Ministry of National Planning, Housing and Infrastructure
Republic of Maldives

TERMS OF REFERENCE

Consultancy to Develop Design and preparation of Tender Documents for Male' Stormwater Management

(Reference No: MV-MONPI-234588-CS-CQS)

MALDIVES URBAN DEVELOPMENT AND RESILIENCE PROJECT

1. INTRODUCTION

The Government of the Republic of Maldives through Ministry of National Planning, Housing and Infrastructure (MNPHI) is implementing "Maldives Urban Development and Resilience Project" (MUDRP) financed by the World Bank and intends to apply part of the proceeds for the survey and design of Storm Water Drainage Improvement and Rain Water Storage tanks component of the project. To carry out this work, MNPHI is seeking the assistance of a qualified and competent consulting firm for Survey, Design and Environmental Impact Assessment (EIA) works related to the storm water drainage and rainwater storage component. The services include preparation of Preliminary designs, EIA, Detailed design, Technical Specifications, Tender documents and Bill of Quantities for the storm water drainage, rain water treatment and storage work.

2. BACKGROUND

Maldives is an archipelagic nation made up of a collection of 26[1] atolls, consisting of 1190 islands, of which 358 are used for economic development and human settlement. The country's population of almost 428,000[2] reside in 195 islands. More than a third of the population reside in Malé, making it the fifth most densely populated island in the world and the remainder is dispersed across the many islands. The country is also urbanizing at an annual rate of about 4.2% with most of the growth taking place in the Male Region, thus resulting in higher density communities in this region.

Being a collection of islands most of which are tiny and low lying, the country is very vulnerable to climatic change issues and related challenges. Therefore, aside from the urgent need to address demographic pressures, risks to natural environmental and climatic related hazard are high. Government is in the process of developing a comprehensive regional development strategy towards the creation of sustainable, resilient and livable islands.

The Government of the Maldives has requested funds from the World Bank/International Development Association (IDA) to finance an urban development and resilience project. This project, called the

[1] Wikipedia
[2] Wikipedia estimate 2016

Maldives Urban Development and Resilience Project (MUDRP) proposes critical new infrastructure (a sewage treatment plant, storm water drainage and rain water storage) and other investments to strengthen urban resilience and emergency preparedness and response in beneficiary cities and islands.

Malé city is built on an island of approximately 2 km^2 only. Naturally the old city, being just about 1 km^2, was built on the highest parts of the island. This means elevations of 1 to 2 meter above sea level, or just a little higher, as 2.4 meters is the overall highest point of the whole Maldives. On the south and south-west side of the island several land reclamation projects have been executed in the past ten years, adding many hectares of land in various phases. The land reclaimed in the first phases has been used mainly for city expansion, and many public buildings like ministries, mosque, hospital etc. are located there. The more recently reclaimed land is about 6 hectares in size and is at present used for harbor, ferry landing, industrial activities, storage of construction equipment, etc.

In general the reclaimed lands in the south and south-west in particular have been afflicted with flooding, as stormwater from the higher, older city area drain slowly and can't be discharged quickly enough. Flooding depths are generally in the order of about 0.40 metres and create large scale traffic, property losses and business activities' disruption. It is well known locally that these heavy floods from increasingly heavy rains occur in every other year, the most recent one was experienced in December 2018.

The existing drainage system of Malé was constructed about two decades ago. The system includes gutters (400mm wide by 600mm deep) installed along the whole length of all the paved roads (about 60 km), covered by concrete grids or steel gratings. The rainwater runs off neighborhoods and streets and collect into these gutters and flows through cross-pipes to underground soaking pits, installed every 6 meters in the middle of the roads. Consequently the water is supposed to infiltrate into the ground to help recharge the underground aquifer. Years of silting in the soaking pits as well as in some of the gutters have reduced the efficiency of the system and its functioning is in doubt. It is thought that some of the grids and/or gutters are clogged. There are broken pipes, and with the possibility of clogging of some of the soaking pits where infiltration is supposed to take place, the system is currently malfunctioning compared to the days when it was newly constructed.

