ENVIRONMENTAL IMPACT ASSESSMENT

The Flood Mitigation Project at Feydhoo, Addu City

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Proposed by

Ministry of Environment and Energy (MEE)

Prepared by

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For **Water Solutions** Pvt. Ltd., Maldives.

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ސ. ފޭދޫގައި ތަރައްގީ ކުރުމަށްޓަކައި ކުރިއަށް ގެންދިއުމަށް ހަމަޖެހިފައިވާ ސްޓޯމް ވޯޓަރ ޑްރެއިނޭޖް ޕްރޮޖެކްޓަކީ މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީ އިން ހުއްދަ ދޫކޮށް ރާއްޖޭގައި ބޭނުން ވާނުވާ ހިސާބު ވަގުތު ކަނޑައަޅައިދޭ ސަރަހައްދުގައި ފެން ބޮޑުވާ ހާއްސަ ފެންފެނުން ގިނައިން ފެންހިފާ ގިނަގުނަ ތަންތަނަށް ދިމާވާ ބަލާއިރު ހިއްސާކުރާ ކުޑަކުދި މައްސަލަތައް ބޭނުންކޮށްފައި ފެންހިންގާ އަދި ފެންބޭރުކުރާ މަސައްކަތް ބޭނުންކޮށްގެން. މެދުގައި ދެންނެވިފައިވާ މަސައްކަތުގައި ފެނަށް އަސަރުކުރާ ބައިތަކެއް ހިނގާނެ. ކުރިއަށް ގެންދާ މަސައްކަތް ހިއްސާކުރާނެ އެކި ޕްރޮޖެކްޓުގެ ބަދަލުތައް ފެނިގެންދާނެ ކަމަށެވެ. އަދި މިޕްރޮޖެކްޓްގެ އަމަލީ މަސައްކަތް ނިމުމުން ޕްރޮޖެކްޓްގެ ހިންގުމާއި، މަރާމާތުކުރުމާއި ބެލެހެއްޓުން ރަނގަޅުކުރުމަށް ތަރައްގީވަނީ ސަރުކާރުގެ ޤާނޫނީ ކަނޑައެޅުން ކަމަށްވާ ފެނަކަ ކޯޕަރޭޝަން ނުވަތަ ލޯކަލް ކައުންސިލް އާއި އެވެ.

ސ. ފޭދޫގައި ގާއިމް ކުރާ ފެން ބޭރު ކުރާ ނިޒާމް ޕްރޮޖެކްޓްގައި ހިމެނޭ އެއްބައިގައި މިވެގެން ހުރިހާ ފެންބަރު ހުރި ފެން ހިނގާ ހިސާބު ފެންބޭރު ބަހައްޓާ ގުދޫގެ 5 ކިލޯމީޓަރު ވުރެ ދިގު ޕައިޕް ލައިން، ހަތް ޕަމްޕިންގ، އެއާއި ގުޅޭ މެނޭޖުމަންޓް ހަރުކުރެވޭނެ. ފެންބޭރު ކުރާ ނިޒާމް ކުރިއަށް ގެންދާ ތަރައްގީ ވަނީ ހަރުދަނާ ނިޒާމް އަށް ވުރެ ދިގުކޮށް ނަރުދަމާ ނިޒާމް ގެ މަރުހަލާ. މި މަސައްކަތް ކުރިއަށް ގެންދާނީ ހަމަ އެއްގައި ޕީ.ވީ.ސީ ޕައިޕް ލެވިލެއިގެން، އެ ޕައިޕަށް 30 މީޓަރުން ބޭނުން ދޭ ކޮންކްރީޓު ކޮންސްޓްރަކްޝަން އަދި ގޭހަށް ގުޅުވާ ސިސްޓަމް ކުރުވާނެ ބަހައްޓާ ބޭނުން ކުރާނެ ގޮތަށެވެ.

ފޭދޫގައި ކުރިއަށް ގެންދާ ތަރައްގީ ކުރާ ސްޓޯމް ވޯޓަރ ޑްރެއިނޭޖް ޕްރޮޖެކްޓްގެ މަސައްކަތްތަކުގެ ތެރޭގައި ކޮންސްޓްރަކްޝަން ބޭނުން ކުރާ ތަކެތި ގެނައުން، ގިރާސާނުކުރުން މި މަސައްކަތްތަކުގެ ސަރަހައްދުން ތިމާވެއްޓަށް ކުރާނެ އަސަރު ކޮންމެ ކޮންޓްރެކްޓަރ އެއް ކުރާނެ ކަންތައްތައް ހިމެނެއެވެ. މި ކަންތައްތައް ކުރުމުގެ ކުރިން ބަލާނެ، ކަނޑައަޅާ، ފަރާތްތަކަށް ދެނެގަންނަ ކަމަށް ބަލައި ރަނގަޅު ސިޔާސަތު ގާއިމުކުރަން މުހިންމު ކަންތައްތަކެއް

އަސަރުތަށް. އަދި މަގު ކޮށުމުގައި ފެންސް ނަގައިގެ ގިނަ ދުވަހު ބެހެއްޓުމާއި އަދި ފެންސް އެޅުމަށް ފަހު ފެންސް ރީއެކަން އެއްވަރު ނުވަތަ ދެފެށި ނުކުރުމުގެ ސަބަބުން ދިމާވާނެ އަސަރުތަކެވެ.

ތިމާވެށްޓަށް އަސަރު ފޯރާ މިންވަރު ދެނެގަތުމަށް ކުރެވުނު ދިރާސާއަށް ބެލުމަށްފަހު ރަށުގެ ވެއްޓަށް، ހިނގަނިވިޔައިވާ ޕްރޮޖެކްޓުން ކޮންޓެން އަސަރުކުރާ ކުރުމަށް އެދެވޭ ޓިޔައިވުމަކާއި އެކިއެކިނަމަ ފުދޭ ސަރަހައްދުގެ ވެއްޓަށް ދިރިހުރިކަމަށް ބެލެވިފައިވާ އިޤްތިޞާދީ ގެއްލުންތަކެއް ކުރެވޭ ޕްރޮޖެކްޓުގެ ސަބަބުން އިތުރު ފައިދާ ކުރާނެ ކަމަށް ބެލެވިފައެވެ.

ހިނގަމުންދާ ޕްރޮޖެކްޓުން އިޖްތިމާޢީ ގޮތުން ދިރިއުޅެން ގެއްލުންތަކެއް ކުރެވުނުކަމަށް އެކިދާން ފިޔަވަޅުތަކެއްވާނީ ރިޕޯޓުގައި ފާހަގަ ކުރެވިފައެވެ. މިގޮތުން މަގުކޮށުމުގެ މަސައްކަތްކުރުމުން އަންނައިރު އަ ސަރަހައްދުގައި ހުންނަ ގެތަކުގެ މީހުންނަށް މަގު ބޭނުން ކުރުމުން އަންނަ ފަރާތްތަކަށް އުދަގޫ ކުރެވޭގޮތަށް މަސައްކަތް ބެހެއްޓުމަކީ މުހިންމު ކަމެކެވެ.

މިކުރުމުން ދިރާސާގެ މައްޗަށް ބެލުމަށްފަހު މަސައްކަތް ކުރުމުންދާއިރު ވިޔާފާރި ގެއްލުން ކުޑަވާނެގޮތަށްވެސް ރިޕޯޓުގައި ހިމެނިފައެވެ. މިގޮތުން މަސައްކަތްކުރުމުގައި ގެންގުޅެން ޖެހޭ މިންގަނޑުތައް ހިމެނިފައިވާނެއެވެ. އަދި ޕްރޮޖެކްޓުގެ ސަބަބުން ފޯރު ހިލޭ މާރައްޗަށް ގެއްލުން ކުރެވިދާނޭ ތަފާސްހިސާބުގެ މަސައްކަތްކުރުމަށް ތަފާތުވެދާނެ ފަދަވެއްޓަކަށް. ކޮންމެ މިފަދަ މަޝްރޫއެއްގެ ތިމާވެށްޓަށް އެކަށީގެން އަސަރު ކޮށްފާނެ ވަރަކަށް ކުރާނެ ކަމެކެވެ. ހަމަ އެފަދައިން، މިފަދަ މަޝްރޫއުތަކުގެ ސަބަބުން އިޖްތިމާޢީ އަސަރު ފައިދާތަކެއްވެސް ކުރާނެކަމެއްވެސް ރިޕޯޓުގައި ފާހަގަ ކުރެވިފައިވާނެއެވެ. މި ޕްރޮޖެކްޓް ކުރިއަށް ގެންދިއުމުން މަގުތަކުގައި އުޅުން ފަސޭހަ ހިނގުމަށް ފަރުވާ އިތުރު މަގުތަކުގައި ފެން ބޮޑުވާ ވަގުތު ބެލުމަށް ދުރަސްކުރެވޭ ކަމެކެވެ. މިބަދަލުތައް ދެނެގަނެވޭ ހުރިހާ ޕްރޮޖެކްޓުގެ މަސައްކަތްތައް ގެވާއިދުން ކުރިއަށް ގެންދިއުމުންނެވެ.

މި ދިރާސާކޮށް ބެލެވުނުގޮތުން މިމަޝްރޫއުގެ ސަބަބުން ފޯރު ހިލޭ ސަރަހައްދުގެ ވެއްޓަށް ރަށުގެ ރަށްކަން ގެނެވިދާނެ އިޤްތިޞާދީ ފައިދާތަކެއް ބޭނުން ކުރެވޭނެ ގޮތްތައް ދެނެގަނެވިފައެވެ. ރަށުގެ ރަށްކަރުގައި ފެން ހިނދާ އަދި ޖެހިލުންތަކާ ނިޒާމު ހުއްޓި ކުރުމުގެ މަސައްކަތްތަކެއް ތަރުތީބުކޮށް ކުރުމަށް މިމަސައްކަތަކީ މުހިންމު ކަމެކެވެ. ރަށުގެ އަހުލުވެރިންގެ ފަރާތުން ކަމަކަށްވެސް މި ޕްރޮޖެކްޓް ކުރިއަށް ގެންދިއުމުގައި މިންނެތް ސަމާލުކަމެއް ދޭން ޖެހޭކަމެވެ.

Non-Technical Summary

This report discusses the findings of an environmental impact study undertaken by Water Solutions Pvt. Ltd. at the request of Ministry of Environment and Energy. This EIA report covers the storm water management project at Feydhoo of Addu City in Maldives. This project would be undertaken on all the flood vulnerable roads of Feydhoo with a total length of more than 5 kilo metres.

Feydhoo is one of the islands that is very vulnerable to floods and past such events has caused damages and losses to properties and wellbeing of the people. Due this the government has selected Feydhoo to undertake the flood mitigation project which will be implemented by the Ministry of Environment and Energy and later the operation and maintenance will be handed over to one of the state owned utility company such as FENAKA or MRDC. The proposed project would help to improve the living condition of the island and facilitate the development of the island.

The environmental impacts have been assessed and the proposed storm water management system and associated work of the project has been assessed. The storm water management system development and associated work of the project would have some irreversible impacts on the island of Feydhoo. The impacts of the project results mainly from dust, noise, backfilling and levelling of the road surface at the island. There is no requirement for backfilling materials as the excavated material will be adequate and a sand burrow area is not required. The implementation of the project would have socio-economic benefits not only to the Feydhoo Island, but as whole to the group of islands in the city. The socio-economic benefit outweighs far more than the negative impacts of the project on the physical environment of the Feydhoo.

Mitigation measures for these anticipated impacts have been identified and outlined in detail, including measures for minimizing negative effects of generation of waste. These mitigation measures will have to be followed in order to minimize environmental damage. The details of the project have been established based on the concept design, detailed design and the land use plan that had been developed for Feydhoo.

Alternative designs and technologies have been investigated for the different components of the project. However, the present project design seems to be a feasible option in terms of costs, durability and safety.

An environmental management plan with environmental monitoring has been developed including the most important elements that require regular checks. This monitoring component need to adhere to and would allow assessing the changes to the island environment due to the road development project.

Although the project involves inevitable negative environmental impacts, such impacts are predicted to be not severe as to not undertake the project in accordance with the concept plan developed for the

island. The project is justifiable in light of the socio-economic conditions and anticipated benefits resulting from the project, which seem to outweigh the negative environmental impacts.

Declaration of the consultant

This EIA has been prepared according to the EIA Regulations 2012, issued by the Ministry of Housing and Environment. I certify that the statements in this EIA study are true, complete and correct, to the best of my knowledge and ability.

Name: Hassan Shah (EIA P02/2007)

Signature:

Commitment and Declaration from proponent

بسم الله الرحمن الرحيم

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

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5th February 2018

No: 438-ENV/203/2018/26

Mr.Ibrahim Naeem

Director-General,

EPA

Malé

Maldives,

Dear Naeem,

Commitment to undertake the mitigation measures and financial commitment

For the EIA for the Flood Mitigation Project at S.Feydhoo

The EIA for the above project has been prepared as per the TOR approved by EPA. The report was prepared by Hassan Shah, environmental consultant, Water Solutions Pvt. Ltd.

As the proponent we confirm that we have read the report and to the best of our knowledge, all non-technical information provided in the report are complete and accurate.
We also confirm that we will be financially responsible to carry out the mitigation and monitoring provided in the EIA report.

Thanking you

Yours Sincerely

Abdulla Ziyad,

Minister of State

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1. INTRODUCTION

The island of Feydhoo is located on the southern peripheral reef of Addu Atoll. Addu atoll is southernmost atoll in Maldives and is located in south of the equator. Feydhoo Island is located at the geographic coordinates of 0°40'59.48"S and 73° 8'11.46"E. Feydhoo is located in a very large reef system sharing the reef with several islands. Feydhoo is second southern island on the eastern reef system of Addu Atoll. It is the southernmost inhabited island in Maldives. The closest inhabited islands are Maradhoofeydhoo and Maradhoo. Closest airport to Feydhoo is Gan International Airport and the capital island of this city is Hithadhoo. All the islands liked by cause ways and land, stretching from Hithadhoo to Gan international airport use Feydhoo as a passage to the airport and any means of disruption in Feydhoo will severely effect on the city's transport system. The land area of the Feydhoo Island is now approximately 120 hectares after the reclamation project undertaken in 2016.

Figure 1: Location of Feydhoo island (Image Source: Google Earth)

Feydhoo is a vital hub located in the Addu City of the country which is very vulnerable to floods. Past flooding events has caused damages to the public and private properties and the wellbeing of the islanders. It has been a priority of the government, to mitigate and find a permanent solution to any potential future floods.

Ministry of Environment and Energy is undertaking mitigation measures of the country's flood vulnerable islands carrying out project across the county and Feydhoo has been selected as one of the islands in a group of islands to implement this project. Ministry of Environment and Energy will implement this project by contracting the project to a successful bidder and the operation and maintenance will be handed over to the FENAKA corporations.

Storm water Drainage projects are classed as projects which require Environmental Impact Assessment (EIA) under the Environmental Protection and Preservation Act (law 4/93), as this project has more than 5 km of excavation, pipe laying and outfalls to the sea. Ministry of

Environment and Energy has engaged Water Solutions to carry out EIA for the Project and obtaining the Environmental Decision Statement (EDS) from the Environmental Protection Agency, Government of Maldives.

The aim of this EIA study is to assess the potential environmental impacts due to the project and identify mitigation measures for minimizing the adverse impacts, while undertaking the project in an environment considerate manner. The EIA takes into consideration, issues and concerns that will be considered as critical with respect to environment, sustainable development and social harmony.

For determination of the scope of the EIA study, a detailed scoping meeting was held with Environmental Protection Agency (EPA) on 10th December 2017. The meeting was chaired by Assistant Director of EPA and included representatives of EPA, Ministry of Environment and Energy, Water Solutions and Addu City Council. During the scoping meeting, all the concerned environmental and social issues and areas relating to the proposed storm water drainage project were discussed. Based on the meeting a Term of Reference (ToR) has been approved by the EPA for this EIA study.

The EIA of the Feydhoo Storm Water Drainage Management Project has focused on areas that are outlined in the approved ToR and considered the applicable national and international environmental and social aspects which are relevant to storm water management projects at the islands.

This Environmental Impact Assessment (EIA) report has been prepared in order to meet the requirements of Clause 5 of the Environmental Protection and Preservation Act of the Maldives to assess the impacts of proposed road development project.

1.1 Scope of the EIA Study

The scope of the study has been guided by the Terms of Reference (ToR) approved by EPA. The key tasks provided in the ToR for the EIA include the following:

Task 1: Description of the Proposed Project
Task 2: Description of the Environment
Task 3: Legislative Regulatory Considerations
Task 4: Potential Impacts of the Proposed Project
Task 5: Analysis of Alternative to the Proposed Project
Task 6: Mitigation and Management of Negative Impacts
Task 7: Development of a Monitoring Plan
Task 8: Stakeholders Consultation and Inter-Agency Coordination

Approved Terms of Reference for the Environmental Impact Assessment is enclosed as Annexure to this report. This EIA has been prepared based on this term of reference.

1.2 Limitations

This report has been prepared to assist MEE, in obtaining the Environmental Decision Statement from EPA and the successful bidder should adhere to the this EIA report. The report has relied on available secondary information, primary environmental baseline data generated during the study period and the review of literature carried out by the consultant's team. Additionally information was obtained by Ministry of Environment and Energy and consultation with stakeholders. The storm water drainage development project and the associated impacts have been considered for the study area and aspects which had been discussed with EPA, Ministry of Environment and Energy and the Terms of Reference for Environmental Impact Assessment issued by EPA in December 2013. The site drawing(s) provided within this report is conceptual and detailed drawings and maps. These maps have been used to present the general relative locations of environmental and social features of the study area.

The major findings of this report are based on qualitative and quantitative assessments undertaken during site visit to the island. However, due to unavailability of long term site-specific data, the impact assessment methodology has been restricted to field data collected, consultations, experience and professional judgment. Available long term data were collected from available sources, such as long term data on meteorology and climate data from global databases.

The Water Solution's Project Team accepts no responsibility for application or interpretation of the surveys, information, data or results provided in the report by any other parties.

1.3 Contents of the EIA report

This EIA report has been organised in the following way:

Non-Technical Summary
Section 1: Provides Introduction – Project Background, Purpose, Scope and limitations
Section 2: Describes applicable Policy, Legal and Administrative Framework
Section 3: Outlines Project Description
Section 4: Outlines methodology adapted to under the Environmental Impact Assessment
Section 5: Details the Existing Baseline Environment of the Project Area
Section 6: Provides an Analysis of Alternatives
Section 7: Analysis Environmental Impact due to the Project Activities
Section 8: Gives an account of the outcome of the stakeholder consultation undertaken
Section 9: Provides Environmental Management Plan for this project
Section 10: Gives Conclusion

1.4 Project Consultants

Water Solutions (Pvt) Ltd. (WS) is a private consultancy firm registered in Maldives in 2005. WS is a dedicated firm which has undertaken various important projects in the field of environment, water

and wastewater. WS has undertaken several environmental consultancy projects and produced a number of EIA reports.

This EIA has been prepared by Water Solutions represented by the following registered EIA consultants working with the Water Solutions. The team has visited S. Feydhoo on a number of times and the details of the visits and their outcomes are provided under the stake holder consultation of this project.

- Hassan Shah, EPA Registration Number P02/2007
- Ibrahim Faiz, EPA Registration number: EIA P05 /2017
- Ahmed Jameel , EPA Registration number: EIA P07 /2007
- Mohamed Umar, EPA Registration number: EIA T07/2017

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The project conforms to the requirements of the Environmental Protection and Preservation Act of the Maldives, Law no. 4/93. The EIA has been undertaken in accordance with the EIA Regulation 2012 of the Maldives by a registered consultant. Furthermore, it adheres to the principles underlined in the regulations, action plans, programmes and policies of Ministry of Housing and Infrastructure, Ministry of Environment and Energy and Environmental Protection Agency. These are discussed in detail in the following sections relevant amendments brought to the regulations from time are also considered in this chapter.

2.1 Laws and Regulations

2.1.1 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:
- Guidelines and advice on environmental protection shall be provided by the concerned government authorities.
- Formulating policies, rules and regulations for protection and conservation of the environment in areas that do not already have a designated government authority already carrying out such functions shall be carried out by MEEW.
- • Identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation.
- An EIA shall be submitted to MEEW before implementing any developing project that may have a potential impact on the environment.
- Projects that have 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 Republic of Maldives is prohibited. Waste shall be disposed only in the areas designated for the purpose by the government.
- Hazardous / Toxic or Nuclear Wastes shall not be disposed anywhere within the territory of the country. Permission should be obtained for any trans-boundary movement of such wastes through the territory of Maldives.
- The Penalty for Breaking the Law and Damaging the Environment are specified.
- 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.

The proposed project will fully abide to the Environmental Preservation and Protection Act. Disposal of oil, chemicals and other hazardous materials will be strictly controlled and managed. Such materials will not be disposed in to the local or the regional environment, but will be transported to designated waste disposal sit and all mitigation measures will be implemented in the interest of the environment.

2.1.2 Protected Areas and Sensitive Areas

Under Article 4 of the Environment Protection and Preservation Act, the Ministry of Environment is vested with the responsibility of identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation.

As part of the Environmental Regulation, EPA has established list of 'sensitive sites' in the Maldives. Although not formalized as a regulation, the sensitive list is mentioned in the EPA documents. The sensitive sites, according to EPA are sites in the Maldives (islands, reefs, mangroves, inter-tidal areas) where developments ought to be restricted, regulated or controlled. Some view those sites mentioned in the sensitive list have no meaning because there is no evidence to show any 'sensitive features' of the areas.

2.1.3 Land Law

The law governs the allocation of Maldivian land for different purposes and uses and other issues regarding the issuing of land, issuing of state dwellings for residential purposes, conduct regarding state dwellings or private dwellings constructed for residential purposes and the sale, transfer and lease of Maldivian Land. All transactions concerning the issuing, receiving, owning, selling, lease, utilizing and using Maldivian land shall be conducted in compliance with this Act.

Allocation of land for various purposes in this project such as the lifting station location must be done according to this law.

2.1.4 Environmental Impact Assessment Regulation 2012

The Ministry of Environment has issued EIA regulation on May 2012, which guides the process of undertaking the Environmental Impact Assessment in the Maldives – This guideline also provides a comprehensive outline of the EIA process, including the roles and responsibilities of the consultants and the proponents. This regulation outlines every step of the EIA process beginning from application to undertake an EIA, details on the contents, minimum requirements for consultants undertaking the EIA, format of the EIA/IEE report and many more.

The guidance provided in this Regulation was followed in the preparation of this EIA report. The EIA has also been prepared by registered consultants.

2.1.5 First Amendment to Environmental Impact Assessment Regulation 2012

This amendment was gazetted on 9th April 2013. As per this amendment the responsible authority has to check the submitted EIA report for everything mentioned in the Regulation's article (Kaafu) was in order and inform the proponent whether the EIA Report has been accepted or rejected within 2 working days. The penalty for repetitive offenses has been also amended in this amendment of the Regulation.

2.1.6 Second Amendment to Environmental Impact Assessment Regulation 2012

This amendment was gazetted on 30th August 2015. With this Addendum to the Environmental Impact Assessment Regulation 2012, the following important points were noted.

- Procedural changes have been made to the EIA process. One of the most important changes was shifting the tourism related developmental project EIA's to the Ministry of Tourism. Slight changes to the process like finalization of the Terms of Reference during the scoping meeting and changes in the fees structure for review process has been made to three different categories.

- Article 8 (a) of the amendment of the decision for screening form is as follows

    1. Environmental Management Plan
    2. Initial Environmental Examination
    3. Environmental Impact Assessment
    4. Approval to go forward with the screened project
    5. Approval to go forward with the project with as per the mitigation measures proposed by EPA.

- The amendment's article 9(b) says the decision for IEE will be as follows

1. Environmental Impact Assessment Report if the project anticipated to have major environmental impacts
2. Environmental Management Plan
3. Approval to go forward with the project if the project is not anticipated to occur major environmental impacts

- Article 10 of this amendment says that two (2) reviewers are required to review the environmental management plan and the selection of the reviewers are to be carried out as per the article 13(b).

2.1.7 Third Amendment to Environmental Impact Assessment Regulation 2012

Amendment 3 (issued on 11th August 2016) covers the point systems for consultants, categories of the consultants and amendment of the penalties to consultants and proponents who fail to follow the regulation. This EIA report was prepared by a Category 'A' registered EIA consultant.

2.1.8 Fourth Amendment to Environmental Impact Assessment Regulation 2012

There was a 4th amendment done on the EIA regulation 2012 and gazetted on 19th January 2017. This amendment explains about the projects that can be preceded without an Environmental Impact Assessment when the proponent requests to the Ministry of Environment and Energy in writing along with commitments or guarantee that the Proponent will carry out the mitigation measures that may impact on the Environment due to such projects. A list of such projects given in the amendment is as follows.

1. Deepening of Existing harbors and channels as same as the foot print
2. Uprooting trees that fall into the existing plots given to citizens for residential purpose
3. Uprooting trees that fall into the roads/path ways to the above plots. (Only councils or who takes such responsibilities can apply).
4. Drilling boreholes to take water.
5. Reclamation carried out as land extension means to the natural existing land. Such lands that are less than 3 years after the reclamation is completed with exception of the projects mentioned article 1 (c) of this amendment.
6. Reclamation carried out in a lagoon with an island shape or characteristics. Such lands that are less than 5 years after the reclamation is completed with exception of the projects mentioned article 1 (c) of this amendment.

Environmental Impact Assessment shall be carried out and permission shall be obtained in Lands that are mentioned in 5 and 6 as above, when such lands become inhabited.

Environmental Impact Assessment shall be carried out in the following projects even in the lands that are reclaimed as per the number 5 and 6 explained above.

1. Projects that involve Dangerous Chemicals
2. Projects that involve in any Oil Storage
3. Projects that involve Incinerators
4. Projects that involves release of any poisonous elements to the atmosphere
5. Projects that involve fibre glass work.

The amendment also says that this amendment will come into force from the date it is gazetted.

The relevance of this amendment to this EIA is related as some of the components of the project at implementation stage may fall on the foot print of the roads that need to be cleared to lay the storm water drainage pipes line is required. S. Feydhoo Town Office has indicated that compensation where necessary must be honoured.

2.1.9 Dredging and reclamation regulation

The dredging and reclamation regulation issued by Ministry of Environment and Energy does NOT have a relevance to this project as this project does not require borrowing sand for the backfilling and levelling work for the storm water management project.

2.1.10 Waste management Regulations

The Ministry of Environment has developed national waste management regulations. The key elements of the regulations include, to ensure safe disposal of solid waste and encourage recycling and reduction in waste generated, develop guidelines on waste management and disposal and advocate enforcing these guidelines through inter-sectoral collaboration and ensure safe disposal of chemical, industrial and hazardous waste.

Waste management for the proposed project during the construction and operation phase will be in line with this regulation. The waste generated from the project site would be taken to the regional waste management facility at Hithadhoo for processing and disposal.

2.1.11 Regulation cutting down, uprooting, digging out and export of trees

The Regulation on cutting down, uprooting, digging out and export of trees and palms from one island to another was recently issued by the Ministry of Environment, Energy and Water. Clause 5 (a) of the regulations states that Prior to the commencement of any project(s) that would require the indiscriminate removal and export of trees/palms from one island to another for the purpose of agriculture, development/development, construction or any other purpose, it is mandatory under the Regulation to prepare an Environmental Impact Assessment Report stating clearly the details of the Project(s) with all necessary information and submit the same through the relevant Ministry to

Ministry of Environment Energy and Water, and the project(s) can only commence upon the grant of written approval from the Ministry of Environment, Energy and Water.

Article 8 (a) requires permission be obtained from Ministry of Environment, Energy and Water, if more than 10 coconut palms that are of a height of 15 ft (from base of the palm to the tip of the palm frond) are cut, uprooted or relocated to another island. The regulation also ensures the replacement of the vegetation that is lost by imposing the planting of two palms for every palm tree that is cut or uprooted (Article 2 (d)). Logging on inhabited islands must be done under supervision of the islands chief or an official appointed by the island chief (Article 8 (c)).

The proposed project does not require removal of mature trees from the island. Hence this regulation would not be applicable to this project.

2.1.12 Decentralization Act

The Decentralization Act establishes the local councils as highest authority in the locality and who shall have executive powers to be exercised in accordance with this Act. The Act establishes Atoll Councils, Island Councils and City Councils.

This project will be monitored and overlooked by the representatives of MEE in Addu City. The project was also formulated and finalized together with input from the local council.

2.1.13 Post EIA Monitoring, Auditing and Evaluation

The environmental monitoring programme given in EIA report is an important aspect of the EIA process. The monitoring programme outlines the objectives of the monitoring; the specific information to be collected; the data collection program, and managing the monitoring programme. Managing the monitoring programme requires assigning institutional responsibility, reporting requirements, enforcement capability, and ensuring that adequate resources are provided in terms of funds, skilled staff, etc.

The monitoring programme outlined in this report will comply with the EIA Regulations 2012.

2.1.14 Regulation on Coral, Sand and Aggregate Mining

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

Neither sand nor aggregate will be mined for this project for the purpose of building construction. Aggregate used for this project will be imported. Local sand would be used for the levelling of the roads. Sand would be excavated from the island's lagoon with the required permit from Environmental Protection Agency. This regulation would not have any implication on the proposed project.

2.1.15 Ambient Air/ Noise and Water Quality Standards

The Maldives lacks the necessary environmental standards for the measurement of ambient air and noise quality or water quality. Therefore, for these quality standards, typically WHO standards or international standards or standards of developed countries are referred.

