ENVIRONMENTAL IMPACT ASSESSMENT

10 Storey Residential Development at H. Sandhaleege

Proponent: Hassan Mughnee

November 2016
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<tbody>
<tr>
<td>BATNEEC</td>
<td>Best Available Technology Not Entailing Excessive Costs</td>
</tr>
<tr>
<td>BPEO</td>
<td>Best Practice Environmental Option</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>H2S</td>
<td>Hydrogen sulphide</td>
</tr>
<tr>
<td>l/d</td>
<td>litres per day</td>
</tr>
<tr>
<td>MCC</td>
<td>Malé City Council</td>
</tr>
<tr>
<td>MEE</td>
<td>Ministry of Environment and Energy</td>
</tr>
<tr>
<td>MHI</td>
<td>Ministry of Housing and Infrastructure</td>
</tr>
<tr>
<td>MVR</td>
<td>Maldivian Rufiyaa</td>
</tr>
<tr>
<td>MRDC</td>
<td>Maldives Road Development Corporation</td>
</tr>
<tr>
<td>MWSC</td>
<td>Malé Water and Sewerage Company</td>
</tr>
<tr>
<td>NBSAP</td>
<td>National Biodiversity Strategy and Action Plan</td>
</tr>
<tr>
<td>NEAP</td>
<td>National Environment Action Plan</td>
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<tr>
<td>NEAP</td>
<td>National Environment Action Plan</td>
</tr>
<tr>
<td>NO2</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>NSSD</td>
<td>National Strategy for Sustainable Development</td>
</tr>
<tr>
<td>PM</td>
<td>Particulate Matter</td>
</tr>
<tr>
<td>RF</td>
<td>Rufiyaa (same as MVR)</td>
</tr>
<tr>
<td>SO2</td>
<td>Sulphur dioxide</td>
</tr>
<tr>
<td>STELCO</td>
<td>State Electric Company</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of Reference</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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Consultants Declaration

This EIA has been prepared according to the EIA Regulations 2012. I certify that the statements in this Environmental Impact Assessment study are true, complete and correct to the best of my knowledge and abilities.

Ahmed Zahid

Consultant Registration No. EIA08/07
Proponent’s Declaration

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

Hassan Mughnee

H. Sandhaleege
Executive Summary

This report discusses the findings of an Environmental Impact Assessment (EIA) carried out for the proposed 10-storey building at Sandhaleege, Henveyru, Burevi Magu, Malé. This project requires EIA as the building has a basement and the foundation of the building goes below 6 feet, under EIA regulations 2012 such buildings require EIA clearance from Environmental Protection Agency (EPA).

The main objective of the EIA is to identify potential impacts of excavation, construction of foundation and dewatering and consider mitigation measures that can be adopted. In addition, the EIA would also consider other construction phase and operational phase activities such as waste management, energy and water supply although they are not directly related to the scope of the EIA.

The main aim of the project is to provide a residence to the proponent and family. In addition the proponent aims to rent out floors in the apartment building for residential and commercial purposes.

Looking at the existing environment of the site, the site is devoid of any significant flora or fauna. There is only one Moringa tree belonging to the proponent, the proponent will give this tree to whoever wants it. The traffic is at Burevi Magu is quiet low, this is mainly because it is not a main street. In this regard, it was found that mainly motor bikes used this road. However the noise level at the site is high, like in other parts of Malé, mostly due to construction activities undertaken nearby. The groundwater quality even though saline, is not very saline when compared to some other parts of Malé.

Almost all of the negative impacts envisioned for the project occurs during construction phase and as highlighted previously most of these impacts are associated with substructure works. However, almost all these impacts are minor and can be reduced to negligible levels with the mitigation measures proposed in this report. In this regard, the potential negative impacts associated with this project can be summarised as impacts related to groundwater quality and quantity, impacts on nearby buildings in terms of structural damage, impacts on air quality, impact on ambient noise, impacts on utility services, impacts on traffic and impacts on health and safety. Mitigation measures proposed for the project like minimizing dewatering to the shortest possible time, ensuring proper storage and transport of construction material and
waste, restricting noisy activities to day time, undertaking works by experienced operators and supervisors, avoiding closure of roads during peak rush hours and implementing international best practice health and safety standards will help to reduce the influence of most of the envisioned impacts to negligible levels.

The EIA report proposes a monitoring program that will help to identify the actual impacts and to identify the effectiveness of the implemented mitigation measures. In this regard monitoring will include, monitoring of groundwater quality, monitoring of dust and noise, visual assessment of nearby buildings and monitoring of traffic condition. The monitoring reports will be submitted to EPA every two months during construction phase and once thereafter to meet the requirements of the EIA regulations. The reports will be submitted in the format specified in the EIA regulations.

Overall, this project is a positive project for the proponent and the negative impacts envisioned are only for the construction phase and all these impacts can be easily mitigated.
EIA for the proposed development of 10-storey building at H. Sandhaleege

Proponent: Hassan Mughnee
Consultant: Sandcays
EIA for the proposed development of 10-storey building at H. Sandhaleege

Proponent: Hassan Mughnee
Consultant: Sandcays


EIA for the proposed development of 10-storey building at H. Sandhaleege

Proponent: Hassan Mughnee
Consultant: Sandeays
1 Introduction

1.1 Introduction

This report addresses the social and environmental impacts associated with the development of 10-storey building with basement at H. Sandhaleege, Burevi Magu, Malé. EIAs were initially required for such high-rise buildings following the damages caused to nearby structures, due to vibrations caused during the construction of Ameenegee (currently Hotel Jen). Hence, the prime objective of EIA for building projects in Malé is to minimize impacts on neighbouring structures. Nevertheless, in the process the whole building process is placed within the scrutiny of the EIA process.

Building projects that require impact assessment under Schedule (Jadhuvalu) Raa of the EIA Regulations of the Maldives include:

1. Buildings that are higher than 31 m;
2. Buildings that are constructed with a foundation that is required for a building of 31 m or higher;
3. Buildings that are constructed with pile foundation;
4. Buildings with foundations that go below 6 feet in depth;
5. Buildings with basement (If the basement is of a depth of more than 1 m or if the area of the basement is bigger than 172 m²)

The proposed building involves a basement 1.6 m below the ground level, the total plot area is 185.79 m² and the foundation depth is 2.75 m (9ft). Thus, it meets the conditions 4 and 5 above, thus requiring an EIA as per the regulation.

This report will identify potential impacts and suitable mitigation options to address these impacts for the project of construction of 10-storey building at H. Sandhaleege. Moreover, the report will explore alternatives for various project components including the no-project option. Moreover, a monitoring program is proposed to determine the actual impacts of the project and to see whether the proposed mitigation measures are effective.

The findings of this report are based on assessments undertaken during a site visit made to the project site in November 2016 as well as professional judgment. The development concept prepared by the project architect and engineering protocols developed by the project engineer...
has been utilized in order to understand and present the project. The impact assessment methodology has been restricted to field data collected, professional judgement and experience of similar building projects in Malé.

1.1 Background to the EIA

This EIA is prepared in accordance with the Terms of Reference (TOR) approved by the Environmental Protection Agency (EPA) on November 2016. It is a legal requirement that new projects having potential for environmental impacts gain environmental clearance or approval prior to construction and operation of such projects. Environmental clearance is obtained through submission and approval of EIA report by the Environmental Protection Agency (EPA) under the Ministry of Environment and Energy.

The principal environmental institution that implements EIA process in the country is Environmental Protection Agency. Additionally, since April 2015, the Ministry of Tourism has taken the authority of EIA process for tourism sector projects.

1.2 Scope of the EIA and Approach

The main scope of this EIA report as per the approved TOR is to broadly assess, identify, predict and document potential environmental impacts from the proposed 10 storey building at H. Sandhaleege. The primary focus of the report is on the impacts associated with foundation aspects as this is the main reason for requiring EIAs for such projects. In this regard, this report investigates existing environmental condition of the project site and its surrounding and foresees the ways in which potential environmental impacts will be managed, mitigated, reduced and monitored.

Hence the key aims of the report are to;

- Describe in detail the proposed project;
- Identify the need and justification for the proposed development;
- Describe the biophysical status of the existing environmental condition of the project area based on the findings undertaken during the site visits;
- Assess, identify and predict potential environmental impacts;
- Evaluate the significance and magnitude of impacts that will be generated; and identify and predict ways in which these environmental impacts will be prevented and removed through appropriate environmental management and mitigation measures;
- Develop a mechanism to closely monitor and understand the long-term effects and changes of the proposed development on the environment with respect to the available baseline information, mostly from field assessments;
- Provide legal protection with regards to the proposed development activities; and
- Review the predictions and assessments made on environmental impacts that are associated with the proposed development activities.

In general, the EIA report has been based upon the following sources of information:
- Review of available project documentation including concept plans;
- Discussions with involved key personnel;
- Field visits to site;
- Baseline environmental assessments;
- Maldives Environmental Protection and Preservation Act No. 4/93;
- Environmental Impact Assessment Regulation;
- Other Environmental Regulations;
- Sandcay’s previous experience of undertaking EIAs for building projects in Malé; and
- Other EIAs for similar development projects that have been carried out for Malé.

### 1.3 Relevant Studies

In order to prepare this EIA, relevant EIA reports for multi-storey buildings in Malé has been carefully studied. These include:
- EIA for H. Del Rio multi-storey building
- EIA for H. Point Villa multi-storey building
- EIA for H. Marvel multi-storey building
- EIA for the development of 10-storey building at H. Campus.
- EIA for the development of 10-storey building at Umar Shopping Arcade.
- EIA for the development of a 14-storey building at G. Hudhukokaa.
- EIA for the construction of a 10-storey building with basement at G. Javaahiru Asseyri
- EIA for the construction of 11-storey building at Ma. Jambugasdhoshuge
- EIA for the construction of 13-storey building at H. Blue Haven.
- EIA for the proposed MWSC customer service building.

Moreover, the following monitoring reports submitted to EPA were used in predicting impacts and mitigation measures associated with the project:
- Environmental monitoring report for the 11-storey building at Ma. Jambugasdhoshuge.
- Environmental monitoring report for the 11-storey residential building at Husham Residence.

1.4 Aims and Objectives of the EIA

This report helps to achieve the following key objectives.
- Allow better project planning through identification of key impacts and measures for mitigating these impacts.
- Ensure efficient resource use and minimize irreversible damage to the environment.
- Ensure and allow informed and environmentally-sound decision making.
- To demonstrate the commitment by the proponent on the importance of environmental protection and preservation.

1.5 EIA Implementation and Methodologies

This study was based mainly on assessment and monitoring data from similar projects, data collected during field investigations undertaken in November 2016 by a team from Sandcays Pvt. Ltd. and published literature on similar projects. The EIA report was compiled by Ahmed Zahid, who is a registered EIA consultant with over 19 years of experience in this field. He was assisted by Mohamed Hamdhaan Zuhair and Ahmed Hassaan Zuhair. Hamdhaan has been working in the environment sector mostly in the regulatory side for the past 09 years, while Hassaan has worked in the sector for the past 10 years, mostly in the Environment Ministry.

Established and widely accepted methods have been applied in this EIA study. Field studies have been undertaken using methods generally employed for EIA studies in the Maldives. The field assessment methodologies are described in Section 4.2 of this report.
The methods used to identify, predict and assess impacts are based on matrices that have been established by the Consultants over a long period. In the matrix, the consultants assign a likert-scale number to represent the magnitude, significance, duration and spatial extent of the potential impact for each project activity against the key environmental and socio-economic components that the specific project activity may have an impact on. The product of the magnitude, significance, duration and spatial extent for each activity and component is summed up to measure the exact nature of the impacts by each activity and the overall impact of the proposed project is the sum of all activities.
2 Project Description

2.1 Project Proponent

The proponent of the proposed project is Mr. Hassan Mughnee. The building belongs to the proponent and is used as the residence of the proponent currently.

2.2 The Project

The project involves development of personal residence of the proponent. The proponent also aims to use some floors for real estate, by renting the apartments. Moreover, the project involves commercial and office space at the ground floor and the basement level. This is a typical residential development in Malé and the impacts associated with the project is very minimal.

2.2.1 Proposed works

The following is a list of significant works that will be carried out under this project;

- Excavation to achieve required depth
- De-watering during the foundation concrete works
- Mixing and application of concrete
- Storage and handling of cement and other raw materials
- Use of heavy machinery and equipment for construction
- Roofing part of the terrace
- Plumbing
- Tiling and railing
- Plastering, painting and finishing

2.2.2 Project Location

Sandhaleege is located in Burevi Magu, Henveiru (Figure 2-1). The plot area is 185.79 m². Except to the side of the house facing Burevi Magu, the remaining three sides have existing three storey buildings. Thus, there are no high-rise buildings in the immediate vicinity of Sandhaleege.
Figure 2-1 Site Location (building foot print shaded)
2.3 Relevant project components

2.3.1 Protection and safety

The Proponent will ensure that the Contractor would have the works and adjoining properties protected from inclement weather. The Contractor would be required to provide all necessary dustsheets, barriers and guardrails during construction period.

2.3.2 Scaffolding

The Contractor will provide, erect, maintain, dismantle and clear away at completion proper and adequate scaffolding required for construction activities. Putlog holes shall be made good to match the adjacent surface as the scaffolding is dismantled.

It will be the Contractor’s responsibility to have all safety precautions in connection with the scaffolding including the provision of all bracing, scaffold boards and toe boards.

2.3.3 Excavation and protection to adjacent structures

The proposed depth of excavation of Sandhaleege is about 2.75 m below the existing ground level. Buildings with a basement normally tend to have slightly deeper foundation. In order to minimize slumping of excavated area due to dewatering and to keep the edges plumb, 6mm GI sheets (2.4m long, 1.2m wide) may be inserted to a depth of 200mm below the proposed excavation depth with GI angle bracing.

The excavation will be done using a back-hoe excavator. Part of the excavated black sand will be later used for backfilling and the remaining excavated material will be transported to the disposal area allocated on the south of Malé.

2.3.4 Foundation

For the foundation works, a raft or mat foundation will be used. This is the most commonly adopted method of laying foundations in the Maldives. Raft foundations help to spread the load from a structure over the entire area of the structure, minimizing the pressure exerted on the base.

When all the necessary excavation is complete, a 50mm thick lean concrete (Grade C15) layer will be laid to provide a level surface to assemble the reinforcement of foundation raft slab.
and beams. Once the lean concrete layer has hardened, the raft foundation works will be carried out starting with steel work. The concrete works for the raft foundation will be done using C30 Grade concrete. An anti-separation additive would be used to promote bonding of the concrete mix. There will be a water proof membrane around the basement concrete to prevent water from getting in.

2.3.5 **Dewatering**

Dewatering will be carried out throughout the foundation works until the casting of the foundation has been completed. The general practice in Malé today is to pump the water to a temporary catchpit/junction provided by Malé Water and Sewerage Company (MWSC) or dispose to sea via a pipeline along the roads provided by Maldives Road Development Corporation (MRDC). One of these methods will be practiced based on the most suitable for the time and location. Details of the selected method will be shared with EPA, when making the dewatering application through the Dewatering Regulations. In order, to improve efficiency and minimize the impact of drawdown on a single point, several pumps will be used. Several pumps each with a flow rate of 30 litres per second is recommended to be located at specific locations to pump out the water. The dewatering works will be done in accordance to Dewatering Regulations.

Engineers often recommend as follows.

- Where the excavation level is below the natural water table and it is necessary to pump continuously from the excavation or to install a specialist type of dewatering equipment around the perimeter of the site or excavation, the Contractor will be responsible for ensuring the safety and stability of all adjoining structures and services or utilities above or below ground level.

- It will also be the responsibility of the Contractor that the equipment installed shall ensure that the excavation and subsequent construction is carried out in dry conditions.

- Continuous or permanent de-watering of the excavation or site may not be undertaken without the written approval of the Consultant and the methods to be employed shall also comply with Codes of Practice and EPA requirements.

- The water pumped from the excavations or well points shall be pumped to disposal points or sumps approved by the Consultant and the EPA/Council/MWSC and, if so required, be passed through settling tanks before disposal.
• Unless prior approval has been obtained no water must be disposed of in the sewerage system or storm water sewers.

During the dewatering process, any important or mature trees in the vicinity of the project site that may be adversely affected due to dewatering would be watered daily to prevent water shortages. Complaints received from neighbouring households and buildings regarding water quality and availability will be resolved through negotiation and if required through compensation.

2.3.6 Backfill

Engineers often recommend as follows.

• All earth used for filling shall unless otherwise stated, be selected hard dry material from the excavation. The maximum dry density of the fill material shall be not less than 1600 kg/m³.

• The backfill of excavations shall be placed in horizontal layers not exceeding 300mm in thickness. Each layer shall be compacted by hand or other mechanical means to the required density before the next layer is added.

• Care shall be taken when filling or back-filling to avoid any wedging action or eccentric action upon or against the structure of the work.

• Before placing of fill, the surface of the sub-grade shall be compacted at optimum water content to the same percentage of maximum dry density required of subsequent lay.

• The Consultant will inspect all compacting devices that the Contractor proposes and shall have the right to reject any device which he feels is unsuitable for the job.

• Heavy equipment for spreading and compacting fill and backfill shall not be operated closer to walls than a distance to the difference in height between the top of the footings and the layer being compacted.

• When back-filling behind retaining walls, basement walls and the like the said structures shall be kept propped during the complete operation. The hydraulic compaction of fill shall not be permitted and the back filling shall be carried out in layers not exceeding 150mm thick.

• Each layer shall be compacted to 90% of the modified compaction. No back filling shall be carried out until the wall concrete has achieved its full works cube strength.
and care shall be exercised so as not to damage the external tanking membrane and its protection.