The existing roads in Malé city are all paved, mostly using interlocking paving blocks (about 57 km of roads) or asphalt-concrete (about 3 km). However, on basis of field visits and inspection, there is serious doubt if the street paving still allows direct infiltration, since most of the space between paving blocks seems to be clogged by dust and/or by natural sealing.

From 2014 through 2018 in 4 different phases a number of 15 pumping stations (*Annexed)* has been installed, pump collection chambers were built, and street gutters in the low laying reclaimed areas were connected. Nevertheless, based on the flooding of December 2018, this apparently is not sufficient to mitigate flooding resulting from recently increasing extreme rainfall events.

One of the issues in the Malé drainage is that 20 years ago the city had a much lower population, there was a significant area of unpaved land, and rainwater collected from most of the roofs was either stored or released to unpaved areas instead of draining it on to the roads. Due to the rapid urbanization in the past two decades the area of unpaved land has been reduced substantially. In addition, due to a lack of space, people have stopped the rainwater harvesting and storage practice, and presently all water from the roofs gets drained to the streets through water spouts.

The large area of newly reclaimed land, with an elevation lower than the natural land c.q. the old city, accumulates all the flood waters and gets heavily flooded even with relatively light intensity rains. As mentioned above, the series of pumping stations installed between 2014 and 2018 hasn't solved the problem of flooding during high intensity rains.

Limitations to the system include (among others): the present size of the gutters (about 400mm wide 600mm deep) which cannot be increased due to the limited space in the streets; part of the space under the streets occupied by other utility lines (e.g. electricity, telephone, sewer etc.). The same basically applies to the gravity pipes that were installed to connect the gutters and the collection chambers to the pumping stations: no space to increase the size. Finally, the rainwater spouts from the roofs cannot be connected to the sewer network due to the limited capacity of the system. Moreover, the design approach was based on a separate system for drainage and sewerage.

Another potential problem observed may be the calcareous characteristics of the (sub)soils and the large amounts of crushed shells used in the construction business in Maldives. This material has a tendency for clogging the spaces between the interlocking paving blocks on the roads, and also creates a kind of natural sealing that may reduce the infiltration capacity of open fields as well as in the soaking pits. Even open areas in an adjoining city, Hulhumalé, reclaimed just a few years ago, seem to show a tendency of natural sealing already, and consequently the infiltration capacity of the sand layers below is reduced significantly.

3. OBJECTIVES

The main objective of this project is to assess the extent of flooding in Male through a series of surveys and design storm water drainage and rainwater storage systems. The stored rainwater is most likely to be used for fire-fighting and so an adequate treatment must be provided to make the harvested rainwater from the streets, safe for spraying at buildings.

4. SCOPE OF WORK

4.1 Part 1: Surveys and Mapping

The consultant shall identify & locate the districts and neighborhoods of Male' that consistently experience flooding during huge downpours of rain. These are the critical areas that need immediate stormwater drainage work or upgrading of existing drainage in these areas. Should the consultant feel necessary, the consultant may conduct topographic surveys to ascertain the finished ground levels in these areas and use those surveys to estimate the volumes of flood water that may accumulate in these areas. The consultant will be responsible to perform services including, but not limited to:

- Collection of all existing information about the most flood prone areas of Male'. Lot of these information will be available from Ministry of National Planning Housing and Infrastructure (MNPHI), Male City Council (MCC) and Road Development Corporation (RDC).

- All public infrastructure developments in the flood prone areas should be updated and shown on existing Male' map. Different government agencies have conducted different public infrastructure developments in Male' and so it is very critical to show all these developments on a single map when working out stormwater drainage design, as these developments might have had an adverse impact on stormwater drainage in that area. A rigorous survey to map these areas is not needed.
- During the surveys, the consultant should also check for all available land spaces to place rainwater storage tanks. These tanks are designed to store runoff stormwater to support the newly installed fire hydrant systems in Male'.
- All blocks should be shown on the map and all blocks other than housing blocks such as parks, parking zones, open areas etc. should be labelled on the map. Information from existing maps maybe copied to finalize the new map.
- Mapping of all required topographic features at a scale of 1:1000. Units used for this survey should be in meters.

