	18
7.80	9.30	Layer 4	15				
9.30	10.80	Layer 1	4				
10.80	15.45	Layer 2	18				
<b>BH 03</b>							
0.00	2.00	Layer 2	8				
2.00	5.00	Layer 3**	38				
5.00	9.30	Layer 2	11				
9.30	10.80	Layer 1	8				
10.80	15.45	Layer 2	22				

\*\* Coral Rock layers are present within the sand layer

## **6.3 FOUNDATION RECOMMENDATIONS**

Recommendations related to both shallow and deep foundations are given.

### **6.3.1 Shallow foundations**

The shallow foundation option considered is a raft foundation. The allowable bearing capacities of the raft foundation is estimated based on the shear failure and settlement considerations.

#### **6.3.1.1 Estimation of Settlement of Shallow Foundations**

Following assumptions are also made in the estimation of allowable carrying capacities of footings:

- Water table may rise upto the ground surface during high tide;
- No lateral forces are acting on the foundations;
- No cavities are present in the sub-surface
- Ground conditions are represented by the soil profiles obtained at the bore hole locations.
- The ground surface surrounding the foundation is horizontal.

#### **6.3.1.2 Allowable carrying capacity of raft foundation**

The loadings from the proposed structures, and the depths and sizes of the foundations are not known at the time of writing this report. However, possibility of carrying a fifteen storey building on individual and combined footings is very low and therefore, allowable carrying capacity of only raft foundation is given.

Considering the presence of loose sand layers even at deeps depth with low SPT values, the allowable carrying capacity of a raft foundation smaller than 30m x 10m placed at 2m depth may be recommended as 125 kPa for an allowable settlement of 100mm.

#### **6.3.1.2 Controlling the settlements**

By the time of writing this recommend, the exact loads induced on the foundation is not known. For a 15 storied building, the pressure under the building may exceed 125kN/m<sup>2</sup>. In such situations, the raft may experience settlements exceeding the allowable settlement of the raft. In such a situation, it may be necessary to design the foundation as a piled raft combination properly designed to control the settlements.

### 6.3.2 Deep foundations

Since the land proposed for construction is located adjoining existing structures on both sides, it may not be possible to use driven piles as deep foundations and the parameters required for designing bored and cast in-situ piles are given here.

#### 6.3.2.1 Skin friction

The allowable skin friction capacities from different layers are given in Table 4.

#### 6.3.2.2 End bearing

Driven piles should be installed to at least 300 mm into the coral rock layer or until refusal to penetration is achieved and bored piles should be socketed at least minimum of 1m or one pile diameter, whichever is higher, into the coral rock. The allowable end bearing capacities are also given in Table 3.

Table 3 – Allowable skin friction and end bearing capacities.

Layer*	Bored piles or micro piles	
	Allowable skin friction (kN/m <sup>2</sup> )	Allowable end bearing (kN/m <sup>2</sup> )
Layer 1	5	-
Layer 2	15	-
Layer 3	20	500
Layer 4	30	1200

\* Refer to Table 2 for the identification of layers

\*\* Driven at least four times pile diameter into Layer 4

If a piled raft system is to be used, the block failure mode of the entire piled raft system and the interaction of the raft-pile-soil system should be considered in the estimation of the pile

capacities. If piles are used, the carrying capacity should be confirmed using high strain dynamic load testing of working pile(s) near BH 1.

#### **6.4 Shoring systems and dewatering**

Temporary shoring systems to prevent collapsing of the sides may be needed during excavation below water table. For this purpose, a shoring system consisting of horizontal timber planks inserted to vertical steel I sections driven at 1.2 to 1.5m spacing may be used. However, if the depth of excavation is large and dewatering of more than about 0.7m is required for construction of foundations, extra care should be exercised not to have piping failure of the sand. If high water inflow with fine sand to the excavation is observed, dewatering should be immediately stopped and the excavation be refilled upto the elevation of the water table. A properly designed earth retaining system consisting of sheet piles should be used before restarting excavation and dewatering.

Since the excavation for the foundations are located very close to existing buildings and dewatering is required during the time excavations are kept open, a properly designed earth retaining system should be in place before the beginning of the excavations. For the design of the earth retaining systems, soil strength parameters given in Table 2 may be used together with the compressibility and permeability of sand relevant to medium dense state. In the design of earth retaining structures close to existing buildings, following factors should be considered:

- Lateral deformation of the earth retaining system so that the lateral displacement of the adjacent structures is within tolerable limits; and
- There is a reasonable factor of safety against piping failure at the toe of the earth retaining system.

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<b>Project</b>	Geotechnical investigation for the H doovehi Building Project				Borehole No	BH-01
<b>Client</b>	M/s. Amin Construction (Pvt) Ltd				Sheet	1 of 2
<b>Location</b>	Rig	Track Drill	Core Diameter	54mm	Ground Water level 1.30m	
<b>Date of Started</b>	15.11.2016	Drilling Method	Rotary	Casing depth	15.00m	
<b>Date of Finished</b>	15.11.2016	Casing Diameter	76mm	Elevation (m)	Coordinates	

Depth (m)	Sa. Cond	Sa. NO.	Sa. Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT)				Moisture Content - %		Undrained Shear Strength - t/m <sup>2</sup>		SPT Resistance - Blows/ft	
								15cm	15cm	15cm	N	10	20	30	40	50	60
0.00							Ground level										
0.00	D1		DS		0.00		Gray, angular to subrounded fine SAND										
1.00	D2		SS		1.00		Loose, gray angular to subrounded fine SAND	5	3	2	5						
2.00	D3		SS		2.30			23	30	HB	>50						
					2.30		at 1.30m										
3.00			CS				Cream, offwhite discoloured fractured CORAL ROCK			CR=38%	RQD=0%						
4.00																	
5.00	D4		SS		4.30		Medium dense light brown, offwhite fine to coarse angular to subrounded CORAL SAND with coral sand	2	4	15	19						
6.00	D5		SS					2	8	8	16						
7.00			WS														
8.00	D6		SS		7.50		Washed sample changed to; light brown, offwhite fine to coarse CORAL SAND with some fine irregular shaped coral fragments and sea shell fragments	16	30	HB	>50						
			WS							NO SAMPLE							
9.00	D7		SS		9.00		Loose light brown, gray offwhite fine angular to subrounded CORAL SAND	10	5	2	7						
10.00			WS														