### 2.4 Implementation Phase Activities

#### 2.4.1 Site Preparation

Site preparation works are underway. Site preparation is considered to be one of the key elements of any such project. Important preparation work includes:

1. Appoint staff for site management and material stock control.
2. Demolish existing building and make access to areas where work will be carried out.

#### 2.4.2 Mobilization of Equipment and Materials

Site mobilization involves mobilization of workforce, machineries/equipment and construction materials to the sites to begin physical work. Materials, equipment/machineries and all other related items will be transported to site by dhoni from Thilafushi or Hulhumalé to Male and by pickup truck from harbour to construction site. Necessary measures will be taken to ensure that no spillage of construction materials occur when transporting the material. In this regard the necessary safety requirements as per the transport regulations and guidelines will be met. Since the project takes place in Malé, which is the primary location for sourcing materials in the Maldives, there will be fewer complications in material mobilisation as well as human resource for the project. However, the Contractor would be expected to plan the entire works to minimize the number of mobilisations that would in turn minimize the cost of the project/increase profits and also minimize the time frame.

For the foundation and each slab, materials will be placed on the road side in a manner approved by the Ministry of Housing and Infrastructure with necessary signboards and safety measures on the day of the concrete works.

Materials for masonry and other works would be kept inside the premise.

#### 2.4.3 Workforce and Services

This is one of the key components that need appropriate management on site during the construction phase. In the proposed project an estimated 25 staff including labourers, engineers, consultants and supervisors will be sited working on the project. It is expected that
the workforce would comprise mainly of foreign labour, as with other similar projects. Prevalent labour laws and regulations shall be adhered to.

The workforce would comprise of Contractor’s staff. They would be provided with adequate and reasonable accommodation, water, sanitation and meals. Foreign labour employed specifically for the project will be provided with labour camps. Temporary toilets may be set up for the workers at the construction site and connected to MWSC sewer network to provide proper sanitation facilities.

2.4.4 Utilities

Water and sewerage services for the building will be provided by the MWSC. Therefore, the main water supply will be desalinated water. However, there will be underground tanks for the collection of groundwater for flushing. As per the usual practice in Malé, MWSC will provide the water supply and sewerage connections up to the building and all internal plumbing has to be done by the Proponent. Therefore, the Proponent would ensure that there will be no cross-connection of desalinated water supplied by MWSC with the ground and rainwater collected and supplied within the building. The Proponent will also make provisions for easy cleaning and maintenance of internal sewer lines.

Electricity will be provided by State Electric Company (STELCO). STELCO will provide temporary electricity during construction and permanent electrical connection to the entire building during the operational phase. STELCO has existing capacity to provide the service to the proposed building.

Considering that it is a residential development backup generator is not considered for this project.

2.4.5 Waste Management

Excess sand excavated during foundation works will also be transported to this landfill site. All waste generated during concrete works phase and finishing phase will be collected at the end of each work day and temporarily stored in closed containers on a designated location at site. Hazardous waste such as empty paint cans will be kept separate and disposed according to the standards established by relevant government authority. All waste will be transported in vehicles approved for waste transportation under waste management regulation, meeting the
required standards of the regulation. Special attention should be made to ensure that no spillage of waste into roads occur during waste transport.

2.4.6  **Road Closure**

Prior to casting of foundation and slabs permit will be taken from MHI/Malé City Council for road blocks as determined by the Ministry/City Council. There are well established procedures followed by Contractors and MHI/City Council for road blockages for building concrete works. These procedures will ensure that the works are carried out with minimal disturbance to pedestrians, traffic and neighbours. Often, concrete works are undertaken in the night time after *Isha* prayer, to minimize disturbance and interruptions. Special consideration will be given to undertake any road closures during low traffic hours. In fact, road closures would be approved by the Ministry/City Council depending on the prevailing circumstances including other projects in the vicinity.

The foundation work is estimated to take around 18-24 hours while the concrete slabs for the rest of the floors will be around 12-15 hours. Information will be provided to neighbors before undertaking works during night time.

2.4.7  **Health and Safety**

Workers’ health and safety is also an important aspect that needs careful consideration during the implementation from beginning till end. Protection of employees from likely adverse effects will be one of the core duties of the Proponent or Contractor. All machineries and equipment must be operated by trained and experienced personnel wearing necessary safety gears. In the event, that there is any need for an employee to work on a different work site, he/she must be given appropriate training before the work. Noisy or dusty works would be minimized or stopped during peak hours and prayers times in order to reduce dust and noise related pollution for pedestrians, traffic and people in the mosque.

All precautions will be taken for safety of workers during the construction stage. Barricades, warning signs or devices will be placed on the road during casting or works involving the use of roads such as power, water and sewer connections. Safety of pedestrians and vehicles will be ensured by appropriate signage, safe scaffolding and netting.
Workers would be informed of local values, respect for religion and culture in addition to health and safety issues at site. Engineers and/or supervisors will brief workers as and when necessary and ensure safety precautions are in place. Personal protective equipment will be made available to all workers. First aid will be available at site for minor injuries.

2.5 Operational Phase Activities

Key activities identified throughout the operational phase of the proposed buildings would be building maintenance, maintenance of fire-fighting equipment, monitoring the adequacy of the proposed structures for their intended purpose and health and safety issues.

2.5.1 Energy conservation

The proposed building will be powered by STELCO power station in Malé. Capacity of diesel powered engines in Malé have been rising rapidly due to growing demand. The Fourth Power Project, which was recently completed, would be able to meet the rising demand for several years with foreseen expansion in the coming years under the Fifth Power Development Project. Also, to minimize the demand for power from diesel gensets, the Government of Maldives has initiated several solar energy programmes, which may be considered by the Proponent during the operational phase of the project.

The proposed building will be fitted with energy-efficient fittings, including light bulbs and air-conditioners with inverters. Solar water heating would also be considered.

2.5.2 Water conservation

Water to the proposed building will be supplied by Malé Water and Sewerage Company (MWSC). Booster pumps will be used for supplying water to the top floors. There are two options for boosting; one is to use in-line booster pumps provided by MWSC and the other would be to collect the water in an underground tank and use a booster pump to pump from the tank. Both options are acceptable, however, it may be ideal to use an in-line booster system.

The option to use groundwater for flushing has always been an option that needs to be evaluated in terms of the cost of pumping the groundwater to the top floors as well as the nuisance of smell in the building, especially toilets, due to the use of smelly groundwater in toilets. This may be considered during the operational phase or during the design/implementation phase.
2.5.3 Solid waste

During the operational phase of the building, waste chutes and/or waste bins will be placed in each floor to be used by tenants. Daily collection and transport of waste will be undertaken as per the normal practice at the time in Malé. At present, waste collection at household level is undertaken by foreign workers as a private operation. However, at present there is talk of Waste Management Corporation starting waste collection service in Malé. Thus, if and when this service starts waste collection will be undertaken by this service.

2.5.4 Maintenance

Maintenance is a subject of little interest in the Maldives. Buildings are not generally maintained once built. However, the proposed building would be maintained to acceptable standards. The proponent will undertake regular maintenance activities of the building both structurally and internally.

Regular maintenance often involves dealing with cracks, especially during the early stages of the development, when the building settles or due to poor workmanship. Maintenance will also involve maintenance of sewerage network within the premise, HACV systems and general repairs, changing of lights, interior maintenance and exterior painting. Interior maintenance will be undertaken by tenants and will be part of the contracts made with the tenants.

2.6 Social and Environmental Design Considerations

In terms of planning and design, the most important and pressing issues to consider are:

- Structural safety over the design period
- Good natural ventilation and lighting for greater energy efficiency
- Use of energy saving and environmental friendly resources such as energy saving or LED lights, eco air conditioning, etc.
- Provisions for uninterrupted power and water supply
- Fire safety
- Adequate waste management facilities
- Adequate drainage and drainage facilities
- Landscaping for improved aesthetics
- Avoid sick-building syndrome
2.7 **Project Duration**

The implementation of the proposed project is expected to be started as soon as the EIA is approved. The duration of the project is estimated to be 720 days with the project completion targeted to end of December 2018. Substructure works, which is considered to be the most sensitive component (socially and environmentally), is expected to be completed within three months. The critical elements of excavation and dewatering are expected to be completed within 80 days.

2.8 **Project Inputs and Outputs**

The project has inputs in terms of human resources, and natural resources and machinery. The main output of the project is improvement in living conditions and standard of living in the capital city. The inputs and outputs are summarised in Table 2-1 and Table 2-2.

**Table 2-1: Matrix of key inputs**

<table>
<thead>
<tr>
<th>Input resource(s)</th>
<th>How to obtain resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction workers</td>
<td>Contractor’s responsibility</td>
</tr>
<tr>
<td>Management and supervisory staff</td>
<td>Appointed by proponent/Contractor</td>
</tr>
<tr>
<td>Construction materials: timber, sand, cement, aggregate, reinforcing steel bars, electrical cables, circuit boards, PVC pipes, HDPE pipes, diesel, petrol, etc.</td>
<td>Imported and/or purchased at competitive prices where locally available – Contractor’s responsibility</td>
</tr>
<tr>
<td>Water supply</td>
<td>Piped desalinated water supply from MWSC; Piped groundwater for flushing (optional)</td>
</tr>
<tr>
<td>Electricity/Energy</td>
<td>Diesel-based electricity from STELCO; Solar energy from roof installations (optional)</td>
</tr>
<tr>
<td>Telecommunication and cable TV</td>
<td>Existing service providers (Dhiragl/Wataniyya/Medianet/ROL)</td>
</tr>
<tr>
<td>Machinery and equipment (concrete mixer, trucks, loaders, forklifts, cranes and general construction equipment and machineries)</td>
<td>Contractor’s responsibility</td>
</tr>
<tr>
<td>Paints, thinners and other solvents</td>
<td>Imported or locally purchased</td>
</tr>
<tr>
<td>Doors, windows and furnishings</td>
<td>Imported or locally purchased</td>
</tr>
</tbody>
</table>

**Table 2-2: Matrix of major outputs**

<table>
<thead>
<tr>
<th>Products and waste materials</th>
<th>Anticipated quantities</th>
<th>Method of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition waste</td>
<td>Small to moderate</td>
<td>Sent to designated landfill site in Malé</td>
</tr>
<tr>
<td>Waste oils from machinery</td>
<td>Minute</td>
<td>Re-used for other applications</td>
</tr>
<tr>
<td>Timber, cardboard, gunny bags</td>
<td>Small</td>
<td>Recovered, reused, recycled</td>
</tr>
<tr>
<td>and scrap metals (construction site waste)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used oil (waste oil), grease and paint</td>
<td>minute</td>
<td>Reused/appropriately disposed</td>
</tr>
<tr>
<td>Waste (kitchen waste, domestic waste)</td>
<td>Small to moderate</td>
<td>Taken for disposal through Malé waste management system</td>
</tr>
<tr>
<td>Sewage effluent</td>
<td>Small</td>
<td>Disposed through existing sewerage network via catchpits and oil traps in the building premise</td>
</tr>
</tbody>
</table>
2.9 Need and Justification

The housing market in Malé is in high demand, with the centralized policies of the government. Thus, there is need to increase the housing availability in the capital Malé both private and public housing. This project, however minutely will contribute to increase this housing capacity.

With the completion of bridge and the construction of housing units in HulhuMalé second phase the demand in Malé is expected to decrease to an extent. The major positive, overall in terms of increased capacity in Malé and HulhuMalé is that a certain point it is going to go to a market saturation point, whereby the prices of the rental properties are going to decline, thus providing more affordable housing to the larger population.

In addition, to residential housing the proposed building includes commercial and office space. These are also high demand in Malé, with limited space in the capital. Even many government offices are renting private buildings, due to limited availability of government office space.
3 Policy, Administrative and Regulatory Framework

This chapter will identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. The proposed project is expected to conform to all of the policy and regulatory aspects outlined in this Chapter. Specific compliance requirements are discussed within the relevant section.

3.1 National Policy Guidance

3.1.1 Third National Environment Action Plan

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.

3.1.2 Waste Management Policy

As waste management has been identified as a key environmental issue in the Maldives, a National Solid Waste Management Policy for the Maldives was first developed in 2007 and updated in 2015 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 centres and decentralizing waste management administration.

3.2 Applicable Laws and Regulations of the Maldives

3.2.1 Environmental Protection and Preservation Act

The Articles of the Environmental Protection and Preservation Act (Law No. 4/93) addresses the following aspects of environmental management, which are relevant, understood and adhered to in the proposed project.

- An EIA shall be submitted to EPA before implementing any developing project that may have a potential impact to the environment.
- Project that has any undesirable impact on the environment can be terminated without compensation.
- Disposal of waste, oil, poisonous substances and other harmful substances within the territory of the Maldives is prohibited. Waste shall be disposed only in the areas designated for the purpose by the government.
- The Penalty for Breaking the Law and Damaging the Environment are specified in the Law.
• The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment.

3.2.2 Environmental Impact Assessment Regulation

The EIA Regulation, which came into force in 2007, has been recently revised and the revised EIA Regulation 2012 is currently in force since May 2012. This EIA is subjected to the EIA Regulations 2012. Further revisions/improvements to the regulation are underway.

The EIA Regulation 2012 is currently only in Dhivehi and an official translation is awaited. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulations defines the type of projects that would be subject to Environmental Impact Assessment. Infrastructure projects that require impact assessment under Schedule D of the EIA Regulations of the Maldives include:

1. Buildings that have a footprint of over 4000square feet
2. Buildings that are higher than 31m or over 10 storeys
3. Buildings with foundations that can support over 10 stories
4. Buildings with basement
5. Buildings with foundations below 5m from ground level or with foundations that is different from normal foundations.

3.2.3 Regulation on Landuse Planning and Management

This Regulation, which sets out the regulatory framework for land use planning and land management in the Maldives, has no specific relevance to the project. However, with the advent of the Regulation, land for residential and institutional areas is located away from industrial zones. However, in some of the islands, poor zoning or land use planning has a negative impact on schools and other noise, dust or smell sensitive environments.

3.2.4 Malé Planning Regulation

The Planning Regulation for Malé has been developed in relation to the Regulation on Land Use Planning and Management in Maldives discussed above. This regulation has been developed
specifically for the 5 wards of Malé, with the first part of the Regulation focussing on the four wards on the island of Malé namely Henveiru, Mahchangolhi, Galolhu and Maafannu and the second part focusing on VililéMalé, which exists as a separate island. The regulation looks at the different aspects relating to construction of high rise buildings focusing on minimizing congested living conditions and related health and safety aspects. The regulation specifies the different conditions for building design, requirements for design approval, height of buildings and ventilation, lighting, fire and safety requirements and other requirements for building safety and occupants’ health and well-being.

The regulation specifies requirements for dewatering, demolition, sighting of open toilets/bathrooms in the vicinity of the building, scaffolding, height restrictions, setback limits, ventilation, railing, mezzanine floor and parking.

### 3.2.5 Maldives Building Act and Building Code

This is possibly the most relevant legislation for the project under consideration. The first draft of the Maldives Building Act was published for public comments in May 2009 and second draft published in 2010. The final draft was published in early 2014 in Dhivehi with some differences from the drafts in English entitled Maldives Building and Infrastructure Bill. This Act has been passed by the Majlis and ratified by the President in 2014.

The Act sets out the importance of adhering to the Building Code, building consents, application procedures, performance standards/requirements including access and facilities for persons with disability, define specific roles and responsibilities of different parties involved in the building process and means to avoid hazards or dangers during construction or use. Clause 46 and 53 of this Act are important for aspects relating to building safety and assurance that the Building and Infrastructure Act has been followed during the building process. Clause 46 states that the certified/registered building practitioner and design checkers shall be responsible for the design. Clause 53 states that the permit to use the building would be issued based on the Building Inspector’s report. Clause 60 and 61 refers to Building Code. Clause 64 states that the building works should be supervised by a Building Inspector appointed by the Developer and who is not associated with the Client/Developer or the Contractor. The responsibilities of the Developer as well as the Contractor are also stated in the (draft) Act.
The proposed project will follow existing design requirements, which are in line with the requirements set out in the Building and Infrastructure Act as well as the Building Code. The designs have already been approved by the concerned government agency. The designs have been done by licensed engineers. Clause 94 refers to place or article of importance/special interest that is found in the building site, which should be immediately notified to concerned parties.

3.2.6 Dewatering Regulation

Dewatering regulation (2013/R-1697) was published on 31 December 2013 and was effective from 1 February 2014. The Regulation covers the following:

- Exceptions under the Regulation including dewatering for cleaning household wells and extraction for agricultural purposes.
- Application for dewatering permits including application form, information required such as size, water quality, work schedule, method of dewatering and disposal location.
- Fees for dewatering permits including MVR500.00 for administrative fees, MVR500 per day for the first 28 days, MVR1000 per day for first extension, MVR1500 per day for second extension and MVR 2000 per day for third extension.
- Water quality testing requirements including parameters that has to be tested
- Provision of information (in writing) regarding dewatering to entities within 30m from the dewatering location and ensuring that in case of difficulty in getting water from neighbouring wells, providing 250litres or RF30 as compensation for each household.
- Provisions for disposal of dewatering effluent.
- Reporting requirements.
- Procedures for termination of work and fines levied.

This regulation is of relevance in the proposed building where dewatering would be required. The foundation for the building is expected to be below the groundwater lens; therefore, dewatering would be required. Hence this regulation will be strictly adhered to and dewatering would be undertaken in a planned manner to avoid inconveniences as well as cost minimization.
3.2.7 Regulation on Environmental Liability

The Environmental Liability Regulation (Regulation 2011/R-9) came into force on 17 February 2011 and covers a wide range of issues which enable charging penalties and compensation due to environmental pollution and environmental damages. Apparently, the key objective of the environmental liability regulation is to practice polluter pay principles in the Maldives. The proposed project will cut down on environmental liabilities and polluting practices will be almost completely abandoned.