2.1.16 Guidelines for Domestic Wastewater Disposal

The guideline is developed and implemented by the Environment Protection Agency. The guideline is to improve public health through improved sanitation and cleaner and safer environment by regulating the disposal of domestic wastewater.

The proposed project has been proposed based on the requirements of this guidelines and EIA has been undertaken within the parameters defined by this regulations. All domestic waste will be disposed as per the guidelines provided by EPA. Hence, the treated wastewater will be as per the following guidelines.

Table 1: Treated wastewater quality standards to be achieved

Parameter	**MEEW guidelines for maximum allowable concentrations for discharge into deep sea**
Biochemical Oxygen Demand (BOD5)	40 mg/l
Chemical Oxygen Demand (COD)	50 mg/l
Suspended Solids	150 mg/L
pH	5 -9.5
Oil & Grease (After effective fat/Grease trap)	5 mg/L

2.2 Environmental Permits

2.1.17 Dredging and Reclamation Permit

Dredging and reclamation permit is required to undertake the excavation of the lagoons and carry our reclamation or burrow sands. Such activities will not be carried out in this project, hence a dredging and reclamation permit is not required.

The EIA Decision Statement is issued on successful evaluation of the EIA report by the EPA, Ministry of Environment and Energy. EIA Decision Statement governs the manner in which the EIA project activities must be undertaken.

2.1.18 Responsible Institutions

The main government institutions that have roles and responsibilities relevant to this project are summarised below.

2.1.19 Environmental Protection Agency

The Environment Protection Agency (EPA) of the Ministry of Housing and Environment has responsibility for efficient operation of the EIA process. This encompasses a number of tasks, including screening of projects and provision of general procedural advice to the project proponents throughout the EIA process. The EPA manages the review of the EIA report and is responsible for any approvals or recommendations associated with the EIA. It is also responsible for verifying that environmental protection measures are properly implemented by undertaking environmental audits in collaboration with other government as well as non-government agencies with a role for environmental protection and preservation.

2.1.20 Ministry of Environment and Energy

The Ministry of Housing and Environment is mandated for the effective implementation of the Environmental Protection and Preservation Act (law 4/93) of the country and has the statutory power over issues related to the environment. It has the central control over the environment protection, management, conservation and environmental emergencies. The Ministry operates mainly at a policy level and the more regulatory and technical assessment activities are mandated to the Environmental Protection Agency (EPA). In this respect EPA has now been mandated to manage all issues relating to Environmental Impact Assessment of individual projects.

2.1.21 Ministry of Housing and Infrastructure

Ministry of Housing and Infrastructure is the government ministry responsible for the development and regulation of the construction sector of the country. It is also the agency which oversees the development of public infrastructure of the country. This project is exclusively driven to develop the the storm water management system in S. Feydhoo to mitigating the flooding issues. Feydhoo Town office is under the Ministry of Housing and Infra structure and its corporation is required to implement this project successfully.

2.3 Relevant Policies

2.1.22 National Water and Sewerage Policy (NWSP)

The National Water and Sewerage Policy (NWSP) was launched by the Minister of Environment and Energy Honourable Thoriq Ibrahim in August 2017. The NWSP addresses concerns on the water and sewerage sector in Maldives and the planned outcomes from the implementation are to improve access to safe and efficient water supply sewerage facilities across the country. This policy has outlined statistical figures and 9 policy goals which are relevant to this project and it aims to create momentum to provide safe water and sewerage services within the country.

2.1.23 Third National Environment Action Plan (NEAP III)

The aim of NEAP III is to protect and preserve the environment of the Maldives and to sustainably manage its resources for the collective benefit and enjoyment of present and future generations. The following principles outlined in the NEAP III for environmental protection and environmental management are;

- Environmental protection is the responsibility of every individual
- Achieve results - The actions, activities, regulations, supervision, reporting, incentives, information and advice for environmental management shall be directed and well co-ordinated to achieve the results the citizens want.
- Promote and practise sustainable development
- Ensure local democracy
- Inter-sectoral co-ordination and co-operation
- Informed decision making
- Precaution first
- Continuous learning and improvement
- Right to information and participation
- Environmental protection complements development
- NEAP III contains environmental policies and guidelines that should be adhered to in the implementation of the proposed project activities.
- The sewerage facility development will also be in accordance with the main strategies of the NEAP III. The proponent is committed to the EIA and the proposed monitoring programme. The monitoring programme proposed in this report outlines the environmental management strategy and plan. This EIA has also been prepared in consultation with the key stakeholders, especially the Addu city council and Feydhoo Town office, and relevant stakeholders. Therefore, these measures address the key strategies outlined in the NEAP III

2.1.24 National Biodiversity Strategy and Action Plan (NBSAP)

The National Biodiversity Strategy and Action Plan 2016-2025 (NBSAP 2016-2025) seeks to ensure that threats to biodiversity are addressed, biodiversity is conserved, sustainably used and benefits arising from them are shared equitably. It also encompasses ways of addressing gaps, challenges and constraints highlighted in earlier sections. It is a living document that will have the capacity to adapt to changes in national conditions, capacities and to the changes in the international arena. In implementing the proposed project activities due care would be given to ensure that the national

biodiversity strategies are adhered. The proponent has committed on conservation and protection of the environment while undertaking this proposed project.

2.1.25 Waste Management Policy

The aim of the waste management policy is to formulate and implement guidelines and means for solid waste management in order to maintain a healthy environment. Accordingly, the key elements of the policy include:

- Ensure safe disposal of solid waste and encourage recycling and reduction of waste generated;
- Develop guidelines on waste management and disposal and advocate to enforce such guidelines through inter-sectoral collaboration;
- Ensure safe disposal of chemical, hazardous and industrial waste.

The proponents of this project must be aware of the policy and all solid and hazardous waste produced in this project should be disposed according to the Environmental Management Plan for the project, which reflects the principles of the Waste Management Policy.

2.4 International Conventions

2.4.1 Climate Change Convention and Kyoto Protocol

The Maldives is a party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol to the UNFCCC. The objective of the Convention is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The greenhouse gas inventory of the Maldives forms an integral part of the First National Communication of the Maldives to the UNFCCC.

In March 2009, the government of the Maldives announced the target to make Maldives carbon neutral by 2020. Hence, in the implementation of the project, careful attention needs to be given to ensure energy efficiency and reduce transport related fuel consumption. Furthermore, planting of trees on pump station areas and elsewhere would help in off-set greenhouse gas emissions from the project.

2.4.2 Convention on Biological Diversity

The Maldives is a party to the United Nations Convention on Biological Diversity. The objective of the convention is "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding. The proposed development activities outlined in this project does not fall on

any area recognised for its ecological value. Therefore it is unlikely there will be a major loss of biodiversity. The loss is not going to be significant at atoll or national level. Yet, it is recommended that the developer ensures that mitigation measures are taken to reduce the impact of terrestrial biodiversity.

2.4.3 National Framework for Development 2009-2013

This framework consists of 10 policies and it is the very important environmental policy guidance given in the Strategic Action Plan. This policy encourages strengthening EIA process and EIA monitoring including conservation and sustainability of biological diversity. Based on this plan, relevant laws, regulations and amendments to such regulations has been done to improve the processes and the relevant laws and regulation are covered under Policy, Legal and Administrative Framework of this report

3. PROJECT DESCRIPTIONS

3.1 Project Proponent

The project is proposed by the Ministry of Environment and Energy (MEE) on behalf of the government of Maldives. This project is widely believed to improve the flooding issues due to heavy rain falls and swells by facilitating the infrastructure development at Feydhoo.

The ministry if Environment and Energy is the responsible government authority for implementing policies, programmes, projects and regulations related to provision of clean water. Appropriate sewerage services, provide clean and affordable energy and a healthy environment that is free from pollution also falls under the mandate of Ministry of Environment and Energy. The mandate of the ministry also includes protection of the islands from coastal erosion, climate change, protection and preservation of natural environment.

3.2 Project Location and Study Area

The proposed storm water drainage system development would be implemented at S.Feydhoo. The project area is 66.4 ha land in Feydhoo where flood mitigation scheme will be implemented. The project area has been exposed to flooding caused by rainfall and swell surges, the most commonly occurring hazard events, causing substantial damages. Due to the climate change and sea level rising, frequency and magnitude of flooding events will be further increase in the future.

The project boundaries are illustrated on the site map attached in the annex and also in Figure 2.

Figure 2: Project location

Figure 3 Project Area: Feydhoo

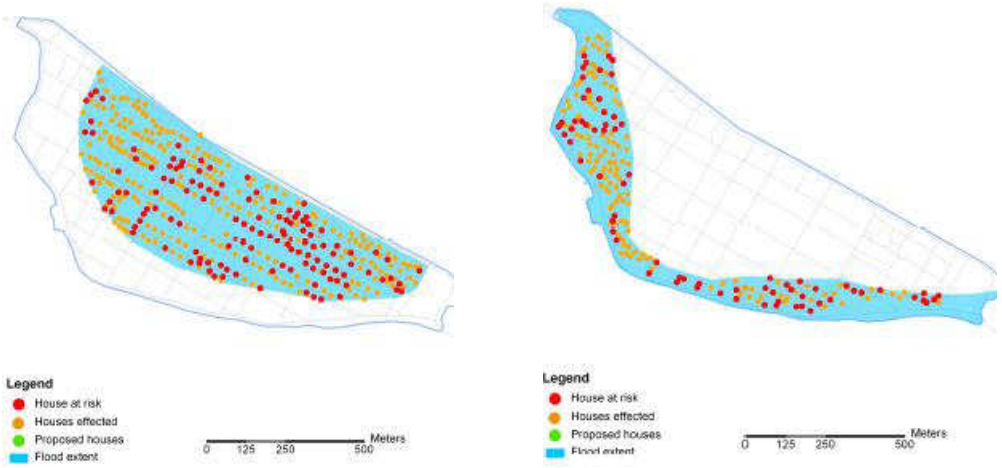

Figure 4 Houses at risk associated with rainfall floods (left) and swell wave/surge floods (right)-Present (Source: UNDP Report 2007: detailed Island Risk Assessment)

3.3 Project Duration

The construction of the storm water drainage system is expected to start during March or April of 2018 and as soon as Environment Decision Statement is issued by EPA. The project's tender is already floated on the gazette and the bid document says the contractor's will submit a schedule for the project. A detailed project schedule will be available once the bid document is assessed and will be submitted to EPA.

3.4 Project Finance

The project has been financed by the Government of Maldives. It is estimated that Maldivian Rufiyaa 23 million would be required for the construction of the proposed storm water drainage system at S.Feydhoo

3.5 The proposed Project activities

The proposed storm water drainage system development project will be carried out in compliance with laws, regulations, standards and guidelines of the Maldives. The proposed storm water drainage system development project consists of laying pipes of all the flood vulnerable roads which has a total length of more than 5.0 km.

3.6 Topography

Feydhoo is mostly low laying area with an average elevation of about 1.5 m above the mean sea level. Elevation of most of houses in the island is lower than the surrounding roads

3.7 Climate

Maldives experiences a typical equatorial monsoonal climate and has wet and dry seasons. In the wet season, the southwest monsoon extends normally from mid-May to November. In the dry season, the northeast monsoon extends from January to March. The month of December and April

are considered as the monsoon transitional periods. In these two seasons, the temperature variations are very small.

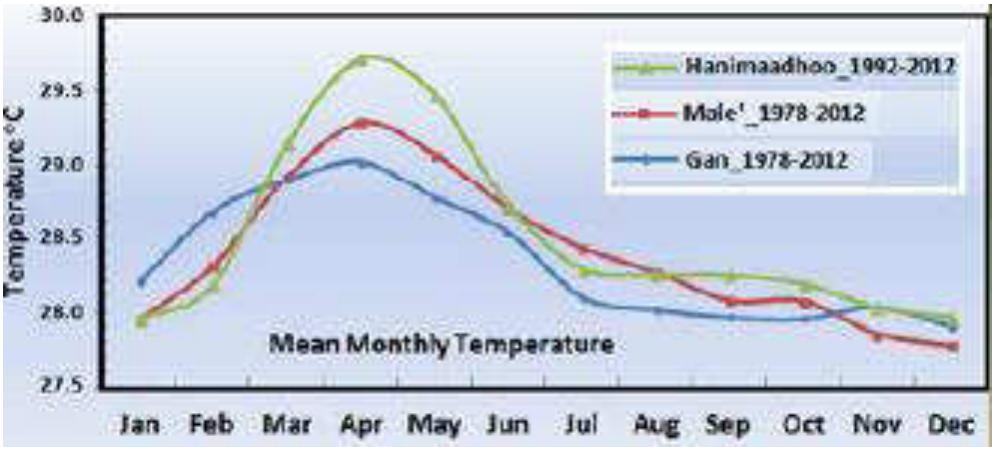

Figure 5 Regional variation of mean monthly rainfall in the Maldives

The central region of the Maldives has a tropical monsoon climate that is consistent throughout the country. The islands in zone 3 features a mix of both wet and dry seasons, with the wet season lasting from May through December and the dry season covering the remaining four months. The islands experiences relatively consistent temperatures throughout the course of the year, with an average high of 30 degrees Celsius and an average low of 26.5 degrees Celsius, which is equivalent to many equatorial cities' average year round daily mean. The islands in the region receives 1900 mm of precipitation annually.

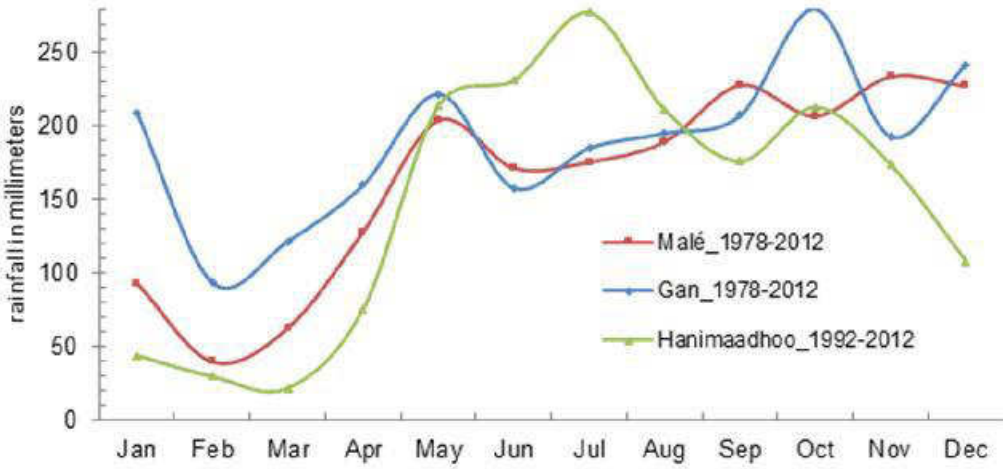

Figure 6 Regional variation of mean monthly rainfall in the Maldives

The average annual precipitation ranges in Maldives increase from north to south with between 1500 mm and 2000 mm.

3.8 Densification

Feydhoo is a highly urbanised settlement with a resident population of 3,431 inhabitants. The average density is about 50 persons per hectare. The vegetation cover is significantly good. Most of the house has a substantial backyard area with a concentration of large trees. The built-up area is about more than 60 % of total area.

3.8.1 The proposed development concept

The overall objective of the present project is to mitigate the Feydhoo flooding problem through a design of a proper storm water drainage system. The specific objective for this project is to achieve adequate and sustainable storm water management for the project area, with adequate technical solutions for the different situation considering possibilities for rainwater harvesting

The proposed storm water drainage system development concept based on the experience of similar projects that had been carried out in the Maldives. The most flood prone zones have been studied and laying of storm water pipes were concentrated on such roads in order to save cost.

3.8.2 Building of the Storm Water Drainage System

The detailed drawing of the design of the storm water drainage system is given in the appendix C of the report. It is a gravity system with a total network length of 5.083 Km, 285 catch pits and 6 lifting stations. Prefabricated manholes are planned to be used along with the pipes.

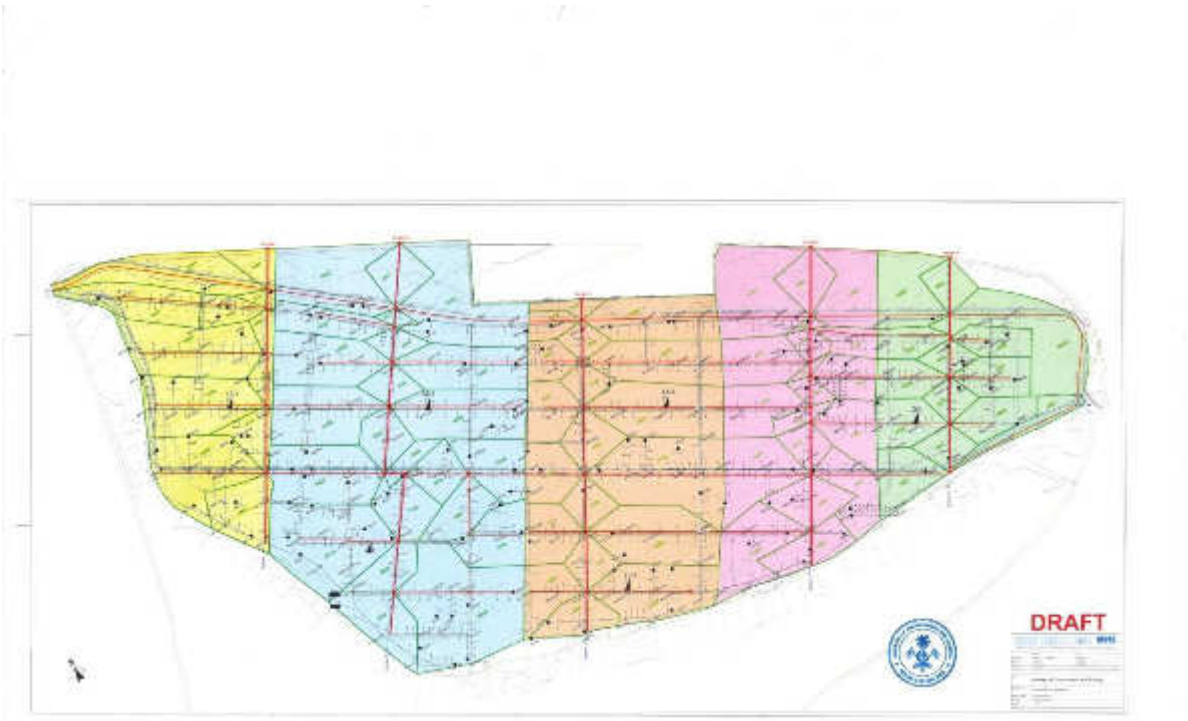

Figure 7: Proposed Storm Water Drainage Development Project

3.8.3 Design Criteria

3.8.3.1 Profile and Sizes

The sizes and profiles of the storm water network are very important design criteria. The main advantage of designing a rectangular cross section concrete channel is the flexibility of selecting a channel depth and changing the width to acquire larger flows whereas in circular channel the size is proportional to the channel diameter.

The disadvantage of rectangular channel is the problem of deposition of sediment due to larger size and flatter bottom compared to the circular pipe.

3.8.3.2 Rectangular Channels

The size for rectangular channels has been chosen according to the computed flows and in the following sizes (Tab 1):

3.8.3.3 Proposed Sizes

Height [m]	Width [m]									
0.25	0.75									
0.30	0.50	0.60	0.80	1.00	1.40	1.60	1.80	2.00	3.00	3.60
3.50	0.80	1.40		1						
0.40	0.60	1.20	1.40	1.60	1.80	2.00	2.20			
0.45	1.20	1.60	1.80							
0.50	2.00	3.60								
0.55	1.20									
0.60	1.40	1.60	1.80							
0.65	2.20	2.20								

3.8.3.4 Manholes

Manholes serve for the monitoring and cleaning of drains and are arranged with changes of direction, section and gradient, with the confluence of other storm water channels, as well as for intermediate manholes in straight stretches of drains. A distance of about 30 m between manholes has been foreseen, considering easiness in monitoring, operation and maintenance. Where the ground elevation allows, the drainage cover is on the ground level and in this case only manhole cover is required.

In cases where the drainage covers are below the ground level and backfilled up to the ground level due to local depressions, the manholes must be extended to the ground level. For this, a manhole shaft ring must be constructed as shown in Fig. 8. To avoid additional costs for circular formworks, prefabricated circular manholes with a diameter of 1.0 m are recommended.

Figure 8 Opening in Reinforcement for Shaft Ring

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The quality assurance shall be ensured through the tendering and construction supervision. Structural analysis shall be prepared for the different size of the drainages. The additional reinforcement shall be considered around manholes as shown in the figure 9 below.

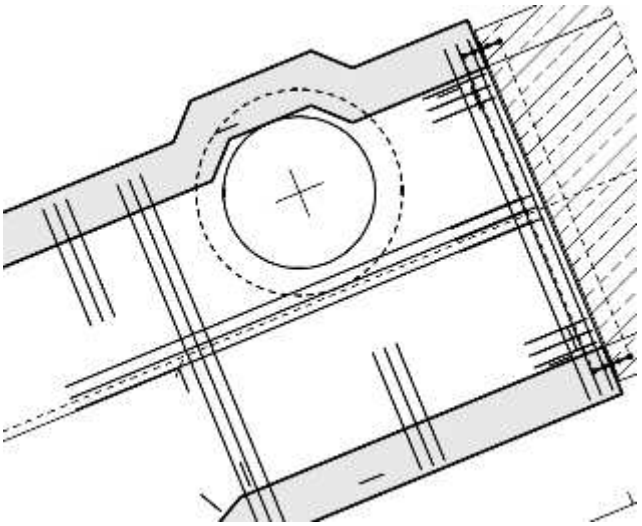


Figure 9 Example of surplus reinforcement around a manhole

3.8.3.5 Bottom for the Rectangular Channel

There are two types of channel bottom: v-shaped and plain bottom. In the table below shows a comparison of characteristics of plain shaped bottom and v-shaped bottom concrete channel of size

1000 mm x 1000 mm for maximum, average and minimum flows is presented. The input data are as follow:

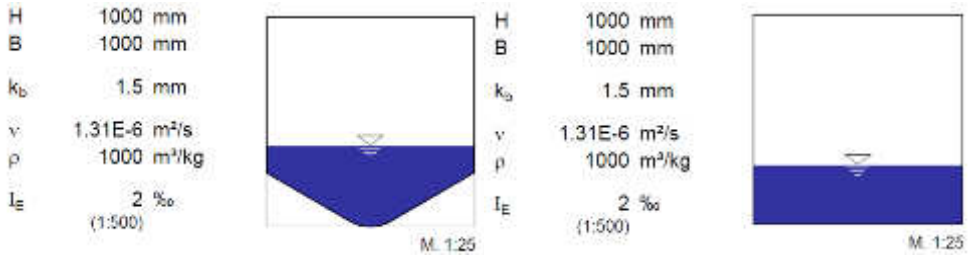


Figure 10 Hydraulic Performance of V and Plain Bottom Channels

Characteristic	Unit	V-shaped bottom channel			Plain shaped bottom Channel		
		Flow (l/s)			Flow (l/s)		
		Max	Average	Min	Max	Average	Min
		900	600	300	900	600	300
Capacity	l/s	1167	1167	1167	1337	1337	1337
Velocity	m/s	1.47	1.34	1.12	1.43	1.3	1.08
Wall Shear Stress	N/m²	5.71	4.94	3.71	5.46	4.7	3.24
Driving Force	N	1324	806.3	336	1288	781.5	324
Reynolds Number	-	1.31E+6	1.03E+6	6.47E+5	1.22E+6	9.54E+5	5.89E+5

According to DWA A110 (German Association of Water, Wastewater and Waste, Rule and standard for hydraulic dimensioning and performance verification of sewers and drains) minimum velocity and shear stress for deposit-free operation of drainages for separate and combined flow are 0.43 m/s and 1 N/m² respectively. As shown in the table above, in both, V and plain bottom shape channels, minimum velocity and shear stress are much higher than the values given in the DWA A110.

In the v-shape bottom channel, the velocity is slightly higher than plain bottom channel. Therefore, regarding hydraulic performance for the transport of silt, having v-shape bottom channel for the storm water drainage has no clear advantage considering easiness of construction and maintenance of plain bottom shape channel.

In Feydhoo, the sanitary sewer network shall be laid below the storm drainage channels in order to provide sewer house connections. Storm water shall be discharged to the sea by gravity whereas wastewater shall be brought to a wastewater treatment plant where pump stations are anyway required in such a terrain.

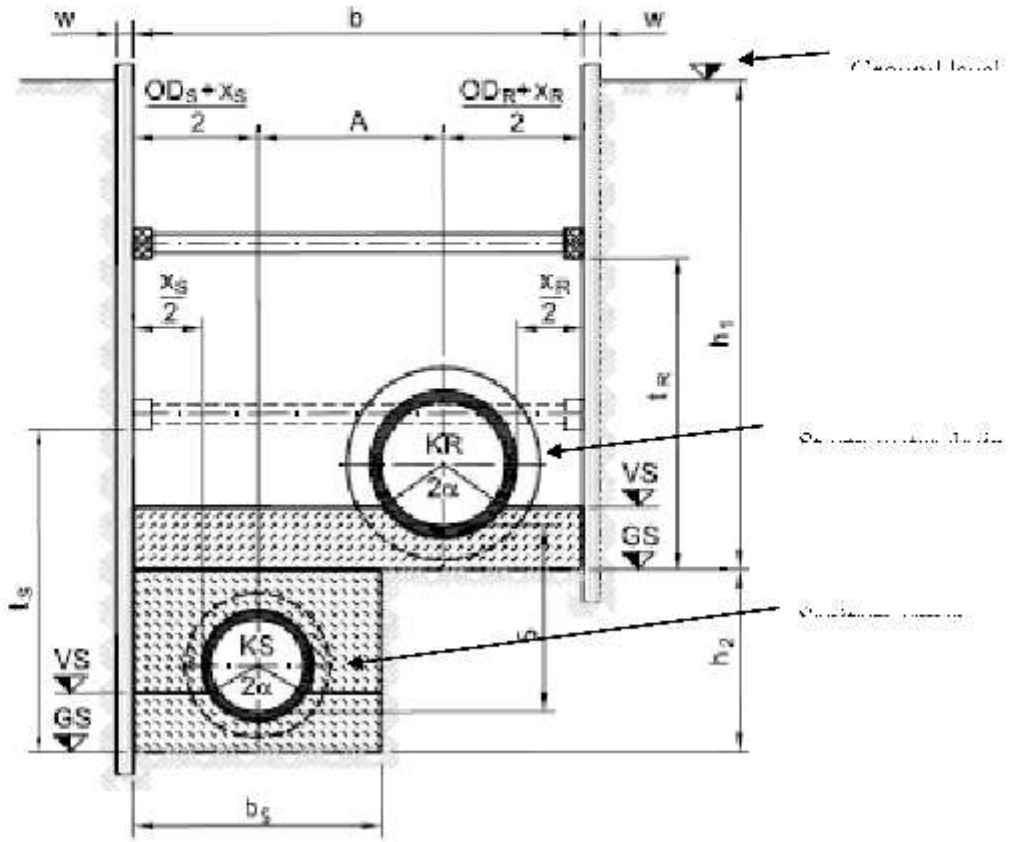


Figure 11 Position of storm water drain and sanitary sewer Pipes

A normal solution to convey storm water to a next receiving watercourse is to use pipes up to dimensions of 2 to 3 meter. Plastic pipes made from HDPE or GRP are available in various sizes.

Figure 12 HDPE Pipe

3.8.3.6 Faulty Connections

Wastewater flow, connected to storm water channels has an adverse effect in the receiving water bodies. Due to a faulty connection, wastewater can end up in the storm water network.

The risk of illegal connections of wastewater from private properties is a significant for separate systems. Therefore, during and after the construction, the inspection of storm water drains for illegal connections is highly recommended.

One of the simple and feasible methods for the detection of sanitary sewer line connection to the storm water drainage is visual inspection. This method is suitable for the inspection of the storm water drainage in this project. First, outfalls are inspected in a dry weather to find out whether there is flow of wastewater. If the wastewater flow is detected, channels are inspected from down to up through manholes. The inspection shall be carried out until the sanitary sewer house connection from where wastewater enters in the drainage channel is identified.

There are also other inspection methods. One of the widely used methods is the filling of storm water drains with fog. A small device blows fog through a manhole into a channel. This fog will spreads through all connections. An illegal connection can easily be detected, as the fog goes through channels. If the wastewater pipes are connected to the storm water channels, the fog will emit through the roof vent pipes. The technical possibility for the detection of faulty connections are shown in Figures 13 and 14 below.