SPT	Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample SS - SPT Sample W - Water Sample WS - Wgrey Sample UD - Undisturbed Sample CS - Core Sample Cr - Core Recovery (%) RQD - Rock Quality Designation (%)	N - Natural Moisture Content L - Atterberg Limit Test G - Grain Size Analysis SG - Specific Gravity Test B - Bulk Density V - Vane Shear Test	C - Consolidation UCT - Unconfined Compression CU - Consolidated Undrained UU - Unconsolidated Undrained pH - Chemical O - Organic content SO <sub>4</sub> <sup>2-</sup> - Sulphate Content Cl - Chloride Content	Remarks	Logged By
	GWL : Ground Water Level observed inside the Borehole, after the saturation				Existing ground level considered as the zero level	M.A.D.N.Kumari Supervised By: Lasantha Drilled By: Nimal Shantha
	NE Not Encountered HB - Hammer Bounce FD - Free Down					
	Made Ground	Silt	Gravel	Laterite Nodules	Completely Weathered Rock	Fresh Rock
	Clay	Sand	Organic Matter	Silty Sand	Highly Weathered Rock	



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<b>Project</b>	Geotechnical investigation for the H doovehi Building Project				Borehole No	BH-01	
<b>Client</b>	M/s. Amin Construction (Pvt) Ltd				Sheet	2 of 2	
<b>Location</b>		Rig	Track Drill	Core Diameter	54mm	Ground Water level	1.30m
<b>Date of Started</b>	15.11.2016	<b>Drilling Method</b>	Rotary	<b>Casing depth</b>	15.00m	<b>Coordinates</b>	
<b>Date of Finished</b>	15.11.2016	<b>Casing Diameter</b>	76mm	<b>Elevation (m)</b>			

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT)				Moisture Content - %	
								1.5cm	1.5cm	1.5cm	N	Undrained Shear Strength - t/m <sup>2</sup>	
												SPT Resistance - Blows/ft	
10.00							Continue from Page 1						
11.00	D8		SS		10.50		Medium dense to very dense light brown, gray, offwhite fine to medium angular to subrounded CORAL SAND with coral fragments	8	10	21	31		
12.00	D9		SS					7	10	17	27		
14.00	D10		SS					6	27	HB	>50		
15.00	D11		SS					9	9	15	24		
15.45					15.45		The borehole was terminated at a depth of 15.45m						

Sample Key / Test Key				Remarks	Logged By:	
SPT	Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	Existing ground level considered as the zero level	M.A.D.N Kumari	
GWL	Ground Water Level observed inside the Borehole, after the saturation	SS - SPT Sample	L - Atterberg Limit Test		Supervised By:	Lasantha
NE	Not Encountered	W - Water Sample	G - Grain Size Analysis		Drilled By:	Nimal Shantha
HB	-Hammer Bounce	WS - Wgrey Sample	SG - Specific Gravity Test			
FD	- Free Down	UD - Undisturbed Sample	B - Bulk Density			
		CS - Core Sample	V - Vane Shear Test			
		Cr - Core Recovery (%)				
		RQD - Rock Quality Designation (%)				
	Made Ground		Silt		Completely Weathered Rock	
	Clay		Sand		Highly Weathered Rock	
	Gravel		Organic Matter		Laterite Nodules	
	Silty Sand		Fresh Rock			



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<b>Project</b>	Soil investigation for the H doovehi Building Project				Borehole No	BH-02
<b>Client</b>	M/s. Amin Construction (Pvt) Ltd				Sheet	1 of 2
<b>Location</b>	Rig	Track Drill	Core Diameter	54mm	Ground Water level 1.30m	
<b>Date of Started</b>	19.11.2016	<b>Drilling Method</b>	Rotary	<b>Casing depth</b>	15.00m	
<b>Date of Finished</b>	21.11.2016	<b>Casing Diameter</b>	76mm	<b>Elevation (m)</b>	Coordinates	

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT)				Moisture Content - %		Undrained Shear Strength - t/m <sup>2</sup>		SPT Resistance - Blows/ft		
								15cm	15cm	15cm	N	5	10	15	20	25	30	35
0.00					0.00		Ground level											
0.00 - 1.00	D1	DS	WS		0.00		Offwhite, light gray angular to subrounded fine SAND											
1.00 - 2.00	D2	SS	WS	G.W.L at 1.30m	1.00		Medium dense, offwhite, light gray angular to subrounded fine SAND	4	4	11	15							
2.00 - 3.00	D3	SS	WS		2.00		Offwhite light brown, CORAL stones	8	10	15	25							
3.00 - 4.00	D4	SS	WS		3.00		Medium dense, offwhite, light brown, gray CORAL fragments and fine to coarse angular to subrounded CORAL SAND	10	12	14	26							
4.00 - 5.00	D5	SS	WS					12	13	15	28							
5.00 - 6.00	D6	SS	WS					11	10	9	19							
6.00 - 7.00	D7	SS	WS					10	15	9	24							
7.00 - 8.00								NO SAMPLE										
8.00 - 9.00	D8	SS	WS					21	15	12	25							
9.00 - 10.00																		

SPT	Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	SS - SPT Sample	W - Water Sample	WS - Wgrey Sample	UD - Undisturbed Sample	CS - Core Sample	Cr - Core Recovery (%)	RQD - Rock Quality Designation (%)	N - Natural Moisture Content	L - Atterberg Limit Test	G - Grain Size Analysis	SG - Specific Gravity Test	B - Bulk Density	V - Vane Shear Test	C - Consolidation	UCT - Unconfined Compression	CU - Consolidated Undrained	UU - Unconsolidated Undrained	pH - Chemical	O - Organic content	SO <sub>4</sub> <sup>2-</sup> - Sulphate Content	Cl <sup>-</sup> - Chloride Content	Remarks	Existing ground level considered as the zero level	Logged By:	M.A.D.N Kumari
GWL	Ground Water Level observed inside the Borehole, after the saturation																									Supervised By:	Lasantha
NE	Not Encountered																									Drilled By:	Nimal Shantha
HB	- Hammer Bounce																										
FD	- Free Down																										
	Made Ground	Silt	Gravel	Laterite Nodules	Silty Sand	Completely Weathered Rock	Highly Weathered Rock	Fresh Rock																			



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<b>Project</b>	Soil investigation for the H doovehi Building Project				Borehole No	BH-02	
<b>Client</b>	M/s. Amin Construction (Pvt) Ltd				Sheet	2 of 2	
<b>Location</b>		Rig	Track Drill	Core Diameter	54mm	Ground Water level	1.30m
<b>Date of Started</b>	19.11.2016	<b>Drilling Method</b>	Rotary	<b>Casing depth</b>	15.00m	<b>Coordinates</b>	
<b>Date of Finished</b>	21.11.2016	<b>Casing Diameter</b>	76mm	<b>Elevation (m)</b>			

Depth (m)	Sa. Cond	Sa. NO.	Sa. Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT)				Moisture Content - %		Undrained Shear Strength - t/m <sup>2</sup>		SPT Resistance - Blows/ft			
								15cm	15cm	15cm	N	5	10	15	20	25	30	35	40
10.00							Continue from Page 1												
11.00		D9	SS				Same as previous description	21	15	12	27								
12.00		D10	SS		12.00		Dense to very dense offwhite fine to medium angular to subrounded CORAL SAND with CORAL fragments	20	15	16	31								
14.00		D11	SS					7	12	35	47								
15.00		D12	SS					8	25	30	>50								
15.45					15.45		The borehole was terminated at a depth of 15.45m												