3.2.8 Waste Management Regulation

The Waste Management Regulation (Regulation No. 2013/R-58) came into effect in August 2013. The objective of Waste Management Regulation is to implement the National Waste Management Policy; through which it aims to protect the environment by minimizing the impact of waste on the environment, including the impact of waste on human health, establishing an integrated framework for minimizing and managing waste in a sustainable manner and establishing uniform measures to reduce the amount of waste generated. The regulation also ensures waste is reused, recycled and recovered in an environmentally sound manner before being safely treated and disposed. The regulation covers the management of general, hazardous and special waste. Wastes arising from paints and chemical solvents are considered as special waste.

Clause 1.4 of this regulation is of relevance to the projects under consideration. This clause is for construction waste and it states that;

a. Building construction works shall be planned and organized in a manner that there is minimal waste

b. Measures shall be in place to minimize construction waste

c. Reusable or recyclable waste among demolition/construction waste shall be reused or recycled

d. Construction waste shall be kept at the demolition site until demolition is completed

e. Demolition of buildings shall be done with minimal disturbance due to dust and emissions to the environment and people living in the vicinity.
Clause 11(e) states that waste management at household level would not require any permits under the regulation.

This regulation was effective from 6 January 2014 and EPA would be responsible for the implementation this regulation. This regulation has little relevance to the project under consideration.

### 3.2.9 General considerations

All building construction and renovation will adhere to the existing building and other applicable codes of practice in the Maldives and any other standard construction specifications approved by the country. In addition, the contractor is expected to pay attention to and address the following in the Environmental Management Plan:

- Air and noise pollution during construction activities
- Preservation of culturally significant buildings
- Preservation of ecological features of the sites
- Good planning in terms of transport and access to site
- Overshadowing and access to daylight and sunlight, with possible options for passive solar design and its effect on site layouts
- Structural integrity of buildings
- External appearance (aesthetics)
- Floodwater protection provisions
- Designing appropriate landscaping
- Energy conservation and efficiency
- Waste disposal, salvage, re-use and recycling of materials
- Avoidance of hazardous materials
- Health, safety, security and fire
- Potential for sick building syndrome

For building projects, General EHS Guidelines of the World Bank Group may be adopted since the EHS risks are low for these projects. The following table presents the specific areas of focus when the EHS Guidelines are considered.
Table 3-1: Project specific aspects under the EHS Guidelines

<table>
<thead>
<tr>
<th>Areas identified in the Guideline</th>
<th>Project specific considerations</th>
<th>Responsible party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Environmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dust and air emissions</td>
<td>• Energy conservation (good lighting and ventilation) in the design</td>
<td>Designer/ Engineer Contractor/ Developer</td>
</tr>
<tr>
<td>• Energy conservation</td>
<td>• Constructional waste management</td>
<td></td>
</tr>
<tr>
<td>• Waste management</td>
<td>• Air and noise emissions minimized</td>
<td></td>
</tr>
<tr>
<td>• Noise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Occupational Health and Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• General facility design and operation</td>
<td>• Contractors and supervisors shall be obliged to implement all reasonable precautions to protect the health and safety of workers</td>
<td>Designer /Engineer Contractor/ Developer</td>
</tr>
<tr>
<td>• Communication and training</td>
<td>• Workers should be made of special hazard envts including confined spaces and lone/isolated events</td>
<td></td>
</tr>
<tr>
<td>• Physical hazards</td>
<td>• Use appropriate signs and PPE during construction works as well as maintenance works during operational phase</td>
<td></td>
</tr>
<tr>
<td>• Chemical hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Biological hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Personal Protective Equipment (PPE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Special hazard environments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Community Health and Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water quality and availability</td>
<td>• Ensure healthy and safe use of the buildings during the design</td>
<td>Designer /Engineer Contractor/ Developer</td>
</tr>
<tr>
<td>• Structural safety of infrastructure</td>
<td>• Ensure structural integrity and use safe and appropriate chemicals and other materials in the construction</td>
<td></td>
</tr>
<tr>
<td>• Life and fire safety</td>
<td>• Promote health and safety in the use of buildings by appropriate signage</td>
<td></td>
</tr>
<tr>
<td>• Traffic safety</td>
<td>• Use appropriate signs and PPE during construction works as well as maintenance works during operational phase</td>
<td></td>
</tr>
<tr>
<td>• Disease prevention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Emergency preparedness and response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Construction and decommissioning</td>
<td>• Project engineers shall outline health and safety measures in the design and incorporate those in the BoQ.</td>
<td>Designer /Engineer Contractor/ Developer</td>
</tr>
<tr>
<td>• Environment</td>
<td>• Contractors shall follow good engineering principles and health and safety measures such as leaving the work area clean and levelled prior to demobilization.</td>
<td></td>
</tr>
<tr>
<td>• Occupational Health and Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Community Health and Safety</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 Administrative arrangements

This EIA falls within the jurisdiction of environmental regulatory bodies in the Maldives. Therefore, their roles have been defined as follows.

3.3.1 Ministry of Environment and Energy

The primary environmental institution in the Maldives is Ministry of Environment and Energy (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, waste and infrastructure.

3.3.2 Environmental 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.

3.3.3 Ministry of Housing and Infrastructure

The Ministry of Housing and Infrastructure (MHI) is the government agency responsible for the provision of housing and infrastructure such as harbours. The Ministry, therefore, regulates housing and infrastructure developments in the country. The Land Act and recent Housing and Infrastructure Act are implemented by the Ministry.

MHI is also the government agency responsible for licensing or registering engineers, architects and other building practitioners including building inspectors.

3.3.4 Atoll/City Councils and Island Councils

Under the Maldives Decentralization Law, elected Atoll Councils, City Councils and Island Councils have been formed as regulatory bodies dealing directly with atoll, cities and island issues. In this regard, some of the development projects are subject to approval of these councils through a public consultation process.

For the proposed project, the Ministry of Housing and Infrastructure will take the role of Malé City Council in approving the concept and detailed drawings based on Malé Planning Regulation, provide approvals for construction and monitor/supervise the works during construction with assistance from relevant government authorities including traffic police. EPA requires that a copy of the final draft of the EIA Report be submitted to the relevant Council and receipt provided to EPA or attached to the EIA report. In the case of Malé, the receipt is provided by the Ministry of Housing and Infrastructure.
3.4 **International conventions, treaties and protocols**

The major global issue facing the Maldives is climate change, global warming and subsequent sea-level rise. The small size of the islands and their low elevation above MSL makes possible impacts of it very serious. Consequently, the country plays a prominent role in foregrounding environmental issues faced by many other small islands developing states including the Maldives in the international arena. The Maldives is therefore, a party and signatory to various international conventions and declarations. These include:

- International Convention for the Prevention of Pollution of the Sea by Oil (1982)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990)
- Convention on Biological Diversity (1992)
- United Nations Framework Convention on Climate Change (1992)
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992)
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997)
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999)
- Washington Declaration on Protection of the Marine Environment from Land-Based Activities
- Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002)
- United Nation Convention to Combat Desertification (2002)
The Maldives is also a key player in formulating and adopting various regional plans and programmes to protect the environment by continuously participating in various activities organized by regional bodies such as SACEP, ESCAP and SAARC.

Some of the international conventions, treaties and protocols of relevance to the proposed project may be identified as follows:

- United Nations Convention on Climate Change (UNFCCC) and the Kyoto Protocol which aims at minimizing greenhouse gases to reduce or combat potential impacts of global climate change, global warming and associated effects such as sea level rise, which are thought to have devastating impacts on the Maldives, a fragile small island nation. The aspects of the proposed project that apply to this convention are the use of diesel-based power, possible use of small excavators, especially their emissions as well as the use of pumps which consume electricity. These are inevitable impacts; however, efforts should and have been made to minimize all such impacts.

- The Montreal Protocol on Substances that depletes the Ozone Layer is also of concern. The Maldives has an accelerated HCFC phase-out schedule as agreed in the Montreal Protocol. Hence, the proposed project will meet such criteria in the area of cooling and refrigeration.
4 Existing Environment

4.1 Introduction

This chapter will provide the data and information relating to the existing project site conditions or environmental and social baseline conditions. Understanding baseline conditions is an important element of an EIA, as baseline conditions are essential for comparative analysis during monitoring. For the proposed 10-storey building at H. Sandhaleege, the baseline data and information has been divided into following three categories:

- Physical and biological environment
  - Noise levels in the vicinity of the site including any noise sensitive location;
  - Traffic flow (size and direction) around the project site;
  - Trees in the project site and major trees around it;
  - Water quality of groundwater wells in the vicinity;
  - Indoor and outdoor air quality in the project vicinity.

- Structural environment
  - State of adjacent buildings including photographic records of existing damages as baseline reference;
  - Condition of the surrounding roads;
  - Existing structures/uses of the proposed site;

- Socio-economic environment
  - Demographic data for Malé and population of adjacent buildings;
  - Brief description of social environment of Malé in general and adjacent residential units in particular;
  - Identify types of vehicles and peak traffic hours in or near the project site.

4.2 Methodologies

Conditions of the existing environment of the study areas were analysed by using appropriate scientific methods. The following site data were collected and the methods of collection are described here.
4.2.1 Location identification
The location of data collection sites has been marked using handheld differential Trimble GeoXH GPS.

4.2.2 Air Quality
Air quality data for greater Malé area was obtained from available literature and available secondary information sources.

4.2.3 Background noise and traffic
Noise was measured using a Type-2 noise meter (handheld). Traffic count was made based on visual count. Noise levels were measured and traffic count was made at four time intervals, morning (10:00-12:00), afternoon (13:00-15:00), evening (16:00-18:00) and night (20:00-22:00). For Noise, readings were taken every hour and an average was taken. The locations and GPS coordinates of traffic and noise survey are provided in the figure below (Figure 4-1).

![Figure 4-1: Traffic and Noise Survey locations](image)

4.2.4 Water quality
Groundwater quality was assessed in-situ at 03 selected households nearby (H. Blusham, H. Elpaso and H. Naseemee Villa). A handheld YSI water quality logger was used to measure temperature, pH, Total Dissolved Solids (TDS) and Dissolved Oxygen (DO). The GPS
coordinates of these locations are highlighted below. Figure 4-9 provides the location map of these households.

**Table 4-1: Coordinates of water sample locations**

<table>
<thead>
<tr>
<th>Location</th>
<th>GPS Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>H. Blusham</td>
<td>4°10'23.60&quot;N</td>
</tr>
<tr>
<td></td>
<td>73°30'59.97&quot;E</td>
</tr>
<tr>
<td>H. Elpaso</td>
<td>4°10'23.51&quot;N</td>
</tr>
<tr>
<td></td>
<td>73°31'0.88&quot;E</td>
</tr>
<tr>
<td>H. Naseemee Villa</td>
<td>4°10'23.02&quot;N</td>
</tr>
<tr>
<td></td>
<td>73°30'59.85&quot;E</td>
</tr>
</tbody>
</table>

4.2.5 **Condition Assessment**

Visual inspection of the nearby buildings were undertaken and apparent cracks were noted and photographed. Figure 4-9 and 4-10 provides the location of these households.

4.3 **Natural hazard vulnerability**

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

Natural hazard vulnerability risks related to global warming and subsequent sea level rise remains a cause for concern. The vulnerability is further aggravated by the fact that rainfall in the region is of high intensity but short duration, which may be affected due to changes in global precipitation patterns related to climate change. The project location is at a location which gets flooded often during high rainfall events due to improper drainage at the road. The Malé road development project is expected to address this concern.
In Developing a Disaster Risk Profile for Maldives by UNDP (2006), the natural vulnerability of the islands and atolls of the country to potential hazards have been modelled to understand the risk factors of the country. In that report, the disaster risk scenario for Maldives was described as moderate in general.

Figure 4-2 show that Maldives faces tsunami threat largely from the east and relatively low threat from the north and south. Islands along the western fringe experience a relatively low tsunami hazard. This map is produced based on the experience of the tsunami in 2004 and also occurrence of historic tsunami events in the greater region where most of the events have identified to have occurred from the Sumatra Region (UNDP 2006). For Malé, the wave was stopped largely by the breakwater surrounding Malé but water rushed inside. There were no reports of damage to structures or structural failures although there is a possibility it there was any lesser degree of coastal protection. Under such circumstances, there is some possibility of unloading of soil depending on the speed of travel of the water. However, it is low due to low porosity of the soil.

![Figure 4-2: Tsunami hazard zones](image)

Besides heavy rains and strong winds during monsoons, hazardous weather events which regularly affect Maldives are tropical storms or ‘tropical cyclones’, and severe local storms. At times, tropical cyclones hitting Maldives are destructive due to associated strong winds
that exceed a speed of 150 kilometres per hour, rainfall of above 30 to 40cm in 24 hours and storm tides that often exceed four to five meters (UNDP 2006).

Cyclonic winds sometimes can cause a sudden rise in sea-level along the coast, leading to a storm surge. The combined effect of surge and tide is known as ‘storm tide’. Storm tides can cause catastrophe in low-lying areas, flat coasts and islands such as Maldives.

Maldives is also affected by severe local storms- thunder storms/ thunder squalls. Hazards associated with thunder storms are strong winds, often exceeding a speed of 100 kilometres per hour, heavy rainfall, lightning and hail; they also give rise to tornadoes in some regions. In general, thunderstorms are more frequent in the equatorial region than elsewhere, and land areas are more frequently hit by thunderstorms as compared to open oceans. However, thunder storms close to the equator are less violent when compared with those in the tropical regions and beyond. Maldives being close to the equator, thunder storms are quite frequent but less violent. Strong winds generated by severe local storms generate large wind-driven waves which are hazardous for Maldives (UNDP 2006).

The islands of Maldives are less prone to tropical cyclones. The northern islands of the country were affected by weak cyclones that formed in the southern part of the Bay of Bengal and the Arabian Sea. Figure 4-3 shows the tracks of cyclones affecting Maldives during the period 1877-2004. The number of cyclones directly crossing Maldives is small. Only 11 cyclones crossed the islands over the entire span of 128 years. Most of the cyclones crossed Maldives north of 6.0°N and none of them crossed south of 2.7°N during the period (UNDP 2006).

![Figure 4-3: Tracks of Cyclones affecting Maldives, 1877-2004](image)

UNDP (2006) stated that there were 21 cyclonic disturbances within the 500km radius during 1877-2004, of which 15 were depressions with an average wind speed of about 28 knots. The
highest wind speed due to cyclonic disturbances that affected the islands during that time was about 65 knots.

Based on the above information, Maldives is divided into zones with varying scales of cyclone hazards based on based on a qualitative judgment based on the gradient of the storm tracks from north to south.

![Figure 4-4: Regions to capture Cyclones passing through Maldives for Hazard Zoning](image)

Figure 4-4 shows the regions used to compute the highest wind speed of each cyclone captured within the region. Majority of the cyclonic disturbances crossed the northern region. The frequency and wind speed decreases from northern region to southern region. Region 1 is not affected by any storm. Thus, Maldives can be divided into three cyclone hazard zones – the northern zone with high cyclone hazard, central zone with moderate cyclone hazard and the southern zone with very little cyclone hazard. The proposed project location in the central zone with moderate cyclone hazard risk.

With regards to the storm surge potential, the bathymetry around the Maldives shows that the ocean slope close to the east coast is steeper than the west coast, hence it can be generalized that the eastern islands of the Maldives are vulnerable to higher surge hazard compared to the western islands. Figure 4-6 shows storm surge hazard zones based on computed model with maximum pressure drops for 100 year return period and with historical data (UNDP 2006).
Based on the above figure, it can be said that the north-eastern parts of the country are very vulnerable to storm surges.

Based on historical catalogues of earthquakes in the region, identifying seismic sources based on this historical information and based on numerical models, it was found that except for Seenu, Gnnaviyani and Gaafu Dhaalu and Gaafu Alifu Atolls, earthquake hazard is low across the country. The probable maximum Modified Mercalli Intensity (MMI) is estimated between 7-8 in Zone 5 (Figure 4-5). This level of MMI can cause moderate to high damages (UNDP 2006).

It can be summarized that the northern parts of the country are vulnerable to cyclones and storm surges while southern parts of the country are vulnerable to seismic activity. The
eastern side of the country is more exposed to potential tsunamis and surges. The proposed project area in Malé have medium cyclone risk and most of the flooding Malé experiences is due to inappropriate drainage of the roads.

4.4 Geology, topography and utilities

The geology of the islands of Maldives is largely sandy soil. The soil is a mixture of coral dust which has been transformed in to sand that is highly alkaline with pH varying from 8.0 to 8.8 at the top with calcium carbonate formations beneath the sand. About a meter of sand layer shall be expected. Along the coastline, the soil is white and very fine resulting from the wave action whereas the soil is darker in colour inland. The soil in the project area has been modified over the years, however, darker soil exists. Typical estimate of sand porosity in the islands of Maldives is 30% (Falkland 2001, Carpenter 2006). Soil in Malé is fairly uniform and therefore highly permeable and subsequently easily susceptible to pollution.

The topography of Malé is almost flat and the relative variation in ground level in different parts of Malé with the western side of Malé being slightly lower than the eastern side. This is because the eastern side is directly facing the eastern rim of the atoll and prone to strong oceanic swells.

The roads in Malé including those around the project site are paved using pavement blocks. The road at which the project is located Burevi Magu, even though not too wide is sufficiently wide enough to cater for vehicle movements. The number of motorcycles in Malé had grown rapidly over the years and motorcycles are parked on all roads on the parking spaces allocated on the side of narrow pavements. This is of primary concern and the project aims to address this concern by providing basement parking space.