Figure 13 Detection of illegal connections

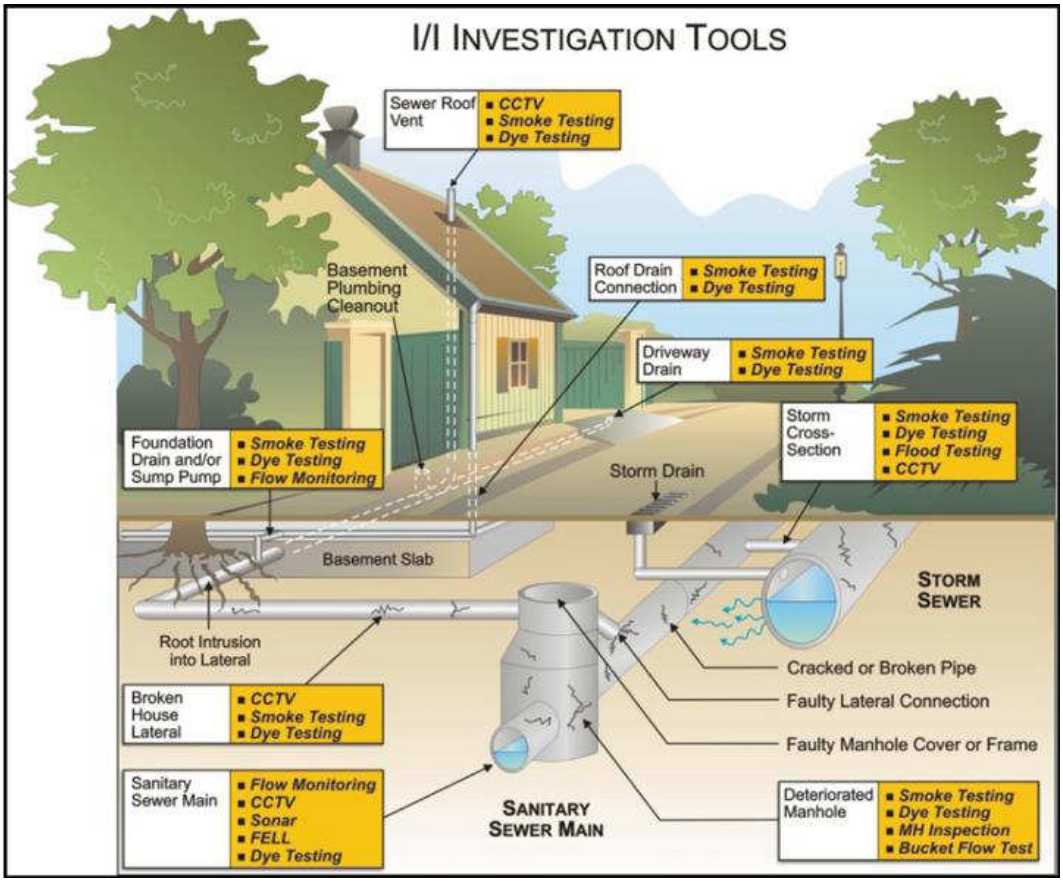


Figure 14 Methods of Detection of Faulty Connections

In order to examine faulty connections in a storm water network, at first a visual inspection is recommended. If there are visually discernible wastewater flow in to the network, the source must be detected with an appropriate method.

3.8.3.7 Minimum Slope and Velocity

The longitudinal slope of all storm water channels shall be 0.1 % as a minimum slope. In a shallow terrain, this slope maintains a velocity in the range of 0.30 to 0.40 m/s as recommended for a storm water drainage, also for minor storm events. Therefore, a minimum slope of 0.1 % and minimum velocity in the range of 0.30 -0.40 m/s shall be chosen for all storm water channels.

For all networks, velocities for the maximum discharge have been computed and presented.

The self-cleaning velocity depends significantly on the discharge so that smaller rainfall events do not cause a sufficient velocity.

3.8.3.8 Selection of an appropriate Design Storm

Two types of design storms are recognised: synthetic and historic storms. Synthesis and generalisation of a large number of actual storms is used to derive the former. The latter are events

which occurred in the past, and which might have well documented impacts on the drainage system. However, it is usual practice in urban storm water drainage to use synthetic design storms.

3.8.3.9 IDF-Curves

IDF relationship is very important in designing storm water drainage as it provides rainfall intensities for the location where storm water drainage will be constructed. The IDF Curve for the project area as shown in Fig. 15 has been developed from the rainfall data measured from 1978 to 2016 by the Maldives Meteorological Service.

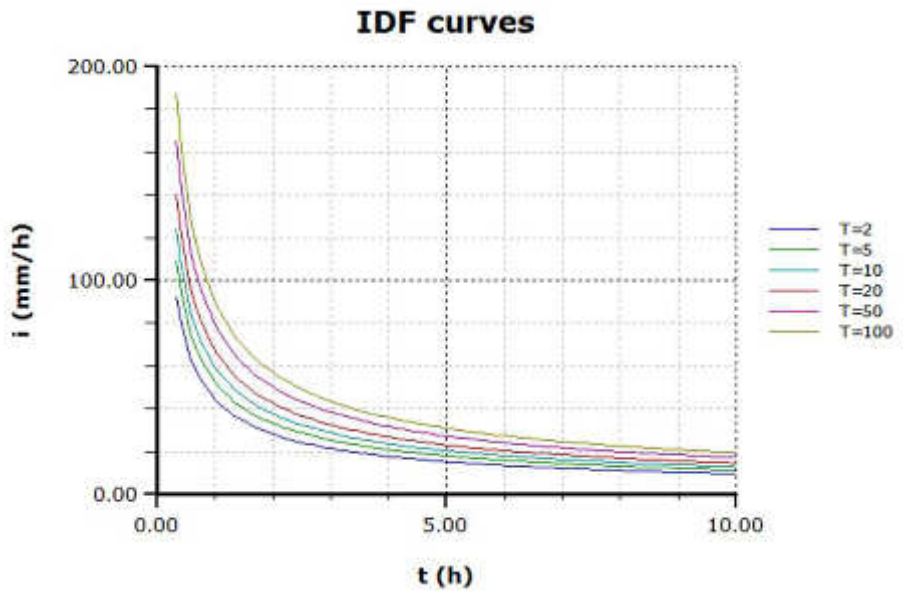


Figure 15 IDF-Curve for Feydhoo

Hydrological Model TechnoLogismiki Works 2017 has been used to develop the IDF Curve..

3.8.3.10 Recurrence Interval

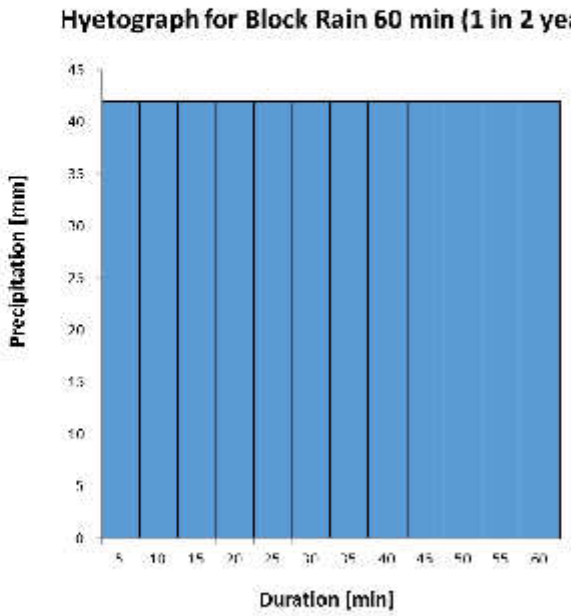
The frequency of the storm events depends on the type of drainage area. The fol-lowing recurrence intervals are common in the Europe Union:

Rural areas:	1 time in 1 Year
Residential areas:	1 time in 2 years
City centers, industrial and commercial areas:	1 time in 5 years
Underground transport systems:	1 times in 10 years

Considering the chosen design storm and the characteristics of the project area, a recurrence interval of 1 time in 2 years is appropriate.

3.8.3.11 Design Storm

Based on the IDF-curve, design storm block rain 42 mm/h of storm frequency of 1 in 2 years has been developed. The resulting hyetographs is shown in the figure below.



The drainage network has been designed under consideration of a certain hydraulic reserve. Proper operation and maintenance of the drainage network is essential. Regular inspection, cleaning, repairing (defects) and replacing (Brocken and aged) of drainages need to be carried with proper methodologies, technologies and coordination.

By considering the above mentioned measures, the enngineers have chosen the design storm generated according to block rain 60 minutes recurrence of 1 in 2 years.

3.8.3.12 Sea Water Level and Tidal Effects

One fact for the project area is that there are 4 outfalls in the detailed design that discharge storm water directly into the sea. Therefore, the normal sea level and tidal range must be considered.

The difference between high and low water level of past 10 years is 1.2 m. The difference between high water level and mean sea level is 0.6m as shown in fig. 16 below. The invert levels for all Outfalls are above 0.60 m from MSL

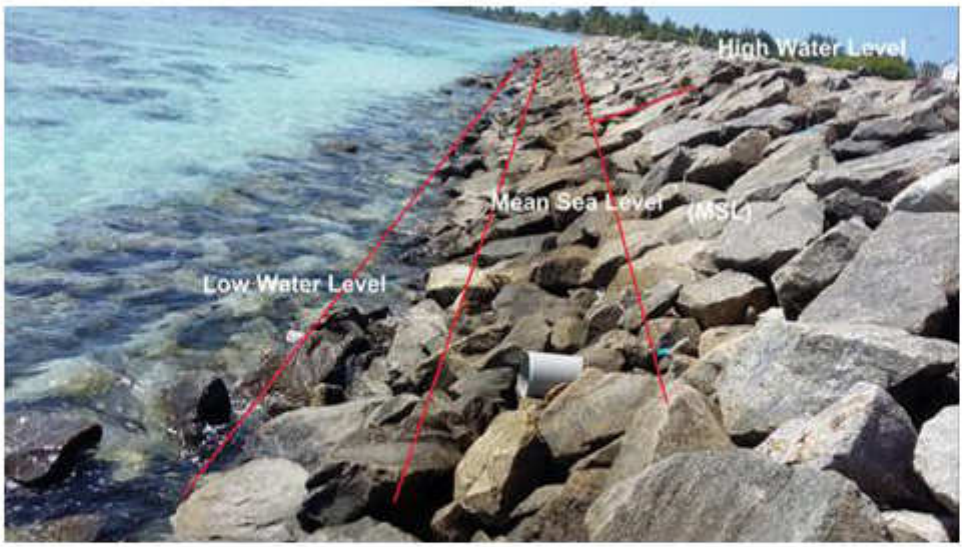


Figure 16 High and low water level at the outfalls

3.8.3.13 Runoff and Hydraulic Calculations

Runoff and Hydraulic calculations are performed by hydraulic model HYSTEM-EXTRAN. It is a hydro-dynamic model, used to model hydraulic and hydrological components of a catchment. It is used for single event or continuous simulation of runoff quantity and quality from primarily urban areas. It tracks the quantity of runoff generated within each sub-catchment, and the flow rate and flow depth in each channel during a simulation period comprised of multiple time steps.

The model is developed by itwh - Institut für technisch-wissenschaftliche Hydrologie GmbH in Germany. It is one of the most sophisticated storm and wastewater water computer models currently available. It can be used for planning, analysis or design (of various hydraulic components) and for that, single events and long-term (continuous) simulations can be applied. Long term simulations over wet and dry periods can be performed.

HYSTEM-EXTRAN is simulating four hydrologic/hydraulic processes starting with the precipitation, continuing with rainfall losses and runoff transportations and at the end flow routing. The hydrodynamic methods are based on the flow process according to the Saint-Venant equations. Water levels and discharges are computed by iteratively time steps.

Modelling results can be viewed and exported in the form of reports, tables, and hydrographs for several parameters at nodes, links, such as flow, flooding, heads, depths.

3.9 Drainage and Flood Control

The principle considerations during the design process were to control and find a solution to the flooding events in the future. At the EIA scoping meeting, and several other meetings, the Ministry

of Environment and Energy and EPA insisted that they would like to have the rain water to be used to recharge the water aquifer of the island and only excess storm water to be discharged through the outfall.

3.9.1 Cabled services

Efforts will be made to prevent any damages that may cause to the cables during the excavations. The contractor shall inform and contact all the service providers namely, STELCO, Dhiraagu, Cable TV service providers, FENAKA, MTCC and MWSC. This was discussed in the stake holder meetings and the presence of some service providers were not able to confirm of the availability of the as built drawings of such cables and pipes. The participants of the meeting held at S. Feydhoo on 18th November 2018 included some service providers such as FENAKA, MTCC, MHI, MEE and Feydhoo town office. The impacts of relevant services interruption due to excavation was discussed in this meeting and the details of the meeting are given under stake holder consultation.

3.9.2 Electrical Power cables

Electricity to Feydhoo is provided by the state owned company FENAKA Corporation and the information about this project was shared with FENAKA in writing and the FENAKA representative participated in the consultation meeting held at S.Feydhoo. His suggestion was to inform them before the excavation and keep them updated about the progress of the project.

3.9.3 Cable TV

The Cable TV services and the potential of damaging such services and their compensations based on past experiences were discussed in the stake holder meeting where the client was present. The client has the opinion that those things should be seriously attended by the contractor and proper mitigation measures should be taken.

3.9.4 Sewerage system

There is an existing sewerage system in this island which is functioning. However the client has contracted MTCC to construct a proper and modern sewerage system in the island. MTCC has already mobilised to the island and started their work. A request to arrange a meeting from the consultant was sent to MTCC and a copy of the letter is attached in the appendix of the report. An MTCC representative attended the consultation meeting arranged by the client at Feydhoo and their concern is addressed under the stake holder consultation of this report.

3.9.5 Water service

The island has a wide water distribution network provided by the state utility company FENAKA. A request for the meeting regarding this project has been sent to FENAKA and their preventative in Addu city was present in the consultation meeting held in Feydhoo which was arranged by the

proponent and the discussions of the meeting was given under stake holder consultation of this report.

3.10 Construction Methodology

The proposed project involves four main activities namely site preparation, excavation, pipe laying and backfilling. Details of the activities and construction methodology for each activity are described in the following sections.

3.10.1 Site Preparation stage

3.10.1.1 Removal of the existing tress

Roads of the island do not have trees planted and the project does not require removing the trees as part of the preparatory phase of the project.

3.10.1.2 Sand for backfilling and levelling work

For back filling and levelling work at the roads materials need not be borrowed. The sand for the back filling and levelling would be obtained from the original sand or the excavated sand.

3.10.1.3 Earth Works

3.10.1.4 Excavation

Trench excavation work shall be carried out in a safe and proper manner with appropriate precautions being taken to safe guard workmen and existing structures and utilities against all hazards. Notwithstanding these provisions, if damage to existing utilities results from the contractor's operations, such damage shall be repaired without delay by the contractor or some other agency approved by the engineer, and the cost of such repairs shall be borne by the contractor.

Trenches shall be excavated to the lines and levels shown on the drawing or as directed by the engineer.

Trenches shall be excavated to a width, which will provide adequate working spaces and sidewall clearances for proper pipe installation, jointing and embedment.

All trench excavation shall be open cut from the surface unless authorized by the engineer and shall be excavated so as that pipes can be laid straight at uniform grade without dips or humps between terminal elevations.

Mechanical equipment shall not be used in locations where its operation would cause damages to trees, buildings, culverts or other existing property, utilities or structures above or below ground. In all such locations hand-excavating methods shall be used.

Where necessary contractor shall use hand tools to excavate test pits prior to excavation to determine the exact location of existing utilities. Test pits shall be refilled by hand as soon as

practicable after the necessary information has been obtained. No extra payment will be made for the excavation of test pits.

The trench shall be excavated to the necessary depth to meet the requirement for preparation of trench bottom for pipe laying. Any part of the trench below grade shall be backfilled to grade with thoroughly compacted materials approved by the engineer. When an unsuitable sub grade condition is encountered and in the opinion of the engineer, it cannot support the pipe, an additional depth as directed by the engineer shall be excavated and refilled to pipe foundation grade with approved suitable material to achieve a satisfactory trench bottom.

All excavated materials shall be piled in a manner that will not endanger the work or obstruct sideways or drive ways. Gutters shall be kept clear or other satisfactory provisions made for street and other drainage. Location will be as given in the drawing or as directed by engineer

The Contractor should take all measures to warn the traffic and people using the stretch of the road where the pipes are being laid. Acceptable road signs and night- lights should be maintained during the work period.

The contractor should keep the de-watering pumps operated and the pumped water should be diverted to suitable point as directed by the engineer.

Where soil is not suitable for laying pipes, the selected fill material should be placed 400 mm deeper than the specified inverted level and the bedding should be placed in 100 mm thick layers under the pipe. Each layer should be compacted to the satisfaction of the engineer. The thickness of layers for compaction above the pipe should not be more than 150 mm. The engineer will decide if the excavated material is suitable for backfill and in which case the contractor should sieve the excavated material.

Trenches shall be excavated to the minimum width necessary to suit the outside diameter of the pipe plus the clearance either side to the trench walls. For smaller diameter pipes this will be less than the minimum width necessary for the work of installing pipes in the trench, particularly in deep excavations. A minimum trench width of 600 mm shall be used and the maximum width under normal conditions should be as follows:

Pipe Size	**Min Trench Width**	**Max Trench Width**
Less than 150 mm (inclusive) nominal diameter	450 mm	750 mm
300 mm nominal diameter	500 mm	800 mm
400 mm nominal diameter	600 mm	900 mm

However for deeper depth, and/or larger diameter of pipe, and where required excavation width, will be more than above specified, so that to have sufficient working space while laying. Excavation

width should be more than above specified where Valves, hydrants and other specials and fittings to be laid or installed and sufficient working space should be provided or made where required.

Stepped trenches may be excavated to provide adequate working space over the pipeline, whilst still permitting pipes to be laid in minimum width trenches.

Trenches shall be carefully excavated to the width specified in the design and any soft spots removed from the bottom. All voids, whether due to the removal of soft spots or over-excavation shall be refilled along with any natural material on which the pipes will be bedded.

3.10.1.5 Sheeting and Shoring

Excavation for trenches shall be sheeted, braced and shored as necessary to prevent caving or sliding.

3.10.1.6 Dewatering

The contractor shall provide and maintain adequate de-watering equipment to remove and dispose of all surface and ground water entering excavations, trenches or other parts of the work as approved by the Government Authorities and copies of such approvals shall be submitted to Employer. The trench shall be kept dry during sub-grade preparation and continually thereafter until the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, floatation, or other cause will result.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damages to the adjacent property. Dewatering shall be carried out with liaising to EPA and as per the EPA's regulations.

3.10.1.7 Backfilling of Trenches

Backfilling shall be undertaken as soon as practicable after the specified operations preceding it, have been completed. Backfilling should not be commenced until the works to be covered have been completed to the extent required by the Employer.

Compacted backfilling will be required for the full depth of the trenches. The backfill shall consist of uniform, readily compatible materials and shall not contain materials deemed unsuitable as directed by the engineer. At least up to 300mm above the top of the pipe only selected soil or fill materials shall be deposited in 150mm layers and thoroughly compacted using an appropriate mechanical compactor. Particular care shall be taken to avoid damages to the pipe. The reminder of the refilling may consist of course materials, which shall be spread in layers of not more than 250mm and compacted as above.

Where the excavations have been supported and the supports shall be removed these shall be withdrawn progressively as backfilling proceeds in such a manner so as to minimize the danger of collapse. All voids behind the supports shall be filled and compacted.

Backfilling shall commence as soon as the work of constructing the pipeline has been completed, but not before the work has achieved sufficient strength to withstand all loads imposed by backfilling. All excavation and backfilling shall be co-ordinate with construction of the pipeline so as to expedite completion with minimum disruption. Backfilling of a trench shall be carried out after inspection of the trench by the Engineer (Employer)

For pipes bedded on the trench bottom, or on a sand or granular bed, selected backfill material free from vegetable matter, building rubbish, stones, etc. shall be placed in unconsolidated layers of 150 mm thickness, and then uniformly compacted.

Backfill used above the selected backfill layer shall be to the approval of the Employer, or others responsible for the upkeep of roads, and will usually be the excavated material. Contractor should arrange local sand in case of insufficient sand in the excavated area. Well compacted back filling should reach at least 95% of Maximum Dry Density.

Backfilling around manholes and inspection chambers shall be undertaken in such a manner that will avoid damage or uneven loading

3.10.1.8 Disposition of Excavated Materials

The disposition of excavated material shall be at the Contractor's discretion but shall be so arranged as to suit the overall requirements for the construction of the Works.

The Contractor shall ensure that no excavated material which is suitable for or is required for re-use in the Works is disposed of outside of the site.

Temporary spoil tips may be used to store excavated material as required, and shall be arranged by the Contractor.

Excavated material which is surplus to requirements or is unsuitable for re-use in the Works shall be disposed off-site either to locations to be found by the Contractor (Contractor's tip) or to locations designated by the Engineer (Engineer's tip). Materials ordered to be disposed of to the Contractor's tip shall become the Contractor's property and he shall be entirely responsible for it's disposal. Material ordered to be disposed of to the Engineer's tip shall remain the property of the Employer.

3.10.2 Construction of Pipe Lines

3.10.2.1 Bedding

The bedding for pipes shall be constructed by spreading and properly compacting suitable granular bedding materials over the full width of the trench. For normal bedding the trench bottom shall be given a final trim and shape so that the pipe will be uniformly bedded on the required grade. Any stones or flints likely to damage the pipe or its coating shall be picked out of the pipe bed, and any hole so formed shall be filled with soft material and trimmed to the correct level.

3.10.2.2 Pipe Laying

All pipe laying shall be carried out according to the standard code of practice. Pipes shall be laid directly on the selected bedding materials properly compacted to the satisfaction of the Employer. Pipes shall be accurately laid and in perfectly straight lines and true gradients in accordance with the plans and sections shown on the drawings or as otherwise directed by the Employer.

Pipes shall be embedded properly by placing embedment materials and shall be protected from lateral displacement during embedment operations. Bricks or other hard materials shall not be placed under the pipes for temporary support except where a concrete bed is to be provided.

After backfilling 300 mm above crown of the pipe, Contractor shall lay acceptable warning tape above all pipes. Wherever pipe laying is stopped, the open end of the pipe shall be closed with an end board closely fitting the end of the pipe, to keep sand and earth out of the pipe. The end board shall have several small holes near the centre to permit water to enter the pipe and prevent flotation in the event of flooding of the trench.

Whenever pipes are laid directly on the trench bottom or on sand or granular bed, depressions shall be formed in the bedding at the pipe joints to ensure that the pipe is uniformly supported throughout the length of its barrel. While laying pipes, no tensile stress shall be applied to pipes previously laid.

3.10.2.3 Pipe Installation

Pipes and fittings shall be carefully examined for cracks and other defects immediately before installation. The interior of all pipes and fittings shall be thoroughly cleaned of foreign matters before being installed and shall be kept clean until the work has been accepted. Precautions shall be taken to prevent foreign materials from entering the pipe during installation. Water shall not be permitted to accumulate in any part of the trench during installation and testing. The Contractor shall strictly follow manufacturer's instructions in laying and jointing pipes and fittings.

3.10.2.4 Reaction Anchorage and Blocking

All exposed piping with mechanical couplings, push-on-or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints. All un-lugged bell and spigot or all bell tees, Y-branches, bends deflecting 11 ¼ degree or more, and plugs or caps, which are installed in buried piping subjected to high internal hydrostatic head, shall be provided with suitable reaction blocking, anchors joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.

Reaction blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair.

3.10.2.5 Handling

The Contractor shall exercise care in handling pipes so as to avoid damage, particularly to pipe ends. The loading and unloading of loose pipes shall be carried out by hand, avoiding the use of skids. Metal slings, hooks and chains shall not come into direct contact with the pipes, and they shall not be dropped onto hard surfaces or dragged along rough ground.

When pipes have fixed sockets at one end, the socket ends shall be placed at alternate ends of the stack with the sockets protruding so that the pipes are evenly supported along their entire length. UPVC pipes and fittings shall be stored under cover out of direct sunlight,

3.10.3 Construction of uPVC Pipe lines

3.10.3.1 Bedding

The bedding for pipes shall be constructed by spreading and properly compacting suitable granular bedding materials over the full width of the trench. For normal bedding the trench bottom shall be given a final trim and shape so that the pipe will be uniformly bedded on the required grade. Any stones or flints likely to damage the pipe or its coating shall be picked out of the pipe bed, and any hole so formed shall be filled with soft material and trimmed to the correct level

3.10.3.2 Pipe Laying

All laying shall be carried out according to the standard code of practice. The pipe shall be laid directly on the selected bedding materials properly compacted to the satisfaction of the Engineer.

Pipes shall be accurately laid in perfectly straight lines and true gradients in accordance with the plans and sections shown on the drawings or as otherwise directed by the engineer. Pipes shall be embedded properly by placing embedment materials and shall be protected from lateral displacement during embedment operations.

Bricks or other hard materials shall not be placed under the pipes for temporary support except where a concrete bed is to be provided. After backfilling 300 mm above crown of the pipe, contractor shall lay acceptable warning tape above all pipes.

Wherever pipe laying is stopped, the open end of the pipe shall be closed with an end board closely fitting the end of the pipe, to keep sand and earth out of the pipe. The end board shall have several small holes near the centre to permit water to enter the pipe and prevent flotation in the event of flooding of the trench.

Whenever pipes are laid directly on the trench bottom or on a sand or granular bed, depressions shall be formed in the bedding at the pipe joints to ensure that the pipe is uniformly supported throughout the length of it's barrel. While laying pipes, no tensile stress shall be applied to pipes previously laid.

3.10.3.3 Pipe Installation

Pipes and fittings shall be carefully examined for cracks and other defects immediately before installation. The interior of all pipes and fittings shall be thoroughly cleaned of foreign matters before being installed and shall be kept clean until the work has been accepted. Precautions shall be taken to prevent foreign materials from entering the pipe during installation. The Contractor shall strictly follow manufacturer's instructions in laying and jointing pipes and fittings.

3.10.3.4 Reaction Anchorage and Blocking

All exposed piping with mechanical couplings, push-on-or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints. All un-lugged bell and spigot or all bell tees, Y-branches, bends deflecting 11 ¼ degree or more, and plugs or caps, which are installed in buried piping subjected to high internal hydrostatic head, shall be provided with suitable reaction blocking, anchors joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure. Reaction blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair.

3.10.4 Installation of UPVC Pipes

UPVC pipes and fittings shall be installed strictly in accordance with the Manufacture's instruction. UPVC pipes shall not be bent to accommodate changes of direction. Pipe shall be cut from measurements taken at the site and shall be cut in a neat manner, without damage to the pipe or to the lining. Cuts shall be smooth, straight and at right angles to the pipe axis. All pipe cutting shall be done with a fine toothed hacksaw or a portable power driven saw with a steel blade or abrasive discs. Cut end shall be bevelled using a plastic pipe-bevelling tool, which cuts the correct taper automatically. Methods of cutting and bevelling the pipe shall be acceptable to the Engineer.

Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed. Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the Employer.

Socket pipes shall be laid singly with the sockets uphill unless shown otherwise on the drawing and each spigot end shall be pushed into the next socket so that the space between the surfaces of the joint is one thirtieth of the internal diameter of the pipe or 10mm whichever is less. This space shall be established by marking the spigots or by other approved means.

Joint preparations and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbounded gaskets) shall be checked with a feeler after the joint is completed.

3.10.5 Connection of New Works with existing works

Connection between new work and existing pipes and junctions or manholes shall be made under conditions which will least interfere with service to users. Where pipe has to be connected to the existing manholes or junctions the opening, if required, for pipe connection shall be made as directed by the engineer. Approved leak proof cement shall be used for such installation or connection of pipes and shall be carried out as directed by the engineer.

3.10.6 Pipe works to concrete fixings

Pipes and fittings passing through or into concrete shall be grip bonded in order to get a satisfactory bond with the concrete. This is achieved by painting the surface with solvent cement and whilst it is wet, sprinkling with dry course sand or grit. Once the surface is dry, it is ready to bond directly to concrete.

3.10.7 Pipe Flexibility

Unless noted otherwise on the drawings pipes passing out of or into manholes, and under or from under structures, shall have their first flexible joint at a position not greater than one pipe diameter from the manhole or vertical line through the face of the overlying structure

3.10.8 Junction and Drain Connection

All junctions are to be oblique and unless the connection is to be laid at the time the junction is laid, are to be fitted with suitable stoppers obtained from the manufacturer of the pipe.

No saddles shall be used except with the prior approval of the engineer, which will only be given exceptional circumstances. If the contractor omits to lay a junction as directed, then the engineer may require the necessary pipe or pipes to be taken out and replaced with the proper junction all at the Contractor's expenses.

3.10.9 Construction of RCC collecting tanks and RCC catch pits

Steel Grating Cover for catch pits shall be installed strictly in accordance with the Manufacturer's instructions. The backfilling of earth around the tanks / Catch shall be in 150mm thick layers properly compacted with a mechanical vibrator. Contractor shall make necessary drilling and making holes in tanks and Catch pits to connect gravity pipe line.

All catch pits, inspection chambers and Manholes shall be confirmed as leak proof structure by performing leak test. Contractor shall bear the cost of performing such successful leak test. Water Proofing Compound shall be applied after performing successful leak test.

3.10.10 Construction of BIOSWALE

Bio swales must be excavated during dry weather and install the overflow outlet pipes and the fill with the media up to the proposed final elevation. A non -woven geotextile screen shall be loosely placed overlaying sand slope surface with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Care must be taken during installation so as to avoid damage occurring to the geotextile as a result of the installation process. Atmospheric exposure of geotextiles to the elements following lay down shall not exceed 7 days. Successive sheets of geotextiles shall be overlapped a minimum of 350 mm (unless stated otherwise in the drawings), with the upstream sheet overlapping the downstream sheet.

During construction contractor must be cautious to keep the sediments out from the infiltration as much as practicable. As soon as the grading is complete, slopes should be stabilized to reduce erosion of native soils. Preventing and alleviating compaction are crucial during construction of the infiltration practices, as compaction can reduce the infiltration rates in sandy soils. Contractor must keep heavy construction equipment away from excavation bottom to avoid compaction. Tracked vehicles should be used to reduce the pressure applied to the soil. Drivable mats can be used for backfill and grading to minimize the compaction. During the final pass with the excavator bucket (i.e bottom of excavation), it is highly recommended to rake the soil with the teeth of the bucket to loosen any compaction.