Sample Key / Test Key				Remarks	Logged By:
SPT	Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample SS - SPT Sample W - Water Sample WS - Wgrey Sample UD - Undisturbed Sample CS - Core Sample Cr - Core Recovery (%) RQD - Rock Quality Designation (%)	N - Natural Moisture Content L - Atterberg Limit Test G - Grain Size Analysis SG - Specific Gravity Test B - Bulk Density V - Vane Shear Test	C - Consolidation UCT - Unconfined Compression CU - Consolidated Undrained UU - Unconsolidated Undrained pH - Chemical O - Organic content SO <sub>4</sub> <sup>2-</sup> - Sulphate Content Cl - Chloride Content	M.A.D.N Kumari Supervised By: Lasantha Drilled By: Nimal Shantha
GWL	: Ground Water Level observed inside the Borehole, after the saturation				Existing ground level considered as the zero level
NE	Not Encountered				
HB	- Hammer Bounce				
FD	- Free Down				
	Made Ground		Silt		Gravel
	Clay		Sand		Organic Matter
			Laterite Nodules		Silty Sand
			Completely Weathered Rock		Highly Weathered Rock
			Fresh Rock		





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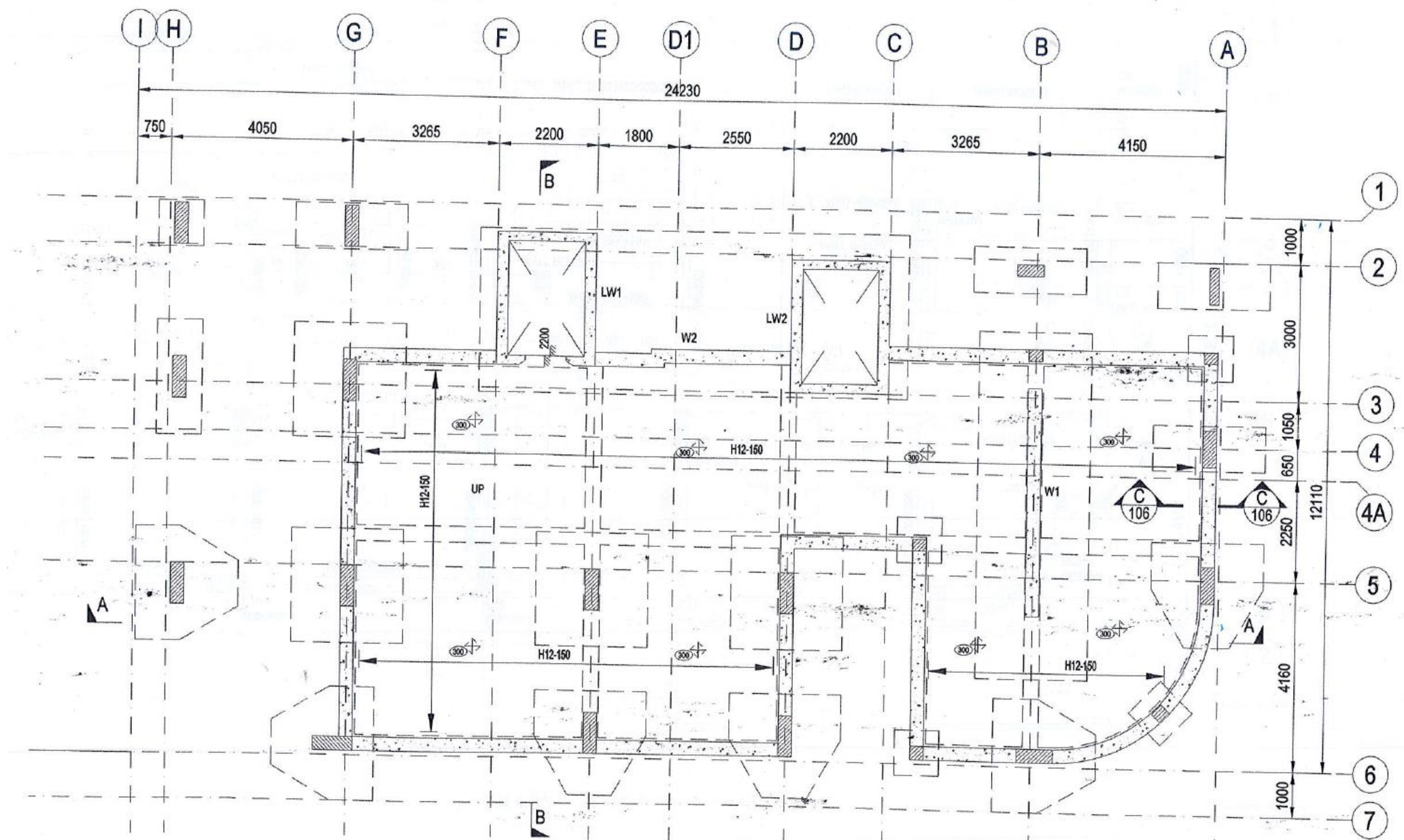
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Email: info@elsamin.com.mv, Web: www.elsamin.com.mv

<b>Project</b>	Geotechnical investigation for the H doovehi Building Project				Borehole No	BH-03	
<b>Client</b>	M/s. Amin Construction (Pvt) Ltd				Sheet	2 of 2	
<b>Location</b>		Rig	Track Drill	Core Diameter	54mm	Ground Water level	1.30m
<b>Date of Started</b>	22.11.2016	<b>Drilling Method</b>	Rotary	<b>Casing depth</b>	15.00m	<b>Coordinates</b>	
<b>Date of Finished</b>	25.11.2016	<b>Casing Diameter</b>	76mm	<b>Elevation (m)</b>			

Depth (m)	Sa. Cond	Sa. NO.	Sa. Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT)				Moisture Content - %		Undrained Shear Strength - t/m <sup>2</sup>		SPT Resistance - Blows/ft			
								1.5cm	1.5cm	1.5cm	N	5	10	15	20	25	30	35	40
10.00			WS				Continue from Page 1												
11.00	D7		SS		10.50		Same as previous description	25	HB		>50							>50	
12.00			WS				Light brown,, offwhite, CORALl fragments with dense to very dense, light brown, gray offwhite fine angular to subrounded CORAL SAND												
13.00	D8		SS					19	8	20	28								28
14.00	D9		SS					35	15	25	40								40
15.00	D10		SS					25	30	HB	>50								>50
16.00					15.45		The borehole was terminated at a depth of 15.45m												