Physical surveys must be conducted as per internationally best practice methods and must comply with all existing standards, criteria and requirements set by Maldives Land and Survey Authority (MLSA) which will be available from the MLSA's website (www.surveyofmaldives.gov.mv). Any uncertainty regarding collecting features should be clarified by MLSA.

4.2 Part 2: Stormwater drainage and Rainwater storage

After the surveys and maps are approved by Client, the consultant shall proceed to design stormwater drainage and rainwater capture and storage options. The consultant will be responsible to perform the following services including, but not limited to:

- Estimate the run-off considering maximum recurrence interval and determine volume of water needed for the hydrants, after consulting with Fire Department of Ministry of National Defense Force (MNDF). This water needs to be stored in primary storage tanks. The balance water can be stored in secondary storage tanks and used by City Council to water lawns / parks, etc.
- Identify possible locations for all rainwater storage tanks. The primary tanks should be sufficiently sized to support the firefighting system in Male (via fire hydrants) based on a suitable discharge rate and length of operation.
- Design stormwater drainage system to direct flow to water storage / retention ponds and excess flow to sea via gravity and mechanical pumping system
- Check adequacy of the existing storm water drainage systems established in the most flood prone areas of Male', and design the necessary upgrading required for these systems. Existing drainage systems are shown in Annex A of this ToR.
- In the event that space for the underground or above ground water tanks cannot be established, then the central objective would be to move the stormwater in affected

neighborhoods quickly to the outfalls at the coast (sea) using appropriately-sized pipes and pumping machines.

5. SCHEDULE OF WORK

	MONTHS					
Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
Contract signing						
Survey and mapping						
Survey approval from Client						
Stormwater concept design						
EIA						
Stormwater detail design						
Preparation of tender documents						

6. TECHNICAL SPECIFICATION

6.1 Part 1: Surveys and Mapping

6.1.1 Topography

Surveys need to be done only for the flood prone areas. All measurements should be taken with reasonable accuracy using one or more of the following methods.

1. Differential GNSS
2. Total Station
3. Auto or Digital level

If the consultant proposes to use other equipment and methods, then they can be used after the details of the equipment and the methodology to conduct the survey are submitted for approval and the Client agrees to the methodology.

6.1.2 Mapping of surveyed areas

Projection: UTM zone 43 north for areas north of the equator and UTM zone 43 south for areas south of the equator.

Spheroid: WGS 84

Datum level for Elevation and Depths: Mean Sea Level (MSL)

6.2 Part 2: Stormwater Drainage and Rainwater Storage tanks

1. Stormwater drainage must be designed to facilitate stormwater removal by gravity flow or pumped flow. The solution must be geared towards first filing a storage tank of

capacity of about 1000 tons (depending on space availability), and then discharging the excess water to sea.

2. Water level in this tank must be monitorable by float switches and incoming flow must be regulatable by motorized valves. The entire operation must be controllable by a panel which should have a PLC (Programmable Logic Controller) - HMI (Human Machine Interface) panel that should be able to allow both manual and automatic control of the operation.
3. Details of all pipes and equipment used in the drainage system must be provided. UPVC (Unplasticised Polyvinyl Chloride) pipe should be SN4 (Nominal stress) & SDR38 (Standard Diameter Ratio) class. HDPE (High Density Polyethylene) pipe used must be PE100 (Polythethylene), PN10 (Nominal Pressure) and SDR11 class.
4. Where pump stations are used, only submersible pumps must be used. These must have cutter / grinder type impeller. All critical components of the pump must be SS 316 grade. At least two pumps must be used which must alternate operating cycles.
5. All pump stations must have an FRP coating of 500 microns on the inside.
6. Single Line Diagrams (SLD) must be stamped by an MEA licensed engineer and structural drawings must be stamped by a Structural Checker
7. Details of tanks to be used must be provided and where underground tanks are used epoxy coated rebars and 40 MPa concrete must be used.
8. Client will provide details of all existing stormwater management systems established in Male'. Layout of the drainage developments is shown in Annex A, Existing Maps of the all districts in City of Male, topographical details of the island.