3.10.11 Cement

Cement shall be Ordinary Portland Cement Grade 52 confirming to B.S. 12 for all works. Other kinds of cements shall not be used unless otherwise approved by the Employer in writing.

3.10.12 Aggregate

Course aggregates shall be clean well graded imported granite chips ranging in average size from 5mm to 20mm. Fine aggregate shall white sand or imported river sand.

3.10.13 Water

Water shall not contain injurious amounts of impurities which may adversely affect concrete and reinforcement. Portable fresh water shall be used for all concrete works and curing. Saline Water Shall not be allowed for any Construction Work or Curing Purpose.

3.10.14 Specified Design Strength

The specified design strength of concrete shall be not less than 40N/mm2 unless otherwise specified.

3.10.15 Water Cement Ratio

Water-Cement Ratio of all concrete shall be 0.4 to 0.5 by weight and concrete mix design must be approved by the project consultant.

3.10.16 Mix and Ratio

All mixes shall be by concrete mixer. Fine and course aggregate shall be measured by volume unless otherwise specified. The mix ratio for all concrete shall be as instructed by Employer

3.10.17 Quality Inspection of Concrete

The contractor shall conduct tests on concrete to ensure its quality. In this respect contractor is required to make three test cubes of standard sizes and make arrangements for testing the strength in 7 days and 28 days and approve the results from Employer.

3.10.18 Consolidation

The concrete shall be properly vibrated immediately after placing by means of a mechanical vibrator designed for continuous operation to ensure proper consolidation.

3.10.19 Concrete Curing

After concrete has been placed the concrete surface shall be kept moist by spraying with water and shall be protected from the direct sunlight and rapid drying. The curing period shall not be less than 7 days.

3.10.20 Construction of Form Work

Form work shall be sufficiently rigid and tight to prevent loss of mortar from the concrete and to maintain the correct position, shape and dimensions of the finished work. It shall be so constructed as to be removable from the cast concrete without shock or damage.

The form shall be capable of producing a consistent quality of surface as required and a neat finish shall be obtained. Where holes are required to accommodate, fixing devices or other built-in items, precautions shall be taken to prevent loss of mortar matrix. The interior of all forms shall be thoroughly cleaned out before any concrete is placed. The faces of the forms in contact with the concrete shall be cleaned and treated with a suitable agent where applicable. Formwork shall be removed without shock to, or disturbance of the concrete.

3.10.21 Project Inputs

The types of resources that will be used during the propose project work and from where and how these will be obtained are given in the following table.

Table 2: Matrix of major inputs during construction stage

Input resource(s)	Source/Type	How to obtain resources
workers (20 to 40)	Maldivians and expatriates	Contractor
Electricity/Energy (if required)	Island grid	Existing power supply from FENAKA Corporation.
Water	Island Grid	Existing Water Supply from FENAKA Corporation
Fuel Storage	No large quantity of fuel need to be	By commercial means from

Input resource(s)	Source/Type	How to obtain resources
	stored.	suppliers.
Imported sand, aggregate, cement for construction of manholes	Purchased from whole sale shops for construction materials	Contractor
Machinery	Lorries, excavators, loaders, JCBs and others	Available with the contractor and hiring from Local suppliers.
Transport	Transfer by domestic plan, dhoni and speed boats. Materials to be transported in carrier vessels.	Available with contractor, barges and carrier vessels will be hired from local suppliers

3.10.22 Project outputs

The type of outputs (products and waste streams) and what is expected to happen to the outputs are given in the table.

Table 3: Matrix of major outputs of environmental significance during construction stage

Products and waste materials	Anticipated quantities	Method of disposal / control
Green waste.	0 m^3 of compacted green waste	The project is not expected to remove any vegetation as no trees are located in the excavation area
Hazardous waste	Approximately 500 litres of waste oil from heavy machineries	Barrelled and stored until disposal. Final disposal at Thilafushi once the project is complete.
Noise	Only localised to the island environment, and mainly to project site.	Limited noise pollution will be occurred. Heavy machineries will be used in day time to minimise its impact on houses.
Air pollution	Limited quantities of dust in only designated areas	Mainly arising as a result of dust emission from cutting trees and moving machinery and vehicles. Only localised to project boundary.
Construction waste	50 to 100 cubic meters of construction waste	Construction waste will be sorted and stockpiled at the site and disposed to regional waste centre regularly or once the project is complete.

3.11 Project Duration and Scheduling

It is planned that the S.Feydhoo Storm Water Drainage project starts during March or April 2018. The project is already on gazette to obtain a successful bidder and the successful bidder is supposed to make a detailed project schedule. Once the detailed project schedule is finalized it will be send to EPA.

There are many risk factors associated with this project that could possibly have both financial and environmental implications. The scheduling of the project would affect the lives of many people at the island, especially at the roads where the excavation and the road closure are as part of the project. Hence proper information needs to be provided to the public as to make them aware of the scheduling of the project. Proper care need to be taken to control and mitigate the emissions of gases and dust. The excavated open trenches shall be fenced or boundary marked with warning tapes.

There is also the risk of project delays caused by bad weather. Part of the project period falls in the south west monsoon. This risk can be minimized if the works are scheduled as such that weather is taken as important aspect in the project planning.

3.12 General Methodologies of data collection

The section covers methodologies used to collect data on the existing environment. The key environmental and socio-economic components of the project that were considered are physical environment, social and coral reef areas as the marine environment.

In order to study the existing environment of the island, the following data collection methodologies were used during the field visits undertaken in July, November and December 2018.

Conditions of the existing environment were analysed by using appropriate scientific methods. The environmental component of the study area of the project was terrestrial and marine environment of the island. The terrestrial environment covered the roads which will be developed as part of the project. Marine environment covers the area where sand would be borrowed for the levelling and backfilling work.

3.13 Mapping and Location identification

The entire island, shore line, vegetation line and marine survey locations, ground water sampling locations and roads were mapped. Mapping was undertaken using hand held differential GPS. The location of data collection sites were marked using handheld GPS.

3.14 Socio-economic condition and stakeholder consultation

A series of stakeholder consultation was undertaken as part of the Environment Impact Assessment for the Storm Water Drainage development project. The purpose of the consultation is to get stakeholders view on the project and analyse the potential impact of the project might have on the residence of the island. The findings were based on a participatory approach and the information provided by them. Secondary sources of information were collected by the census 2006, reports public by government authorities and information and data available on the internet.

4. EXISTING ENVIRNMENT

The baseline information of the proposed project and surrounding area were collected through data collected during the study period and available secondary data. The environmental baseline data includes general geography, meteorology, demographic status, geology, ecologically protected areas and terrestrial environment of the island. A detailed description of baseline data compiled through the surveys and monitoring is provided in the following subsections:

4.1 Geographic Setting

Maldives has a total of 1,192 islands, distributed over 26 natural atolls that encompass ocean area with much less land area. The country's total land area is estimated to approximately 300 km^2, with islands varying in size from 0.5 km^2 to 5.0 km^2. Only 197 of the islands are inhabited. The islands

consist of coral, sea grass, seaweed, mangrove and sand dune ecosystems which are of great ecological and socio-economic significance.

The island of Feydhoo is located on the southern peripheral reef of Addu Atoll. Addu atoll is southernmost atoll in Maldives and is located in south of the equator. Feydhoo island is located at the geographic coordinates of 0°40'59.48"S and 73° 8'11.46"E. Feydhoo is located in a very large reef system sharing the reef with several islands. Feydhoo is second southern island on the eastern reef system of Addu Atoll. It is the southernmost inhabited island in Maldives. The closest inhabited islands are Maradhoofeydhoo and Maradhoo. Closest airport to Feydhoo is Gan International Airport. All of these islands are connected through a causeway. The land area of the island is now approximately 120 hectares after the reclamation project undertaken in 2016.

Figure 17: Location of Feydhoo island (Image Source: Google Earth)

4.2 Physical Environment

S. Feydhoo is a highly urbanised island with currently over 3431 inhabitants and is the second largest populated centres in Addu City. The harbour area contains a large proportion of the islands business establishments. The key economic infrastructures on the island are the harbor, Addu Link Road and communications infrastructure and the Gan International Airport. Furthermore, coastal protection has been established, a health centre services is provided. Hithadhoo Regional Hospital being the main hospital in the region, the role of health centre has not been decreased, waste collection services are established, electricity is provided 24 hours. Feydhoo's lagoon on southwest side of the island is now reclaimed adding 50 hectares to the island to provide more land space.

Addu Link Road is one of the main infra-structure that links from Hithadhoo island up to Gan International airport and Feydhoo falls into an important part of this link road. One of the main economic activity in Feydhoo in terms of estimated income is civil service. Other activities include wholesale and retail trade, hotels and restaurants, manufacturing, construction, guest services and

transport services. After the development of link road the economic opportunities has been increased particularly the transport, restaurant and trade sectors.

4.3 Topography and Island elevation

Topographic survey of Feydhoo was undertaken using GNSS-RTK surveying techniques and UAV mapping using DJI Phantom 4. Results show that large part of the island on the northwest side are very low compared to other areas of the island. Newly reclaimed land is also elevated from the original island with levels of 1.7 to 1.9m. . According to Feydhoo Flood Assessment report by EPA (2016), the low level area of Feydhoo is previously a swamp that was later used for house construction. Level reading of this area shows that ground elevation of the previous swamp area is less than 1 meter. Since most of the roads Feydhoo are modified as part of the road maintenance undertaken because of severe flood events, the roads are higher than the household level. Overall, the topographic survey of the island shows that north-western side of the island is lower than the south western side of the island. Detail topographic survey map is attached as an annex.

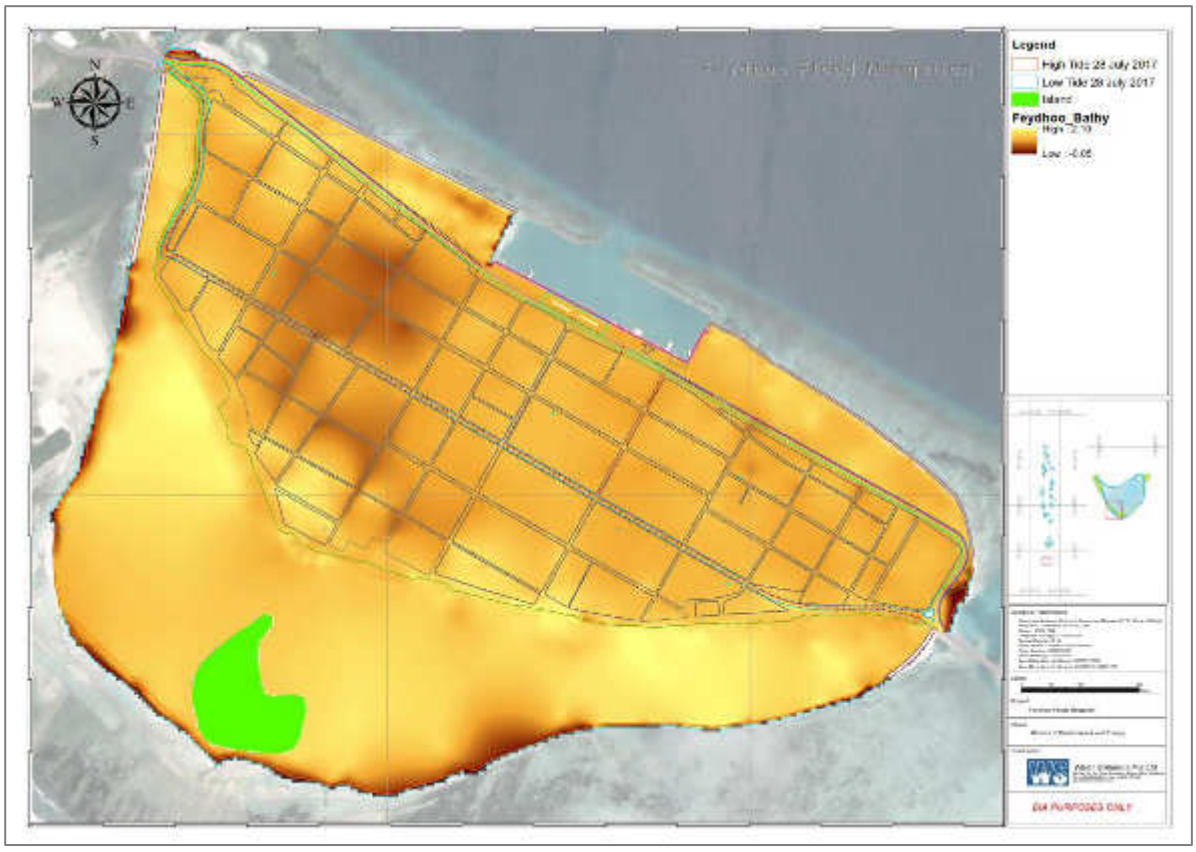


Figure 6: Topographic map of Feydhoo Island (Water Solutions Pvt Ltd 2017)

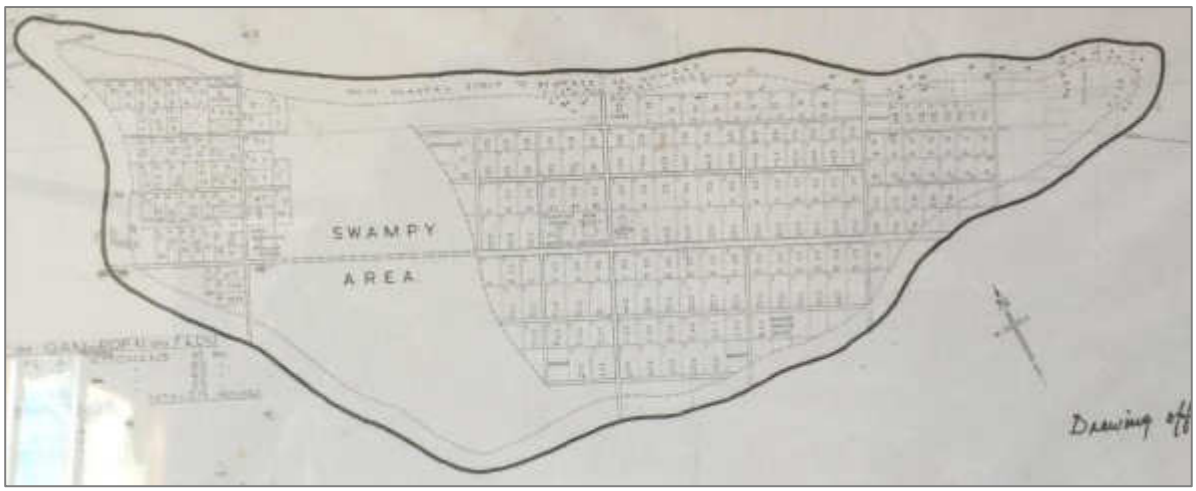


Figure 7: Drawing of Feydhoo done in 1950s showing the swampy area (Source: Flood Assessment Report of Feydhoo 2016)

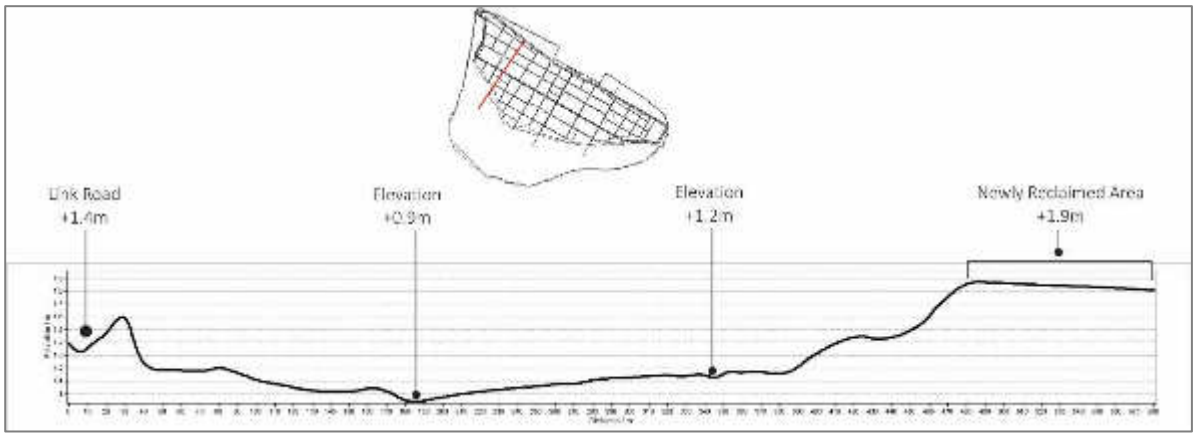


Figure 8: Topographic Profile 1 of Feydhoo (Water Solutions Pvt Ltd 2017)

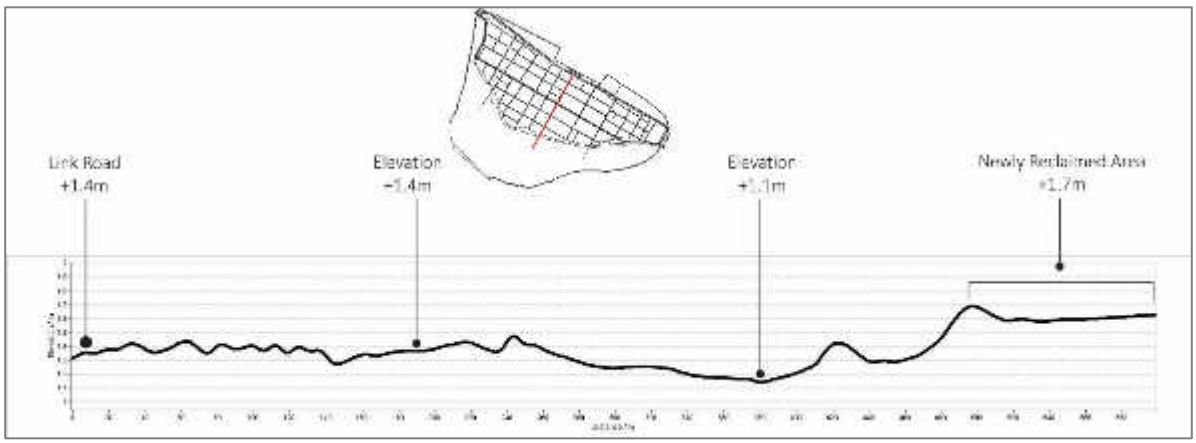


Figure 9: Topographic Profile 2 of Feydhoo (Water Solutions Pvt Ltd 2017)

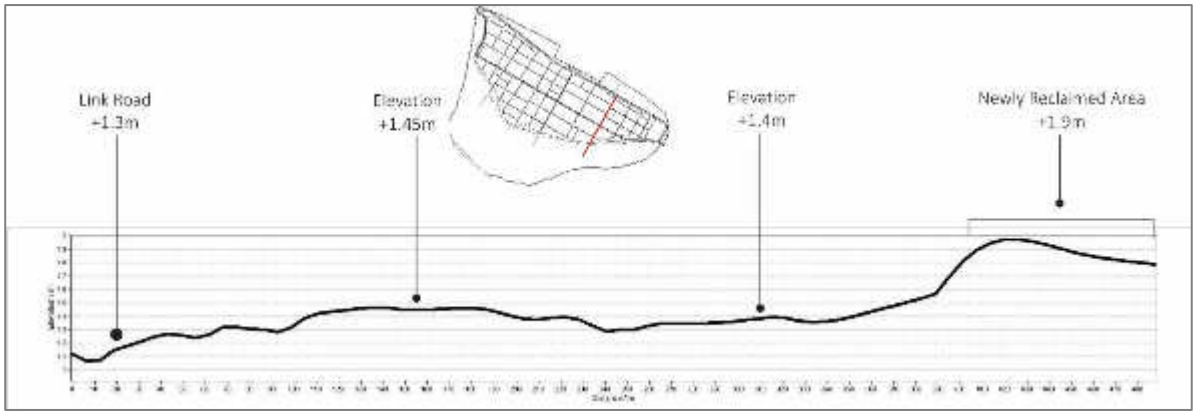


Figure 10: Topographic Profile 3 of Feydhoo (Water Solutions Pvt Ltd 2017)

4.4 Topography and Island elevation

4.5 Geological Conditions

The islands occupy the central portion of the 3,000 km-long Laccadive-Chagos submarine ridge, which is a major feature of the Indian Ocean seafloor. They form a double chain of north-south oriented parallel atolls separated by an inner sea. The atolls rest on a submarine plateau that is 275-700 m deep, 700 km long and up to 130 km wide. Several east-west trending deep channels (~1000m) separate the atoll groups.

The islands are low-lying and began forming between 3,000 and 5,500 years ago. They represent the most recent deposition along a submarine plateau that is underlain by approximately 2,100 m of mostly shallow-water carbonates resting on a slowly-subsiding volcanic foundation.

It is estimated that 80% of the islands are 1 metre or less above mean sea level. Their low elevation makes them particularly vulnerable to storms and changes in sea level. The prospect of global sea level rise and its potentially catastrophic impact on low-lying islands makes erosion management all the more urgent.

Figure 18 Features of Feydhoo Coastal Environment

Feydhoo has undergone major morphological changes over the past 15 years. The above figure shows that Feydhoo has increased its land area since the reclamation project was implemented in 2017.

4.6 Meteorological Conditions

Meteorology at Maldives is monitored by the Maldives Meteorological Service (MMS) through stations established at the domestic and international airports. Some of them are detailed the following table below. The stations monitor rainfall, temperature, wind and tide levels at the islands. The secondary data presented in this section has been sourced from recordings of MMS monitoring stations.

Table 4: Geographical Coordinates of the Meteorological Centres in Maldives

Location	Latitude	Longitude	Tide gauge
National Meteorological Centre, Malé	04.19°N	73.53°E	Yes
HD. Hanimaadhoo Meteorological Office	06.75°N	73.17°E	Yes
L, Kadhoo Meteorological Office	01.86°N	72.10°E	No

Hourly meteorological data was also collected for L. Kadhoo for the period 1990-2009. The data includes parameters such as atmospheric pressure, temperature, humidity, wind speed and direction and precipitation which are provided in the subsequent section.

Climate

Maldives is located at the equator and experiences monsoonal climate. Maldives has two distinct seasons; dry season (northeast monsoon) and wet season (southwest monsoon). In these two seasons the temperature remains more or less the same. The wet season- southwest monsoon runs from mid-May to November. In this season Maldives experiences torrential rain. Central, Southern and Northern parts of the Maldives receive annual average rainfall of 1924.7mm, 2277.8mm, and 1786.4mm, respectively. The highest rainfall ever recorded in the Maldives with in 24 hour period was on 9th July 2002 at Kaadedhdhoo Meteorological Office and amounts to 219.8mm of rainfall. Maldives being located at the equator, receives plentiful of sunshine throughout the year. On average Southern atolls (Gan) of the Maldives receives 2704.07 hours of sunshine each year. Furthermore, on average central (Hulhule) parts of the country receives 2784.51 hours of sunshine per year. The relative humidity in Maldives ranges from 73% to 85%.The monthly average sunshine and rainfall is presented in the figure below

The month wise rainfall data for Maldives recorded for the month of 2012 is as provided below:

Table 5: Month-wise Rainfall Data for Maldives

Locality	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Male'	2,201	85.2	12.8	36.8	86.6	175.1	213.3	275.9	416.4	193.3	107.5	409.2	189.4
Hanimaadhoo	1,635	2.6	7.6	31.5	55.5	145.4	156.6	218.7	234.8	177.3	83.9	234.4	286.9
L.Kadhdhoo	2,158	58.3	193.1	30.9	149	244.5	187.7	42	295.3	165.4	203.8	336.1	252.5
Kaadedhdhoo	2,023	242.7	50	60.5	124.3	307.3	32.5	83.2	318.1	180.8	188	155.2	280.6
S.Gan	2,307	247.3	23.6	54.1	134.6	253.7	105.1	252.8	165.2	224.9	322	261.3	263.1

Rainfall in Maldives varies seasonally while average temperature usually stays at 28^{o}C. Since this report is focused on S. Feydhoo, meteorological data of Gan International Airport is used to describe the climate setting of Feydhoo.

4.7 Marine Environment

Methodology of marine surveys

Several methods are available to estimate the per cent benthic cover on coral reefs. Some of the common methods are rapid visual assessment, line-point intercept, and photo-quadrat surveys. For this particular survey, a photo quadrat method was used. Photo quadrat surveys involve taking

photos at a fixed distance from the substrate generally at a random or regular intervals along a transect line.

The photo quadrat surveys are undertaken as follows. A transect line of 20 metres at each site, surveyor then places a half a metre quadrat made from PVC along the transect line and takes a photo directly vertically. The second photo is then taken along in the same manner after approximately 1 m away from the first photo. In this manner, photos are taken along the transect line and in total, 10 photos on each transect line is taken.

4.8 Data Processing Methodology

Analysis of the photos was done using a computer program called, CPCe (Coral Point Count with Excel extensions). This is internationally recognized software used all over the world to assess the benthic composition of the reefs. In this programme, photographs are analysed using a pre-defined benthic categories. Depending on the type of survey, these categories can be user defined at any given level. Users can have very complex levels ranging from individual coral families or have broader assessments categories. As the objective of this survey was to assess the impact of dredging and reclamation, it made sense to use broader categories. Hence, benthic categories adopted by the Reef Check protocol was utilized. A text file containing these categories were created and imported to CPCe. The Reef Check protocol allows categorizing life forms followed under the Reef Check protocol, which emphasizes on benthic composition categorizing such as hard corals, sand, rock and others. The emphasis is not on recording corals to their species levels, but rather the general coral and other life forms such as hard and soft corals. This method is more accurate as the percentage of healthy coral cover and other life forms can be more accurately recorded even by a non-experienced surveyor.

The following are definition of benthic categories used in this survey.

- **HC:** All living coral including bleached coral; includes fire, blue and organ pipe corals
- **SC**: Include zoanthids but not anemones (OT)
- **ALG**: All algae (Macro/ Fleshy, Halimeda, coralline, turf)
- **DC**: dead standing coral.
- **SP**: All erect and encrusting sponges (but no tunicates).
- **RC**: Any hard substrate; includes dead coral more than 1 year old and may be covered by turf or encrusting coralline algae, barnacles, etc.
- **RB**: Reef rocks between 0.5 and 15cm in diameter

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

- **SI**: Sediment that remains in suspension if disturbed; recorded if color of the underlying surface is obscured by silt.

- **OT**: Any other sessile organism including sea anemones, tunicates, gorgonians or non-living substrate.

Each of the 10 photos from transect are imported, cropped and prepared for analysis. The CPCe program then generates a matrix of random points overlaid on the image for each point to be visually identified. Users can then input the defined categories for each photo and once all the photos are analysed, the results are displayed on a table.

4.9 Coral reef

Five sites from the marine environment were surveyed to assess the marine environment as baseline for reef benthic community. The selection of site was determined by assessing the outfall location of the discharge pipe which is towards the eastern side. There geographical coordinates are as follows.

Table 6 Geographical coordinates of marine sample locations

S.No	Survey points	Latitude	Longitude
1	M1	0°40'35.50"S	73° 7'58.50"
2	M2	0°40'40.96"S	73° 8'5.73"E
3	M3	0°40'48.27"S	73° 8'10.53"E
4	M4	0°40'50.85"S	73° 8'23.76"E
5	M5	0°40'54.33"S	73° 8'30.06"E

4.9.1 Benthic composition at site 1 (M1)

Site M1 was chosen from north-east side of the island house reef. This site is the proposed site for the sea outfall 1. Benthic composition of this site is dominated by rubbles. Very few live corals were observed on the site during the survey. The following figure outlines the percentage benthic composition at site M1.