Sample Key / Test Key				Remarks	Logged By:
SPT	Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample SS - SPT Sample W - Water Sample WS - Wgrey Sample UD - Undisturbed Sample CS - Core Sample Cr - Core Recovery (%) RQD - Rock Quality Designation (%)	N - Natural Moisture Content L - Atterberg Limit Test G - Grain Size Analysis SG - Specific Gravity Test B - Bulk Density V - Vane Shear Test	C - Consolidation UCT - Unconfined Compression CU - Consolidated Undrained UU - Unconsolidated Undrained pH - Chemical O - Organic content SO <sub>4</sub> <sup>2-</sup> - Sulphate Content Cl - Chloride Content	M.A.D.N. Kumari Supervised By: Lasantha Drilled By: Nimal Shantha
	Made Ground		Silt	Existing ground level considered as the zero level	
	Clay		Sand		
	Gravel		Organic Matter	Completely Weathered Rock	Fresh Rock
	Laterite Nodules		Silty Sand		
	Highly Weathered Rock				



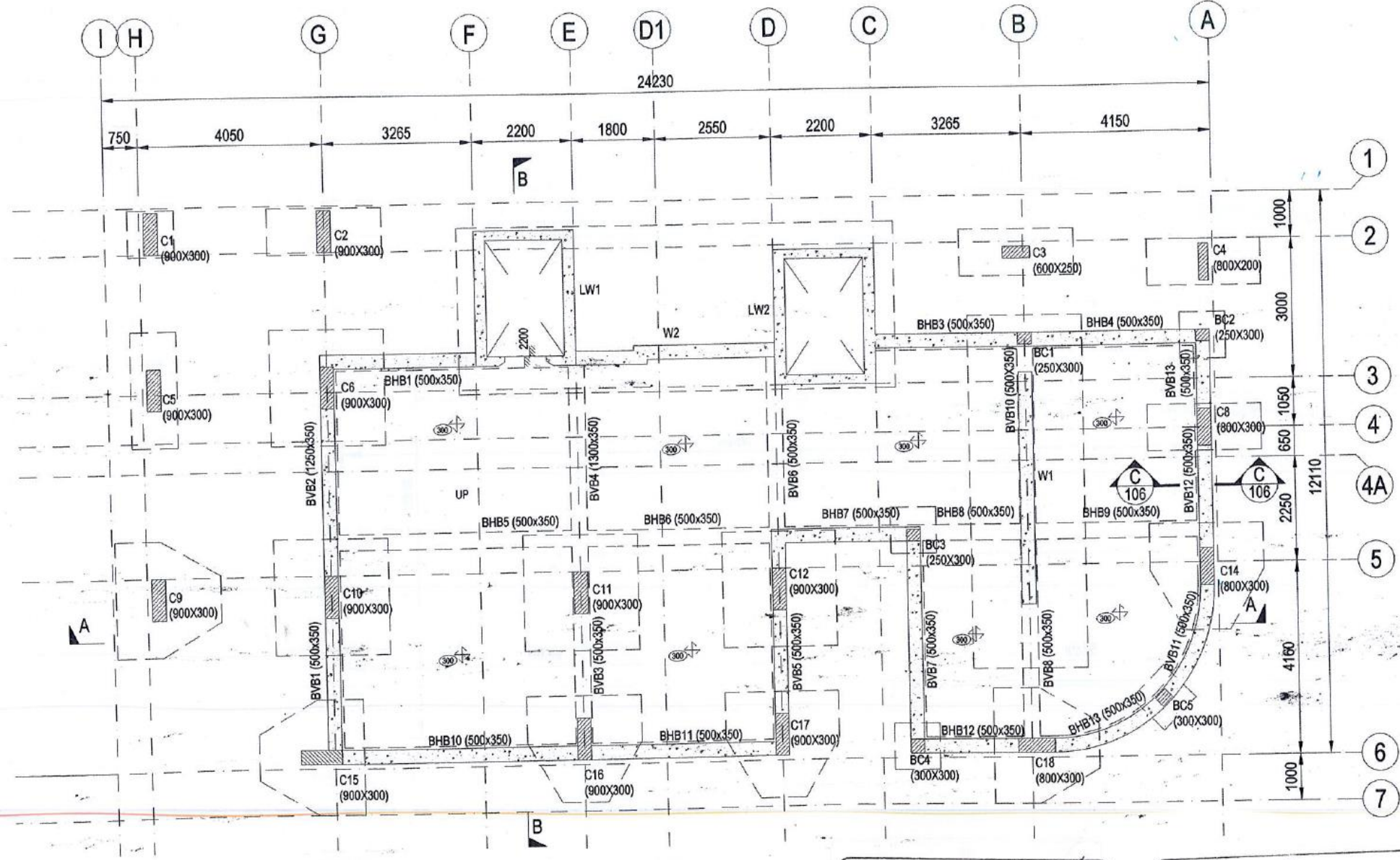


**BASEMENT LEVEL SLAB PLAN**  
SCALE - 1:100

Ministry of Housing & Infrastructure  
**ACCREDITED CHECKER**  
**ARCHITECTURAL CHECKER B1**  
 Name: Ismail Rasheed    VALIDITY: 22.09.16 - 21.09.17  
 Registration No: BPR2016012B1    81-2016-012-001

Ministry of Housing & Infrastructure  
**STRUCTURAL CHECKER A1**  
 Name: Ibrahim Naital    VALIDITY: 06.11.16 - 05.11.17  
 Registration No: BPR2016019A1    A1-2016-019-001


No.	Amendment	Date
ARCHITECT, MEP & CAS		
<b>JPL CONSULTANTS PTE LTD</b> <small>ARCHITECTS / MECHANICAL ENGINEERS / ELECTRICAL ENGINEERS / CIVIL ENGINEERS</small> 3520 KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 200980 TEL : 6396 0555 FAX : 6396 8555		
<small>Knowledge    Innovation    Vision</small>		
<b>OWNER</b>		
<b>AMIN CONSTRUCTION PRIVATE LIMITED</b> 52, BODUTHAKURUFANU MAGU, MALE' 20-01, REPUBLIC OF MALDIVES TEL: +960 3324369 FAX: +960 3328424		
<b>Tenure of Land</b>		
FREEHOLD		
<b>Project Title</b>		
PROPOSED 15-STOREYS H-DOOVEH BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFANU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD		
<b>Drawing Title</b>		
BASEMENT LEVEL PLAN		
<b>Scale</b> A3-1:100		AS SHOWN
<b>Date</b>		
MARCH 2017		
<b>Drawn by :</b>	BC	<b>Checked by :</b> GUO
<b>Drawing No.</b>		
JPL/16/AMIN/DVST-105		
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**BASEMENT LEVEL PLAN**  
SCALE - 1:100

Ministry of Housing & Infrastructure  
ACCREDITED CHECKER  
ARCHITECTURAL CHECKER B1  
Name: Ismail Rasheed VALIDITY: 22.09.16 - 21.09.17  
Registration No: BPR2016012B1 B1-2016-012-001