The underground utilities present on the roads include the power, telephone and cable TV cables as well as water and sewerage pipes. The main sewerage pipes run in the middle of the road and so does the manholes while other utilities are on the side of the road.

4.4.1 Groundwater

The fresh groundwater aquifers generally are formed as freshwater lenses floating on salt water which depends on island width, recharge rate and the ease of transmission of freshwater through soil (Falkland et al 2007). According to the USGCRP team (Carter et al 2001), “the
size of the groundwater lens is directly related to the size of the island also related to the normal amount and type of precipitation (e.g., heavy downpours recharge lenses, while light rain generally does not). Therefore, the type of rainfall that occurs in the Maldives with high intensity-high duration-low frequency rainfall is useful for the development of groundwater lenses in low-lying islands. This argument also supports the belief held by the consultants that aquifer recharge is not easily possible by grey water recharge. However, while heavy downpours help to recharge the lens, it also aids flooding of roads, which have been hardened over time, resulting in poor permeability/percolation.

The water lens in small islands is illustrated in Figure 4-7.

![Figure 4-7: Conceptual Illustration of freshwater lens in a small coral island (after Falkland)](image)

The above illustration is typical of most of the islands. Like other islands in the Maldives, Malé is also small, low-lying and flat with thin, superficial groundwater lenses. The groundwater lens in Malé has been severely deteriorated due to congestion and subsequent over-abstraction and sewage contamination. The fresh water lens has dwindled from over 20m in the early 1970s to less than 2m below the water table in 2000 as a result of the rapid urbanization over the years. There are high levels of faecal and total coliforms everywhere with high levels of hydrogen sulphide and nitrates in the water. The salinity in the project area is quite higher than the levels of fresh water (0.5ppt) with levels measured at 1.30ppt, 1.26ppt and 0.90ppt. However compared some parts of Malé these levels are still low. The generally high salinity levels in ground water in Malé is due to excessive abstraction, however with the
increase in use of desalinated water for most of the domestic purposes in most households, the salinity levels of groundwater in Malé has decreased in recent times.

The water table in the project site is expected to be approximately 1.2m below the ground surface. The water table was believed to fluctuate with tides. However, recent findings of Sandcays indicate that there is very little or no variation of water table with tides in larger islands.

**Table 4-2: Groundwater quality at and around the project site**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Blusham</th>
<th>Elpaso</th>
<th>Naseemee Villa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>27.12</td>
<td>26.36</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>8.63</td>
<td>8.82</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/l</td>
<td>1050</td>
<td>1312</td>
</tr>
<tr>
<td>Salinity</td>
<td>ppt</td>
<td>0.9</td>
<td>1.30</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/l</td>
<td>1.90</td>
<td>1.46</td>
</tr>
</tbody>
</table>

**4.4.2 Water and sewerage**

Since its incorporation in 1995, Malé Water and Sewerage Company Ltd. has been providing water and sewerage services in Malé. The service was previously provided by the Government under the mandate of Maldives Water and Sanitation Authority.

In Malé, a comprehensive sewerage system with about 9 pump stations disposing wastewater into the ocean via six ocean outfalls had been installed in the late 80s. Untreated wastewater is discharged via these ocean outfalls. This was done following epidemics of cholera in the late 70s and typhoid and shigella in 80s. At the same time a proper water scheme depending on rainwater collection was also introduced. The result was a dramatic improvement in sewage disposal and water-borne disease prevalence. However, sewage and wastewater leaked into the ground via household catchpits made from cement and kept contaminating the groundwater aquifer. As a result, hydrogen sulphide or sewer gas was present in extremely high levels until the whole system was ventilated in 2000 following an incident of hydrogen sulphide poisoning which caused two deaths in 1997. Due to the smelly groundwater emanating hydrogen sulphide inside toilets, some of the new buildings in Malé are almost entirely dependent on desalinated water.

The entire Malé is supplied with desalinated water produced by reverse osmosis, which is an energy-intensive process. From the first plant of 200tons in 1988 to a current production of over 10,000tons in the greater Malé region, desalinated water is heavily depended upon.
However, even today, groundwater is being used in Malé for flushing. Nonetheless, the trend is to avoid use of groundwater even for flushing to avoid smell in toilets as well as the building. Some argue that the use of desalinated water sets-off the cost of pumping groundwater to flush tanks and provides a living environment free from poisonous gases such as hydrogen sulphide. Rainwater tanks are also installed in some buildings as backup and for domestic uses including watering plants.

4.4.3 Waste management

Waste may be considered as the main environmental problem facing Malé and the rest of the Maldives today. Waste management is an important municipal service that has been mismanaged in Malé for a long time. With the advent of Malé City Council with elected members in 2009 and the Decentralization Act passed in 2011, Councils have been entitled to manage waste although clear roles and responsibilities were not defined. However, for Malé City, the central government has taken the decision to allocated this responsibility to Waste Management Corporation under the guidance of Ministry of Environment and Energy.

In Malé, waste collection at household level is undertaken by individuals, mainly as a part time job by the large number of foreign labourers working in the government, private companies and households. They collect waste and transport the waste to the designated waste collection site. The waste collection yard was cleaned up in 2012, following which waste that is taken to the site is regularly ferried to Thilafushi to avoid smell and other inconveniences related to rotting waste and overflow of waste from the collection area. A few local companies are also involved in the waste collection business. Currently there are plans to start systemic waste collection by Waste Management Corporation.

Since the clean-up of Malé waste collection yard in 2012, waste is taken to Thilafushi on a regular basis without letting any waste to stand on the island. However, a greater problem remains to be addressed at its ultimate disposal location at Thilafushi. Open burning of tons of waste from Malé and the rest of the Maldives received in Thilafushi on the west of Malé has been a critical environmental health issue for a long time. The thick cloud of smoke from the burning carried with it carcinogens due to burning all sorts of waste at low temperature in the open. The southwest monsoon winds blow the cloud over the greater Malé region (populated by over a third of the entire population of Maldives) covering Gulhifalhu, VilliMalé, Malé, Hulhulé and Hulhumalé. In addition, Thilafushi is the host to several important commercial
and industrial activities and home of the large foreign workforce who are directly impacted by the smoke from burning waste. Nuisances associated with rotting garbage including smell and flies in the neighbouring inhabited islands as well as resorts have been a long due environmental and health concern that remains to be addressed. In order to address this long overdue social and environmental disaster, the government through assistance from development banks are developing plans for waste management in the greater Malé region.

The recently introduced Waste Management Regulation requires that licensed parties undertake waste collection, disposal and management. However, the means to implement the regulation yet remains to be discovered.

4.4.4 Electricity

Electricity is provided in Malé City by State Electric Company (STELCO), wholly owned by the Government of Maldives. STELCO has a total installed capacity of 61.42MW powered by diesel of which 40MW is utilized at peak load. Therefore, STELCO is currently capable of providing uninterrupted electricity service to the growing demand in Malé. Therefore, there will be no need for a backup facility. However, the ever-increasing population and growth in the economic sector appears to have effected recent power cuts in Malé City and there are plans for further expansion of the power generation capacity.

4.4.5 Other utilities

Telephone lines are installed throughout Malé by Dhiraagu while Dhiraagu and Ooredoo provide telecommunication services to Malé and the rest of the Maldives. ROL (Raajje Online) also provides internet services separately.

Cable TV is provided in Malé by MediaNet. There is a possibility that the above-named telecommunication service providers may also start live TV services with all local channels being live-streamed now by Dhiraagu in association with Schwack Maldives.

Natural gas/cooking gas, which is imported and stored at Thilafushi by Villa Hakatha and Maldives Gas is distributed in cylinders by several parties including Villa Gas and Maldives Gas.
4.5 Air Quality

In the Maldives, air quality is generally good with few sources of air pollution in the islands although Malé has several air pollution concerns due to open burning of waste at Thilafushi, congestion, ever-increasing construction works and high number of vehicles and vehicular movements.

Maldives EPA has established a few Air Quality Monitoring Stations in the capital, Malé, in December 2012, which measures PM10 and the results published on www.epa.gov.mv. According to EPA (personal communication with former Deputy Director General, Mr. Ibrahim Mohamed), only one sample has been tested during the initial phase and further tests could not be done due to financial constraints since samples have to be sent to foreign laboratory. The 5-day average for 10 to 15 Dec 2011 was 20 µg/m³ (24-hourly interval), which is well within acceptable international standards.

Detailed laboratory tests were also undertaken for the EIA for modernizing and expansion of Malé International Airport (AECOM and WS 2010). The results of this study are based on air quality readings over 2 weeks, the results of which are given below (adapted).

Table 4-3 Air quality at the greater Malé area (AECOM and WS, 2010)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Skai Lodge, Malé</th>
<th>Site Office, Hulhulé</th>
<th>Central Store, Hulhulé</th>
<th>HDC Building, Hulhumalé</th>
<th>WHO guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM10 (µg/m³)</td>
<td>29</td>
<td>24</td>
<td>22.8</td>
<td>15</td>
<td>50 (24-hourly)</td>
</tr>
<tr>
<td>PM2.5 (µg/m³)</td>
<td>8.5</td>
<td>4.3</td>
<td>4.8</td>
<td>4.1</td>
<td>25 (24-hourly)</td>
</tr>
<tr>
<td>SO2 (µg/m³)</td>
<td>6.5</td>
<td>4.5</td>
<td>4.5</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>NOx (µg/m³)</td>
<td>8.5</td>
<td>6.8</td>
<td>6.2</td>
<td>5.8</td>
<td>20 (24-hourly)</td>
</tr>
<tr>
<td>CO (µg/m³)</td>
<td>138</td>
<td>47</td>
<td>48</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

4.6 Ambient Noise

As highlighted in the methodology ambient noise levels were measured from two different locations in four different time intervals. As can be seen from table 4-3 the average noise reading is quiet high with all readings being around 80db(A). In general terms, a noise reading of more than 65db(A) is considered as a nuisance. Thus, this area can be considered as an already noisy area with traffic and existing construction going on at locations such as Veymuli Villa. As the ambient noise in the area is already high, the project is not likely to significantly increase noise pollution in the area, as the activities proposed under the project are quiet similar to those undertaken already at the location.
Table 4-4: Noise levels in the project area

<table>
<thead>
<tr>
<th>Time</th>
<th>Average Noise at Location 1 (dBa)</th>
<th>Average Noise at Location 2 (dBa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00-12:00</td>
<td>82.1</td>
<td>79.8</td>
</tr>
<tr>
<td>13:00-15:00</td>
<td>80.4</td>
<td>82.8</td>
</tr>
<tr>
<td>16:00-18:00</td>
<td>80.6</td>
<td>82.4</td>
</tr>
<tr>
<td>20:00-22:00</td>
<td>83.1</td>
<td>84</td>
</tr>
</tbody>
</table>

4.7 Traffic

One of the main contributors to air and noise pollution is traffic. Traffic is also an increasing social and environmental concern in Malé, which has the largest proportion of traffic in the Maldives. With over 50,000 motorbikes, over 5,000 cars and several heavy traffic including lorries/trucks, Malé is congested with traffic. With slow moving traffic during peak hours and frequenting traffic jams, getting around in vehicles is not easy. Bus service, which started in 2010, also suffers due to congestion and the service has stopped. Since Malé is not a pedestrian-friendly city, vehicles are still preferable over walking.

Figure 4-8 Traffic count at project site

Traffic in the area was considered important and was assessed to be similar to other similar high traffic areas of Malé. At the time intervals investigated it was Traffic flow in the project area was assessed on an average day to provide an insight into the traffic flow pattern in the
area and understand peak hours. As can be seen from Figure 4-8, no large cars or lorries frequent the project location, it is almost exclusively motor bikes and pedestrians that use the site. In terms of time interval, the afternoon time and the evening time is the busiest as this falls to the time where people return from work and schools (Figure 4-8).

4.8 Ecology

No significant ecologically flora or fauna are found in the proposed building location. Only existing tree at the site is a Moringa Tree (*Moringa oleifera*) planted by the proponent at the site. The proponent proposes to give this tree to any person who might want it.

4.9 Visual inspection of the nearby buildings

A brief visual inspection of the existing buildings nearby were undertaken. The results of which are represented in the photo representations (Figure 4-9 and Figure 4-10). This is a brief inspection and visual inspection by licensed engineer will be undertaken prior to construction commencing and after project completion as highlighted under monitoring.

Generally, as highlighted in the description accompanied in the Figures, all buildings are in good condition except one, H. Blusham. H. Blusham is a quite old building with visual cracks on the outside. However, this is not a major issue as the proposed construction is undertaken at the opposite side of the road and considering the foundation type and method of construction, no impacts are envisioned. Other than this, as described in Figure 4-9 and Figure 4-10, there are no major cracks in any of the nearby buildings.
**Figure 4-9: Photographic summary of conditions of project site and vicinity**

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hillsham</td>
<td>Old building with cracks observed outside the building. Ground water used only for flushing (cracks are marked with red circles)</td>
</tr>
<tr>
<td>Vemvuy Villa</td>
<td>New 10 story building under construction.</td>
</tr>
<tr>
<td>El Paso</td>
<td>3 building on same property built on different dates but maintained well no cracks observed from outside. Groundwater used only for flushing.</td>
</tr>
<tr>
<td>Elshum</td>
<td>3 Story building with ground floor used as a salon. No cracks were observed from outside.</td>
</tr>
<tr>
<td>Kosindashungu</td>
<td>Ground floor on property</td>
</tr>
<tr>
<td>Sandhalelge</td>
<td>Maringa/drumstick tree found on the property. Client’s current building for construction. Old building constructed on different phases.</td>
</tr>
<tr>
<td>Felina</td>
<td>4 Story building no visible damages observed</td>
</tr>
<tr>
<td>Sezerow</td>
<td>Ground floor constructed on the property</td>
</tr>
</tbody>
</table>

---

**Water Sample**

- **Hillsham**
  - Temp: 27.12°C
  - pH: 8.63
  - 0.90 ppt Sal: 1050 mg/l
  - 1.90 mg/l DO

- **El Paso**
  - Temp: 25.36°C
  - pH: 8.82
  - 1.30 ppt Sal: 1312 mg/l
  - 1.46 mg/l DO

- **Naseemee Villa**
  - Temp: 25.16°C
  - pH: 7.97
  - 1.20 ppt Sal: 1107 mg/l
  - 1.12 mg/l DO

---

*Proponent: Hassan Mughirae*
*Consultant: Sandays*
Figure 4-10: Photographic summary of conditions of project site and vicinity (contd.)
5 Stakeholder Consultations

Stakeholder consultation is one of the most important aspects of the EIA process. It has been identified in literature that it is one of the most ignored aspects of the EIA process in the Maldives and that it is usually undertaken at present as only a formality with no real power of the consulted stakeholders to influence the decision-making process. Some of the issues are procedural while others are related to the broader socio-economic and political context of the country (Zuhair & Kurian 2016). Broader consideration at policy level is required to ensure proper stakeholder participation via the EIA process.

As for the proposed project, the neighbouring residents are the most important stakeholders. In this regards, proactive consultation was undertaken with the neighbouring houses namely H. Bloosham, H. Elpaso and H. Naseemee Villa on 17 November 2016. According to these neighbours, there are not much concerns regarding the impact of dewatering on the groundwater as ground is used only for toilet flushing in these houses and there are no freshwater trees that could be affected by the dewatering. The main concern by the neighbours is about the noise, especially during night time and they really would like to see that no noisy works are not undertaken at night unless it is necessary. Since the road is already a one-way road, there is also a concern regarding blocking the road, which would cause several difficulties, especially during peak hours. However, everyone believes that the difficulties would have to be borne intermittently over the construction period, although the Proponent shall consider minimizing all difficulties and avoiding any nuisances or undue disturbances.
6 Environmental Impacts

This chapter addresses the basic concepts and methodological approach for conducting a scientifically based analysis of the potential impacts likely to accrue as a result of the proposed project. Environmental Impact Assessment (EIA) for quite a few disciplines is subjective in nature and cannot be quantified. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken. This Chapter deals with the anticipated positive as well as negative impacts due to construction of the proposed infrastructure including the operational phase.

6.1 Impact Identification

Environmental and social impacts from various activities of the proposed development have been identified through:

- Consultation with Proponent and other relevant parties
- Purpose-built checklists and matrices
- Existing literature and reports on similar developments in the Maldives
- Baseline environmental conditions
- Consultant’s experience of projects of similar nature and similar settings

The impacts on various aspects of Environment shall be assessed for construction as well as operation phases of Environment. The impacts proposed to be covered for assessment during construction and operation phases is given in Table 6-1 and Table 6-2 respectively.