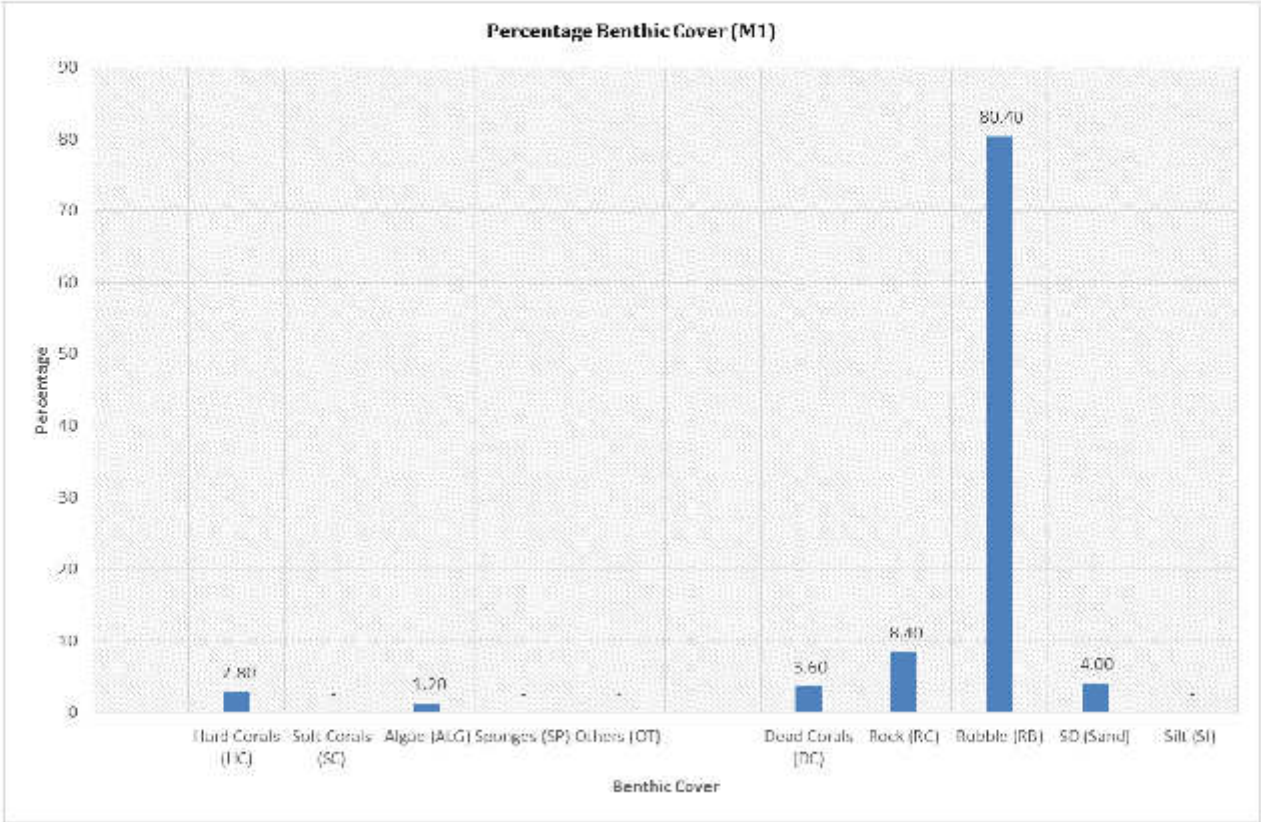


Figure 19: Percentage of bottom substrate components at site 1

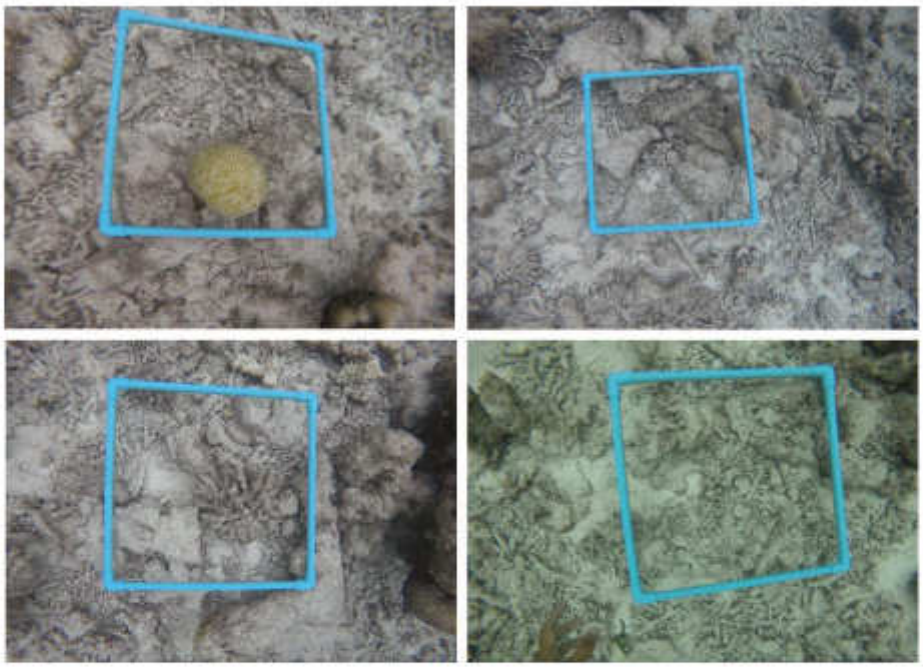


Figure 20: Photos taken from site 1 (M1) (25 December 2017)

4.9.2 Benthic composition at site 2 (M2)

Site M2 was also chosen from north-east side of the island house reef. Reef health of M2 is similar to M1. This site is the proposed site for the sea outfall 2. Benthic substrate on this site is also dominated by rubble and by rock. Living corals in this site are mostly massive corals. The following figure outlines the percentage benthic composition at site M2.

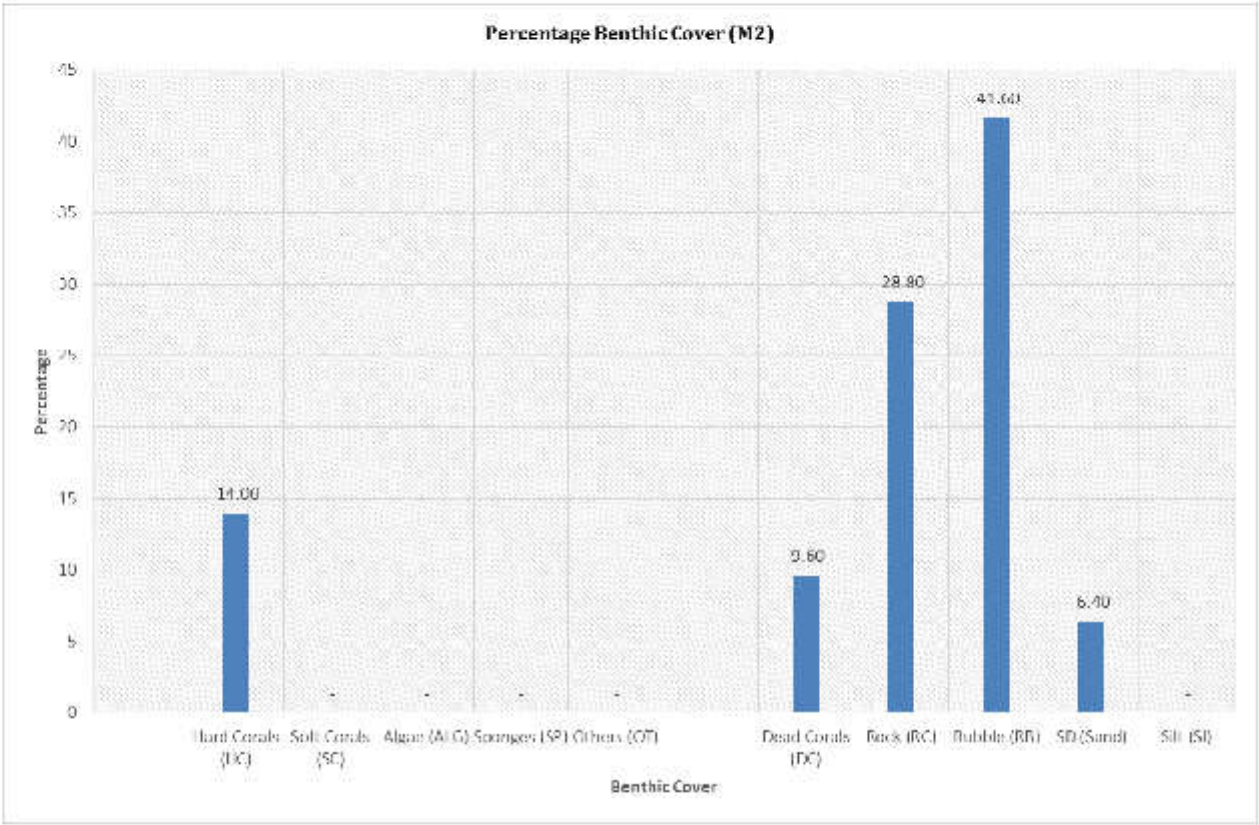


Figure 21: percentage of bottom substrate components at site 2 (M2) (25 December 2017)

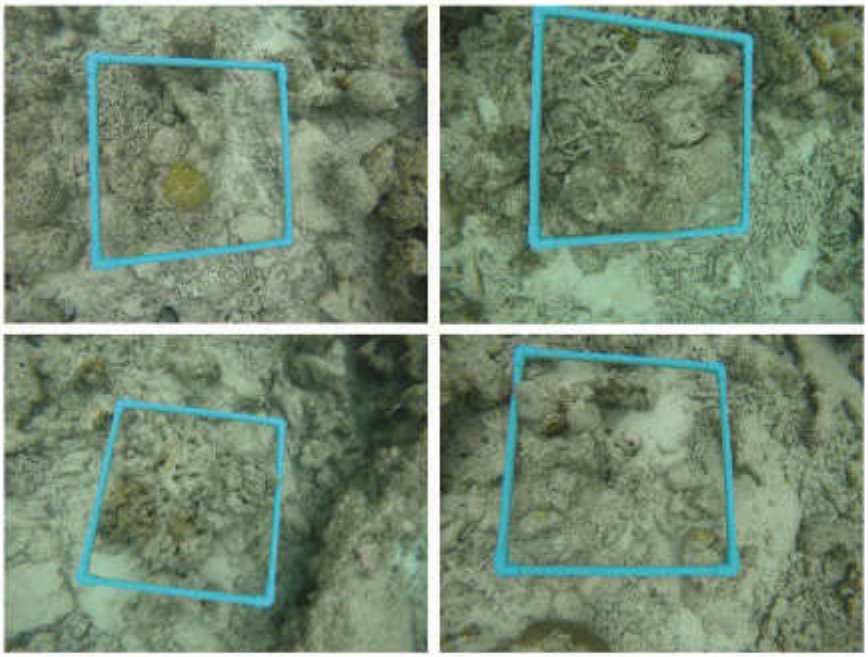


Figure 22: Photos taken from site 2 (M2) (25 December 2017)

4.9.3 Benthic composition at site 3 (M3)

Site M3 was chosen from inside north-east side harbor. This site is the proposed site for the sea outfall 3. Benthic composition of this site is dominated by sand. Since the harbor was a dredged, no live corals were observed during on the site during the survey. The following figure outlines the percentage benthic composition at site M3.

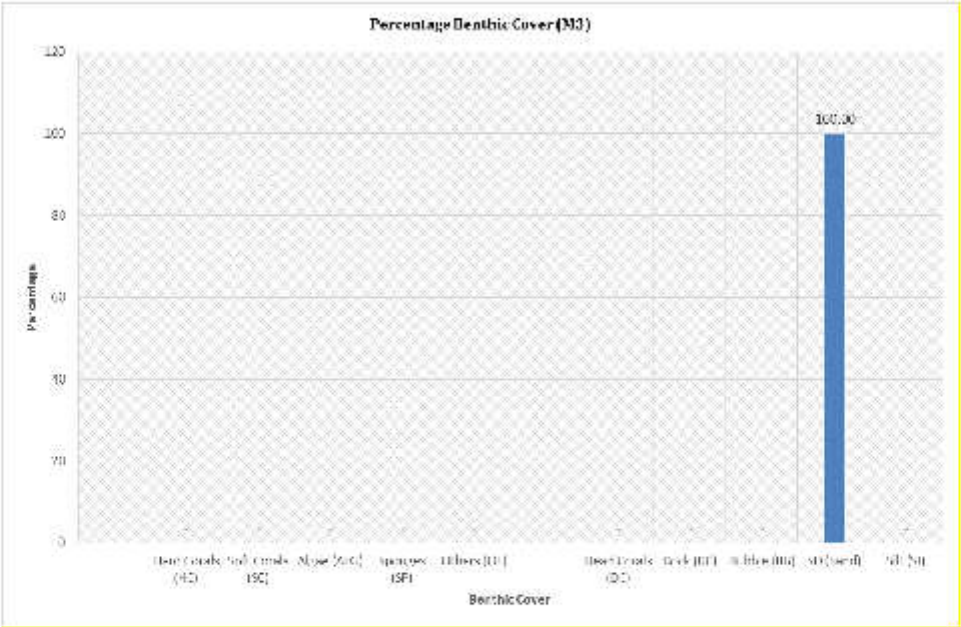


Figure 23: percentage of bottom substrate components at site 3 (M3) (25 December 2017)

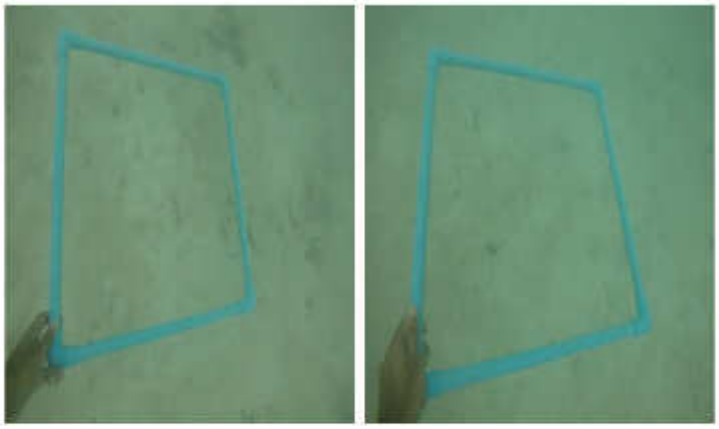


Figure 24: Photos take from site 3 (25 December 2017)

4.9.4 Benthic Composition at site 4 (M4)

Site M4 is on the south east side of the island house reef. This site is the proposed site for the sea outfall 4. Benthic composition of this area is dominated by live corals and dead corals. Massive corals were mostly observed in this site. The following figure outlines the percentage benthic composition at site M4.

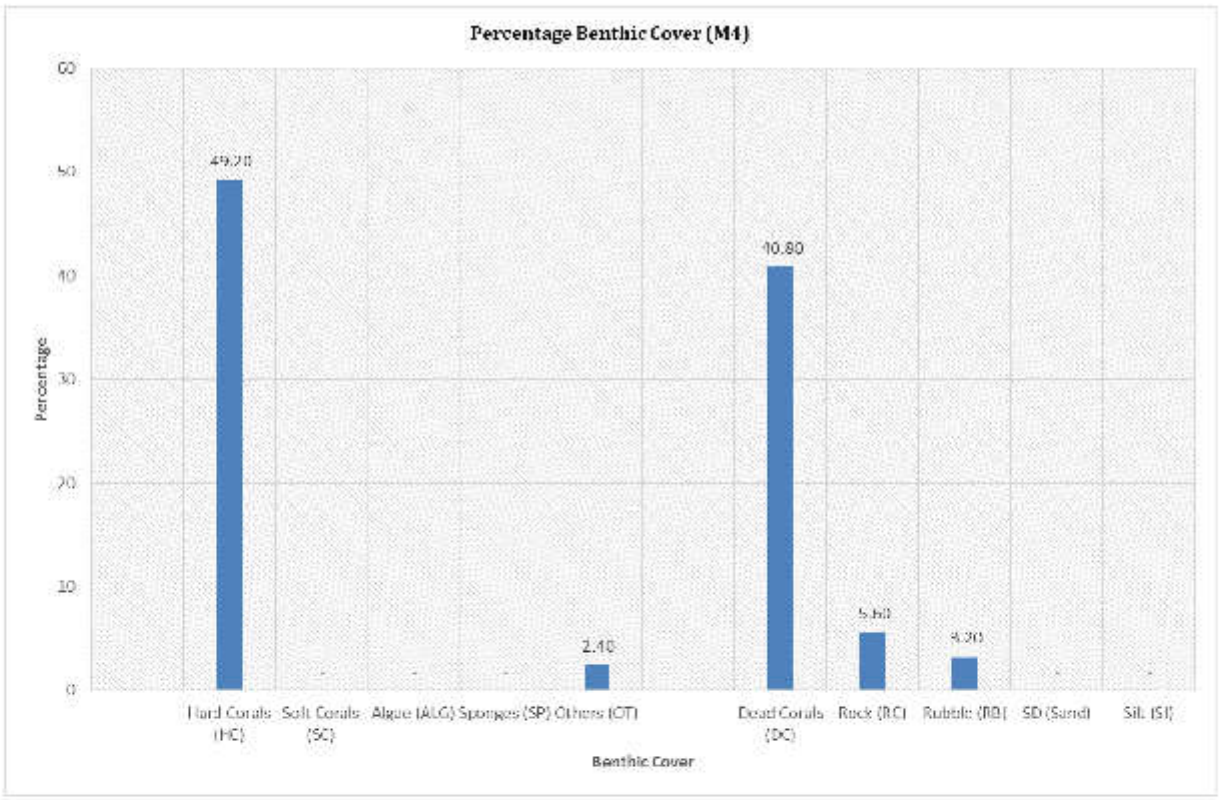


Figure 25: Percentage of bottom substrate components at site 4 (M4) (25 December 2017)

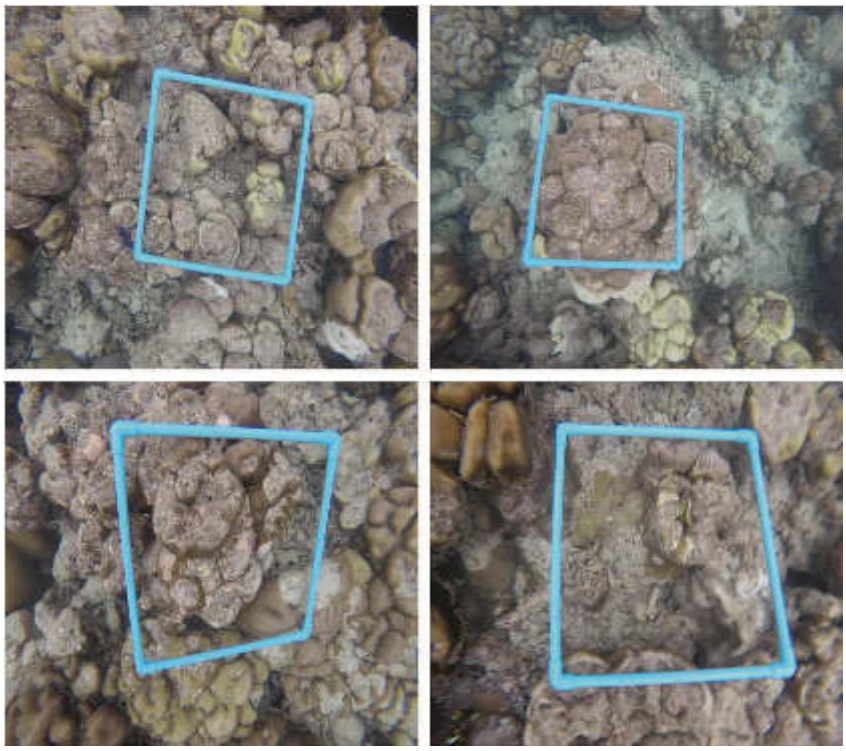


Figure 26: Photos take from site 4 (25 December 2017)

4.9.5 Benthic Composition at site 5 (M5)

Site M5 is on the north east side of the island house reef. This site is the proposed site for the sea outfall 5. The bottom of this area is mostly covered with Rubbles. Very few live corals were observed on the site during the survey. The following figure outlines the percentage benthic composition at site M5.

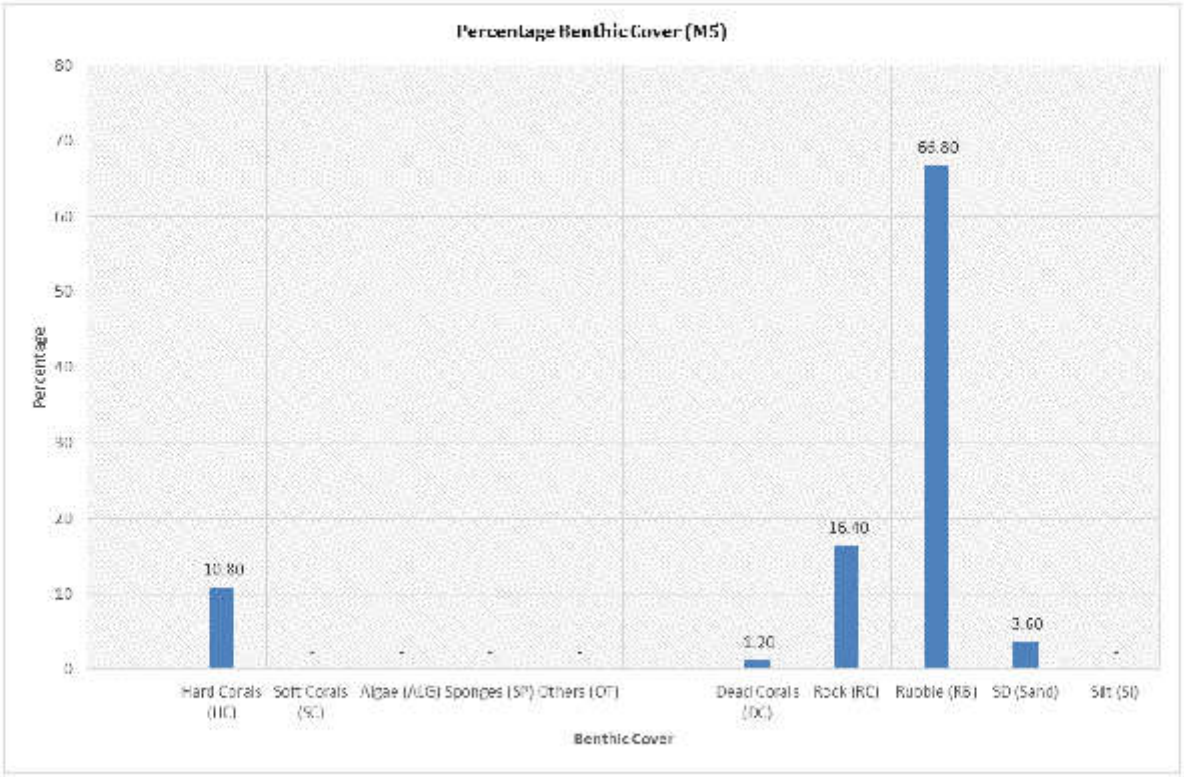


Figure 27: Percentage of bottom substrate components at site 5 (M5) (25 December 2017)

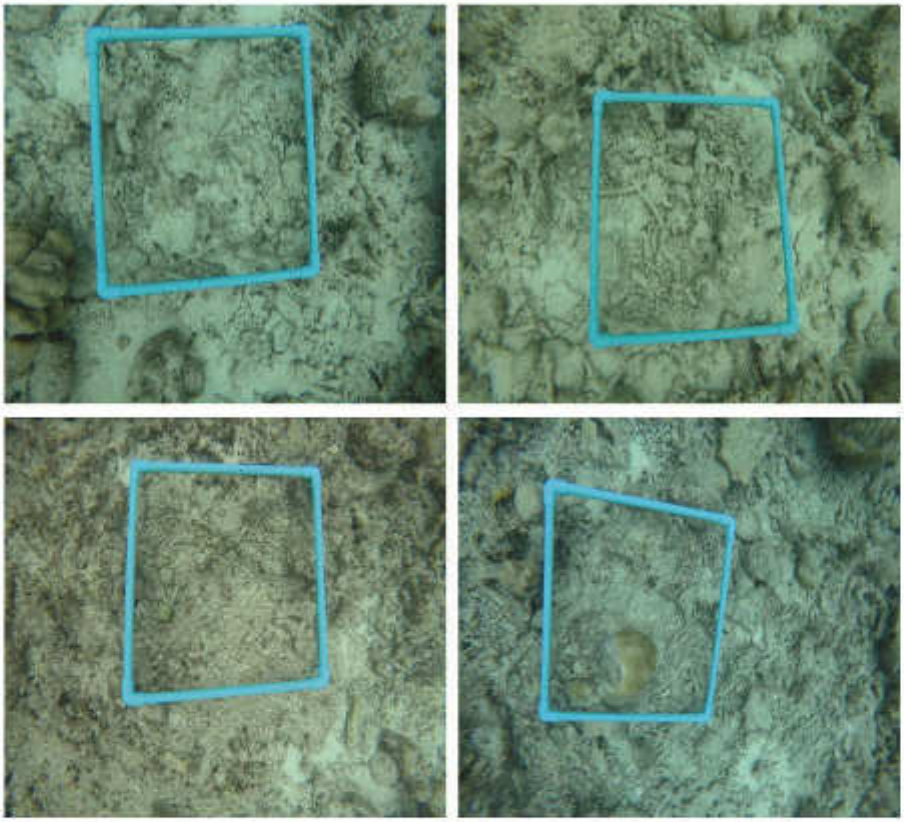


Figure 28: Photos take from site 5 (25 December 2017)

4.10 Status of fish abundance

The amount and type of fish present at a given site can be a good indicator of the marine environment. For example, increased grazers are generally a sign of increased nutrients in the area, thus decreased coral cover and increased algal cover. Similarly, more live corals will attract more fish and some of the fishes are associated with different types and growth forms of corals. For example, Damselfish like *Dascyllus sp.* or *Chromis sp.* are common fish found in branching corals and large schools are often seen around healthy branching corals.

In abundance, fish communities were by far dominated by the herbivorous Acanthuridae. Details of the fish census survey are outlined below

Table 7: Fish abundance based on the fish survey at survey sites (25 December 2017)

Family	**Site M1**	**Site M2**	**Site M3**	**Site M4**	**Site M5**
Angelfishes (Pomacanthidae)	-	-	-	-	-
Anthias	-	-	-	-	-
Batfish	-	-	-	-	-
Bigeyes (Priancanthidae)	-	-	-	-	-
Blennies	-	-	-	-	-
Butterflyfishes (Chaetodontidae)	-	-	-	C	R
Damselfishes (Pomacentridae)	R	C	-	C	C
Emperors	-	-	-	-	-
Fusiliers (Caesionidae)	-	-	-	-	-
Goatfishes	-	R	-	-	-
Gobies	-	-	-	-	-
Groupers	-	R	-	C	R
Hawkfishes	-	-	-	-	-
Jacks	R	-	-	R	-
Moorish idol (Zanclidae)	-	-	-	R	-
Parrotfishes (Scaridae)	R	R	-	C	R
Pipe fish	-	C	-	-	-

Rudderfishes (Kyphosidae)	-	-	-	-	-
Snappers (Lutjanidae)	-	-	-	-	-
Squirrelfishes (Holocentridae)	-	-	-	-	-
Surgeonfishes (Acanthuridae)	C	C	-	A	C
Sweetlips	-	-	-	C	-
Triggerfishes (Balistidae)	-	R	-	-	-
Wrasses (Labridae)	-	-	-	-	-

A= Abundant (Meaning that during the 15 minute time swim survey, species counts were recorded more than 50, hence it is difficult to count their numbers).

C=Common (Meaning that during the 15 minute time swim survey, they were spotted occasionally and throughout the survey, but their numbers were less than 50)

R=Rare (Meaning that during the survey, only few of these species were observed, often 1 or 2. Blank cells indicate zero occurrences.

4.11 Water Quality Results

Marine Water Quality Results

Table 8: Results of the marine water quality tests undertaken in Feydhoo Island.

Water Quality	Site SW1 (outfall 1)	Site SW2 (outfall 2)	Site SW3 (outfall 3)	Site SW4 (outfall 4)	Site SW5 (outfall 5)
Physical appearance	Clear with particles	Clear with particles	Clear with particles	Clear with particles	Clear with particles
pH	8.01	8.02	8.08	8.05	8.03
Temperature	24.1	23.4	23.3	23.3	23.3
Total Dissolved Solids (TDS)	24900	25100	25200	25400	25200
Total Suspended Solids (TSS)	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)
Turbidity	2.58	1.87	2.05	0.737	0.170
Nitrate	3.4	4.5	3.3	4.4	4.0
Phosphate	0.09	0.28	0.08	0.11	0.08
Biological Oxygen Demand (BOD)	2	3	3	2	2

4.12 Ground Water

Groundwater is valuable natural resource providing a primary source of water for domestic and agricultural sectors of Maldives islands. Like other islands of Maldives, groundwater lens in Feydhoo is very vulnerable and relatively thin. The groundwater lens is often thickest beneath the center of the island. In some parts of Feydhoo, the groundwater lens can be found just a feet from ground level. This is because the elevation of the island is very low. Large area of Feydhoo was once a swamp, later filled and used for human settlements. Low elevation coupled with high rainfall rate in south of Maldives, groundwater lens of Feydhoo could be reached in shallow depths. Considering the high population density, the groundwater condition of Feydhoo is in good condition. However, during the field visits some of the public members reported salinization and contamination of groundwater in some households. According to public, groundwater condition of the island improves during rainy season. The following table shows the sample locations for the ground water and the results for the parameters tested.

Table 9 Geographical location of ground water sampling

S.No	Sampling pints	Latitude	Longitude
1	WS1	0°40'42.15"S	73° 7'56.18"E
2	WS2	0°40'56.60"S	73° 8'6.27"E
3	WS3	0°41'4.89"S	73° 8'18.84"E

Table 10: Results of the groundwater quality tests undertaken in Feydhoo Island

Water Quality	**WS1: Lady's Mosque**	**WS2: Masjidhul Amaan**	**WS3: Masjidhul Nasru**
Physical appearance	Pale yellow	Clear with particles	Clear with particles
Conductivity	620	110	500
pH	7.90	7.58	7.53
Salinity	0.30	0.06	0.24
Temperature	23.4	23.3	23.3
Total Dissolved Solids (TDS)	310	55.1	250
Nitrate	17.9	1.2	1.0
Phosphate	0.21	0.19	0.10

4.13 Existing Drainage System

Feydhoo is one of the most vulnerable islands to rainfall induced flooding. This is due to the low elevation of the island. According to community members consulted during the field visit, even 1 hour rain causes significant amount of floods on both paved and unpaved roads of the island. Sometimes floodwater remains on roads for weeks. To ease this issue, there is an existing drainage

system constructed to make the storm water runoff to sea. However, due to poor maintenance, the drainage system is not working properly. Some of the inlets of the system are on unpaved roads. These inlets gets filled with sand very quickly which blocks the pipes and needs regular maintenance. According to public, some of the runoff outfall pipes on the southwest side of the lagoon is now underneath the newly reclaimed area. Some of them were connected to a small chamber just before the reclamation. Chamber being filled with sand may also block the pipe network. Even though the paved roads of Feydhoo has drainage inlets in very short distances on both sides of the roads, these roads also gets flooded even after 1 hour rain event. This possibly is because of lack of regular maintenance of these inlets. Drainage inlets need to be maintained regularly for them to efficiently drain the storm water collected on the road. Inlets of the existing drainage system is mapped and attached in detail topography map of Feydhoo (attached as an annex).