7. DELIVARABLES

7.1 Survey Report

The report should explain the methods of survey, survey equipment and devices, the dates of surveys, details of the control points, condition of the site, information about the surveyors and people involved in the survey from community side. This should be submitted before end of 2nd month after signing of contract.

7.2 Stormwater Concept design

Based on the surveys and stakeholder meetings, the consultant shall carryout the concept design for stormwater drainage and rainwater storage systems. The drainage system needs to be tested for various extreme weather events and should be designed for appropriate recurrence interval.

The consultant should include a preliminary cost estimate for the proposed design.

The design should consist of a short report explaining the findings and the proposed design for stormwater drainage & rainwater storage . The report should include supporting drawings and show all possible outfall locations for stormwater discharge. All locations identified for

rainwater storage must be shown on a map and how stormwater is conveyed or pumped to these tanks must be explained and shown on drawing. If sufficient space could not be allocated for storage tanks, then all the stormwater can be discharged to sea.

This should be submitted within 1 month after Client approves the surveys submitted.

7.3 Environmental Impact Assessment

This shall include carrying out Environment Impact Assessment up to the requirement of Environment Protection Agency (EPA). Client will assist speeding up the approval process such that all EIA work will be completed within the time frame specified in Section 5.0.

It is the responsibility of the consultancy firm to expedite the process of EIA application submission, follow up on scoping meeting, draft TOR submission, and follow up on TOR approval, obtain and address the queries made by the EIA reviewers and follow up on the EIA review and approval process.

7.4 Stormwater Detailed design

The design should consist of a detailed report explaining the proposed design and should provide all the supporting drawings. Drawings should include general arrangement drawings, sections, elevations, typical details and other related drawings. All tank details, outfall details and rainwater treatment system details must be included in this design. Consultant should do estimate of the energy demand for the rainwater storage, stormwater discharge and

This should be submitted within 3 months after EIA decision statement is awarded.

7.6 Preparation of Tender Documents

a) Preparation of Conditions of Contract and Evaluation Criteria

b) Preparation of Technical Specifications
    a. Technical Specifications will include Technical Specifications and Schedules. Technical Specification will be prepared for all items to be constructed, supplied or erected. Materials and work specifications will cover all aspects of materials and equipment to be provided.
    b. The Consultants will use local or national standards where possible. Where no suitable local or national standards exist then international standards such as BS, ASTM, ISO etc. will be used.
    c. Where possible, the specification of materials (locally produced or imported) will be specified. Construction Schedules will be issued in details.

c) Preparation of Bill of Quantities
    a. The Bill of Quantities will include Bills for each type of works i.e. earth works, sidewalk, paving works, road safety works, road drainage works, etc. The Consultants will here explain the unit costs as well as the percentage considered for miscellaneous and contingencies.
    b. Bill of Quantities will be established separately for each island.

This should be submitted together with the detailed design.

8 THE EXPERTS REQUIRED

The following staff members will be required for each package and should not be repeated in other packages that are applied. The key expertise required for the consulting services are:

Post	**No**
Project Manager (Team leader)	1
Hydrologist / Drainage Engineer	1
Procurement Specialist	1
Quantity Surveyor	1
Surveyor	1
EIA Specialist	1
Other	

The Consultant should submit full CV's for each of the proposed staff members highlighting the criteria given below.

8.1 Project Manager (Team Leader)

Qualifications;

He/She should be graduated from university level in the civil/structure disciplines and having at least 15 years working experiences after graduation. An experience as project manager/resident engineer at least for the period of 5 years is also required for this position. An experience also shall include at least 10 years in road project, at least one year project in Maldives.