Table 6-1: Environmental impacts to be considered during project construction phase

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Key Issues to be covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Environment</td>
<td>Sewage generation from labour force</td>
</tr>
<tr>
<td></td>
<td>Pollution due to disposal of effluent with high suspended solids from construction site</td>
</tr>
<tr>
<td></td>
<td>Temporary salinization and possibility of reduced water flow due to dewatering activities</td>
</tr>
<tr>
<td>Air Environment</td>
<td>Emissions due to operation of construction equipment</td>
</tr>
<tr>
<td></td>
<td>Increased fugitive emissions from stock piles of construction materials and construction waste.</td>
</tr>
<tr>
<td>Noise Environment</td>
<td>Noise due to operation of construction equipment and workforce</td>
</tr>
<tr>
<td>Land Environment</td>
<td>Risks to adjacent building due to deep excavation</td>
</tr>
<tr>
<td></td>
<td>Impacts on waste collection yard(s)</td>
</tr>
<tr>
<td></td>
<td>Solid waste generation from labour force</td>
</tr>
<tr>
<td></td>
<td>Pollution due to runoff from construction sites</td>
</tr>
<tr>
<td>Biodiversity (flora and fauna)</td>
<td>Increased human interferences for meeting fuel wood and timber requirements</td>
</tr>
<tr>
<td></td>
<td>Impacts on aquatic ecology due to disposal of effluents with high suspended solids/turbidity</td>
</tr>
</tbody>
</table>
Table 6-2: Environmental Impacts to be considered during project operation phase

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Key Issues to be covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic Environment</td>
<td>Ease for the proponent in terms of space and comfort. Reduced parking load on the roads due to dedicated parking. Financial benefit for the proponent.</td>
</tr>
</tbody>
</table>

A purpose built matrix has been used to evaluate the overall impacts of the proposed project. The impacts of the project have been evaluated according to the following criteria:

1. Magnitude (or severity): the amount or scale of change that will result from the impact

2. Significance: importance of the impact. Reversibility is considered part of its significance

3. Duration: the time over which the impact would be felt

4. Extent/spatial distribution: the spatial extent over which the impact would be felt

The scales associated with the above criteria are given in the table below.
Table 6-3: Impact evaluation scale

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scale</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>-3</td>
<td>Major adverse</td>
</tr>
<tr>
<td>Change caused by impact</td>
<td>-2</td>
<td>Moderate adverse</td>
</tr>
<tr>
<td></td>
<td>-1</td>
<td>Minor adverse</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Minor positive</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Moderate positive</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Major positive</td>
</tr>
<tr>
<td>Significance/Reversibility</td>
<td>0</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Impact implications /</td>
<td>1</td>
<td>Limited implications / easily reversible</td>
</tr>
<tr>
<td>Reversibility of impact's effects</td>
<td>2</td>
<td>Broad implications / reversible with costly intervention</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Nationwide or global implications / irreversible</td>
</tr>
<tr>
<td>Duration</td>
<td>0</td>
<td>Immediate</td>
</tr>
<tr>
<td>Duration / Frequency of Impact</td>
<td>1</td>
<td>Short term/construction period only</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Medium term (five years of operation)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Longterm/continuous</td>
</tr>
<tr>
<td>Extent/Spatial Distribution</td>
<td>0</td>
<td>None/within 1m from point of discharge/no affected party</td>
</tr>
<tr>
<td>Distribution of impact</td>
<td>1</td>
<td>Immediate vicinity/household level/developer/consumer</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Specific areas within the island/atoll/specific parties</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Entire island/atoll/nation/all stakeholders</td>
</tr>
</tbody>
</table>

Based on the above scale, an impact matrix was developed for the proposed development to determine the overall impact of the proposed project. This matrix is given in Table 6-5.

An impact potential index was then developed from Table 6-5. The impact potential index table represents a product of the magnitude (M), significance (S), duration (D) and extent/spatial distribution (E) given in the above table. The sum of all key component specific indexes for one activity (i.e. sum by rows) provides the Activity Potential Impact Index (API) and the sum of all activity specific indexes for one key component (i.e. sum by column) provides the Component Potential Vulnerability Index (CPVI) which gives an indication of the vulnerability of each key component to activity related impacts. Table 6-6 represent the impact potential indices for the proposed project.

### 6.2 Overall Impacts of the Proposed Project

The overall impact of the proposed project is greatly positive resulting mainly from improved housing infrastructure and quality of housing as well as access to housing. There would also be direct and indirect employment opportunities in the planning/design phase, construction phase as well as operational phase of the project. The project is also expected to contribute in
maintaining current rent prices in Malé and ensure that the rent do not escalate beyond a socially acceptable value by alleviating the pressure on housing and by providing competition within the real-estate market. Thus, the socio-economic benefits of the project may be considered to outweigh the negative impacts of the project. In fact, the project has minor negative impacts, mainly during construction phase, which could be appropriately mitigated by implementing the mitigation measures proposed in this report.

There are a few negative impacts of the project including mainly impacts related to excavation and dewatering. Excavation has the potential to loosen subsoil, which is the foundation on which the neighbouring buildings are built. Since the three buildings directly adjacent to the proposed project are relatively small developments, no damage to neighbourhood buildings are envisaged during excavation and foundation works. The impact of vibration and noise to the neighbouring buildings will also be relatively low as the foundation method to be employed is a raft foundation and not a deep pile foundation. There will also be little or no horizontal movement of sand due to excavation given that sandy carbonate soils have heterogeneous material that will adhere to each other and lock into place, providing additional stability. While the impact potential is low for this project, it is still important to provide protective measures as proposed in this EIA to ensure protection and stability. Dewatering may also cumulatively add to the loosening of sand under adjacent buildings. Therefore, it is necessary to provide soft/silent piling to a depth of no more than 1m below the proposed foundation depth around the periphery to mitigate potential impacts of subsoil movement. This has been proposed and included in the project.

There are no notable vegetation that require clearance at the proposed site, hence the impacts on flora and fauna are non-existent.

Additionally, minor impacts will be experience by neighbours during the construction phase. These impacts include noise and dust during construction as well as sanding and tiling works. However, as the area is devoid of any government buildings, educational institutions or mosques, the impact of noise and dust are only local. These impacts are inevitable but can be minimized through appropriate mitigation measures.

The summary of impacts is given in Table 6-4 followed by simple quantification matrices of the overall impacts given in Table 6-5 and Table 6-6.
Table 6-4: Summary of potential impacts

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Significance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Socio-Economic Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Economic activities</td>
<td>Minor</td>
<td>Minor impacts on economic activities especially to the nearby restaurants and cafes in Boduthakurufaamu Magu and Majeeddee Magu may occur due to road closure. However these impacts will be negligible, as this not a major road used by people to access nearby restaurants and cafes. Moreover, many other roads provide adequate access to Majeedhee Magu and from Boduthakurufaamu Magu. Road closures are also expected to occur outside the peak hours. Therefore the impact is temporary and insignificant.</td>
</tr>
<tr>
<td>2</td>
<td>Cultural property</td>
<td>None</td>
<td>No impact is envisaged.</td>
</tr>
<tr>
<td>3</td>
<td>Water rights / rights of common</td>
<td>Minor</td>
<td>Dewatering may impact neighbouring well water levels. However this is only a minor temporary impact and not significant since groundwater is not currently widely used in Malé.</td>
</tr>
<tr>
<td>4</td>
<td>Public health condition</td>
<td>Minor</td>
<td>Increased noise, fumes and dust in the area due to machinery, dusty processes and construction material.</td>
</tr>
<tr>
<td>5</td>
<td>Waste</td>
<td>Minor</td>
<td>The construction waste and excavation material will be suitably disposed.</td>
</tr>
<tr>
<td>6</td>
<td>Hazard</td>
<td>Minor</td>
<td>No significant impact. Scale of facilities is small.</td>
</tr>
<tr>
<td></td>
<td><strong>Natural Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Topography &amp; geology</td>
<td>Minor</td>
<td>No significant Impact. Scale of facilities is small</td>
</tr>
<tr>
<td>8</td>
<td>Groundwater</td>
<td>Minor</td>
<td>There may be some negative impact in an unlikely event of damage to existing sewerage facilities or dewatering to lay foundation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Additionally, dewatering will induce salinization around the project area, but groundwater use is restricted due to current status of the groundwater lens. Hence, minor impacts.</td>
</tr>
<tr>
<td>9</td>
<td>Flora</td>
<td>None</td>
<td>No flora.</td>
</tr>
<tr>
<td>10</td>
<td>Fauna</td>
<td>None</td>
<td>No fauna.</td>
</tr>
<tr>
<td>11</td>
<td>Hydrological situation</td>
<td>Minor</td>
<td>Dewatering may impact neighbouring well water levels. However this is only a minor temporary impact and not significant since groundwater is not currently widely used.</td>
</tr>
<tr>
<td>10</td>
<td>Meteorology</td>
<td>None</td>
<td>No impact.</td>
</tr>
<tr>
<td>11</td>
<td>Landscape</td>
<td>Minor</td>
<td>The adjoining 3 buildings are comparatively small (3 storeys) compared to the proposed development. However, there are many other high rising building at the vicinity of the project site (Veymuy Villa directly opposite to the proposed...</td>
</tr>
</tbody>
</table>
development and Thulusdhooge). Hence, considering that the development is in Malé which already has many high-rise buildings the development is expected to blend in well with the surrounding environment.

### Environmental Pollution

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Air Pollution</td>
<td>Minor</td>
</tr>
<tr>
<td>13</td>
<td>Soil contamination</td>
<td>Minor</td>
</tr>
<tr>
<td>14</td>
<td>Noise and vibration</td>
<td>Minor</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No significant impact but some degree of dust due to vehicular movement to and from site, dusty operation, etc.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>No significant impact but potential for contamination due to accidental spills of paint and other chemicals etc.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Some noise and vibration during demolition and construction period is expected. Considering it is Malé high background noise levels offsets the impacts of noise from site.</strong></td>
<td></td>
</tr>
</tbody>
</table>

**KEY:**

- **Major:** Significant negative impact anticipated
- **Moderate:** Moderate negative impact anticipated
- **Minor:** Negative impact is almost negligible
- **None:** No impact anticipated
- **Positive:** Positive impact is anticipated
### Table 6-5: Impact matrix for the proposed project

<table>
<thead>
<tr>
<th>PROJECT ACTIVITIES</th>
<th>KEY COMPONENTS</th>
<th>Environment</th>
<th>Socio-Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terrestrial flora &amp; fauna</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Soil and groundwater</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Topography / roads</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Landscape</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Air / Noise</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Services and infrastructure</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Health and Safety</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Employment</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Property Value</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Costs to consumer / tax payer</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary facilities, machinery and workforce</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Transport of materials to the site</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Concrete works and finishing of the building</td>
<td>0</td>
<td>-1</td>
<td>1</td>
</tr>
<tr>
<td>Utilities and services</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of building</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Waste and wastewater disposal</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Power and water consumption</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**KEY:**

- **M:** Magnitude
- **S:** Significance
- **D:** Duration
- **E:** Extent (spatial)
Table 6-6: Impact potential indices for the proposed project

<table>
<thead>
<tr>
<th>PROJECT ACTIVITIES</th>
<th>Terrestrial flora &amp; fauna</th>
<th>Soil and groundwater</th>
<th>Topography/roads</th>
<th>Air/Noise</th>
<th>Services and Infrastructure</th>
<th>Health and Safety</th>
<th>Employment</th>
<th>Property Value</th>
<th>Costs to consumer/tax payer</th>
<th>TOTAL API</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>Temporary facilities, machinery and workforce</td>
<td>0</td>
<td>0</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>Transport of materials to the site</td>
<td>0</td>
<td>0</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>Concrete works and finishing of the building</td>
<td>0</td>
<td>0</td>
<td>-0.03</td>
<td>-0.01</td>
<td>-0.02</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>Utilities and services</td>
<td>0</td>
<td>0</td>
<td>-0.01</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>Operation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.03</td>
</tr>
<tr>
<td>Use of building</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.48</td>
</tr>
<tr>
<td>Waste and wastewater disposal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>Power and water consumption</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.08</td>
</tr>
<tr>
<td>TOTAL CPVI</td>
<td>0</td>
<td>0</td>
<td>-0.03</td>
<td>-0.03</td>
<td>-0.03</td>
<td>0.12</td>
<td>1.03</td>
<td>1.4</td>
<td>0.61</td>
<td>3.91</td>
</tr>
</tbody>
</table>

The table above indicates that the project has few negative environmental impacts and these impacts occur exclusively during the construction phase. All of these are temporary, minor impacts and hence can be managed easily through proper mitigation measures. Thus, overall the project is seen as a positive impact.

6.3 Project Specific Impacts during Construction

6.3.1 Water Quality

The water quality of groundwater at the project site and nearby areas may diminish during project construction phase because of leaks and spillage of chemicals, paints, oils and waste oil. The resultant effluents from the construction site is another source of groundwater pollution. Additionally, poor handling and management of diesel and other fuel in fuelling of vehicles often lead to contamination of the aquifer. However, these impacts can be minimised by employing appropriate mitigation measures.

High pumping rates of groundwater during dewatering may decrease the water levels of the groundwater wells of neighbouring areas. In addition to this, dewatering often causes
saltwater intrusion that subsequently leads to salinization of groundwater lens (Geiben-Hertzberg principle). These may have a negative impact on the households that use groundwater. However, this impact is only temporary and spatially limited. As in most other areas of Malé, water quality tests done near the development site indicate that groundwater is already considerably salty at this area. Moreover, most of the households in Malé currently use groundwater only for flushing with desalinated water being commonly utilised for other purposes. Hence any temporary impacts due to this are likely to be insignificant.

6.3.2 **Hazard to nearby buildings**

Excavation will be undertaken for laying the concrete foundation. According to Horodecki and Dembicki (2006), there are two types of influences on soil due to deep excavation: changes of stress state in a subsoil and technological influence. Excavation causes unloading and reloading of subsoil and the intensity of these impacts depends on geotechnical parameters of the subsoil and geometry of excavation (depth, width and length). Hence, the unloading effect for small excavations has negligible influence on displacements. The closeness of the excavation to the adjacent building is also a cause for concern. The weight of the adjoining building (height of the structure) is also an important factor. Problems of settlement or structural damage often occur if the adjoining building is a high-rise building. The buildings adjacent to the development site are 3 three-storpy buildings to the South, East and West. Therefore, as no high-rise buildings currently occupy the adjoining areas, no major impacts in terms of structural damage are envisaged to nearby buildings due to excavation and foundation works.

Method of construction including type of excavation, type of support, dewatering methodology and vibrations due to sheet pile wall installation causes changes in subsoil and impacts adjacent constructions is induced by the excavation and loading by the construction. In recent building works for which EIAs have been undertaken, monitoring reports submitted to EPA as well as other reports have indicated that there have been very few instances of failure of adjoining structures. One incident that was reported in media and the monitoring report is the lateral displacement of sand underneath the adjoining 6-storey building during the excavation for foundation works at Ma. Jambugasdhoshe. According to the monitoring report, it was the Contractor’s fault and could have been avoided. Refilling the area was the mitigation measure that was taken.
6.3.3 Impacts due to material transport

The transport and supply of material, excavator, truck and any other machinery may have impacts that may arise from:

- Accidental spillage of construction materials (e.g. cement, paint).
- Accidental oils, paint and other chemical spills.
- Damages to road surfaces
- Accidental Spillage of waste

Considering the scale of the project, the above impacts are expected to be minor and can be managed through appropriate mitigation actions.

6.3.4 Impacts on land

The major impacts anticipated on land environment during construction phase are as follows:

- Operation of construction equipment
- Soil erosion
- Disposal of construction waste
- Impacts due to temporary closure of roads

Operation of construction equipment

During construction phase, various types of equipment will be brought to the site. These include concrete mixers, earth movers, mixers, graders, etc. The siting of this construction equipment would require significant amount of space. Similarly, space will be required for storing of various types of construction material as well. Efforts must be made for proper siting of these facilities. Efforts must be made to site the contractor’s working space in such a way that the adverse impacts on environment are minimal.

Soil erosion

If excavation and foundation works are undertaken during the rainy season, rainwater runoff could cause unloading of the sand, which in turn will weaken structures standing on them.
Therefore, it would be necessary to plan foundation works in such a way that soil erosion due to rainwater runoff can be minimized. Thus, ideally the works should be planned at period where there is no significant rain.

The runoff from the construction sites will tend to flow along with natural drainage, and get accumulated in depressions or low lying areas, leading to formation of stagnant pools of water. This can lead to increased proliferation of mosquitoes. Another instance of mosquito proliferation reported in Mustafa (2013) is when the elevator pit is left for mosquitoes to breed. Hence, it is important to ensure that the runoff from construction sites is properly collected and disposed. Adequate measures need to be implemented to ameliorate the adverse impact on this account to the extent possible.

**Disposal of construction waste**

The waste material generated during construction phase needs to be appropriately disposed. A part of the construction waste can be used for restoration of the construction site, including excavated soil. The remedial measures have been identified in chapter 8 under mitigation measures.

Due consideration will be given for waste storage at the construction site such that it doesn’t cause any hindrance to local movement and daily routine of the workforce within the site. Stockpiles will be covered to protect from dust and erosion.

It would be necessary for the contractor to dispose construction waste at the Construction Waste Disposal Site in the southeast of Malé on a regular basis during demolition as well as construction. Sadly, construction waste disposal site in Malé is a hazard in itself, however, remedial measures for construction waste management at disposal site is beyond the scope of the EIA report.

**Impacts due to temporary closure of roads**

As the project site is located quite close to the Artificial Beach, Boduthakuruwaanu Magu and Majeedhee Magu that has many shops, cafes and restaurants, temporary road closure may impact traffic follows and daily activities of the people using these places. However, there are no major government office buildings, universities, schools or mosques at the vicinity of the project site and the site is not located on a major road, so the forgoing is the only cause of concern.
The Artificial Beach, restaurants and cafes in this area are most frequently visited during the evening, after official working hours. Therefore, careful consideration must be given to not coincide the timing of road closure to fall during this period. Any impact related to road closure is nevertheless expected to be negligible as this is not a major road frequented by people to access nearby shops, restaurants and cafes. Moreover, many other roads provide adequate access from Boduthakurufaanu Magu and to Majeedhee Magu. Therefore, no significant impacts are envisaged due to road closure, while any impact envisaged is only short-term.

6.3.5 Ambient Air

Dust is a cause for concern in building projects in residential areas and areas with public institutions such as schools. Research has shown that fine dust particles from cement, aggregate, silicates and wood can cause a variety of illnesses such as allergies, asthma and bronchitis and have also been linked to cancer in case of long term exposure. Sensitive individuals such as those with asthma or sinusitis will be affected most during construction activities. In the Maldives, fine cement dust from finishing works for interior of walls (sanding) is one of the main causes for concern in building projects. Cutting tiles in tiling is another dusty operation. Wet processes are available, however, may be cost-prohibitive.