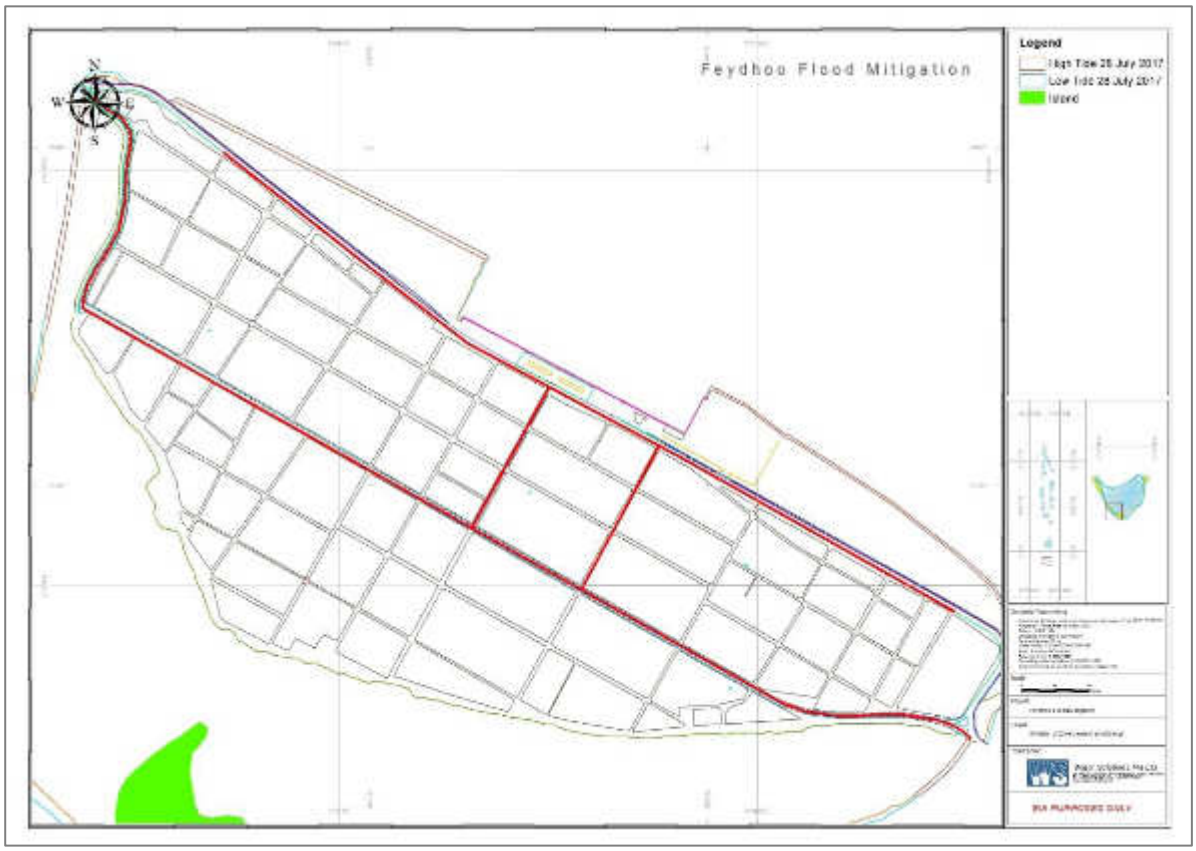


Figure 29: Roads with existing drainage inlets (marked with red)

Figure 30: Existing drainage inlets on unpaved roads

4.14 Existing Road Conditions

The outer ring roads of Feydhoo and the main central road "Bondu Magu" have been paved with other roads not paved. The following picture shows the existing conditions of the roads on a rainy day. IT was noted during the field visit that MTCC has been cutting the asphalt road of the main road to lay sewerage pipes. There was no progress of road development projects seen on the existing roads.

Figure 31 Paved and unpaved road of Feydhoo

4.15 Marine Protected Areas and Environmentally sensitive sites

There is a marine protected area in this atoll and it is located at the western end of Hithadhoo Island. This is the closes protected area and it is approximately 11km from the project site or island. There are other environmentally sensitive areas within this atoll namely Meedhoo North Kandu, Boda Rahgandey, Rocky reef and Maakanaa Herangandu. It is unlikely that these area will be impacted due to this project if the given mitigation measures are followed and the EIA is adhered.

5 ANALYSIS OF ALTERNATIVES

This section looks at alternative ways of undertaking the various alternatives of the proposed project. There are two basic options: (1) leave the island as its form, without undertaking the storm water drainage development (no project option) or (2) undertake the proposed storm water drainage project as part of the development (undertake the project options). If the project were to continue, it would be necessary to take technical and social aspects of the project into consideration and ensure that these concerns are adequately considered before taking decisions. It is therefore important to consider all practicable options and ensure that the best available option(s) is/are chosen. The following section details the development options.

1.1 No Development Option

The "No Development Option" implies not proceeding with the proposed storm water drainage development. This option would likely lead to adverse socio-economic impacts and to allow the existing improper, malfunctioned, interrupted drainage system to be used at its present state without any development. The advantage of this option is that there is only a little part of the island is covered at only minimal rainfall. No excavation for the proposed drainage is also a short term advantage as there will be no environmental impact and no temporary inconvenience due to the proposed project. The disadvantage of this option is that the island infrastructure development will be impeded and affected at a larger scale. The existing storm water has many issues and it is not able to manage the flood from the rain fall. Flooding from rain fall has become an issue now there has such events which as caused damages to the public and private property and the well-being of the people. Review of literature has shown that flooding event takes place one in every two years and there are depressions in the island with low elevation.

Hence the socio-economic benefits outweigh far more than the potential negative environmental and social effects. Therefore, the "No Development Option" is not recommended.

1.2 Open Concrete Channel Storm Water Drainage System

A storm water system with open concrete channels for the discharge of rain water is very common in the urbanised areas. The channels usually drain rain water into oceans and rivers. Open concrete channel's storm water systems are efficient and the accessibility to clean is easier and convenient. The disadvantage of the open concrete channel is that it involves cement. Cement manufacturing is the second largest emitter of greenhouse gas and cause air pollution and the more cement consumption raise a higher demand. The site specific disadvantages of concrete are the dust from cement, sand, aggregate which impacts on environmental health. In addition to the above, the excavation to lay concrete channel are more, form work for plan concrete cement and the cost of casting on site or casted elsewhere, transportation and laying the concrete channel was studied as far more than the other alternatives.

Most of the roads in Feydhoo are narrow, and the wider roads have been paved using asphalt. The excavation for these asphalt roads need to be minimized in order to reduce cost. Therefore this option is not recommended either.

1.3 PVC pipe methods to carry out the storm water drainage system.

There are a few options to develop the proposed storm water drainage system. One of the favourite alternatives is to use PVC pipes connected to manholes and from manholes to outfall pipes and discharge into the sea with the help of pumps. The analysis of bill of quantities showed that this system is cheaper compare to the above said open concrete channels. This system is environmentally friendly and the disturbance or the negative impacts on public during construction are less compare to the other systems. Therefore this option is selected and the details of construction of this system is given under building of Storm Water Drainage System in Section, 3.10.2 (Building of the Storm Water Drainage System), and the Drawings are annexed in the appendix.

The scope of work for the PVC type of storm water drainage system are as follows.

(a) Removal of road payment block where necessary & Re-paving ASPHALT where necessary.
(b) Excavation works.
(c) PVC Pipe laying work.
(d) Construction of Catch pit as per the drawings.
(e) Supply and installation of Steel Grating Cover as per the drawing.
(f) Construction of Collecting tanks as per the drawings.
(g) Construction of BIOSWALE as per the drawings.
(h) Connection of pipes with existing trench/RCC well with making necessary holes and ensure all connections are water tight.
(i) Back filling and reinstatement with payment block and levelling of the road surfaces.
(j) Traffic diverts arrangement during construction.

6 STAKEHOLDER CONSULTATION AND SOCIO ECONOMIC IMPACT

1.4 Socio Economic Profile

Estimating the island economy is a difficult task in the Maldives since there is not enough local economic data to undertake such an assessment. Much of the statistical data are aggregated at the national level. Hence, the value for GDP – the widely used measure for economic performance – is only available at the national level. There is no established mechanism to measure the inputs and outputs from a local island economy.

1.5 Introduction to Atoll

Addu Atoll, also known as Seenu Atoll, is the southernmost atoll of the Maldives. Addu Atoll is located 541 km south of Malé. Addu City consists of the inhabited areas of Addu Atoll, namely the natural islands of Hulhudhoo, Meedhoo, Maradhoo, Feydhoo, and Hithadhoo. Hithadhoo is the capital island in Addu atoll. The following table outlines the list of island and their population.

Table 11: Population of Addu atoll

Island Name	Population
Hulhudhoo	1,242
Meedhoo	1,871
Maradhoo	2,374
Feydhoo	3,431
Hithadhoo	11,129

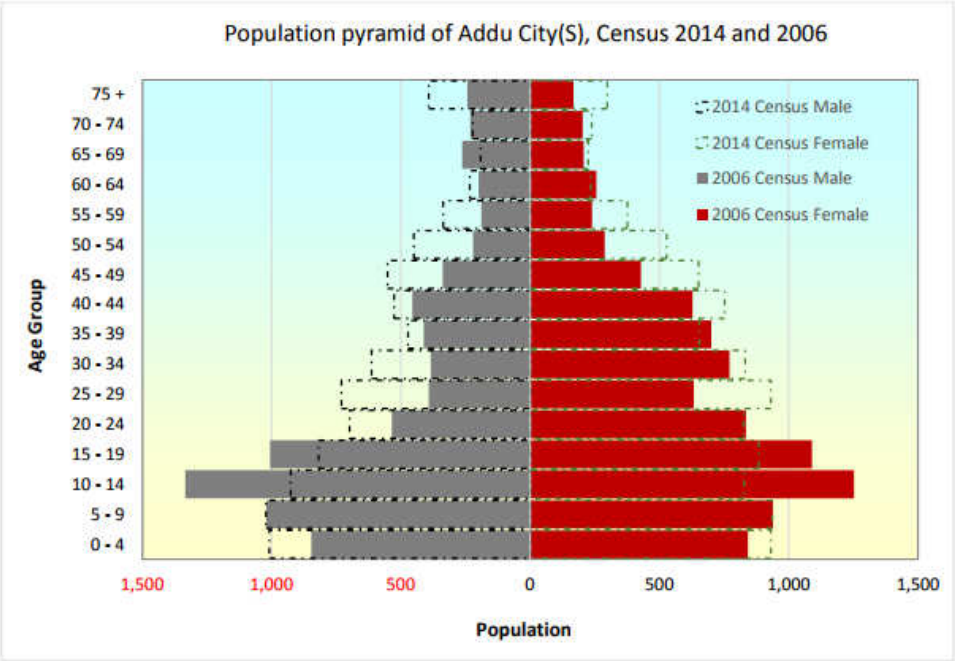


Figure 32 Population pyramid of Addu city

The graph shows the difference in population between 2006 and 2014 census, the population has increased from 2006 to 2014 and it is expected to increase more in the future.

1.6 Feydhoo Island

Feydhoo is located in Addu atoll at 0°40'59.19" S 73°08'11.83" E. The island is situated at about 537km from capital Male'. The registered population of the island is 3,431.

Table 12: Population of Feydhoo

	Census 2000	**Census 2006**	**Census 2014**
Total population	2829	2724	3431
Male	1262	1223	1793
Female	1567	1501	1638

Feydhoo is a highly urbanized island. The harbor area contains a large proportion of the islands business establishments. The key economic infrastructures on the island are the harbor, Addu Link Road and communications infrastructure. Furthermore, coastal protection has been established, a health center services is provided. Though Hithadhoo's Regional Hospital the main hospital in the region the role of health center in Feydhoo has been marked as helpful, waste collection services are established, electricity is provided 24 hours.

Land allocation in the past did not consider land for economic activities. It was only recently, after the development of the Addu Link Road, that land was identified specifically for commercial purposes. The main economic activity in Feydhoo in terms of estimated income is in civil service. It is followed by wholesale and retail trade, hotels and restaurants, manufacturing, construction, guest services and transport services. After the development of link road the economic opportunities has been increased particularly the transport, restaurant and trade sectors.

1.7 Socio Economic Impact of Storm Water Drainage Development

1.7.1 Positive Impact of Storm Water Drainage project

The project would help to improve the road conditions of island during rainy days and during flooding events due to heavy rain and storm surges. This would be a huge benefit for the road users. This project will increase the economic activity at the island which would create additional employment opportunity to the resident community

1.7.2 Opportunities for Tourism Sector- Guest Houses and City Hotels

Demand for Guest house and City Hotels are yet to increasing in Addu City. This is expected to become an industry as the airport infrastructure has improved and the Gan airport has become an international airport now. It is anticipated, more and more guest houses would be built on inhabited islands. The proposed storm water drainage would facilitate the development of the city hotels and guest houses at the island.

1.8 Stakeholder Consultation

1.8.1 Ministry of Environment & Energy

The Ministry of Environment and Energy is the proponent of this project and the proponent has been consulted many times during the project to discuss about the design and progress of the project. During the scoping meeting, the Ministry of Environment and Energy noted that flood mitigation is an important project for the development of the islands and it has become a government priority. The environmental consultant, Water Solutions Private Limited is the consultant to carry out the feasibility study, concept design, detailed design and preparation of bid documents. Hence, many meetings with the minister of state Mr. Abdullah Ziyad and the excecutive coordinator Adnan Haleem was conducted.

1.8.2 Environment Protection Agency

As per the EIA regulation 2012, an scoping meeting was held at EPA and relevant stakeholders were invited by EPA for the scoping meeting. A project brief was provided by the proponent (MEE) and the consultant followed by questions and answers. The questions were raised by the participants and the answers were provided by the proponent and the consultant. The following are the details of the attendees and the outcome of the meeting was incorporated to the approved TOR .This TOR was used as a basis to carry out the EIA for the flood mitigation measures by designing a storm water system and it is attached in the annex of this report. The below participant's list with the attendee's signature is also attached in the appendix.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Venue: EPA Meeting Room
Date: 10-12 2017
Time: 10:00am - 11:30am

NO	NAME	DESIGNATION	OFFICE	CONTACT NO
1	Adnan Haleem	Executive Coordinator	MEE	7775922
2	Ali Fahmee Ahmed	Addu Cuty Council Member	Addu City Council	9996602
3	Hassn Shah	Consultant	WS	7778941
4	Ahmed Anwar	Assistant Director	EPA	3018362
5	Abdulla Ziyad	Minister of State	MEE	7781502
6	Adam Mubeen	Assistant Engineer	EPA	7588930
7	Hussain Ibrahim	Assistant Env Officer	EPA	3335949
8	Isaac		EPA	3335949

1.8.3 Ministry of Housing and Environment

Ministry of housing and Infra structure is among the stake holders where the TOR has made mandatory to meet. An invitation letter from the consultant was sent to MHI in Male' requesting for a meeting and MHI's participation was received from the Feydhoo branch and from the Feydhoo Town Office. The outcomes of the meeting are given under the section of the topic consultation with Feydhoo Town Office.

1.8.4 Addu City Council

Addu City Council was among the major stakeholders consulted and two meetings were held with Addu City council. One meeting was held before the TOR for the EIA was approved and the meeting was held with presence of project engineers and city council members to brief about the project and to collect information for the project. e meetings attendance, venue date, time and major outcomes are highlighted below and the participant's list with the attendee's signature is attached in the appendix too.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Venue: Addu City Council Office

DATE 12th July 2017

TIME 11:00-12:00

NO	NAME	DESIGNATION	CONNTACT NO	OFFICE
1	ABDULLA SODIG	MAYOR	7924030	ADDU CITY COUNCIL
2	MOHAMED YASHRIF	Deputy Mayor	7781342	ADDU CITY COUNCIL
3	ALI FAHUMYAHMED	COUNCILLOR	9996602	ADDU CITY COUNCIL
4	JAMSHEEDA MOHAMED	COUNCILOR	7772284	ADDU CITY COUNCIL
5	HASSAN SHAH	CONSULTANT	7778941	WATER SOLUTIONS

- Meeting was started by the Mayor and stated that it was not only Feydhoo who were affected by flood and he added part of Hithadhoo also has flooding issues and went on the details of the Hithadhoo issues.
- The council has the concern of all the rain water pumped into the sea and needs at least part of water to be infiltrated to the ground to recharge the ground water lens.
- City council noted that flooding issues has worsened due to the road development projects and paved roads act as a roof and cause flooding. The new roads are elevated and lack of

proper drainage systems causes water to flow into individual plots causing floods. The council added that filling of road puddles with sand makes the roads elevated and is also a cause of flooding.

- The council reports to NDMC whenever there is flood and seeks their assistances
- The council requests to provide incentives to the poor households to raise their plots from this project.
- Maintenance of the existing drainage systems is also an issue and the responsible part is not able to maintain it in appropriate manner.

The second meeting was held after the TOR was approved and this meeting was to brief about the progress of the project concept and design and to collect environmentally sound information from the council members. The meetings attendance, venue date, time and major outcomes are highlighted below and the participant's list with the attendee's signature is attached in the appendix too.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Venue: Addu City Council Office

DATE 12/25/2017

TIME 09:00-10:00

NO	NAME	DESIGNATION	CONNTACT NO	OFFICE
1	ABDULLA SODIG	MAYOR	7924030	ADDU CITY COUNCIL
2	FAISAL IBRAHIM	COUNCILLOR	7727716	ADDU CITY COUNCIL
3	ALI FAHUMEE AHMED	COUNCILLOR	9996602	ADDU CITY COUNCIL
4	HASSAN SHAH	CONSULTANT	7778941	WATER SOLUTIONS
5	MOHAMED UMAR	CONSULTANT	9930606	WATER SOLUTIONS

- The council raised the concerns of recharging the water lens of the Feydhoo Island and requests to put maximum effort to infiltrate the storm water into the island and to pump only excess water to the sea.
- The council also raised concerns on the impacts on the reef due to the discharge of storm water as the storm water will be contaminated with sand and silt.
- The council also discussed about the existing outfall pipes and the new reclamation has buried those out falls and most of the outfalls or not to be seen now.

In conclusion the council wants this project to an efficient and effective storm water drainage system that will help people to prevent from flooding due to the storm waters.

1.8.5 S.Feydhoo Council

Two meetings were held at Feydhoo Ward office and the first one was organized by MEE and it was held on 18th November 2017. The participants attended in this meeting were from institutions where TOR has made mandatory to meet. The first meeting with Feydhoo ward office was held before the TOR was approved and the meeting was held with presence of proponent (MEE) and various relevant stake holders. The purpose of the meeting was to brief about the project and to collect information for the project. The meetings attendance, venue date, time and major outcomes are highlighted below and the participant's list with the attendee's signature is attached in the appendix too.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo				
VENUE	FEYDHOO WARD OFFICE, FEYDHOO ISLAND			
DATE	18th NOVEMBER 2017			
TIME	08:30pm -0930pm			
NO	**NAME**	**DESIGNATION**	**CONTACT NO**	**OFFICE**
1	ADNAN HALEEM	EXECUTIVE COORDINATOR	7775922	MINISTRY OF ENVIROMENT ENERGY
2	MAHESWARAN	ENGINEER	9563601	MTCC
3	ALI HARIS	PROJECT COORDINATOR	9847030	MTCC
4	MOHAMED MU-UMIN	DEPUTY DIRECTOR	7787120	FENAKA
5	HASSAN ABDUL SAMAD	ENGINEER	7722956	FENAKA
6	MOHAMED JALEEL	ASSISTANT DIRECTOR	7981980	HOUSING MINISTRY
7	ADAMA SHAMOON	SENIOR ADMIN OFFICER	7941314	HOUSING MINISTRY
8	AHMED RASHEED	ASSISTANT DEPUTY MANAGER	7972956	FEYDHOO TOWN OFFICE
9	AMINATH AREESHA	ASSISTANT PROGRAM OFFICER	7584285	FEYDHOO TOWN OFFICE
10	FATHIMATH DHIMYANA	ASSISTANT DIRECTOR	7926000	FEYDHOO TOWN OFFICE
11	HASSAN SHAH	CONSULTANT	7778941	WATER SOLUTIONS

- This meeting was started by the deputy minister of MEE Mr. Adnan Haleem and in his speech he has detailed about the past flooding events and the damages caused to the properties and it is the government's priority to find a solutions for the flooding.
- The consultant briefed about the concept designs mainly about the severe flood zones and the outfalls and their locations.
- The existing drainage system for storm water and its issues were discussed in the meeting. The participants highlighted that the new reclamation from the western side has interrupted the existing drainage system and their outfalls were not extended to the sea. The consultant also highlighted that during field visits no outfalls for the drainage system were seen on the western side.
- The participants highlighted that reclamation on the eastern side and western side were elevated than the original land, making water to flow inwards to the mainland causing flooding and this need to be solved.

- The participants noted that there are no as built drawings of existing drainage system or other services and it is important to have it in their office for necessary actions.

The second meeting was organised by the consultant and it was held at S.Feydhoo ward office on 25th December 2017. The details of the participants, venue, date, time and the outcomes are given below.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Venue : Ward office/Ministry of Housing & Infra structure, S.Feydhoo

Date: 25th December 2017

Time: 11:00 - 12:00

STAKEHOLDER MEETING ATTENDANCE FORM

NO	NAME	DESIGNATION	OFFICE	CONTACT NO
1	ADAM SHAMOON	SENIOR ADMIN OFFICER	HOUSING FEYDHOO	7941314
2	ASJADH MOHAMED	SUPERVISOR	HOUSING FEYDHOO	9664783
3	IBRAHIM ZUHAIR	ASSISTANT DIRECTOR	AMAL /S.HITHADHOO	7913022
4	ABDULLA ZUHAIR	EXECUTIVE COORDINATOR	ABHAREE/ S.HITHADHOO	7777950
5	HASSAN SHAH	CONSULTANT	WATER SOLUTIONS	77778941
6	MOHAMED UMAR	CONSULTANT	WATER SOLUTIONS	9930606

- The existing out fall pipe is blocked and there has been inflow of sea water into the island through the pipe during high tides
- No extension to this out fall was given during the reclamation and it the our fall is not to be seen now
- There must be a drainage pipe laid by Maldives National Defense Force (MNDF) and the participants requested to make sure that the project status and updates to the council and town office are shared.
- Flooding due to link road project is also noted. The road is elevated and the water flows inwards to the main land during rains
- As built drawings of service providers not available is an issue to monitor, maintain and sustain the projects.
- The participants also noted about the house connections to the storm water designs and it is important to incorporate this into the system.

1.8.6 Consultation Meeting with NDMC

A letter requesting for a meeting to carry out the stakeholder consultation of S.Feydhoo flood mitigation measures was sent to NDMC on 14th December 2017. NDMC arranged the stakeholder meeting on 21st December 2017 and the following are the main points discussed and details of the attendees. The below participant's list with the attendee's signature is attached in the appendix too.

Title: Consultancy Service for conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Venue: NDMC/Meeting room

Time: 11:00 - 12:00

STAKEHOLDER MEETING ATTENDANCE FORM

NO	NAME	DESIGNATION	OFFICE	CONTACT NO
1	HISAAN HASSAN	PROJECT DIRECTOR	NDMC	7733002
2	HASSAN SHAH	CONSULTANT	WATER SOLUTIONS	778941
3	MOHAMED UMAR	CONSULTANT	WATER SOLUTIONS	9930606

- NDMC noted that there is a lacking of coordination and Disaster Risk Reduction (DRR) should be addressed in the planning stages of these projects to avoid chaos
- Land reclamations are elevated than the original island and this shore side elevation causes flooding during rain and NDMC have to attend this ultimately.
- S.Feydhoo also have the same problem of elevated land reclamation on both sides making vulnerable for flooding
- Flooding has become a burden to NDMC these days and calls from islands where there were no flooding has started calling to NDMC. There are islands where NDMC is not yet able to pay compensation and the citizens have started expressing disappointments to the center.
- Recent flooding in Dh. Meedhoo was discussed and Mr, Hissan Hassan expressed that this was due to the reclamation and he expressed the importance of incorporating disaster reduction risk the planning stage.
- Other islands noted for flooding by NDMC were Th. Thimarafushi, Ha. Hoarafushi, G.Dh. Thinadhoo and Gn. Fuvahmulah. NDMC addressed that F.Nilandhoo's proposed reclamation would experience the same if precautions are not taken and has become a concerned island to NDMC. He added that H.Dh. Kulhudhuffushi airport project is not an exception and would experience the same if precautions not taken appropriately.

- ❖ NDMC also addressed to the road development projects by MRDC and MTCC and noted the elevated roads without proper storm water drainage systems cause flooding.
- ❖ In conclusion NDMC addressed the importance of incorporation that Center for developmental projects at the planning stage.

7 ENVIRONMENTAL IMPACTS AND MITIGATION

1.9 Impact Identification

The proposed storm water drainage system development at S.Feydhoo is not expected to have significant impacts on the existing terrestrial and marine environment of the island. Smooth and compacted backfilling and levelling is required on all the excavations designated for pipe laying. Backfilling would be carried out using the same materials obtained by excavating the designated area and no sand from elsewhere will be dredged for this purpose. The project is also expected to impact the livelihood of the beneficiaries and also impact the existing society in many ways. In preparing this EIA report, various methodologies were used to collect information on the existing environment and also identify the impacts of the project. Impact identification has been focused on the environment. Impacts have also been identified for short and long term as well. It is only by identifying thoroughly the likely impacts; the mitigation measures can be identified and implemented. It is also one of the objectives of this EIA to identify the impacts and propose mitigation measures.

Figure 33 Environmental impacts expected from the project would be mitigated

1.10 Assessing Impacts

Environmental impacts of the proposed project have been examined through a number of processes. These include consultations with the stakeholders, field surveys, observations and assessment, and field experience gained from similar development projects implemented throughout the country and

overseas. Potential positive and negative impacts on the environment have been considered. In general, the impacts of the project have been assessed for terrestrial, marine and social environment.

The impacts of the proposed project on the terrestrial and marine environment of the proposed area have been looked into and are considered to be significant. The most significant impact on the environment due to the project would be to the impact on people due to road closures and excavations of open trenches.

All impacts have been categorized into short-term and long-term. Most of the short-term impacts are related to levelling of the roads during constructional phase, while the long-term impacts are associated with risk of flooding and water pooling. Possible negative impacts on the environment have been considered in worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in both constructional and operational phases.

This EIA identifies and quantifies the significance of adverse impacts on the environment from the proposed project. Impacts on the environment were identified and described according to their location/attribute, extent (magnitude) and characteristics (such as short-term or long term, direct or indirect, reversible or irreversible) and assessed in terms of their significance according to the following categories:

- Negligible – the impact is too small to be of any significance;
- Minor – the impact is very minor and not serious
- Minor adverse – the impact is undesirable but accepted;
- Moderate adverse – the impact give rise to some concern but is likely to be tolerable in short-term (e.g. construction phase) or will require a value judgment as to its acceptability;
- Major adverse – the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project

1.11 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, geo-morphological or social conditions in a particular place. There is also limited data and information regarding the particular site under consideration, which makes it difficult to predict impacts. The level of uncertainty, in the case of this project is expected to be significant due to the unavailability of necessary data, lack of clear understanding of the activities that can change the hydrology of the site. Nevertheless, considering that there will be uncertainties and under taking voluntary monitoring of natural processes as described in the monitoring programme given in this report would reduce the impact of the uncertainty in the impact identification process.

1.12 Environmental impacts and mitigation measures

Environmental impacts assessed of the project based on the criteria's above are discussed in detail in Table 13. The matrix provides the impacts during construction stage for terrestrial and marine environment as well as the cost of mitigation for each impact identified.

Table 13: Matrix of environmental impacts and mitigation measures

Environmental Aspect	Potential Impacts to the environment	Mitigation Measures proposed	Cost of Mitigation
Impacts during pre-construction phase			
Cable TV cables, Telephone cables and Electric Cables	The utility cables are located at the roads which are marked for development. Electric cables have been laid under the ground and under the asphalt road, when the storm water drainage project is completed. The Cable TV cables and telephone cables are laid at very shallow depth. There is a high tendency for these cables to be damaged during the excavation of storm water drainage development work.	The contractor need to work with the Cable TV, telephone cable and electric cable service providers to shift or relocate the said cables wherever and whenever necessary and protect such cables from damages and break downs. The contractor is required to approach the service providers, provide excavation information and obtain as built drawings where possible and look for of utility cables and look for all the warning tapes that	The cost for this task is included in the BOQ under the Earth Works for pipe and Aqua cell laying
Impact of flood from heavy rainfall	Some roads get flooded during heavy rainfall.	The existing old partial storm water system is clogged and blocked. Carry out a minimum cleaning of these manholes and pipes to prevent from flooding Make water pumps available and handy at construction sites and be prepared of such flooding events.	Already included with the contract.
Environmental impacts during construction phase			
Transportation and Storage of Construction Materials	Transportation of machinery and construction supplies/materials implies some movement traffic temporarily for the island leading to possible negative impacts to the surrounding area. Improper storage of project materials like construction materials for concrete works especially gravel, sand and cement, on the construction site could lead to inadvertent dispersal of materials during heavy rains or high winds. Improper storage of hazardous or	Arrangements should be made with contractor/subcontractors to ensure that the vehicles used for transporting project materials like construction materials to the site are appropriately covered to minimize dust. This should apply to both debris and materials transportation. Dust producing building materials such as sand or cement should be stored away from the main residential areas and covered, away from drainage areas where they could easily be washed away during rainfall.	Cost included in the contract as contractors will be required to follow the mitigation measures identified.