STRUCTURAL CHECKER A1  
Name: Ibrahim Nufal VALIDITY: 06.11.16 - 03.11.17  
Registration No: BPR20160101.1 A1-2016-010-001

No.	Amendment	Date
ARCHITECT, MEP & CAS		
 <b>JPL CONSULTANTS PTE LTD</b> <small>PROVIDING ARCHITECTURAL, STRUCTURAL, MECHANICAL AND ELECTRICAL SERVICES</small> 352B KING GEORGE'S AVENUE, KING GEORGE'S BUILDING, SINGAPORE 208590 TEL: +65 6396 0055 FAX: +65 6396 6505 <small>Knowledge Innovation Value</small>		
OWNER		
<b>AMIN CONSTRUCTION PRIVATE LIMITED</b> 52, BODUTHAKURUFANNU MAGU, MALE' 20-01, REPUBLIC OF MALDIVES TEL: +960 3324309 FAX: +960 3328424		
Tenure of Land		
FREEHOLD		
Project Title		
PROPOSED 15-STORY'S H-DOOMER BUILDING PROJECT DEVELOPMENT AT BODUTHAKURUFANNU MAGU IN MALE', MALDIVES FOR AMIN CONSTRUCTION PVT LTD		
Drawing Title		
BASEMENT LEVEL PLAN		
Scale	A3-1:100	AS SHOWN
Date	MARCH 2017	
Drawn by:	BC	Checked by: GUO
Drawing No.	JPL/16/AMIN/01/ST-106	
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**Male' Water & Sewerage Company Pvt Ltd**  
**Water Quality Assurance Laboratory**  
 FEN Building, 5th Floor, Machangolhi, Armeenee Magu, Male', Maldives  
 Tel: +96033323209, Fax: +96033324306, Email: wqa@mwsc.com.mv



**WATER QUALITY TEST REPORT**  
 Report No.: 500173748

Report date: 17/05/2017  
 Test Requisition Form No: 900175603  
 Sample(s) Received Date: 16/05/2017  
 Date of Analysis: 16/05/2017 - 17/05/2017

**Customer Information:**  
 Amin Construction Pvt Ltd  
 52, Boduthakurufaanu Magu  
 Bodu Thakurufaanu Magu  
 Male' -

Sample Description	H.DHOOVEHI	TEST METHOD	UNIT
Sample Type	Ground Water		
Sample No	83186613		
Sampled Date	16/05/2017		
<b>PARAMETER</b>	<b>ANALYSIS RESULT</b>		
Physical Appearance	Yellow color with particles		
Dissolved Oxygen (DO)	5.82		
Faecal Coliforms	>2420	Standard Methods 19th edition APHA Coliforms-18 Quanti-Tray@2000	MPN/100ml

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

Checked by

*[Signature]*  
 Afnan Farooq  
 Laboratory Executive Gr.1

Approved by

*[Signature]*  
 Mohamed Eyman  
 Assistant Manager, Quality

**Notes: Sampling Authority:** Sampling was not done by MWSC Laboratory  
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\*\*\*\*\* END OF REPORT \*\*\*\*\*



**WATER QUALITY TEST REPORT**  
 Report No: 500173748

Report date: 17/05/2017  
 Test Requisition Form No: 900175603  
 Sample(s) Received Date: 16/05/2017  
 Date of Analysis: 16/05/2017 - 17/05/2017

**Customer Information:**  
 Amin Construction Pvt Ltd  
 52, Boduthakurafaanu Magu  
 Male' -

Sample Description	HLHOOVEHI	TEST METHOD	UNIT
Sample Type	Ground Water		
Sample No	83186613		
Sample Date	16/05/2017		
<b>PARAMETER</b>	<b>ANALYSIS RESULT</b>		
Physical Appearance	Yellow color with particles		
Conductivity	2390	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	µS/cm
pH	8.01	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-
Salinity	1.23	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	%
Temperature	24.5	Electrometry	°C
Total Dissolved Solids	1197	Electrometry	mg/L
Turbidity	19.0	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU
Nitrate	2.6	Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Nitrogen Ammonia	1.30	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Sulphide	126	Method 8131 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	µg/L
Phosphate	0.07	Method 8048 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L

**Keys:** µS/cm : Micro Seimen 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

Afneah Farooq  
 Laboratory Executive Gr.1

Approved by

Mohamed Eymen  
 Assistant Manager, Quality

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AC/2017/1561  
24<sup>th</sup> May 2017

Mr. Ibrahim Naeem  
Director General  
Environmental Protection Agency  
3<sup>rd</sup> Floor, Green Building  
Male'  
Maldives

Dear Mr. Naeem,

**Re: Commitment Letter for Environmental Impact Assessment of Proposed 15-Storey Building with Basement at H. Dhoovehi, Male'**

As the Proponent of the above mentioned project, AMIN Construction Pvt. Ltd. hereby commit to finance and implement the environmental mitigation measures and environmental monitoring programme outlined in the EIA Report for the Proposed 15-Storey Building at H. Dhoovehi, Male' submitted to Environment Protection Agency (EPA).

Thanking you

Yours sincerely,


Ahmed Adham Abdulla  
Chief Operating Officer





<b>Chapter</b>	<b>Page</b>	<b>Chapter Contributors (including data collection)</b>	<b>Consultant Registration Number</b>	<b>Signature</b>
Introduction	20	Mohamed Zuhair	EIA01/2015	
Project Description	31	Mohamed Zuhair Ibrahim Shakir	EIA01/2015	
Legislative (Project Setting)	51	Mohamed Zuhair	EIA01/2015	
Existing Environment	69	Mohamed Zuhair Ibrahim Shakir	EIA01/2015	
Impact and Mitigation	92 104	Mohamed Zuhair	EIA01/2015	
Stakeholder Consultation	117	Mohamed Zuhair	EIA01/2015	
Monitoring	127	Mohamed Zuhair	EIA01/2015	
Conclusions	130	Mohamed Zuhair	EIA01/2015	



# Mr. Mohamed Zuhair

## Personal Details

---

**Full Name:** Mohamed Zuhair

**ID Card:** A-045870

**Date of Birth:** 18 December 1971

**Address (Home):** H. Eforiumge (South),  
4<sup>th</sup> Floor, Moonlight Hingun/Lonuziyaarai Hingun,  
Male' 20023,  
Rep of Maldives  
Mobile: (960) 777 6800  
EMail: [moh.zuhair@gmail.com](mailto:moh.zuhair@gmail.com)