Like high background noise, high background dust, compared to other islands in the Maldives, is an everyday phenomenon in Malé due to increasing number of construction activities occurring concurrently in a given area at a given time. The dust from the proposed construction work is not going to be any worse than the everyday dust that people may be prone to. However, on-site carpentry or aluminium works and other similar works shall be avoided to the greatest possible extent by installing precast-units. If necessary, such dusty operations shall be undertaken in confined space with appropriate personal protective equipment provided to personnel. Pre-fabricated doors and windows shall be encouraged. Good engineering standards, quality materials and material preservatives as well as paint shall be used in order to avoid release of toxic substances during the operational phase.

Transportation of material to site will also generate sand or silica dust while the operation of construction equipment/machinery on site and vehicles used for transport will generate soot and air pollutants, mainly carbon dioxide, sulphur dioxide and nitrogen dioxide, which contributes to global warming and subsequent climate change. In addition, incomplete
combustion can lead to release of carbon monoxide and hydrocarbons. Hydrocarbons can react with oxides of nitrogen to form ozone. Carbon monoxide reduces flow of oxygen in blood stream and ozone is an irritant that can cause respiratory illnesses. However, the proposed projects will use mainly manual labour and use of machinery and vehicles will be limited mainly to concrete works and transport. Therefore, emissions due to the project is considered to be minimal although there will be some cumulative contribution from the project towards overall emissions. Hence overall, no significant impact on ambient air quality is expected. The size of the project being small, the impact due to fuel for energy is not a significant contribution to global warming by itself. However, the cumulative impact shall be considered to be minor to negligible.

6.3.6 Ambient Noise

The impacts on ambient noise levels are expected only during the project construction phase, due to demolition works and the operation of construction equipment and electric tools.

Noise levels in the immediate proximity of most work sites are expected to be only slightly higher during construction. This is because of the high background noise levels in Malé. The duration of this exposure will also be relatively brief. This exposure represents temporary, localized, minor adverse residual effect of low significance for affected receptors. While building damage due to ground vibrations is unlikely, there may be annoyance to spatially located receptors during construction. Noise levels associated with the operation of construction equipment will be minor as civil works will be confined in relatively small sites and use of machinery is expected to be minimal at all worksites.

Walls of various houses or other structure will attenuate at least 30 dB(A) of noise. In addition there is noise attenuation due to the following factors.

- Air absorption
- Rain
- Atmospheric inhomogeneties

As construction works of many other building projects are currently progressing at the proximity of the site (such as Thulusdhooge and Veymuiy Villa), and as Majeedhee Magu and Boduthakuruvaanu Magu are busy roads, the background noise level at this area is already quite high. Thus, no significant increase in noise levels are anticipated, due to already high background noise levels at Malé.
The effect of high noise levels on the operating personnel may be considered. It is known that continuous exposures to high noise levels above 90dB(A) affects the hearing acuity of the workers/operators and hence, should be avoided. Despite this, during the construction phase the generation of significant noise will be for fairly short periods during operation of certain machinery and equipment, thus the impact is likely to be only minor. Noise pollution can also indirectly impact the quality and accuracy of work, as exposure to high levels of continuous noise can trigger anger, disappointment, depression, anxiety, distraction, agitation and exhaustion (Berglund et al., 1999). However, there are no schools, universities, government offices or mosques located at the vicinity of the project site. Moreover, most of the construction works are expected to occur during day time when most people will be away at work or in schools. Therefore, this development activity will have no bearing on the quality of work due to increased noise levels. Appropriate mitigation measure will be adhered to prevent construction workers from getting exposed to prolonged periods of high noise levels during the construction phase.

6.3.7 Ecology

No significant impacts are likely to occur as a result of the project from an Ecological sense as the site is completely devoid of any flora and fauna. However ecological impacts may occur during transfer of construction material and waste during construction phase. A degree of sea transport is likely to be involved as material stored in warehouses in Thilafushi and HulhuMalé are likely to be transported to Malé for construction. This transport if appropriate measures are not taken can lead to spillage into sea and impact on marine life. Thus, as highlighted in chapter 8 appropriate measures need to be taken to ensure that sea transport vessels have appropriate safety measures in place and all transported materials are sealed and secured such that no spillage into ocean occurs. Spillage can also occur during land transport, however the impact is likely to be much less significant from an ecological point of view, as in terms of land ecology Malé is devoid of any significant flora or fauna.

6.3.8 Cultural Property

There are no impacts on any sites or property of religious, historical and/or cultural significance as a result of this project, hence this impact is none existent for this project.
6.3.9 Impacts on Utilities

No significant adverse impact on utilities is envisaged. There will not be a significant change in number of users of utility services during construction phase. However, during excavation if proper precaution is not taken it can lead to damage to existing utility cables and pipes. Moreover, according to Zahir (2010), during dewatering, it is important to monitor toilets of adjacent buildings to ensure that flow rate is not excessive so as to exceed capacity of the sewers since dewatering effluent is direct into the sewerage system. According to some engineers if rate of flow exceeds the capacity of discharge pipes back flow could occur in toilets at nearby plots. Therefore, it would be important to keep track of such incidents and to immediately stop pumping or reduce speed if backflow is observed or reported. However, as highlighted under project description, sewer pipes will not be used for dewatering, hence this impact is none existent.

6.3.10 Socio-Economic Environment

There are a few minor negative socio-economic impacts of little or no significance during the construction phase. These include the disturbance to vehicular and pedestrian movements during loading and unloading of materials to site, especially during the concrete works. Moreover, there are no major disturbances envisaged due to road closure as many other roads provide adequate access to nearby areas. Noise from construction equipment, which has been discussed earlier, poses no potential concerns.

There is also potential for impact due to cultural differences with foreign labour force, which is not a cause for concern due to the small labour requirement for the project as well as the fact that the community is already socially integrated and generally tolerant of people from other cultures. Malé hosts the largest no. of foreign labour force. Therefore, this impact is considered negligible.

The construction phase of the project is expected to increase employment opportunities in the construction sector. However, most of the current construction workforce is largely devoid of locals as such workers are mostly foreign expatriates. Nevertheless, the project will provide direct and indirect employment opportunities for locals and in terms of provision of goods and services during project implementation. This is considered as a major positive impact of the project.
6.4 Project Specific Impacts during Operational Phase

6.4.1 Land

No major impacts are anticipated on land environment during project operation phase. The adjoining 3 buildings to the East, West and South side of the proposed development are currently 3 storey buildings. However, there are many other high rise buildings being developed close to the project site such as Veymuy Villa directly opposite to the development and Thulusdhooge towards the west, both of which are 10 storey buildings. The construction works of these two buildings have already commenced, hence it is expected that these two buildings will be completed by the time the construction works of the proposed building is complete. Therefore, proposed building is expected to harmonize well with the surrounding neighbourhood. Furthermore, it is anticipated that the new building will have some landscaping the responsibility of which will be carried on to the operational phase. This is expected to improve the overall aesthetics of the area.

The operation of the proposed developed is expected to increase the demand for parking, as more people will occupy the premise than at present. The parking area proposed at the basement level of the building is considered sufficient to accommodate any additional parking demands.

6.4.2 Energy

The operational phase of the proposed development will slightly increase the energy usage, as more people are expected to occupy the premise. Increase in energy use will be in terms of increased use of air-conditioning, fans, lights and other appliances. However, this increase has no significant bearing on the overall power requirement within the Malé region. The generators currently operated by STELCO is designed to cater for the increased demand in energy requirement anticipated due to current construction boom. Thus, there will not be a need to increase the existing capacity of the diesel generator sets in Malé. The impacts of emissions related to burning of fossil fuel due to this increase in energy consumption would be minor.

6.4.3 Ambient Noise

No major impacts are anticipated on noise environment during the operational phase.
6.4.4 **Ecology**

No major adverse impacts are anticipated on ecology during operation phase.

6.4.5 **Socio-economic impacts**

As one third of the entire population of the Maldives reside in Malé, the proposed development will assist in alleviating the housing problem experienced by many people living in the capital city. Overall, this development will contribute to the enhancement of the living condition, minimization of congestion, improvement of aesthetics of the living environment and to improve general health and wellbeing of the population. Moreover, the development is expected to increase the land value of the project site and provide direct and indirect economic opportunities. By reducing the pressure on housing demand and providing competition in the real-estate market, the project will also indirectly contribute to maintain the real-estate value of such properties and ensure that the value of rent, which is already high, does not escalate further. There would also be indirect economic growth and state revenue from taxation.

6.4.6 **Utilities**

No significant impact on existing water supply, sewerage, power systems and waste management system as the number of users will change little, if any.

6.5 **Uncertainties in Impact Prediction**

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. However, the level of uncertainty, in the case of the proposed infrastructure project may be expected to be low due to the experience of similar projects in Malé. Given that there may be uncertainties in terms of structural failures of neighbouring structures as well as potential claims of damage or nuisances such as availability of groundwater during the dewatering period, it is important to undertake monitoring as described in the monitoring programme given in this EIA report.
7 Alternatives

The project is of small scale and the project components are of suitable nature to the project. However, an important component of all EIAs is to consider alternative options that are feasible and to come up with the best possible alternative. This includes consideration of no project option as well. As for this project, two aspects are investigated with regards to alternatives that is the no project option and alternative foundation option.

7.1 No Project Option

The ‘no project’ option investigates the advantages and disadvantages of status quo when compared with the project option. In the case of the proposed project ‘no project’ option means that the existing old household of the proponent with limited capacity remains and hence the living condition of the proponent will not increase. However, this option will prevent the minor negative impacts that are envisioned for the construction phase. Despite this as highlighted in detail below, the overall the project is beneficial and the ‘no project’ option has far more disadvantages than advantages.

Table 7-1 Comparative analysis of project and ‘no project’ option

<table>
<thead>
<tr>
<th>Advantages of “no project” option</th>
<th>Disadvantages of “no project” option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary construction related impacts will not occur</td>
<td>Living space of the proponent is reduced. Proponent has to live in the existing difficult condition.</td>
</tr>
<tr>
<td></td>
<td>Possibility of existing old building collapsing due to age.</td>
</tr>
<tr>
<td></td>
<td>Loss of revenue to the proponent from renting of residential and commercial space.</td>
</tr>
<tr>
<td></td>
<td>Improved aesthetics as a result of the project will not be realized.</td>
</tr>
<tr>
<td></td>
<td>Parking space for the residents of the building as a result of the project will not be realized.</td>
</tr>
</tbody>
</table>

7.2 Type of Foundation

In addition to ‘no project’ option, considering the fact that EIA for building projects are required primarily due to impacts during foundation works, it is important to look into alternative foundation options. The alternative method of foundation would be to opt for deep pile foundation. In this method, metal load-bearing piles are driven to depths of 30 to 40 metres. Deep Pile Foundation was undertaken in Male for the 15-storey building at Athireege.
Aage (Currently Hotel Jen). Complaints of small degree tremors and cracks in walls were observed in neighbouring buildings including Dharumavantha School opposite the building. The piling had already been almost completed by the time the issues were addressed and EIA was undertaken. So, the project was allowed to proceed. However, based on the outcomes and experience from this project, deep pile driving for building foundation has been disregarded in most similar building projects ever since. Only recently this was considered for part of the building works required for the Nasandhura development. However, the method of pile driving used for Nasandhura building is different to that practiced in Athireege Aage, as instead of hammering the piles, piles are place in pre-drilled holes. Despite this, the drilling involved in the Nasandhura project, has also caused public concern due to vibrations experienced by the nearby buildings. Nevertheless, this method is feasible for foundations in less urban areas and in countries with more compact and stable soil and hence is not recommended for the proposed project.
8 Impact Mitigation and Management

8.1 Introduction

Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this Chapter outlines the mitigation measures that needs to be adopted in order to minimize the potential negative impacts to a low significance level. As highlighted in in Chapter 6 under impacts, the negative impacts are envisioned to occur almost exclusively during the construction stage. Thus, the focus of impact management and mitigation is on the construction phase of the project. As highlighted in Chapter 6, the main impacts that are likely to occur during construction phase are related to groundwater quality, air quality, noise, marine ecology, hazard to nearby buildings, health and safety, traffic disruptions and utilities. Thus this chapter focuses primarily on mitigation measures for these eight aspects.

A detailed explanation of the proposed mitigation measures are provided at first, followed by a summary table that outlines the impacts, mitigation measures, parties responsible for implementation of mitigation measures and the estimated cost of mitigation.

8.2 Mitigation Measures

This chapter explains mitigation measures in detail. As highlighted above the focus is on construction phase, as no negative impacts are envisioned to occur as a result of this project during operational phase.

8.2.1 Groundwater Quality

Groundwater quality of the site and surrounding houses maybe affected due to spillage during transfer of construction material to the site or during waste transportation, damage to sewer lines while undertaking excavation works, and through dewatering. Most of the impacts to groundwater are envisioned to occur during excavation and dewatering. Therefore, the following mitigation measures must be strictly adhered during the construction phase.

- All chemicals used for construction such as paints, lubricants and oils must be stored in hard surfaces to prevent seepage into the water lens in case of a spillage.
- All liquids to be used in the construction phase must be transported to the site in sealed container to prevent spillage during transportation.
- Construction waste must be covered from all sides to prevent spillage while transferring to the waste collection yard.
- Hazardous waste and liquid waste must be transported in sealed containers and according to the guidelines specified in the waste regulation.
- Ensure that the vehicles used for waste transportation are approved thorough the waste regulation.
- The location of sewer lines must be identified prior to commencement of excavation works to prevent damage to sewer lines and potential leakage of sewage into the groundwater lens.
- Dewatering must be completed at the shortest possible time to minimise impacts on groundwater.
- Excavation must be undertaken by expert operators, under the supervisor of a licensed engineer.
- A compensation plan must be developed to accommodate for a worst case scenario. Such a plan should include measures to provide water to nearby households to compensate for any shortage of water experienced during dewatering.
- Onsite refuelling and maintenance of machinery should be avoided at all times.

8.2.2 Air Quality

Air quality of the surrounding areas may be impacted during the construction phase as the overall construction process itself is a dusty operation. The vehicles used to transport materials to and from the site may also induce air pollution to a small degree. The following mitigation measures are proposed to minimise such impacts of the project.

- Avoid usage of old vehicles for transporting materials to and from the project site. The project should only consider vehicles that are well serviced and have up to date road worthiness certificates.
- The construction site should be watered regularly to minimize the impact of dust nuisance to neighbours.
- Cover the construction site as much as possible (by using nets) to minimize spreading out of dust.
• Activities like tile cutting must be undertaken indoor as much as possible. Prefabricated doors and windows should be used as much as possible to minimise spreading out of dust.

• Avoid keeping construction material in open air. If any material is stockpiled ensure that they are properly covered.

• All vehicles and machinery should be well tuned.

8.2.3 Ambient Noise

The operation of heavy machinery and vehicles during construction and demolition works may lead to increased noise levels. The following mitigation measure must be followed to minimise the impact of noise.

• Except for foundation and concrete works, other high noise generating activities should be undertaken during day time.

• Instruct construction workers to wear ear muffs when using machinery that produce significant noise.

8.2.4 Marine Ecology

Only minute impacts are envisaged for marine ecology due to a spillage into sea during material and waste transfer. However, a spillage to marine environment can be catastrophic to the aquatic biota, including coral reefs. Hence, the following mitigation measures are required to be implemented to minimize such impacts.

• Ensure that the transport vessels are well covered from all side.

• Waste must be transported according to the specifications given in the waste regulation. The vessels used for waste transportation should acquire the required licences through the waste regulation.

• All liquid oils and paints must be transported in sealed containers.

• All transport vessels shall be operated by experienced captains to reduce the potential for accidents.
8.2.5 **Hazard to nearby buildings**

The main reason for requiring EIA for building projects is to minimise the extent of structural damage done to nearby buildings. Potential for such damages are high during excavation and foundation works. Therefore, it is very important to adhere the mitigation measures proposed.

- Excavation will be closely supervised by an experienced engineer.
- Excavations shall conform to the lines, grades, side slopes and levels shown in the drawings or as directed by the engineer.
- Adjacent buildings will be monitored for cracks by a licensed engineer prior to commencement of excavation works and after foundation works are complete.
- Compensation in terms of finance or maintenance and repair will be provided to adjacent buildings in case of structural damage.

8.2.6 **Health and Safety**

Protecting the health and safety of the public and workers is a very important component of building project. In this regard, the following mitigation measures needs to be considered from a health and safety perspective:

- Necessary barriers, warnings, signs demarcating unsafe areas should be followed according to standard construction practices.
- Where relevant, safety nets should be used to cover buildings and prevent injury to public. Safety paths should be identified for public movements.
- Provide first aid facilities in case of an emergency and safety protocols during such event.
- Aluminum and wood works at site shall be supervised and workers informed of the necessity to take care when using tools such as electric cut-offs.
- Contractor shall be required to comply with all the precautions as required for the safety of the workers as per the International Labour Organization (ILO) Convention No. 62 as far as those are applicable to the contract.
- Provide necessary safety appliances such as protective footwear, cloth gloves, safety goggles for welders, helmets, masks, ear muffs for operation of noisy machinery etc to the workers and staff.
- Chemical-Liquid protective gloves should be used when handling any chemicals, waste oil or other liquid waste.
• Should install temporary toilet facilities at the construction site for construction workers.
• During construction period, any visitors could enter the site with the approval of the project supervisor. Unauthorized visitors should not be permitted to the project site.
• The construction area should be secured to prevent unauthorized access.
• No open electrical wiring or cables should be kept on site.
• Health and Safety briefing should be given to all construction workers.
• In order to guarantee construction safety, efficient lighting and safety signs shall be installed during construction.
• All temporary structures need to be dismantled once construction is completed.
• Avoid leaving pits, holes open empty containers at the constructions site. As these act as potential locations for mosquito breeding.
• Ensure 24-hour security at the construction site to prevent burglary of nearby buildings.