Environmental Aspect	Potential Impacts to the environment	Mitigation Measures proposed	Cost of Mitigation
	flammable materials, including fuel, paints and solvents) could result in soil contamination.		
Management of Construction Debris	Construction phase of the road will produce solid waste, the disposal of which, if not managed properly could have negative impacts to the site and the surrounding area. Construction materials including concrete waste, wood, steel, packaging plastics, could be dispersed and could end up in residential areas creating nuisance and hazard if not disposed of at approved disposal sites.	A site waste management plan need to be developed by the contractor explaining collection and storage of construction waste. The contractor needs to transport the collected waste at the temporary site and then to waste dump site at Hithadhoo. WAMCO does the waste management service at Addu City and can be approached.	Cost included in the contract as contractors will be required to follow the mitigation measures identified. This component will not have a cost implication.
Ground Water pollution	Use of machinery, equipment and materials such as fuels can contaminate the ground and groundwater if they are not stored or handled properly. Excavation for the pipe laying, manhole installation and making catchment area may expose groundwater and require dewatering. Impact not likely to be significant.	The machineries and equipment need to be maintained properly to avoid any spillage or pollution. The site supervisors will be required to check the matter on regular basis. All fuels and other hazardous materials stored will be on hard floor and protected from rain and wind. All temporary fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of an adequate capacity. Storage at or above roof level should be avoided. Leaking or empty oil drums must be removed from the site immediately and disposed. Washings from concrete mixers, paint or paint utensils should not be allowed to flow into the ground.	The contractor will be responsible for any such act and shall be compensated in accordance with the existing laws and regulations
Injuries and accidents	There is the potential to cause injuries and accidents during the construction stage if this element is not adequately addressed.	The workers will be provided with protective gear. Any emergency will be referred to regional hospital. All workers will be briefed about safety measures during construction and also be briefed about first aid procedures.	Already included in the contract.

Environmental Aspect	Potential Impacts to the environment	Mitigation Measures proposed	Cost of Mitigation
Poor quality work.	Negative impacts such as conflicts and delays may result as a result of poor quality work,	The contractor must hire supervisors to monitor the work. There will be regular visits to the site by EPA officials or representatives.	Cost included in the project
Environmental impacts during Operation phase			
Storm Water Drainage System	The catchments drain pits, manholes and pipes laid under the ground of the road will be getting blocked with the sand, silt and dirt. The drains need to be cleared regularly to prevent flooding.	Ensure proper maintenance and monitoring of drainage system	Cost to be included in the Utility Company or the councils budget
Road Surface	Since the roads would be excavated on 9.9 km of roads at the island, there would be significant number of road surfaces which are not paved. Hence the catchments on the road surfaces will get a lot of sand, silt and dirt from the paved and unpaved roads.	Ensure proper maintenance and monitoring of drainage system	Cost to be included in the Utility Company or councils budget

Table 14: Summary of the impacts and their characterization

Impact indicator	Impact type (NEG or POS) +	Significant (H/M/L)*	Direct	Indirect	Magnitude # (N/M/MA/MoA/MaA)	Short term	Long term	Unavoidable	Reversible	Irreversible	Cumulative	Mitigation Required
Impacts during pre-construction phase												
Noise pollution due to use of vehicles, machineries and equipment leveling and preparation of the road.	Neg	M	x		M	x		x	x			x
Removal of trees roots	Neg	L	x		MA		x	x	x		x	x
Environmental impacts during construction phase												
Transportation and Storage of Construction Materials	Neg	M	x		M	x		x	x			x
Management of Construction Debris	Neg	M	x		M	x		x	x			x
Ground Water pollution	Neg	H		x	M	x			x			x
Risk of flooding (reducing the flooding risk)	POS	M		x	N	x		x		x	x	x
Excavation and backfill material	Neg	H	x		M	x		x		x	x	x
Environmental impacts after construction phase												
Storm Water Drainage System (operation and maintenance)	Neg	L		x	M	x	x		x			x
Bush Clearance	Neg	L		x	M	x	x		x			x

+ **POS** = positive impacts, **NEG**= negative impacts, * **H**=high, **M**=Moderate, **L**=Low, # **N**=Negligible, **M**=Minor, **MA**=Minor Adverse; **MoA**= Moderate adverse;**MaA**=Major Adverse

8 ENVIRONMENTAL MANAGEMENT AND MONITORING

8.1 Introduction

Environmental monitoring is essential to ensure that potential impacts are minimized and to mitigate unanticipated impacts. The parameters that are most relevant for monitoring the impacts that may arise from the proposed storm water drainage system are included in the monitoring plan. These include noise level, groundwater and marine water. Monitoring will be carried out as a follow up activity of the environmental impact assessment and mitigation of possible negative impacts from the proposed project.

8.2 Environmental Monitoring

Environmental monitoring is essential to ensure that potential impacts are minimized and to mitigate unanticipated impacts. It is recommended that environmental monitoring to be carried by the contractor during the excavation phase to monitor the impact on ground and marine water quality. It is recommended that this activity would be carried out as per the proponent's committed for this development

8.3 Environmental Supervision

It is recommended that the Ministry of Environment and Energy to undertake the environmental supervision during the implementation of the project as to ensure the project is implemented as outlined in the EIA report. The Ministry of Environment and Energy or its consultant needs to provide necessary technical advice and guidance to the design of the project and undertake supervision and environmental monitoring during the implementation of the project.

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

8.4 Monitoring Programme

Outlined here are project specific monitoring requirements that the proponent shall include in their annual monitoring programme. This monitoring programme for the proposed project includes at bi-annual monitoring and covers the three stages of the project implementation.

Stage 1**:** Immediately before starting storm water drainage development work

Stage 2**:** During storm water drainage development work

Stage 3**:** 6 months after the completion of the project

The monitoring needs of each stage are discussed in detail below:

<u>Stage 1</u>

- Pipe laying and installation of manholes
- Noise level

- Frequency of flooding of the streets

Stage 2

- Pipe laying and installation of manholes
- Noise level
- Frequency of flooding of the streets

Stage 3

- Pipe laying and installation of manholes
- Noise level
- Frequency of flooding of the streets

8.5 Monitoring Timetable

The following table shows the frequency at which the different parameters may be monitored at different phases of the storm water management development project implementation.

Table 15: Monitoring framework

Monitoring Schedule	**Monitoring Attribute**	**Indicator**	**Methodology**	**Responsible**	**Monitoring Report**
Start of the project	Progress of the Storm Water development work	Length of the pipes laid	Field measurement	Contractor	Monitoring Report 1 – at the start of the project
	Noise level	Noise level at monitoring locations	Measuring noise levels using noise meter	Contractor	
	Flooding frequency	Flooding of the road	Number of days the road was flooded	Contractor on behalf of MEE	
During the implementation of the project	Progress of the Storm Water development work	Length of pipes laid and number of manholes installed	Field measurement	Contrac*tor*	Monitoring Report 2 – during the project implementation work
	Noise level	Noise level at monitoring locations	Measuring noise levels using noise meter	Contractor	
	Flooding frequency	Flooding of the road	Number of days the road was flooded	Contractor on behalf of MEE	
After completion of the project	Flooding frequency	Flooding of the road	Number of days the road was flooded	Contractor on behalf of MEE	Monitoring Report 3 – 6 months after completion of the project
	Progress of the Storm Water development work	Length of pipes laid and number of manholes installed	Field measurement	Contractor	
	Noise level	Noise level at monitoring locations	Measuring noise levels using noise meter	Contractor	
	Groundwater quality	Groundwater quality	In-situ and laboratory measurement	Contractor on behalf of MEE	

8.6 Monitoring Report

An environmental monitoring report would be compiled and submitted to the EPA six months after the completion of the project, based on the data collected for the monitoring the parameters included in the monitoring plan given in the EIA.

The environmental 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.

In addition to this more frequent reporting of environmental monitoring will be communicated among the environmental consultant, proponent, the contractors and supervisors to ensure possible negative impacts are mitigated appropriately during and after the project works.

8.7 Cost of monitoring

It is estimated that during the project implementation phase, the monitoring cost would be US$ 3,500.

9 CONCLUSION

This EIA report covers proposed storm water drainage development project at Feydhoo, Seenu Atoll. The storm water drainage development projects are classed as projects which require Environmental Impact Assessment (EIA) under the Environmental Protection and Preservation Act (law 4/93). This report discusses the findings of environmental impact study undertaken by Water Solutions Pvt. Ltd. at the request of Ministry of Environment and Energy. Ministry of Environment and Energy is undertaking storm water drainage projects by means of flood mitigation in flood prone islands across the county. S.Feydhoo has been selected as one of the islands in a group of islands to implement this project. Ministry of Environment and Energy is implementing this project and a successful contractor will be selected in a competitive bidding process.

The storm water drainage development project is widely believed to prevent the flooding in the islands during heavy rains and storm surges at Feydhoo. The proposed storm water management project would require an approximately 6 kilometre of excavation, pipe laying and back filling on the roads at Feydhoo.

The assessment reveals that the major impact of the project would be the prevention of flooding in the island. Flooding is a critical environmental problem which the island faces in south west monsoon. This project will benefit the community of S. Feydhoo and the people who visit the island from different parts of the country. The project will help to provide better services, facilities and opportunities for the population of the region and also stimulate the growth of the local economy of Feydhoo.

The project will require significant excavation, backfilling and levelling of the roads at the island. No sand mining is required for this project and no sand burrowing areas has been discussed for this project. The proposed project work will need to be closely monitored by MEE and EPA in consultation with the town office of Feydhoo. It is also advised to hold regular meeting with City Council, Town Office, community members, and relevant government agencies to reduce any environment impacts during project implementation. This kind of dialogue will help to bridge the gap between different stakeholders and will develop a trust among relevant stakeholders. As the success of such projects can only be undertaken with proper monitoring, it is strongly encouraged to undertake the monitoring programme outlined in this report. The monitoring programme has been focused for terrestrial environment. Monitoring during the construction stage has also been suggested.

Although the project involves inevitable negative environmental impacts, such impacts are predicted to be not severe as not to undertake the project at the island. The project is justifiable in light of the socio-economic conditions and anticipated benefits resulting from the project, which seem to outweigh the negative environmental and economic impacts.

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- Mr. Abdullah Ziyad, Minister of State, MEE
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- Ahmed Jameel, Environmental Engineer (EIA Registration No: EIA 07/07)
- Abdul Aleem, Environmental Consultant (GIS EXPERT)
- Hassan Shah, Environment Consultant
- Ibrahim Faiz, EIA Consultant
- Mohamed Umar, EIA Consultant
- Chakir Kasdarli, Civil Engineer, Kocks Consults, Germany
- Michael Brinman, Project Engineer, Kocks Consults, Germany
- WS Surveying Team

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List of Abbreviations

List of Abbreviations and Acronyms

Abbreviation	Meaning
EIA	Environmental Impact Assessment
EDS	Environmental Decision Statement
EPA	Environmental Protection Agency
MRDC	Maldives Road Development Cooperation Limited
MNDF	Maldives National Defense Force
MEE	Ministry of Environment and Energy
MHI	Ministry of Housing and Infrastructure
MSL	Mean Sea Level
TOR	Terms of Reference
RCC	Reinforced Concrete Cement
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
NEAP	National Environment Action Plan
GOM	Government of Maldives
WS	Water Solutions Pvt Ltd
MTCC	Maldives Transport and Contracting Company
MWSC	Male' Water and Sewerage Company
uPVC	Unplasticized Poly Vinyl Chloride
NWSP	National Water and Sewerage Policy

Appendix A: Terms of reference

NO: 203-EIARES/438/2017/174

Terms of Reference for the Environmental Impact Assessment for the Flood Mitigation Project at Feydhoo, Addu City

The following is the Terms of Reference (ToR) following the scoping meeting held on *10/12/2017* for undertaking the EIA of the Flood mitigation Project by establishing an appropriate storm water drainage system at Feydhoo, Addu City. **The proponent of the Project is Ministry of Environment and Energy.**

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

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

2. **Study area** – Submit an A3 size scaled plan with indications of all the proposed land infrastructures. Specify the boundaries of the study area for the environmental impact assessment highlighting the location and size of the proposed construction. The study area should include nearby environmentally sensitive areas. Justification for site selection is required. Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

3. **Scope of work** – The report should be categorized into the following components.

   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. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

   Storm water collection System
   1. Type of storm water collection (gravity or forced)
   2. Details of the conceptual design
   3. Pump stations, number of pump stations and locations wherever required.
   4. Justify pump stations location selection if pumping stations are to be installed.
   5. Locations to discharge excess water or out falls.
   6. Describe equipment needed and construction methods for the project.
   7. Detailed of disposal mechanisms, equipment used and periodicity
   - Project management: Include communication of construction details, progress, target dates and duration of works, construction/operation/closure of labor camps, access to site, safety, equipment and material storage, water supply, waste management from construction operations, power and fuel supply:
   - Describe rain water collection scheme including sizing of storage tanks;
   - Vegetation (if any) removal and management

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

All data must be collected as per the requirements of the EPA Data Collection Guidelines (published on www.epa.gov.mv). The report should outline detailed methodology of data collection utilized.

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

General climatic conditions

- Temperature, Rainfall data (including extreme conditions)

Ecology

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles).

Socio-economic environment

- Demography: total population, sex ratio, density, growth and pressure on land and marine resources;
- Land use planning, natural resource use and zoning of activities at sea;

Existing Road Conditions

- Assess the existing road facilities including the road project progress.
- Assess existing drainage systems
- Topography of the island

Hydrography/hydrodynamics

- Assess the quality of aquifer for physical, chemical and biological parameters such as temperature, pH, salinity and E. Conductivity, nitrates, phosphates, TDS
- Marine water quality assessment at outfall locations and alternative sites measuring parameters such as temperature, pH, TSS, turbidity, nitrates, phosphates, TDS, BOD
- Bathymetry of outfall locations

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project.

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

Terrestrial impacts from construction

- Loss of vegetation and fauna from land clearance activities, pumps stations and pipe works
- Ground water quality;

Impact from installing aqua cells and pump stations

- Impacts from excavation works on groundwater
- Equipment, technical and spillage impacts during construction;

Impact of water discharge into sea (if any)

- Specify methods of collection and transportation to sea

The methods used to identify the significance of the impacts shall be outlined. 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.

Task 5. Alternatives to proposed project – Describe alternatives including the *"no action option"* should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include alternatives for environmental, social and economic considerations. The report should highlight how the location for the outfall was determined. All alternatives must be compared according to commonly accepted standards as much as possible.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Mitigation measures must also be identified for both construction and operation phase. Cost of the mitigation measures, equipment and resources required to implement those measures should be specified. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included.

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 for:

- Physical parameters such as ground water quality assessments.
- Rainfall data

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 - EIA report should include a list of people consulted and what were the major outcomes. Identify appropriate mechanisms to supply stakeholders and the public with information about the development proposal and its progress. Major stakeholder consultation shall include Ministry of Environment and Energy, Environmental Protection Agency, Ministry of Housing and Infrastructure, Addu City Council, S.Feydhoo Council, MTCC, FENAKA, STELCO, MWSC, NDMC and MRDC.

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 EIA Regulations, 2012 and relevant amendments.

Relevant documentation, references for consultants – Include publicly available studies or references relevant to the current project to be used by the consultant.

Timeframe for submitting the EIA report *– The developer must submit the completed EIA report within 12 months from the date of this Term of Reference.*

11.12.2017

Environmental Protection Agency
Green Building, 3rd Floor, Handhuvaree Hingun
Male', Rep. of Maldives, 20392
Tel: [+960] 333 5949 [+960] 333 5951
Fax: [+960] 333 5953
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

Appendix B: Detailed design of the Proposed Storm Water Management System

S.FEYDHOO

North

PROPOSED GRAVITY STORMWATER COLLECTION NETWORK & DISPOSAL SYSTEM

TOTAL NETWORK LENGTH (5.083Km)

TOTAL PROPOSED CATCH PITS (285Nrs)

LS — LIFTING STATION LOCATIONS (8Nrs)

NOTE: Reference Levels are taken from Mean Sea Level

PIPE SPECIFICATIONS: PVC C9 --- Class 150,
Ductile iron class 52
HDPE DR17 class 100

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM

TITLE : NETWORK DRAWING

CLIENT : MINISTRY OF ENVIRONMENT & ENERGY

DRAWN BY: WATER SOLUTIONS PVT. LTD

DESIGNED BY: WATER SOLUTIONS PVT. LTD

DATE DECEMBER 2017

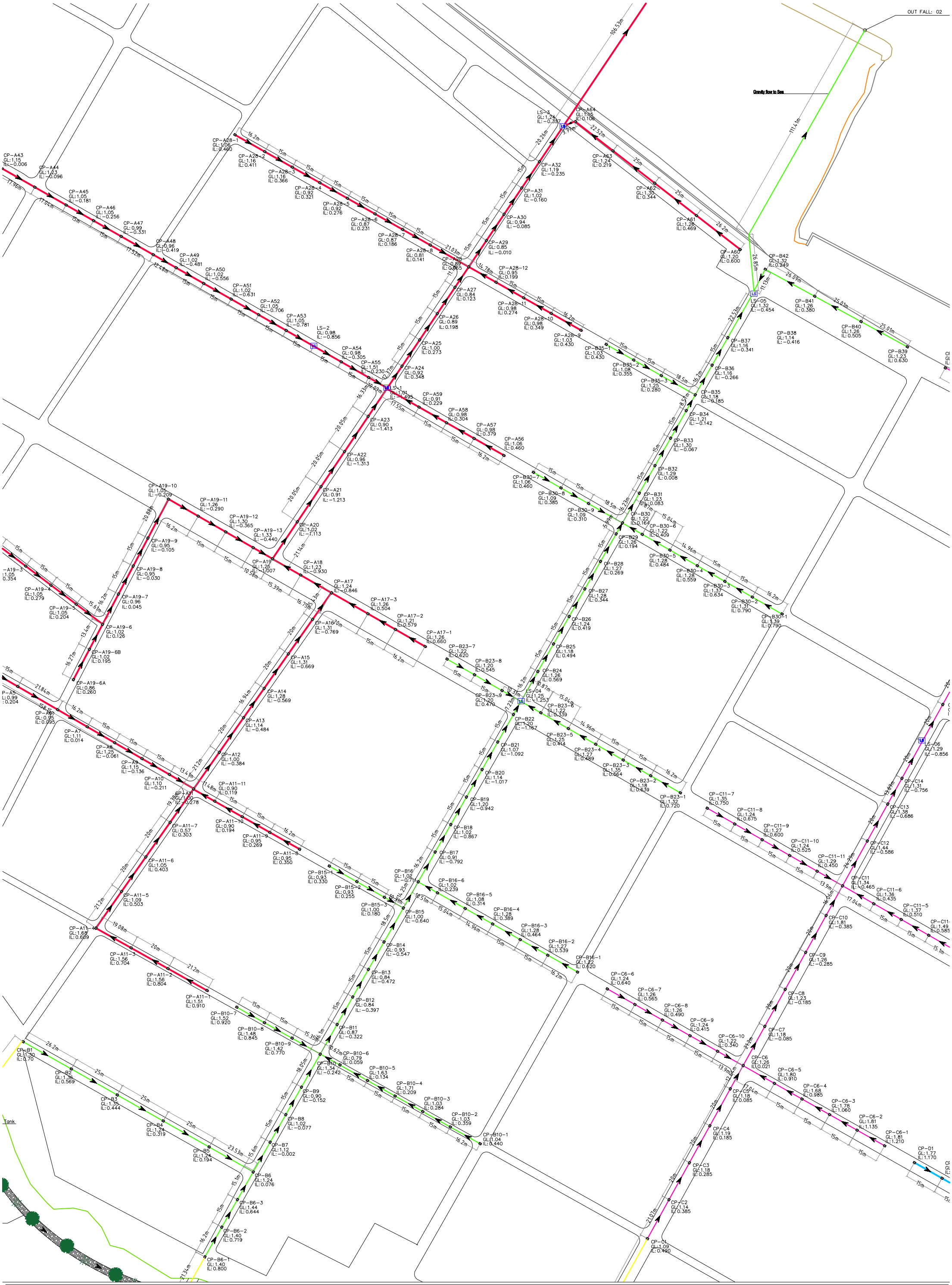
SCALE AS GIVEN

PROJECT No

IF IN DOUBT - ASK - DO NOT SCALE

PAGE NO. 1

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM			
TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE: DECEMBER 2017
CLIENT : MINISTRY OF ENVIRONMENT & ENERGY	DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN
		IF IN DOUBT - ASK - DO NOT SCALE	PROJECT No
			PAGE NO. 2



PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN	
	CLIENT : MINISTRY OF ENVIRONMENT & ENERGY			PROJECT No	
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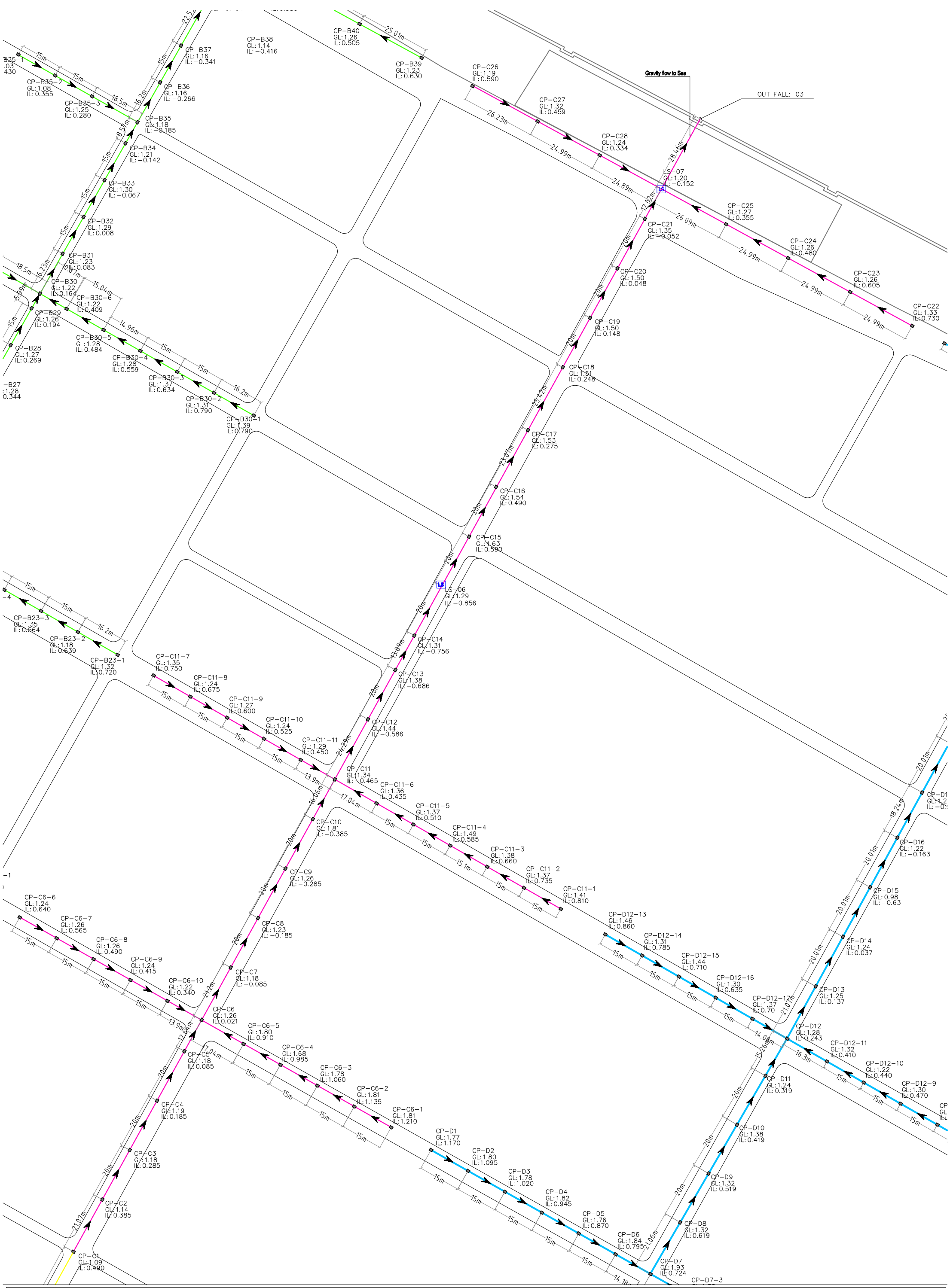
PAGE NO. 3



PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN	
	CLIENT : MINISTRY OF ENVIRONMENT & ENERGY			PROJECT No	
			IF IN DOUBT - ASK - DO NOT SCALE		

PAGE NO. 4

Gravity flo

CP–C19
GL: 1.50
IL: 0.148

CP–C18
GL: 1.51
IL: 0.248

CP–C17
GL: 1.53
IL: 0.275

CP–C16
GL: 1.54
IL: 0.490

CP–C15
GL: 1.63
IL: 0.590

LS–06
GL: 1.29
IL: –0.856

CP–C14
GL: 1.31
IL: –0.756

CP–C22
GL: 1.33
IL: 0.730

CP–D25
GL: 1.33
IL: 0.730

CP–D26
GL: 1.34
IL: 0.608

CP–D27
GL: 1.42
IL: 0.483

CP–D28
GL: 1.25
IL: 0.382

LS–08
GL: 1.25
IL: –0.916

CP–D23
GL: 1.20
IL: –0.806

CP–D22
GL: 1.13
IL: –0.706

CP–D21
GL: 1.11
IL: –0.606

CP–D20
GL: 1.05
IL: –0.554

CP–D19
GL: 1.12
IL: –0.454

CP–D18
GL: 1.23
IL: –0.354

CP–D17
GL: 1.22
IL: –0.254

CP–D16
GL: 1.22
IL: –0.163

CP–D15
GL: 0.98
IL: –0.63

CP–D14
GL: 1.24
IL: 0.037

CP–D13
GL: 1.25
IL: 0.137

CP–D12
GL: 1.28
IL: 0.243

CP–D11
GL: 1.24
IL: 0.319

CP–D10
GL: 1.38
IL: 0.419

CP–D9
GL: 1.32
IL: 0.519

CP–D8
GL: 1.32
IL: 0.619

CP–D7
GL: 1.93
IL: 0.724

CP–C11–5
GL: 1.37
IL: 0.510

CP–C11–4
GL: 1.49
IL: 0.585

CP–C11–3
GL: 1.38
IL: 0.660

CP–C11–2
GL: 1.37
IL: 0.735

CP–C11–1
GL: 1.41
IL: 0.810

CP–D12–13
GL: 1.46
IL: 0.860

CP–D12–14
GL: 1.31
IL: 0.785

CP–D12–15
GL: 1.44
IL: 0.710

CP–D12–16
GL: 1.30
IL: 0.635

CP–D12–17
GL: 1.37
IL: 0.70

CP–D12–11
GL: 1.32
IL: 0.410

CP–D12–10
GL: 1.22
IL: 0.440

CP–D12–9
GL: 1.30
IL: 0.470

CP–D12–8
GL: 1.33
IL: 0.500

CP–D12–7
GL: 1.23
IL: 0.530

CP–D12–6
GL: 1.33
IL: 0.560

CP–D12–5
GL: 1.37
IL: 0.590

CP–D12–4
GL: 1.35
IL: 0.620

CP–D12–3
GL: 1.26
IL: 0.650

CP–D12–2
GL: 1.26
IL: 0.680

CP–D12–1
GL: 1.31
IL: 0.710

CP–D1
GL: 1.77
IL: 1.170

CP–D2
GL: 1.80
IL: 1.095

CP–D3
GL: 1.78
IL: 1.020

CP–D4
GL: 1.82
IL: 0.945

CP–D5
GL: 1.76
IL: 0.870

CP–D6
GL: 1.84
IL: 0.795

CP–D7–3
GL: 1.80
IL: 0.768

CP–D7–2
GL: 1.93
IL: 0.783

CP–D7–1
GL: 1.40
IL: 0.800

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN	
	CLIENT : MINISTRY OF ENVIRONMENT & ENERGY			PROJECT No	
			IF IN DOUBT - ASK - DO NOT SCALE		

PAGE NO. 5

S.FEYDHOO

North

PROPOSED GRAVITY STORMWATER COLLECTION NETWORK & DISPOSAL SYSTEM

Ø375mm PVC Pipes (1.127Km)

Ø300mm PVC Pipes (3.956Km)

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM

TITLE : NETWORK DRAWING

CLIENT : MINISTRY OF ENVIRONMENT & ENERGY

DRAWN BY: WATER SOLUTIONS PVT. LTD

DESIGNED BY: WATER SOLUTIONS PVT. LTD

DATE DECEMBER 2017

SCALE AS GIVEN

PROJECT No

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PAGE NO. 6

S.FEYDHOO

North

PROPOSED GRAVITY STORMWATER COLLECTION NETWORK & DISPOSAL SYSTEM

SURVEYED GROUND LEVELS

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DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE	AS GIVEN
		PROJECT No	