His/her responsibilities shall include but not be limited to:

Overall responsibility for management or the project liaison with the Client, and all authorities concerned with matters relevant to the design and final physical implementation of the proposed sub-project, reporting of project progress, financial control and coordination of work carried out;

Responsible for Preliminary Design, Detailed Design and Tender Documents and any other information necessary, assessing the survey requirements, organization of personnel review of surveys and obtaining Client's approval;

Organization of personnel and management of the consultant team experts and staff;

Responsible for prequalification of contractors, tender evaluation and construction supervision;

Responsible for all progress reporting, financial control, approval of all contract documentation and advice to the Client on all measures to improve efficiency;

8.2 Hydrologist / Drainage Engineer

Qualifications;

He/She should be graduated from university level in the Water Engineering disciplines and having at least 10 years working experiences after graduation. An experience as a drainage engineer at least for the period of 5 years is also required for this position.

The engineer shall have extensive experience and knowledge in the various types of road drainage expertise required for design works:

His/her responsibilities shall include but not be limited to:

Responsible for conducting the hydrological surveys and also design the road drainage system based on these surveys.

Review and assessment of all available data and information related to the works.

8.3 Procurement Specialist

Qualifications;

He/She should be graduated from university level and having at least 10 years working experiences after graduation. An experience as document specialist at least for the period of 5 years is also required for this position.

The Document Specialist shall have extensive knowledge and experience in preparation of tender documents for the international competitive bid of the civil works.

His/her responsibilities shall include but not be limited to:

Preparation of prequalification documents;

Preparation of tender documents consisting of general condition of contract, specifications and bills of quantities.

8.4 Quantity Surveyor

Qualifications;

He/She should be graduated from university level in the Civil/Quantity Surveying disciplines and having at least 10 years working experiences after graduation. An experience as cost estimator at least for the period of 5 years is also required for this position.

The Quantity Surveyor shall have extensive experience and knowledge in the cost estimate for the project

His/her responsibilities shall include but not be limited to:

Responsible for preparation of the Preliminary Cost Estimate, Final Cost Estimate and also preparation of the Bill of Quantity.

8.5 Surveyor

Qualifications;

He/She should be graduated from university level in surveying and having at least 5 years working experiences after graduation. An experience as Surveyor at least for the period of 5 years is also required for this position.

The surveyor shall have extensive knowledge and experience in engineering related works for the international civil and building works projects.

His/her responsibilities shall include but not be limited to:

Carrying out detailed topographic surveys.

Establishment of reference datum points to be used during design and construction stage.

Mapping out utilities and services networks.

8.6 EIA Consultant

Qualifications;

He/She should have a minimum Bachelor's Degree in Environmental Engineering/ Environmental Science/ Environmental Management or related field and having at least 5 years working experience in Environmental Impact Assessment (EIA) after graduation.

The consultant should hold a permanent EIA license and his/her EIA license copy shall be submitted along with a dated letter stating his/her association with the bidding party

9 EQUIPMENT, LOGISTICS AND FACILITIES

The Consultants shall ensure that experts are adequately supported and equipped. In particular he/she shall ensure that there are sufficient administrative, computing and secretarial provisions to enable experts to concentrate on their primary responsibilities. The Consultant shall meet the full costs for the supply of the teams including all travels, remuneration, insurance, emergency medical aid, facilities and all else necessary for the competent operation of the teams. The Consultants will provide their own office space for the Project team.

10 SPECIFIC TERMS OF REFERENCE

The Consultant shall be solely responsible for gathering and analysis of all data required relating to the project and shall undertake such surveys and investigations for the satisfactory implementation of the Project.

The Consultant shall at all times utilize the most economical, effective and widely accepted engineering concepts and standards.

ANNEX A

MALE STORMWATER MANAGEMENT SYSTEM

LEGEND:
PHASE 1
PHASE 2
PHASE 3
PHASE 4

MINISTRY OF HOUSING AND INFRASTRUCTURE

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DRAWN BY:

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SCALE: NTS

DATE: 03RD JANUARY 2018