**Marital Status:** Married with 3 children

**Languages:** English (Professional)  
Dhivehi (Native)

## Education and Training

---

- **Master of Applied Science (Protected Area Management), 2003**  
James Cook University, Townsville, Queensland 4811  
Australia
- **Certificate in Integrated Management of Coastal and Marine Protected Areas, 1998**  
South Asia Cooperative Environment Program (SACEP) in collaboration with Great Barrier  
Reef Marine Park Authority, Male'  
Maldives
- **Certificate in Coral Reef Survey Methods, 1998**  
IOCUNESCO/UNEP/IUCN, Global Coral Reef Monitoring Network (GCRMN) in  
collaboration with Ministry of Fisheries and Agriculture, Male', Maldives
- **B.Sc (Hons) Combined Studies (Major: Environmental Biology), 1994**  
Bath College of Higher Education, Newton Park, Bath BA2 9BN  
United Kingdom
- **Certificate in Coral Reef Ecology, Theory and Practice, 1990**  
International Center for Ocean Development and Ministry of Fisheries and Agriculture, Male', Maldives

## Employment

---

- **Freelance Environmental Consultant (2011 - Present)**

Provide technical consultancy on environment-related work including development of environmental management plans, preparation of Environmental Impact Assessments (EIA) and environmental monitoring plans, field assessment and environmental analysis of potential development sites, technical input for proposed development projects, as well as assist in project development, etc

**Recent Clients:** Hotel and Resorts Construction, Leisure Horizons, Amin Construction, Malahini Holdings, Cocoon Investments, Akirifushi Investments, Hanimaadhoo City Hotel Investments, Mr. Ali Zahir, Mr. Hassan Moosa, Mr. Ali Moosa, ABN, CPM Consultants, Cowrie Investments, Oliva Efficient, Island Channels, Sandcays, Beachrock, SAS e Senok JV, Group X, Coastline Investments, Sanken Overseas

- **Director General (2009 – 2011)**

Environmental Protection Agency (EPA), 4th Floor, Jamaaluddin Complex, Nikagas Magu, Male', Rep. of Maldives

**Duties:** Overall in charge of the Environmental Protection Agency directly reports to Minister and Deputy Minister. Direct, supervise and technical input to the work of the Sections including Environmental Impact Assessment, Biodiversity Conservation, Coastal Zone Management, Waste Management, Water and Sanitation, Physical Oceanography, Resource Valuation and support to implementation of Environmental Protection Act and subsequent Regulations and develop national Environmental Standards, etc.

### **Recent Consultancies Undertaken**

---

- **Project Proposal**  
Establishment of a Seaweed Mariculture Farm on Funagaadhoo Island, Laamu Atoll, Maldives, 2011
- **Project Proposal**  
Community Development in Thaa Atoll and Establishing a Tourist Resort on Thaa. Fushifaru Island, Maldives, 2011
- **Environmental Impact Assessment**  
Proposed Harbour Development in Noonu Magoodhoo Island, Maldives, 2011
- **Project Proposal**  
Establishment of a Jetty on the Eastern Side of Noonu Henbadhoo Island, Maldives, 2011
- **Marine Environmental Assessment for the Environmental Impact Assessment**  
Coastal Developments at Thulhaagiri Island Resort and Spa, Maldives, 2011
- **Environmental Impact Assessment**  
Proposed Water Supply and Sewerage System in Haa Dhaalu Vaikaradhoo, Maldives, 2012
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Banana Island, Qatar, 2012
- **Environmental Impact Assessment**  
Proposed Airstrip Development on Maavarulla Island, G.Dh. Atoll, Maldives, 2012
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Kodhipparu Island, K. Atoll, Maldives, 2014
- **Environmental Impact Assessment**  
Proposed City Hotel Development on Hanimaadhoo, H. Dh Atoll, Maldives, 2014
- **Environmental Impact Assessment**  
Proposed Proposed Tourist Resort Development on Maamunagau Island, Raa Atoll, Maldives, 2014
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Akirifushi Island, K. Atoll, Maldives. 2014
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Kuda Bandos, K. Atoll, Maldives, 2014

- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Kudafushi Island, Raa Atoll, Maldives, 2014
- **Project Proposal**  
Establishment of Marine Finfish Aquaculture Farm on Fonagaadhoo Island, Laamu Atoll, Maldives, 2014
- **Project Concept**  
Development of Aquaculture, Aquarium Fish Culture, Hydroponics, and Organic Farming in Huruvalli Island, Raa Atoll, Maldives, 2014
- **Project Proposal**  
Development of Agriculture, Hydroponics, Organic Farming, and Fish Drying in Maarehaa Island, GA Atoll, Maldives, 2014
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development on Ookolhu Finolhu Island, Lhaviyani Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Proposed Harbour Development in Himandhoo Island, AA Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Kottafaru Island, Raa Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Proposed Harbour Rehabilitation in Thoddoo Island, AA Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Aarah Island, Raa Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Proposed Coastal Protection Measures in Plam Beach Resort and Spa, Lh. Atoll, Maldives, 2015
- **Hazard Analysis and Risk Assessment**  
Sunken Excavator near Havodda Island, GDh. Atoll, Maldives, 2015
- **Environmental Impact Assessment**  
Coastal Modifications at LUX Maldives, South Ari Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Agriculture Product Development in Hulhudhoo Island, Baa Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Coastal Protection Works in Ukulhas Island, AA Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Mariculture, Hydroponics, Aquaponics and Boatyard Development in Vihamaafaru, AA Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Coastal Protection Works in Maaenboodhoo, Dhaalu Atoll, Maldives, 2015
- **Situation Analysis Report**  
EIA for Proposed Coastal Modification and Partial Renovation Project, LUX South Ari, ADh. Atoll, Maldives, 2015
- **Technical Study of Erosion and Coastal Protection Measures**  
Northern side of Dharavandhoo Island, B. Dharavandhoo, Maldives, 2015

- **First Addendum:**  
EIA for Coastal Protection Works in Maaenboodhoo, Dhaalu Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Tourist Resort Development in R. Filaidhoo Island, Raa Atoll, Maldives, 2015
- **Environment Impact Assessment**  
Proposed Agriculture, Water Sports and Training Facility Development in Faadhoo Island, Maldives, 2016
- **Environment Impact Assessment**  
Proposed Tourist Resort Development in Vashugiri Island, Vaavu Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Sunny Lagoon in South Male' Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Access Channel and Mooring Area Deepening in B. Fehendhoo Island, Baa Atoll, Maldives 2016
- **Environmental Analysis Report**  
For Tourist Resort Development in Ethigili Island, Raa Atoll, Maldives, 2016
- **First Addendum to Environmental Impact Assessment**  
Proposed Coastal Protection Works in Ukulhas Island, AA Atoll, Maldives 2016
- **Environment Monitoring**  
Land Reclamation Works at Bodufinolhu, ADh Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Uthuruboduveli, Uthurugasveli, Hurasveli, Meemu Atoll, Maldives 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Maniyafaru Lagoon, South Male' Atoll, Maldives 2016
- **Environmental Impact Assessment**  
Proposed Beach Nourishment Works at Ayada Maldives, GDh. Mugudhuvaa Island, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Beach and Swimming Area Development in K. Himmafushi Island, Male' Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed 11 Storey Building Development at H. Finimaage Aage, Male', Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Land Reclamation and Tourist Resort Development in Maavaru Lagoon, North Male' Atoll, Maldives, 2016
- **Environmental Monitoring**  
Land Reclamation Works at Akirifushi Island, North Male' Atoll, Maldives, 2016
- **Third Addendum to the Environmental Impact Assessment**  
Proposed Tourist Resort Development in Akirifushi Island, North Male' Atoll, Maldives. 2016
- **Second Addendum to the Environmental Impact Assessment**  
Proposed Resort Development in Kodhipparu Island, North Male' Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Aerodrome and Access Channel in the Lagoon near St. Regis Vommuli Resort, Dhaalu Atoll, Maldives, 2016