8.2.7 Traffic Disruptions

Since the project is not located in a major road, no major traffic disruptions are envisaged. However, since the site is close to many areas frequently used by the general public, appropriate measure needs to be considered to prevent traffic congestion. In this regard, the following mitigation measure needs to be implemented.

• Construction material should be transported to and from the site during off peak hours.
• Road closure should be avoided as much as possible and should be to the shortest possible period. Must avoid road closure during peak hours. This area is most heavily used during evening hours, so road closure must be avoided at such times.

8.2.8 Utilities

As highlighted in chapter 6 utilities can be affected during construction phase as utility lines and pipes maybe damaged during excavation works. Moreover, if dewatering is undertaken through the existing sewer pipes it can lead to backflow in toilets of nearby buildings. In order to prevent these scenarios, the following mitigation measures needs to be realised:

• Excavation works needs to be undertaken by experienced operators.
• All utility lines and pipes needs to be identified prior to excavation.
8.2.9 **Responsibility**

The primary responsibility of implementing these mitigation measures lie with the proponent and the contractor. However, it is the task of the proponent to ensure that the contractor is fully aware of the mitigation measures and the measures are adequately implemented. Moreover, as per the recent revision to the EIA regulations it is must to have the EIA report and the decision statement at the site with the contractor. Hence the proponent should ensure that this condition is met by the contractor.

The proponent should assign a suitably qualified person to oversee the project implementation by the contractor. This person needs to be thorough with the requirements specified in this EIA report and needs to brief the contractor and its staff on these requirements. Alternatively, the proponent could assign a consultant to undertake this activity.

In addition to this, the proponent should ensure that any grievances from nearby residents could be easily communicated with the contractor and the proponent. In this regard, a board displaying the contact information of the proponent and the contractor should be placed at the site. Addressing social grievances are one of the weakest implemented systems in the Maldives EIA process.

### 8.3 Summary of Mitigation Measures

The table below summarizes the main impacts of the project, proposed mitigation measures, responsible party for implementation of mitigation measures and the cost of mitigation measures.
Table 8-1: Summary table of environmental impacts and mitigation measures

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Impact</th>
<th>Mitigation Measures</th>
<th>Responsible Party</th>
<th>Cost of Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground water Quality</td>
<td>Spillage of oils into the ground during refueling and maintenance of machinery may enter the water lens and cause groundwater pollution. Spillage of construction material and waste at construction site and during transportation may impact groundwater quality of the site and surrounding areas. Groundwater salinization due to dewatering. Decrease in water levels of nearby groundwater wells during dewatering. Damage to sewer lines during excavation may cause sewage to enter into groundwater.</td>
<td>All chemicals used for construction such as paints, lubricants and oils will be stored in hard surfaces to prevent seepage into the water lens. All liquids to be used in the construction phase will be transported to the site in sealed container to prevent spillage during transportation. Construction waste will be covered from all sides to prevent spillage while transferring to the waste yard. Hazardous waste and liquid waste will be transported in sealed container according to the guidelines specified in the waste regulation. Vehicles used for waste transportation will be designed to the specification given in the waste regulation. Locating the positions of sewer lines and giving instructions to workers about these locations prior to commencement of work.</td>
<td>Proponent/Contractor</td>
<td>No potential costs involved in implementing these measures.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Proponent/Contractor</td>
<td>Proponent: Hassan Mughnee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation of dust during construction may cause health implications to neighbours.</td>
<td>Avoid usage of old vehicles. The project should only use well serviced vehicles that have up to date road worthiness certificates.</td>
<td>No potential costs associated with implementation of these mitigation measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generation of dust from the stockpiled construction material.</td>
<td>Regularly water the construction site to minimize the impact of dust nuisance to neighbours.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pollution from the vehicles used for transporting materials to the site and transfer of waste to disposal sites.</td>
<td>Cover the construction site with nets to minimize dust spreading out to surrounding areas.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenhouse gas emissions and dust from vehicles used in the project.</td>
<td>Undertake construction activities like tile cutting indoors as much as possible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission of carbon monoxide and hydrocarbons due to incomplete combustion.</td>
<td>Avoid keeping construction material in open air. If any material is stockpiled ensure that they are properly covered.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ambient Noise</strong></td>
<td>Disturbance to nearby residents from construction noise. Noise pollution to workers.</td>
<td>Avoid undertaking construction activities during night time, except for foundation and concrete works. Instruct construction workers to wear ear muffs when using machinery that produce significant noise.</td>
<td>Proponent/Contractor</td>
<td>No potential costs associated with implementation of these mitigation measures</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Marine Ecology</strong></td>
<td>Spillage of construction material and waste to sea during transport to and from Male.</td>
<td>Ensure that the transport vessels are well covered from all side. Waste will be transported according to the specifications given in the waste regulation. The vessels used for waste transportation should acquire the required licences through the waste regulation. All liquid oils and paints will be transported in sealed containers. All transport vessels will be operated by experienced captains to reduce the potential for accidents.</td>
<td>Proponent/Contractor</td>
<td>No potential costs associated with implementing these mitigation measures.</td>
</tr>
<tr>
<td><strong>Hazard to nearby buildings</strong></td>
<td>Structural damage to nearby buildings during excavation works and foundation works.</td>
<td>Excavation will be closely supervised by an experienced engineer.</td>
<td>Proponent/Contractor</td>
<td>MVR 30,000 for the engineering assessment.</td>
</tr>
</tbody>
</table>
Excavations shall conform to the lines, grades, side slopes and levels shown in the drawings or as directed by the engineer.

Adjacent buildings will be monitored for cracks by a licensed engineer prior to commencement of excavation works and after foundation works are complete.

Compensation in terms of finance or maintenance and repair will be provided to adjacent buildings in case of structural damage.

| Health and Safety | Necessary barriers, warnings, signs demarcating unsafe areas should be followed according to standard construction practices. Where relevant, safety nets should be used to cover buildings and prevent injury to public. Safety paths should be identified for public movements. Provide first aid facilities in case of an emergency and safety protocols during such event. | Contractor | No additional costs are envisioned to occur as these are standard safety measures |
| Health and Safety | Health and safety of construction staff will be compromised if appropriate health and safety standards are not followed. Health and safety of the public compromised due to inappropriate safety conditions at the construction site. | | |
Aluminum and wood works at site shall be supervised and workers informed of the necessity to take care when using tools such as electric cut-offs.

Contractor shall be required to comply with all the precautions as required for the safety of the workers as per the International Labour Organization (ILO) Convention No. 62 as far as those are applicable to the contract.

Provide necessary safety appliances such as protective footwear, cloth gloves, safety goggles for welders, helmets, masks, ear muffs for operation of noisy machinery etc to the workers and staff.

Chemical-Liquid protective gloves should be used when handling any chemicals, waste oil or other liquid waste.

Should install temporary toilet facilities at the construction site for construction workers.

During construction period, any visitors could enter the site with the approval of the project supervisor. Unauthorized visitors should not be permitted to the
The construction area should be secured to prevent unauthorized access.

No open electrical wiring or cables should be kept on site.

Health and Safety briefing should be given to all construction workers.

In order to guarantee construction safety, efficient lighting and safety signs shall be installed during construction.

All temporary structures need to be dismantled once construction is completed.

Avoid leaving pits, holes open empty containers at the construction site. As these act as potential locations for mosquito breeding.

Ensure 24-hour security at the construction site to prevent burglary of nearby buildings.

| Traffic Disruptions | Traffic disruption due to road closure and during loading and unloading of construction material. | Construction material should be transported to and from the site during off peak hours. | Proponent/Contractor | No additional cost likely to occur |
be to the shortest possible period. Must avoid road closure during peak hours.

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Utility pipes, lines maybe damaged during excavation. Backflow of water in toilets nearby due to dewatering.</th>
<th>Excavation works needs to be undertaken by experienced operators. All utility lines and pipes needs to be identified prior to excavation. Do not use sewer pipe for dewatering.</th>
<th>Contractor</th>
<th>No additional cost likely to occur.</th>
</tr>
</thead>
</table>
9 Monitoring

This chapter contains the monitoring plan recommended for the project. The monitoring plan is based on the baseline data collected for existing environment, potential impacts identified in chapter 6 and mitigation measures proposed in chapter 8.

The primary objective of including a monitoring plan in the EIA is to determine the accuracy of the predicted impacts and also to check whether the proposed mitigation measures have been adequately followed according to the recommendations given in the EIA. Moreover, implementation of the proposed mitigation measures do not necessarily mean that all negative impacts of the project are avoided, as any development activity would involve a certain degree of uncertainty. In this regard, another important aspect of the monitoring plan is its potency to discern unforeseen impacts. Furthermore, information collected during monitoring can be used for future references in other EIAs of similar projects, leading to overall improvement of the EIA process.

Monitoring would essentially ensure that the proposed activities are undertaken with caution and appropriative care to protect and preserve the built environment of the areas in proximity to the site or those areas and environmental aspects affected by the development.

The monitoring programme shall target to determine:

- foundation and structural integrity of adjacent buildings during excavation and dewatering
- changes in groundwater table due to dewatering
- groundwater quality during dewatering
- noise and air quality during construction
- incidents and accidents
- impacts are accurate and mitigation measures taken are effective and
- threshold levels are kept within the baseline limits predicted.

9.1 Responsibilities

Overall monitoring responsibility lies with the Proponent or Contractor assigned by the Proponent. EPA and City Council should also monitor the construction activities.
9.2 Project specific monitoring requirements

A project specific monitoring programme has been developed by taking in to account the parameters highlighted in the forgoing section. For each parameter, sample locations, monitoring method, frequency, monitoring responsibilities and cost is indicated. The overall cost of monitoring is estimated to be around MvR 70,000.

Table 9-1 provides the monitoring programme recommended for this project. As all the negative impacts identified for the proposed development are envisaged to occur during the construction phase, this monitoring plan is exclusively targeted for the construction phase of the project.

<table>
<thead>
<tr>
<th>Parameters to be Monitored</th>
<th>Location/ Parameters</th>
<th>Monitoring Method</th>
<th>Frequency</th>
<th>Monitoring Responsibility</th>
<th>Cost (MVR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural damages and dewatering</td>
<td>30m radius of project site. Complaints of structural damages, groundwater deterioration mainly, vibration, noise and air quality related issues rarely</td>
<td>Records of complaints Structural engineer to inspect excavation and dewatering works and keep logs on site. Records of start and end times of relevant works Assess structural damages to adjacent building by a licensed engineer prior to start of work and upon completion of work</td>
<td>Daily during excavation and dewatering And after completion of foundation works</td>
<td>Licensed Engineer/ Proponent</td>
<td>30,000</td>
</tr>
<tr>
<td>Groundwater quality for salinization due to dewatering</td>
<td>2 samples in areas adjacent to project site. Parameters to be monitored include pH, TDS/electrical conductivity/DO, level of water table</td>
<td>In-situ sampling using water quality logger and measurement of level of groundwater wells</td>
<td>Daily during dewatering</td>
<td>Proponent/ Contractor</td>
<td>20,000</td>
</tr>
<tr>
<td>Dust and noise nuisance at site</td>
<td>Construction sites and surrounding areas</td>
<td>Assess the situation through visual inspection and interviews with local people. Take noise reading using a noise level meter</td>
<td>Once a month (noise readings should be taken during peak and off peak hours)</td>
<td>Proponent/ Contractor</td>
<td>20,000</td>
</tr>
</tbody>
</table>
### Parameters to be Monitored

<table>
<thead>
<tr>
<th>Parameters to be Monitored</th>
<th>Location/ Parameters</th>
<th>Monitoring Method</th>
<th>Frequency</th>
<th>Monitoring Responsibility</th>
<th>Cost (MVR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste removal including excavated sand</td>
<td>Complaints received regarding traffic disruptions. Observation of traffic disruption.</td>
<td>Site observations</td>
<td>During road closure</td>
<td>Proponent/ Contractor</td>
<td>0</td>
</tr>
<tr>
<td>Disruption to traffic flow</td>
<td>Roads</td>
<td>Site observations/logs</td>
<td>Weekly</td>
<td>Proponent/ Contractor</td>
<td>0</td>
</tr>
<tr>
<td>Ensuring that workers wear Personal Protective Equipment</td>
<td>Project site</td>
<td>Site observation and records</td>
<td>Monthly</td>
<td>Proponent/ Contractor</td>
<td>0</td>
</tr>
</tbody>
</table>

### 9.3 Monitoring Report

A detailed environmental monitoring report is required to be compiled and submitted to the Environment Protection Agency annually, based on the data collected for monitoring the parameters included in the monitoring programme given in this report. EPA may submit the report to the relevant Government agencies in order to demonstrate compliance of the Proponent.

#### 9.3.1 Monitoring report submission format and schedule

The monitoring report shall be submitted in accordance to the requirements of the EIA Regulations 2012. As per Schedule (Jadhuvalu) Laamu of the regulations, summary reports needs to be submitted every two months during construction phase and detailed report or reports after project completion as per the schedule identified in the EIA report. In this regard for this project, it is recommended to submit only one monitoring detailed report following completion of construction as no impacts are envisioned to occur during the operational phase of the project.

The monitoring report will include details of the site, strategy of data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. It will follow the recommended format under Schedule Laamu of the regulation.
10 Conclusions

The proposed project involves construction of 10-storey residential building at Sandhaleege, Henveyru, Burevi Magu, Malé. The project is undertaken to provide personal residential space for the proponent and to provide, rental residential, commercial and office space.

The negative impacts envisioned for the project are likely to occur during construction phase and all these impacts are minor in significant. The main impacts identified in this report relate to impacts on nearby buildings, impacts on traffic, impacts on groundwater, impacts on air quality, noise impacts and impacts on utility services. All these impacts can be minimized to negligible levels by adopting the mitigation measures proposed in this report and by following proper construction standards and supervision.

The environmental monitoring program proposed in this report will help to identify actual impacts of the project and effectiveness of the proposed mitigation measures. Moreover, it will help to identify potential unforeseeable impacts and help to take corrective measures immediately. The focus of the monitoring program is on the construction phase and monitoring is proposed to aspects that are likely to be impacted as a result of the proposed project; that is groundwater, noise, impact on nearby buildings and traffic.

Overall this is a very small project with only minor negative impacts. All in all, the project is a beneficial project that is financially beneficial to the proponent.
11 Acknowledgements

Thanks to Hamdhan Zuhair for co-authoring this document. Special thanks to Mohamed Visham for assisting in data collection, data entry and mapping.

The assistance provided the Proponent, Mr. Hassan Mughnee in timely provision of information and for attending the Scoping Meeting with the Consultant as well as for reviewing the information provided in this document.
12 References

AECOM and Water Solution (2010), *Social and Environmental Impact Assessment for Modernization of Malé International Airport*, Malé, AECOM.

Horodecki, G.A. and Dembicki, E. (2012), *Impact of deep excavation on nearby urban area*


MEE (2013), *Dewatering Regulation of the Maldives* (Regulation No. 2013/R-1697)


MHE (2010), *Fourth National Report to the Convention on Biological Diversity*, Maldives

MHI (2014), *Dhivehiraajjejeyge imaaraaicy kurumaai umraanee tharaggeyge bill (Draft Building Act)*, Maldives

Ministry of Housing, Transport and Environment (2009), *Maldives National Sustainable Development Strategy*, Maldives


Musthafa, A. (2013), *EIA for proposed 14-storey building at G. Hudhukokaa*, Malé


Saeed, S., *Environmental monitoring report for the 11-storey building at Jambugasdhoshuge*, Malé, CDE

Saeed, S., *Environmental monitoring report for the 11-storey residential building at Husham Residence*, Malé, CDE
Saeed, S., *Environmental monitoring report for the 11-storey residential building at M. Mulammaage, Malé, CDE*

Sandcays (2015a), *EIA for proposed multi-storey building at H. Del Rio*

Sandcays (2015b), *EIA for proposed multi-storey building at H. Point Villa*

Sandcays (2014), *EIA for proposed multi-storey building at H. Marvel*

Sandcays (2016), EIA for development of 13-Storey building at H. Blue Haven

UNDP (2006) *Developing a Disaster Risk Profile of the Maldives*, UNDP, Malé, Maldives

Zahir, H. (2011), *EIA for construction of a 10-storey building with basement at G. Javaahiru Asseyri, Malé, LaMer*


13 Appendices

Appendix 1: Approved Terms of Reference

Appendix 2: Proponent Commitment Letter

Appendix 3: Receipt from Malé City Council of final draft EIA report

Appendix 4: Building permit

Appendix 5: Foundation protection plan

Appendix 6: Design details

Appendix 7: Construction Schedule
Terms of Reference for Environmental Impact Assessment for the Proposed Multi-storey Building at H. Sandhaleege

The following is the Terms of Reference (ToR) following the scoping meeting held on 22\textsuperscript{nd} November 2016 for undertaking the EIA of the proposed multi-storey building at H. Sandhaleege, Male', K. Male'. The Proponent of the Project is Hassan Mughnee, H. Sandhaleege.