- **Environmental Impact Assessment**  
Proposed 20-Storey Rehendhi 5 Building, Male', Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Hanimaadhoo, HDh. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Hoarafushi, HA Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Farming Development Project at Aidhoo Island, Baa Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Villingili, GA. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Ungoofaaru, Raa. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Milandhoo, Sh. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Guraidhoo, Th. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Kudahuvadhu, Dh. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Naifaru, Lh. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Water Production and Distribution Facility at Villingili, GA. Atoll, Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in the Lagoon Plot 4.155882 / 73.251890, North Male Atoll, 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Amingiri Lagoon, Kodhipparu Falhu, North Male' Atoll, 2016
- **Environmental Impact Assessment**  
Proposed 10-Storey Mixed Use Residential Complex in Block D10-4C, Hulhumale', Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Mixed Use Residential Complex in Block C4-3, Hulhumale', Maldives, 2016
- **Environmental Impact Assessment**  
Proposed 10-Storey Building with Basement at H. Loveside, Male', Maldives, 2016
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Dhidhoofinolhu Lagoon, Kodhipparu Falhu, North Male' Atoll, 2017
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Dhigudhefaru Island, Baa Atoll, Maldives, 2017
- **Environmental Impact Assessment**  
Proposed Tourist Resort Development in Maarandhoo Island, GA Atoll, Maldives, 2017

- **Environmental Impact Assessment**  
Proposed Coastal Protection Project at Hulhudhoo Island, Addu City, Maldives, 2017
- **First Addendum to the Environment Impact Assessment Report**  
Proposed Tourist Resort Development in Uthuruboduveli, Uthurugasveli and Hurasveli Islands in Meemu Atoll, Maldives, 2017
- **Environmental Audit Report**  
Powerhouse Registration at Malahini Kuda Bandos, North Male Atoll, Maldives, 2017
- **Environmental Impact Assessment Report**  
Proposed Tourist Resort Development in Aanugandufalhu, North Male' Atoll, Maldives, 2017
- **Fourth Addendum to the Environmental Impact Assessment Report**  
Proposed Tourist Resort Development in Akirifushi Island, North Male' Atoll, Maldives. 2017

### **Professional Certifications**

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- **Registered EIA Consultant (2015)**  
Registration (EIA01/15) at Environmental Protection Agency  
3<sup>rd</sup> Floor,  
Green Building  
Male'  
Republic of Maldives
- **PADI Research Diver (1998-Present)**  
Sea Explorers Dive School,  
2<sup>nd</sup> Floor, Ma. Thuniveli,  
Male' 2001  
Republic of Maldives

## **Ibrahim Shakir (Shark)**

*Date of Birth:* 18 July 1967

*Contact Address:* Ma Sharky Shark  
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Male' 20-30  
Maldives

*E-mail:* [Sharkydives@gmail.com](mailto:Sharkydives@gmail.com)

*Nationality:* Maldivian

*Contact no:* +9607759695

### **Qualifications**

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#### ***Associate Diploma of Land information Management Systems***

*(Surveying) South Australian Institute of vocational Education (1994), Australia*

#### ***Certificate from the Group Training Course in Hydrographic Survey (international accredited Category B Course) –***

*Conducted by the Japan International Cooperation Agency under the International Cooperation Programme of the Government of Japan, Tokyo, Japan (1996)*

*Certificate of participation in Environment Management at Singapore Environmental Management and Engineering Services Pte Ltd (January 2000)*

### **Relevant Experience**

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#### ***Surveying projects***

##### ***Current*** \_\_\_\_\_

***AA.Fesdhoo*** 2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.

##### ***Completed*** \_\_\_\_\_

***K.Fulmoon*** 2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.

***K.Velassaruu*** 2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.

<b>K.Kurumba</b>	<i>2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>K.Baros</b>	<i>2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>M.Hakuraa Huraa</b>	<i>2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>K.Dhonveli</b>	<i>2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>AA.Ehlidhoo</b>	<i>2012 PSM survey to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>N.fushivellavaru</b>	<i>2012 Control and as built survey, after establishing PSM to surveying and land surveying standard to tourist properties of Maldives ref to technical brief 2011.</i>
<b>Gdh.Dhigulaabadhoo</b>	<i>Topographic survey and Hydrographic Survey.</i>
<b>K.Kaashidhoo</b>	<i>set-out survey for tourist hotel</i>
<b>B.Vakkaru</b>	<i>Topographic survey and Hydrographic Survey including set-out survey for Back of the house</i>
<b>Laguna Maldives (Male' Atoll) managed by Universal Enterprises</b>	<i>Topographic Survey, Hydrographic Survey, Tree Survey, Set out Survey &amp; Environment impact assessment study.</i>
<b>Konnota Island (Gaafu Dhaal atoll) managed by PCH</b>	<i>Topographic Survey, Hydrographic Survey, Tree Survey and Setout Survey.</i>
<b>Maavelavaru Island (Noonu atoll) managed by Athama Marine</b>	<i>Topographic Survey, Hydrographic Survey and Setout Survey.</i>
<b>Halaveli Tourist Resort (Ari Atoll) / Waterfront Pvt Ltd.</b>	<i>Topographic Survey, Hydrographic Survey, Tree Survey and Setout Survey.</i>
<b>HANDHUFUSHI (Herathere) ADDU Atoll / managed by Yatch tours</b>	<i>Hydrographic Survey of the proposed water villa site</i>
<b>Madoogali Island (Ari atoll)</b>	<i>Topographic survey includes buildings, structures and water villas.</i>
<b>Ariyadhoo Island (North Male' atoll) / managed by VB</b>	<i>Topographic survey and Hydrographic survey, includes buildings, structures and water villas.</i>

***Full Moon Maldives / Universal Enterprises***

*Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.*

***Baros island Resort / Universal Enterprises***

*Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.*

***Dhigufinolhu island Resort / Universal Enterprises***

*Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.*

***Palm Beach Resort, Lhaviyani Atoll, Maldives***

*Provided all consultancy work including equipment layout design and procurement analysis for all F&B areas and laundry*

***Ari Beach Resort, Ari Atoll, Maldives***

*Topographic survey and Hydrographic survey, includes set-out survey for all buildings, structures and water villas.*

***Coco Palm Resort, / Sunland Travels, Baa Atoll, Maldives***

*Provided all consultancy work including equipment layout design and procurement analysis for all F&B areas, Environment design, Water & Waste Management, Project Management and Laundry Design and Layout in addition, the project included the supervision of the installation of the designed system, surveying and instructing the contractors on construction methodology.*

***Veligandu Huraa, Maafushivaru (Twin island)***

*Tree survey, including identification of species and their respective locations through out the island, set-out survey for all structures.*

***Fesdu Fun island / Universal Enterprises***

*Reef survey, identification of coral species and condition of the reef with regard to coral bleaching, Tree survey including detailed layout of vegetation line and shoreline, set-out survey.*

***NakatchaaFushi / Huvafenfushi***

*Topographic survey, Hydrographic Survey, Tree survey, set-out survey for water bungalows and land villas.*

***Hilton on Rangali / Crown company***

*Topographic Survey, Hydrographic survey and set-out survey for water villas, land bungalows, current and wave action surveys, tide measurements for the under water restaurant.*

**Reethi Rah Resort / One & Only**

*Environment impact assessment study.*

**Moofushi island Resort**

*Topographic survey, including vegetation, shore line, High tide and Low tide line and all structures.*

**Villivaru & Biyadhoo / Ministry of Tourism**

*Environment impact assessment study for the bidding project includes Plant identification survey, soil contamination survey, Ground water monitoring, coral diversity and abundance survey, coastal erosion survey, sediment movement and setting studies, beach profiles and land topography survey.*

**Mushimas Migilli / Dhoani Migilli**

*Environment impact assessment study including Harbour development.*

**Keekimini / Fisheries Project**

*Environment impact assessment study including, Harbour development and set-out survey for infrastructure development.*

**Hudhufushi island Resort / Abdul Rauf**

*Topographic survey and Hydrographic Survey including set-out survey for all buildings and villas.*

**Ministry of Health, Malé Maldives**

*Development of a master plan for the provision of safe, adequate and affordable freshwater for Malé (Maldives) including the designing of processes to harness and distribute water on a commercial basis. Includes study on sustainability of utilizing the freshwater aquifer of Malé as well as utilizing airport runway and a loading collector (shallow lagoon) for rainwater catchments vis-à-vis desalination of seawater.*

**Hinnavaru island, Lhaviyani Atoll, Maldives**

*Provision of a wastewater collection and disposal systems for a densely populated island.. Design to overcome the problems associated with a high water table and flat low lying island with limitations for proper gradients.*

**Maadhoo island, Maldives**

*Environmental impact study on Harbour Development and Recreational Boating Activity for the Management Kandooma island Resort, Republic of Maldives.*

**Fuah Mulaku**

*Hydrographic study and Environment impact study on harbour development and commercial boating activity.*

***Mirihi island Resort***

*Hydrographic Study, Land survey / and Environmental impact assessment on harbour Development.*

***Hebadhoo island Resort***

*Hydrographic Study and Environmental impact assessment on harbour Development.*

***Embudhoo Finolhu island Resort / Taj***

*Hydrographic Study and Environmental impact assessment on harbour Development.*

***Shaviyani Atoll (all inhabited islands)***

*Hydrographic Study and Environmental impact assessment on Harbour Development.*

***Hulhumeedu island***

*Hydrographic Study and Environmental impact assessment on Harbour Development.*

***Kulhuduffushi island Harbour***

*Hydrographic Study and Environmental impact assessment on Harbour Development.*

*Vangaaru(shaviyani atoll)*

***Dh.Eboodhoo/Olhuveli***

*Topographic survey and Hydrographic Survey including set-out survey for all buildings and villas.*

***Gdh.Gazeera***

*Topographic survey for resort construction*

***ADh.Athurugaa***

*Topographic survey and Hydrographic Survey*

***AA.Thundufushi***

*Topographic survey and Hydrographic Survey*

***Ha.Uligamu***

*Topographic survey and Hydrographic Survey including set-out survey for buildings.*

***STO Building***

*Set-out survey in Male',Maldives.*

***Velaanaage office Building***

*Set-out survey in Male',Maldives.*

***K.Giraavaru***

*Topographic survey for Resort Construction*

***Ga.Handahaa***

*Topographic survey and Hydrographic Survey including set-out survey for all buildings, Beach Villa and Water Villa.*

***N.Huivani***

*Topographic survey and Hydrographic Survey.*

***N.Minaavaru***

*Topographic survey and Hydrographic Survey.*

***Gdh.Baulhagilaa***

*Topographic survey and Hydrographic Survey.*

***Rendheli Island (Noonu atoll) managed by INT Management Pvt Ltd.***

*Setout Survey of Rendheli Island, Noonu Atoll.*

***Finolhas Island (Baa atoll) managed by Coastline Maldives***

*Topographic & Hydrographic Survey of Finolhas Island, Baa Atoll.*

***Kuramathi Maldives (Ari Atoll) managed by Universal Resorts, Maldives.***

*Topographic Survey (update the site plan) of Kuramathi Maldives, Ari Atoll.*

**EIA Projects Participated**

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*Environmental Impact Assessment for Tourist Resort Development in Kudafushi Island, Raa Atoll, Maldives, Mr. Ali Zahir*

*Environmental Impact Assessment for Tourist Resort Development in Kottafaru island, Raa Atoll, Maldives, ABN Pvt Ltd*

*Environmental Impact Assessment for Tourist Resort Development in Ookolhu Finolhu Island, Lhaviyani Atoll, Maldives, Cocoon Investments, Pvt. Ltd.*

*Environmental Impact Assessment for Resort Development in K. Kuda Bandos, North Male Atoll, Maldives, Malahini Holdings Pvt. Ltd.*

*Environmental Impact Assessment for Resort Development in K.Akirifushi, North Male Atoll, Maldives, Akirifushi Investment Pvt. Ltd.*

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*Environmental Impact Assessment for Development of a CityHotel Hanimaadhoo, H.Dh. Atoll, Maldives, Island Expert Pvt. Ltd.*

*Environmental Impact Assessment for Resort Development in K. Kodhipparu, North Male Atoll, Maldives, Kodhipparu Investment Pvt.Ltd.*

*Environmental Impact Assessment for Proposed Tourist Resort Development on Raa. Maamanagau Island, Maldives, Bir Hotel Management Pvt. Ltd.*

## **Employment**

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*Managing Director of Beach Rock Investment Pvt Ltd. Ma Sharky Shark, Male', Maldives.*

*Managing Director of Beach Marine Pvt Ltd. Ma Sharky Shark, Male', Maldives.*

*Managing Partner of Sharkventures LLP, Ma Sharky Shark, Male', Maldivesharkventures LLP, Ma Sharky Shark, Male', Maldives*

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