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, modelling 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 and Concrete Works
a) Type of foundation and foundation depth
b) 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
c) Water connection plan
d) Waste management plan during operation

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). 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:

**Physical and biological environment**
- Noise levels in the vicinity of the site including any noise sensitive location;
- Traffic flow (size and direction) around the project site;
- Trees in the project site and major trees around it (if present);
- Water quality of groundwater wells in the vicinity; parameters; pH, salinity, conductivity, TSS, DO
- Indoor and outdoor air quality in the project vicinity

**Structural environment**
- State of adjacent buildings including photographic records of existing damages as baseline reference;
- Condition of the surrounding roads;
- Existing structures/uses of the proposed site;

**Socio-economic environment**
- Demographic data for Malé and population of adjacent buildings;
- Brief description of social environment of Malé in general and adjacent residential units in particular;
- Identify types of vehicles and peak traffic hours in or near the project site.

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

**Task 3. Legislative and regulatory considerations** – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. Legal requirements (but not limited to)

**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 any physical and biological environment
- Impacts on terrestrial flora and fauna from land preparation works, if any;
- Impacts on groundwater table and quality as a result of dewatering and groundwater use;
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment
- Impacts on employment and income such as job opportunities in the construction and operational phase;
- Disturbances to residents and cultural facilities/activities;
- Impacts on transportation/traffic.

Construction related hazards and risks
- Dust and emissions;
- Impacts due to foundation works;
- Weather related hazards and risks;
- Risk of accidents to workers;
- General public health and safety issues.

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

Task 5. Alternatives to Proposed Project – Describe alternatives including “no action option” should be presented. Determine the best practical environmental option. Alternatives examined for the proposed project that would achieve the same objectives including the “no action alternative”. This should include alternative location, construction technologies, taking into account environmental, social and economic factors. The report should highlight how the location was determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Measures for both construction and operation phases shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of the commitment of the developer to implement the proposed mitigation measures shall also be included. An environmental management plan for the proposed project, identifying responsible persons, their duties, and commitments shall also be given. In case where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan during and after completion of the proposed project. Reporting requirements shall be outlined.
baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

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

**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 6 months from the date of this Term of Reference.

---

**Environmental Protection Agency**  
Green Building, 3rd Floor, Handhuvare Hingun  
Male', Rep. of Maldives, 20392  
Tel: [+960] 333 3966 [+960] 333 0851  
Fax: [+]960] 333 5953  
Email: secretariat@epa.gov.mv  
Website: www.epa.gov.mv
Ibrahim Naeem  
Director General  
Environmental Protection Agency  
Maldives

27 November 2016

Dear Sir,

This is in reference to the Environmental Impact Assessment (EIA) for the Proposed Multi-storey building at H. Sundhaleege, Male City.

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

Sincerely yours,

Hassan Mughnee
ARCHITECTURAL CHECKER’S CERTIFICATE
for architectural design compliance - category B1

1. I, Mohamed Shamin being a registered checker, hereby certifies that I have in accordance with Male’ Planning Regulation and other applicable regulations relevant to planning, design and construction of buildings set out by the Government Authorities, have carried out an evaluation and review of the drawings of the building works attached and to the best of my knowledge and belief the drawings do not show any incompliance in the design of the building to be erected or by the works carried out in accordance with those drawings.

2. In arriving at my conclusion, I confirm that I have reviewed and checked the design in accordance with the relevant regulations using the following criteria:

   a. rules and regulations set out by the authorities in relation to building design and construction;
   b. codes of practice adopted in the design;
   c. standards and specifications of materials;
   d. architectural design concept;
   e. architectural detailing;
   f. appropriate checklists set out by the authorities (included with this Certificate);
   g. others specify.....................................................

Plot Name/No: H. Sandhaleege
City/Atoll/Island: K. Male’
Type of Building (use): Residential
Plot Owner’s Name: Akhutarunnisa & Mohamed Hussain Didi

Name of Architect: Mohamed Shamin
Date: 16-10-2016
Reg. Number: BPR2015013B1
Signature:

[Stamp: APPROVED]

[Stamp: Ministry of Housing & Infrastructure]

FOR OFFICIAL USE ONLY
Building Permit No.: ..................................................
Local Authority’s Stamp
Dear Sir, Madam

Please find attached EIA report of H.Sandhaleege.

Regards,

Visham
1. I Hussain Shihan being a registered checker, hereby certifies that I have in accordance with Male’ Planning Regulation and other applicable regulations relevant to planning, design and construction of buildings set out by the Government Authorities, have carried out an evaluation and review of the drawings of the building works attached and to the best of my knowledge and belief the drawings do not show any incompliance in the design of the building to be erected or by the works carried out in accordance with those drawings.

2. In arriving at my conclusion, I confirm that I have reviewed and checked the design in accordance with the building regulations using the following criteria:
   a. Codes of practice adopted in the design;
   b. Including wind load, construction load or dynamic load, (if applicable) checked;
   c. Standards and specifications of structural elements;
   d. Structural design concept and identification of the key structural elements;
   e. Structural analysis and design of all key structural elements including foundation systems;
   f. Stability of structural frame;
   g. Structural detailing;
   h. Others specify.................................

Plot Name/No: H. Sandhaleege  
City/Atoll/Island: K. Male’  
Type of Building (use): Residential  
Plot Owner’s Name: Ms. Akhtarunnisa  
Mr. Mohamed Hussain Didi

Name of Engineer: Hussain Shihan  
Date: 17th October 2016  
Checker’s Reg. Number: BPR2016024A1  
Checker’s Signature: ................................

Ministry of Housing & Infrastructure
ACCREDITED CHECKER
STRUCUTURAL CHECKER A1
Name: Hussain Shihan  
VALIDITY: 04.01.16 - 03.31.17  
Registration No: BPR2016024A1  
A1-2016-004-001

Official Stamp of the Registered Structural Checker

FOR OFFICIAL USE ONLY
Building Permit No.: ..........................................................  
Local Authority’s Stamp

Page 1 of 1
Date: 4th September 2016
Time: 1135Hrs

VISUAL SOIL INSPECTION REPORT FOR
H. SANDHALEEGE

![Diagram showing soil layers and water table](image)

The ground condition from the trial pits dug at H. Sandhaleege revealed that the top layer (700mm) consists of Black sandy soil.

At a depth of −700mm to −1100mm the soil sample consists of Slightly White Sandy Soil and no garbage was encountered.

The Water table is at a depth of −1600mm below the ground level.

The base of the foundation is proposed to be found at a depth of −2750mm, which is below the water table, hence dewatering will be required.

---

Ministry of Housing & Infrastructure

**ACREDITED CHECKER A1**

Name: Hussain Shihan

Registration No: BDR2016072A1

Hussain Shihan

Civil/Structural Engineer

BDR2016071E
PROPOSED EXCAVATION AND EARTH PROTECTION METHOD

PROJECT: PROPOSED 10 STOREY BUILDING AT H. SANDHALEEGE

DATE: 16TH OCTOBER 2016

<table>
<thead>
<tr>
<th>PROPOSED DEPTH OF FOUNDATION</th>
<th>2750MM FROM GROUND LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAILS OF THE NEIGHBOURING BUILDING</td>
<td>AS SHOWN ON SITE PLAN (DRAWING NO: 1)</td>
</tr>
<tr>
<td>DETAILS OF THE FOUNDATION OF NEIGHBOURING BUILDINGS</td>
<td>PRESENTLY NO INFORMATION IS AVAILABLE ABOUT THE FOUNDATION OF THE NEIGHBOURING BUILDINGS</td>
</tr>
</tbody>
</table>


PROPOSED EXCAVATION METHOD

EXCAVATION FOR THE FOUNDATION ALONG THE BOUNDARY LINE OF THE ADJOINING PLOTS WILL BE CARRIED OUT IN STEPPED UNITS OF 450 X 600MM IN VERTICAL AND HORIZONTAL DIMENSIONS RESPECTIVELY. ALL NECESSARY PRECAUTIONS WILL BE TAKEN INTO ACCOUNT, TO PROTECT THE FRESHLY CUT SURFACE OF THE NATURAL GROUND, TO PREVENT IT FROM FALL DUE TO THE ACTION OF WEATHER OR ANY OTHER ACTION THAT MAY CAUSE SUCH A FALL. HENCE, THE FOLLOWING EARTH PROTECTION METHOD WILL BE ADOPTED AT THE BOUNDARIES OF ALL ADJOINING PLOTS AS SHOWN BELOW.

![Site Plan Diagram]

SHEET PILE RETAINING WALLS
Driving 9mm thick steel sheets supported by 6mm thick L-shaped MS bars to form a cantilever sheet-pile retaining wall as shown in Figure-1. G.I. pipe supports will be provided simultaneously with the stepped excavation. The sheet piles will be firmly braced until the completion of back filling.

ADJOINING PLOT

PROPOSED BUILDING SITE

FIGURE-1

Driving depth of sheet pile: 3500mm from the natural ground

Ministry of Housing & Infrastructure

ACREDITED CHECKER

STRUCTURAL CHECKER A1

Name: Hussain Shihan

Validity: 14.01.16 - 03.01.17

Registration No: BPR2016024A1 A1-2016-424-001

HOUSSAIN SHIHAN
CIVIL ENGINEER (BDR2016071E)
2nd-9th FLOOR PLAN
SCALE = 1:100

Ministry of Housing & Infrastructure
ARCHITECTURAL CHECKER A1
Name: Hasin Shirin
Registration No: B0018555A

Ministry of Housing & Infrastructure
ARCHITECTURAL DESIGN BY
Name: Mohamed Shrin
Registration No: BPR201901391
TERRACE FLOOR PLAN
SCALE: 1:100

Ministry of Housing & Infrastructure
ARCHITECTURAL DESIGN BY
MOHAMMED SHAMIM
DATE: 8/07/2018
DRAWING NUMBER: A7

Ministry of Housing & Infrastructure
STRUCTURAL DESIGN BY
SHAMIM
DATE: 8/07/2018
DRAWING NUMBER: A7
ROOF SLAB PLAN
SCALE: 1:100

MACHINE ROOM ROOF SLAB AT +31014
OPEN TERRACE BELOW -3387

Ministry of Housing & Infrastructure

ARCHITECTURAL CHECKER A1
Name: Hussan Echien
Registration No: 079P880A1

Ministry of Housing & Infrastructure

STRUCTURAL CHECKER A1
Name: Mohamed Ibrahim
Registration No: 079P880150A1
FOUNDATION PLAN
SCALE - 1:100

NOTE:-
- SLAB THICKNESS = 500MM
- TOP RFINT = T16 @ 150 C/C BW (TB)

ARCHITECTURAL CHECKER: D1
Drawing No. : 01SP/01/03
Registration No.: BR2015/03/1

MINISTRY OF HOUSING & INFRASTRUCTURE

STRUCTURAL CHECKER: A1
Name: Ruben Eshan
VINIL: 34188192-02920
Registration No.: BPR2015/03/01

H. SANDHOLEEGE

NOTE: ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE CONSTRUCTION
Curriculum Vitae

Personal Information

Name: Mohamed Hamdhaan Zuhair
Date of Birth: 13 July 1987
Permanent Address: G.Vehi, Male’, Maldives
E-mail Address: m.hamdhaan.zuhair@gmail.com
Maldives National Identity Card Number: A-073472
Contact Number: +9607668606

Employment

(a) Maldives Environmental Protection Agency

Assistant Director, Environment Assessment June 2015- February 2016
Working under the Director to implement EIA regulations
and executing the work plan for Environmental Compliance
and Assessment Section.

Environmental Analyst December 2010– February 2013
Worked as stand in head of EIA section while the section head
was abroad for studies. Took responsibility of looking after day
to day activities in terms of implementing EIA Regulations and
planned and executed the work plan for the EIA section in
years 2011 and 2012.

Surveyor (Trainee) October 2006– February 2008
Worked as a trainee staff in the EIA section of Maldives EPA,
under the guidance of the section head. Involved in assisting
the implementation of EIA regulations and other activities of the section.

(b) Independent EIA Reviewer

(C) Project Management Unit, Ministry of Environment and Energy
Social and Environmental Safeguards officer (March 2016 to Present)

(d) Independent EIA consultancy work

---

Tertiary Education

University of Waikato

**Masters in Management Studies (Management and Sustainability)** 2014
Graduated with First Class Honors

University of Waikato

**Postgraduate Diploma in Management Studies (Management and Sustainability)** 2013
Graduated with Distinction

James Cook University

**Bachelor of Environmental Science (Natural Resource Management)** 2008
Graduated with Academic Medal

---

Training and Workshops

UNEP EIA training 2006 Maldives -August 2006

BOBLME Scientific Writing workshop in Phuket, Thailand -August 2011

BOBLME Scientific Presentation Workshop in Male’, Maldives- October 2011
Curriculum Vitae

Participated in Asian Environmental Compliance and Enforcement Network workshop on mainstreaming climate change adaptation in Environmental Impact Assessment, Bangkok, Thailand- October 2011

Inception Workshop on Establishing a Data Management System in South Asia, Colombo, Srilanka- January 2012

Participated in Asian Environmental Compliance and Enforcement Network Regional Forum in Bangkok, Thailand- March 2012

Conference Presentations & Publications


Zuhair, MH. 2013. “Climate change policy in Maldives: An analysis of the National Adaptation Programme of Action”, paper presented at the FASSGRAD conference, University of Waikato, 11th -12th November 2013


Professional Experience

Actively participated as a facilitator in EIA Training and Awareness Program for councils of GDh. atoll, GDh. Thnadhoo- August 2011

Actively participated as a facilitator in EIA Training and Awareness Program for councils of Ha atoll, Ha.Dhihdhoo- September 2011

Actively participated as a facilitator in EIA Training and Awareness Program for councils of HDh atoll, HDh. Kulhudhufushi- September 2012

Organized staff capacity development program (EIA inspection and monitoring) for EPA- June 2012

Actively participated as the lead facilitator environmental awareness program at Dh. Kudahuvadhoo- September 2015
Curriculum Vitae

Actively participated as the lead facilitator environmental awareness program at Dh. Maenboodhoo- September 2015

Actively participated as the lead facilitator environmental awareness program at Dh. Bandidhoo- September 2015

Actively participated as the lead facilitator environmental awareness program at Dh. Rinbudhoo- September 2015

Actively participated as the lead facilitator environmental awareness program at Dh. Hulhudheli- September 2015

Actively participated as the lead facilitator environmental awareness program at Dh. Meedhoo- September 2015

Guest Lecture Maldives National University to students studying bachelor of tourism, Topic “EIA process in the Maldives”- September 2012

Guest Lecture Maldives National University subject Environmental Impact Assessment, course Bachelor Environmental Management, Topic “Public Participation in EIA process of Maldives”- March 2015

Guest Lecture Maldives National University subject Environmental Impact Assessment, course Bachelor of Environment Management, Topic “EIA quality and decision making”- March 2015

Participated in administratively organizing the 6th Regional 3R Forum in Asia and the Pacific- August 2015

Participated in the following EIA inspection trips as team leader:

EIA inspection of Ha.Manafaru resort development project- September 2007

EIA inspection in Thundufushi island resort resort development project- March 2011

EIA inspection of Traders hotel Power plant- February 2011
EIA Inspection of L.Maandhoo harbor development and reclamation project- June 2011

EIA Inspection of GDh. Faresmaathodaa harbor development project- March 2012

EIA Inspection of GDh. Gahdhoo harbor development project- March 2012

EIA Inspection of GDh. Maguadhuvaa resort development project- March 2012

EIA Inspection of Ibrahim Nasir International Airport Development project- April 2012 and June 2012

EIA inspection of Kandooma- August 2012

EIA inspection trip Dh.Kudahuvadhoo road development project- September 2015

EIA inspection trip Dh. Maamboodhoo harbour development project- September 2015

EIA inspection trip Dh. Meedhoo reclamation project- September 2015

EIA inspection trip Dh. Bandidhoo harbour development project- September 2015

Note: Inspection trips are undertaken to check weather projects are undertaken as per the EIA report submitted.

Prepared the following EIA/EMP/Environment Monitoring Reports as lead author/consultant (work done in the capacity of environmental and safeguards officer for PMU):


ESMP for the proposed IWMC upgrade at Hulhudhoo-Meedhoo (August 2016)

ESMP for the proposed IWMC upgrade at Fuvahmulah (May 2016)

ESIA monitoring Visitor Centre Development project, Eydhigali Kilhi and Koattey, S.Hithadhoo (October 2016)
Prepared the following EIA/EMP/Environment Monitoring Reports as a team member (Consultancy work):

EIA for the proposed development of an agricultural island at R.Ungulu (May 2016) (lead consultant Ahmed Zahid)

EIA for the proposed development of 10-storey MWSC customer service building (October 2016) (lead consultant Ahmed Zahid)

Involvement in International Organizations

Environmental Protection Agency, Maldives focal point for Asian Environmental Compliance and Enforcement Network (AECEN) from 2011-2012.

**Objectives and aims of AECEN:** Asian Environmental Compliance and Enforcement Network (AECEN) aims to promote improved compliance with environmental legal requirements in Asia. AECEN accomplishes this task through the exchange of innovative policies and practices among member enforcement agencies.
Awards and Achievements

Academic Medal (Masters Degree) – 2016

Golden Key Membership for Academic Excellence- January 2014

New Zealand Aid Scholarship- February 2013- March 2015

Academic Medal (Bachelors Course Work): James Cook University- May 2011

UBS Environmental Award James Cook University 2010 (for the student with highest overall GPA in second year for an environmental science degree)- May 2010

Australian Aid Scholarship- February 2008-December 2010

A’level: Maldives National top ten 3rd place- 2006

O’levels: Maldives National top ten 5th place- 2004

Referees

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Phone: +6478562889 (extension: 4083), E-mail: evacollin@waikato.ac.nz

Associate Professor Kevin Parnell (James Cook University, Townsville, Australia)
E-mail: Keven.Parnell@my.jcu.edu.au

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