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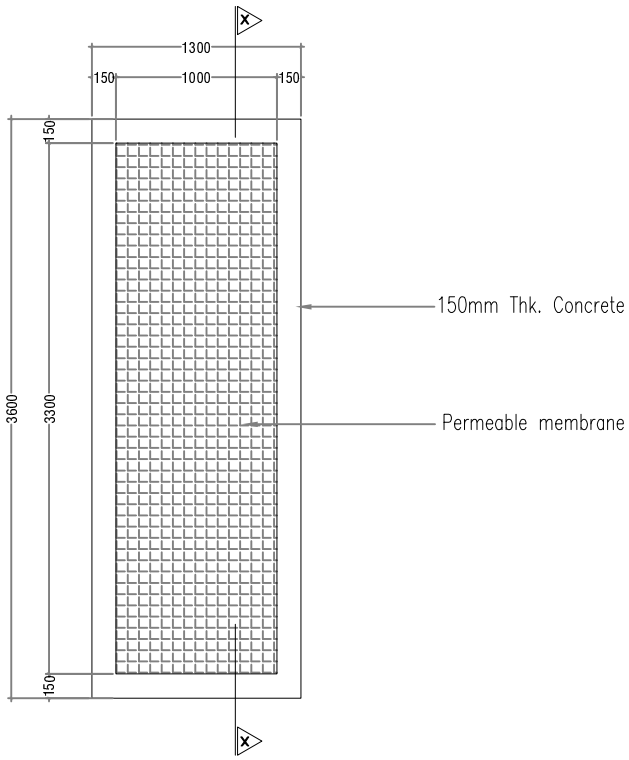
PAGE NO. 7

TITLE : NETWORK DRAWING

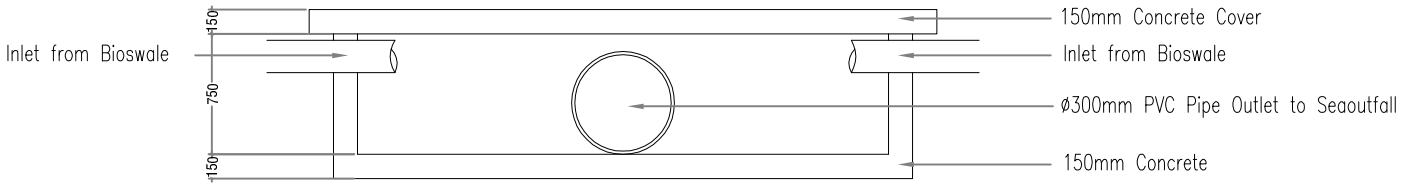
CLIENT : MINISTRY OF ENVIRONMENT & ENERGY

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM



RCC COLLECTING TANK FROM BIOSWALE - PLAN VIEW

NTS



RCC COLLECTING TANK FROM BIOSWALE -SECTION X-X

NTS

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017	PAGE NO.
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN		8
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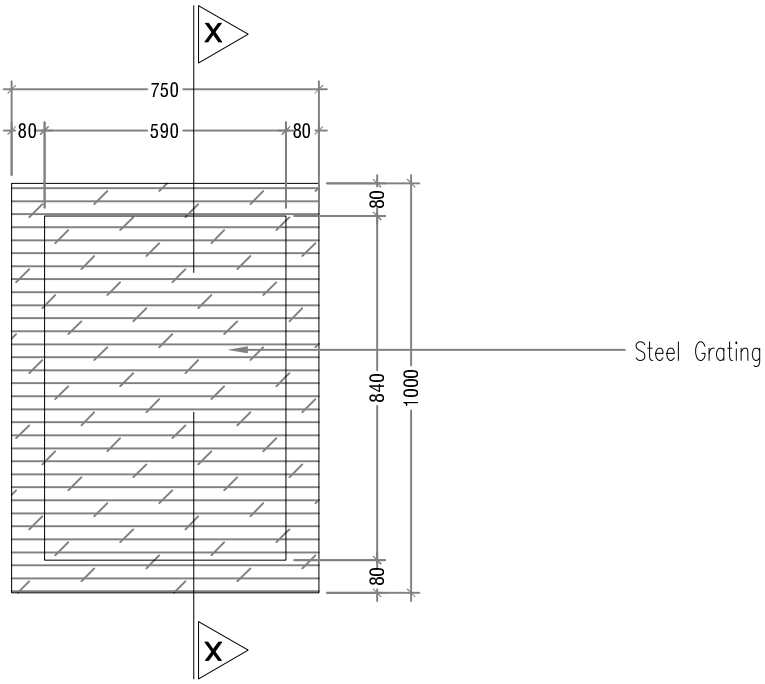
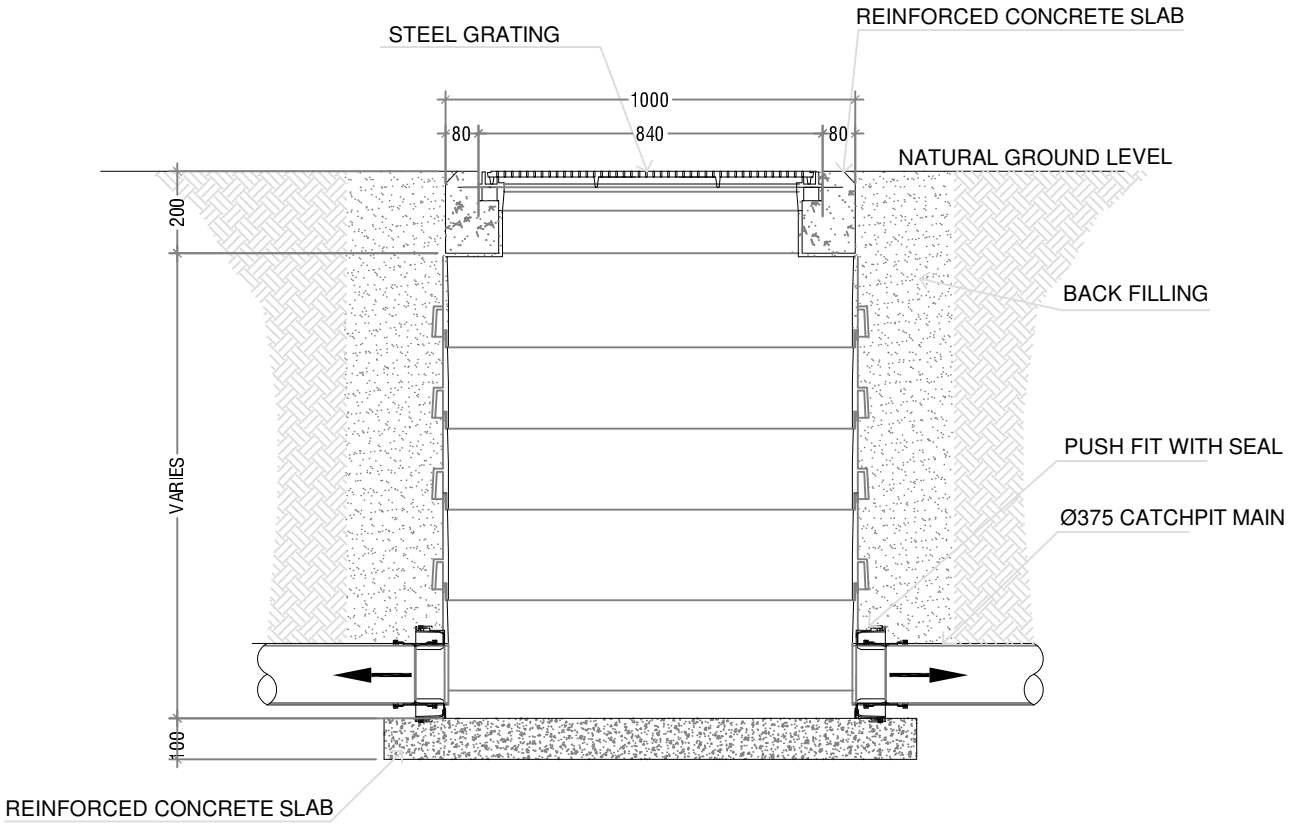


CATCH PIT - PLAN VIEW

NTS



SECTION-X-X

NTS

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017	PAGE NO.
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN		9
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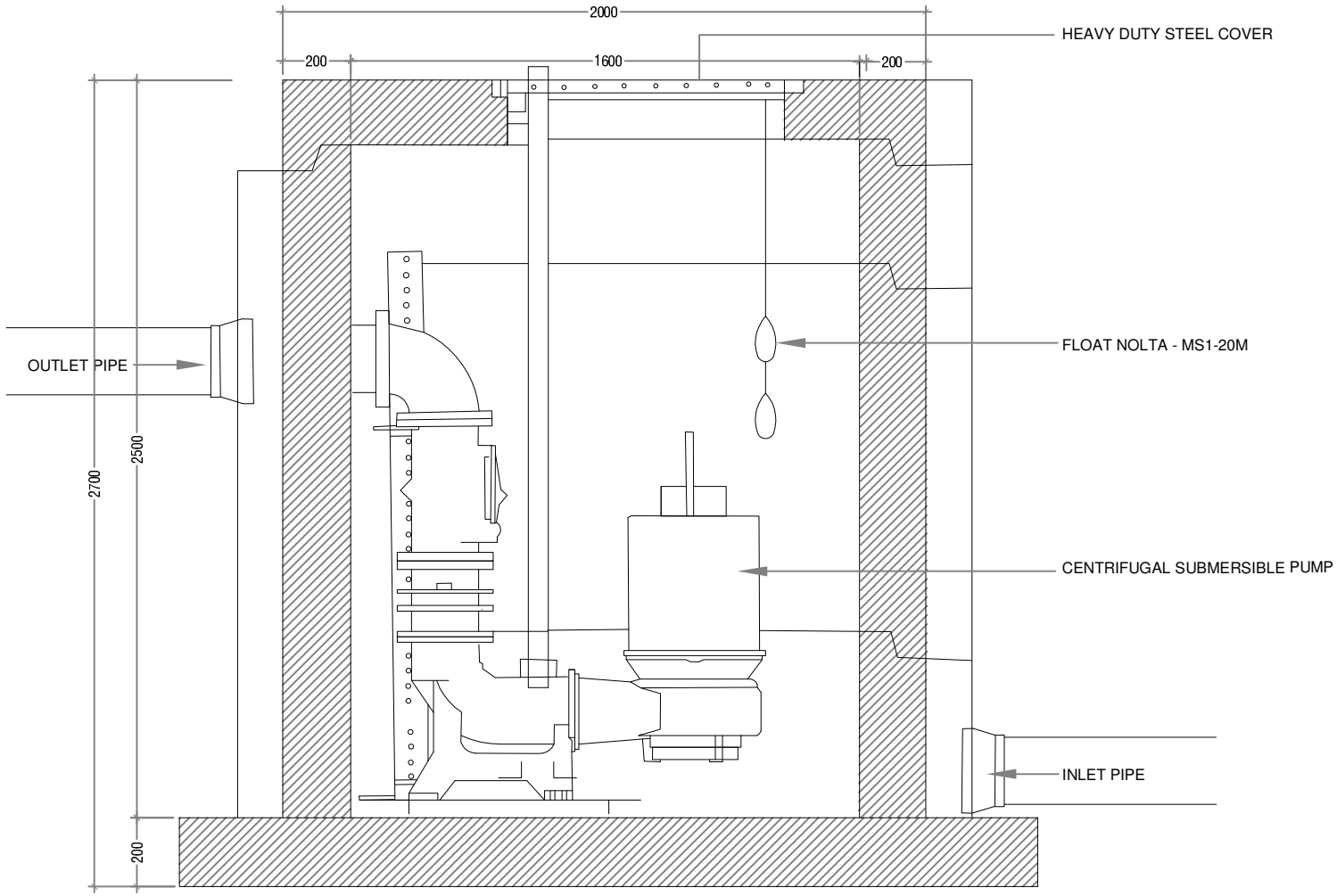

TYPICAL LIFTING STATION PLAN

NTS

NOTE: PUMP SPECIFICATIONS;

PUMP TYPE: CENTRIFUGAL SUBMERSIBLE PUMP
MINIMUM FLOW RATE: 40HP
LIQUID LEVEL CENSOR: USE AST45200 FLUSH SUBMERSIBLE LIQUID CONTROLLER MS1 / EQUIVALENT

LEVEL CONTROLLER MS1: THE NIVA CONTROLLER MS1 / EQUIVALENT

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017	PAGE NO.
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN		10
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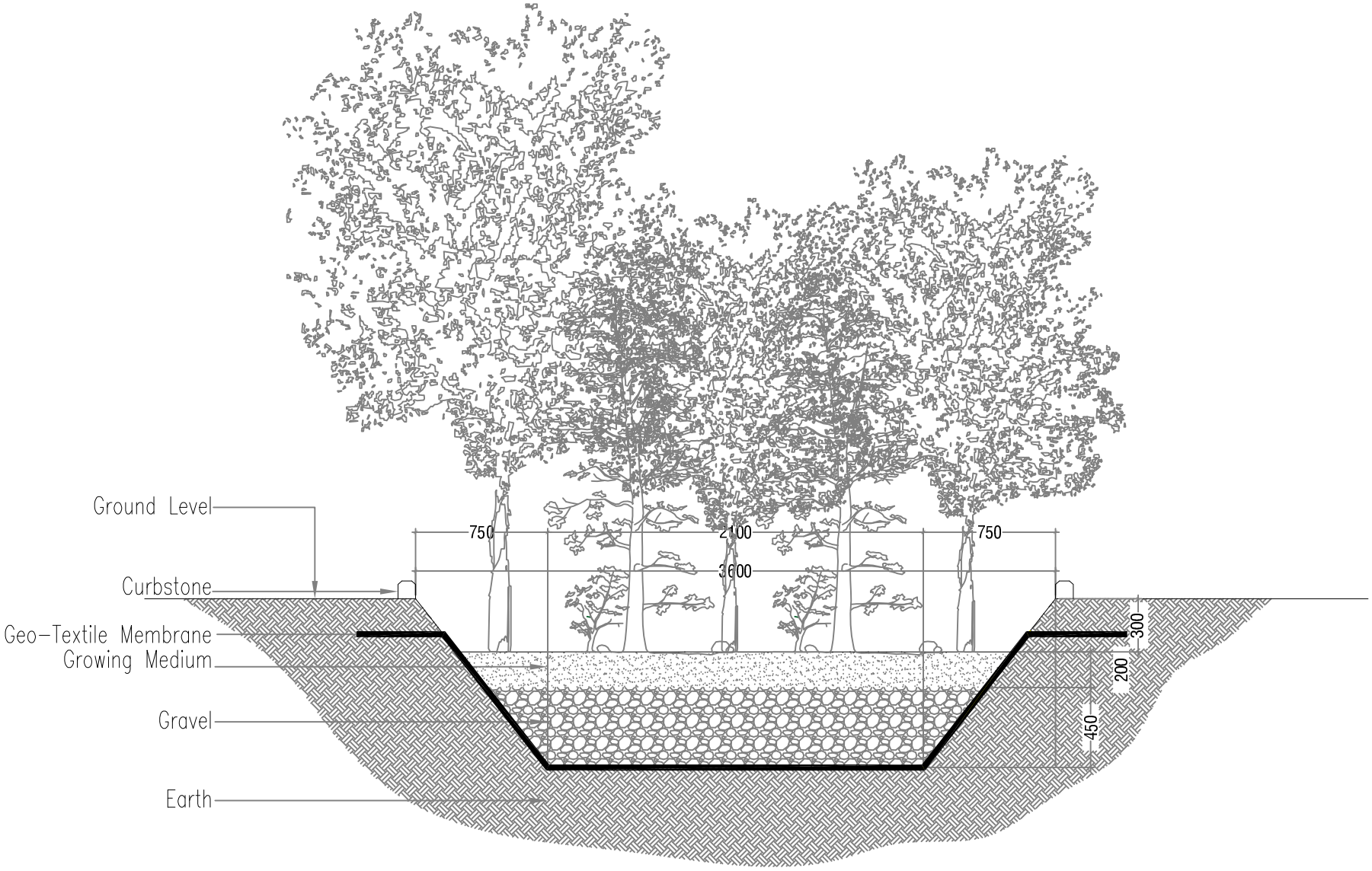


BIO SWALE - CROSS SECTION

NTS

PROJECT : S.FEYDHOO STORMWATER DRINAGE SYSTEM	TITLE : NETWORK DRAWING	DRAWN BY:	WATER SOLUTIONS PVT. LTD	DATE	DECEMBER 2017	PAGE NO.
		DESIGNED BY:	WATER SOLUTIONS PVT. LTD	SCALE AS GIVEN		11
	CLIENT : MINISTRY OF ENVIRONMENT & ENERGY			PROJECT No		
			IF IN DOUBT - ASK - DO NOT SCALE			

S.FEYDHOO STORM WATER NETWORK - CP-A

Profile no.	Particulars of Flood		Length	Dia. of pipe (ID)	Material	Slope	Cover Level		Invert Level		Pipe Depth	Pipe Depth
	From CP	To CP	m	mm			Upper CP	Lower CP	Upper CP	Lower CP	Upper CP	Lower CP
1	CP-A01	CP-A02	16.20	375	Upvc	0.0050	1.110	1.180	0.510	0.429	0.60	0.75
	CP-A02	CP-A03	15.00	375	Upvc	0.0050	1.180	1.160	0.429	0.354	0.75	0.81
	CP-A03	CP-A04	15.00	375	Upvc	0.0050	1.160	1.160	0.354	0.279	0.81	0.88
	CP-A04	CP-A05	15.00	375	Upvc	0.0050	1.160	0.990	0.279	0.204	0.88	0.79
	CP-A05	CP-A06	21.84	375	Upvc	0.0050	0.990	0.950	0.204	0.095	0.79	0.86
	CP-A06	CP-A07	16.20	375	Upvc	0.0050	0.950	1.110	0.095	0.014	0.86	1.10
	CP-A07	CP-A08	15.00	375	Upvc	0.0050	1.110	1.250	0.014	-0.061	1.10	1.31
	CP-A08	CP-A09	15.00	375	Upvc	0.0050	1.250	1.150	-0.061	-0.136	1.31	1.29
	CP-A09	CP-A10	15.00	375	Upvc	0.0050	1.150	1.100	-0.136	-0.211	1.29	1.31
	CP-A10	CP-A11	13.41	375	Upvc	0.0050	1.100	1.000	-0.211	-0.278	1.31	1.28
	CP-A11	CP-A12	21.20	375	Upvc	0.0050	1.000	1.000	-0.278	-0.384	1.28	1.38
	CP-A12	CP-A13	20.00	375	Upvc	0.0050	1.000	1.140	-0.384	-0.484	1.38	1.62
	CP-A13	CP-A14	16.94	375	Upvc	0.0050	1.140	1.280	-0.484	-0.569	1.62	1.85
	CP-A14	CP-A15	20.00	375	Upvc	0.0050	1.280	1.310	-0.569	-0.669	1.85	1.98
	CP-A15	CP-A16	20.00	375	Upvc	0.0050	1.310	1.310	-0.669	-0.769	1.98	2.08
	CP-A16	CP-A17	15.43	375	Upvc	0.0050	1.310	1.240	-0.769	-0.846	2.08	2.09
	CP-A17	CP-A18	16.75	375	Upvc	0.0050	1.240	1.230	-0.846	-0.930	2.09	2.16
	CP-A18	CP-A19	15.39	375	Upvc	0.0050	1.230	1.260	-0.930	-1.007	2.16	2.27
	CP-A19	CP-A20	21.14	375	Upvc	0.0050	1.260	1.020	-1.007	-1.113	2.27	2.13
	CP-A20	CP-A21	20.05	375	Upvc	0.0050	1.020	0.910	-1.113	-1.213	2.13	2.12
	CP-A21	CP-A22	20.05	375	Upvc	0.0050	0.910	0.960	-1.213	-1.313	2.12	2.27
	CP-A22	CP-A23	20.05	375	Upvc	0.0050	0.960	0.900	-1.313	-1.413	2.27	2.31
	CP-A23	LS-01	16.33	375	Upvc	0.0050	0.900	1.010	-1.413	-1.495	2.31	2.50
	LS-01	CP-A24	12.37	375	Upvc	0.0050	1.010	0.920	0.410	0.348	0.60	0.57
	CP-A24	CP-A25	15.00	375	Upvc	0.0050	0.920	1.000	0.348	0.273	0.57	0.73
	CP-A25	CP-A26	15.00	375	Upvc	0.0050	1.000	0.890	0.273	0.198	0.73	0.69
	CP-A26	CP-A27	15.00	375	Upvc	0.0050	0.890	0.840	0.198	0.123	0.69	0.72
	CP-A27	CP-A28	11.70	375	Upvc	0.0050	0.840	0.890	0.123	0.065	0.72	0.83
	CP-A28	CP-A29	15.00	375	Upvc	0.0050	0.890	0.850	0.065	-0.010	0.83	0.86
	CP-A29	CP-A30	15.00	375	Upvc	0.0050	0.850	0.940	-0.010	-0.085	0.86	1.03
	CP-A30	CP-A31	15.00	375	Upvc	0.0050	0.940	1.020	-0.085	-0.160	1.03	1.18
	CP-A31	CP-A32	15.00	375	Upvc	0.0050	1.020	1.190	-0.160	-0.235	1.18	1.43
	CP-A32	LS-03	20.26	375	Upvc	0.0050	1.190	1.240	-0.235	-0.337	1.43	1.58
2	CP-A11-1	CP-A11-2	21.20	300	Upvc	0.0050	1.510	1.560	0.910	0.804	0.60	0.76
	CP-A11-2	CP-A11-3	20.00	300	Upvc	0.0050	1.560	1.560	0.804	0.704	0.76	0.86
	CP-A11-3	CP-A11-4	19.08	300	Upvc	0.0050	1.560	1.680	0.704	0.609	0.86	1.07
	CP-A11-4	CP-A11-5	21.20	300	Upvc	0.0050	1.680	1.090	0.609	0.503	1.07	0.59
	CP-A11-5	CP-A11-6	20.00	300	Upvc	0.0050	1.090	1.050	0.503	0.403	0.59	0.65
	CP-A11-6	CP-A11-7	20.00	300	Upvc	0.0050	1.050	0.570	0.403	0.303	0.65	0.27
	CP-A11-7	CP-A11	19.38	300	Upvc	0.0050	0.570	1.000	0.303	0.206	0.27	0.79
3	CP-A11-8	CP-A11-9	16.20	300	Upvc	0.0050	0.950	0.950	0.350	0.269	0.60	0.68
	CP-A11-9	CP-A11-10	15.00	300	Upvc	0.0050	0.950	0.900	0.269	0.194	0.68	0.71
	CP-A11-10	CP-A11-11	15.00	300	Upvc	0.0050	0.900	0.900	0.194	0.119	0.71	0.78
	CP-A11-11	CP-A11	11.48	300	Upvc	0.0050	0.900	1.000	0.119	0.062	0.78	0.94
4	CP-A17-1	CP-A17-2	16.20	300	Upvc	0.0050	1.260	1.210	0.660	0.579	0.60	0.63
	CP-A17-2	CP-A17-3	15.00	300	Upvc	0.0050	1.210	1.260	0.579	0.504	0.63	0.76
	CP-A17-3	CP-A17	20.00	300	Upvc	0.0050	1.260	1.240	0.504	0.404	0.76	0.84
5	CP-A19-1	CP-A19-2	16.20	300	Upvc	0.0050	1.110	1.110	0.510	0.429	0.60	0.68
	CP-A19-2	CP-A19-3	15.00	300	Upvc	0.0050	1.110	1.050	0.429	0.354	0.68	0.70
	CP-A19-3	CP-A19-4	15.00	300	Upvc	0.0050	1.050	1.050	0.354	0.279	0.70	0.77
	CP-A19-4	CP-A19-5	15.00	300	Upvc	0.0050	1.050	1.050	0.279	0.204	0.77	0.85
	CP-A19-5	CP-A19-6	15.60	300	Upvc	0.0050	1.050	1.020	0.204	0.126	0.85	0.89
	CP-A19-6	CP-A19-7	16.20	300	Upvc	0.0050	1.020	0.960	0.126	0.045	0.89	0.92
	CP-A19-7	CP-A19-8	15.00	300	Upvc	0.0050	0.960	0.950	0.045	-0.030	0.92	0.98
	CP-A19-8	CP-A19-9	15.00	300	Upvc	0.0050	0.950	0.950	-0.030	-0.105	0.98	1.06
	CP-A19-9	CP-A19-10	20.88	300	Upvc	0.0050	0.950	1.050	-0.105	-0.209	1.06	1.26
	CP-A19-10	CP-A19-11	16.20	300	Upvc	0.0050	1.050	1.260	-0.209	-0.290	1.26	1.55
	CP-A19-11	CP-A19-12	15.00	300	Upvc	0.0050	1.260	1.300	-0.290	-0.365	1.55	1.67
	CP-A19-12	CP-A19-13	15.00	300	Upvc	0.0050	1.300	1.330	-0.365	-0.440	1.67	1.77
	CP-A19-13	CP-A19	10.58	300	Upvc	0.0050	1.330	1.260	-0.440	-0.493	1.77	1.75
6	CP-A19-6A	CP-A19-6B	16.27	300	Upvc	0.0040	0.860	1.020	0.260	0.195	0.60	0.83
	CP-A19-6B	CP-A19-6	13.40	300	Upvc	0.0040	1.020	1.020	0.195	0.141	0.83	0.88
7	CP-A33	CP-A34	16.20	375	Upvc	0.0050	1.350	1.200	0.750	0.669	0.60	0.53
	CP-A34	CP-A35	15.00	375	Upvc	0.0050	1.200	1.270	0.669	0.594	0.53	0.68

	CP-A35	CP-A36	15.00	375	Upvc	0.0050	1.270	1.270	0.594	0.519	0.68	0.75
	CP-A36	CP-A37	15.00	375	Upvc	0.0050	1.270	1.270	0.519	0.444	0.75	0.83
	CP-A37	CP-A38	15.00	375	Upvc	0.0050	1.270	1.240	0.444	0.369	0.83	0.87
	CP-A38	CP-A39	15.00	375	Upvc	0.0050	1.240	1.240	0.369	0.294	0.87	0.95
	CP-A39	CP-A40	15.00	375	Upvc	0.0050	1.240	1.180	0.294	0.219	0.95	0.96
	CP-A40	CP-A41	15.00	375	Upvc	0.0050	1.180	1.180	0.219	0.144	0.96	1.04
	CP-A41	CP-A42	15.00	375	Upvc	0.0050	1.180	1.150	0.144	0.069	1.04	1.08
	CP-A42	CP-A43	15.00	375	Upvc	0.0050	1.150	1.150	0.069	-0.006	1.08	1.16
	CP-A43	CP-A44	17.96	375	Upvc	0.0050	1.150	1.230	-0.006	-0.096	1.16	1.33
	CP-A44	CP-A45	17.04	375	Upvc	0.0050	1.230	1.050	-0.096	-0.181	1.33	1.23
	CP-A45	CP-A46	15.00	375	Upvc	0.0050	1.050	1.050	-0.181	-0.256	1.23	1.31
	CP-A46	CP-A47	15.00	375	Upvc	0.0050	1.050	0.990	-0.256	-0.331	1.31	1.32
	CP-A47	CP-A48	17.52	375	Upvc	0.0050	0.990	0.960	-0.331	-0.419	1.32	1.38
	CP-A48	CP-A49	12.48	375	Upvc	0.0050	0.960	1.020	-0.419	-0.481	1.38	1.50
	CP-A49	CP-A50	15.00	375	Upvc	0.0050	1.020	1.020	-0.481	-0.556	1.50	1.58
	CP-A50	CP-A51	15.00	375	Upvc	0.0050	1.020	1.020	-0.556	-0.631	1.58	1.65
	CP-A51	CP-A52	15.00	375	Upvc	0.0050	1.020	1.050	-0.631	-0.706	1.65	1.76
	CP-A52	CP-A53	15.00	375	Upvc	0.0050	1.050	1.050	-0.706	-0.781	1.76	1.83
	CP-A53	LS-02	15.00	375	Upvc	0.0050	1.050	0.980	-0.781	-0.856	1.83	1.84
	LS-02	CP-A54	15.00	375	Upvc	0.0050	0.980	0.980	0.380	0.305	0.60	0.68
	CP-A54	CP-A55	15.00	375	Upvc	0.0050	0.980	1.510	0.305	0.230	0.68	1.28
	CP-A55	LS-01	10.09	375	Upvc	0.0050	1.510	1.010	0.230	0.180	1.28	0.83
8	CP-A56	CP-A57	16.20	375	Upvc	0.0050	1.060	0.980	0.460	0.379	0.60	0.60
	CP-A57	CP-A58	15.00	375	Upvc	0.0050	0.980	0.980	0.379	0.304	0.60	0.68
	CP-A58	CP-A59	15.00	375	Upvc	0.0050	0.980	0.910	0.304	0.229	0.68	0.68
	CP-A59	LS-01	17.55	375	Upvc	0.0050	0.910	1.010	0.229	0.141	0.68	0.87
9	CP-A28-1	CP-A28-2	16.20	375	Upvc	0.0030	1.060	1.160	0.460	0.411	0.60	0.75
	CP-A28-2	CP-A28-3	15.00	375	Upvc	0.0030	1.160	1.160	0.411	0.366	0.75	0.79
	CP-A28-3	CP-A28-4	15.00	375	Upvc	0.0030	1.160	0.920	0.366	0.321	0.79	0.60
	CP-A28-4	CP-A28-5	15.00	375	Upvc	0.0030	0.920	0.920	0.321	0.276	0.60	0.64
	CP-A28-5	CP-A28-6	15.00	375	Upvc	0.0030	0.920	0.870	0.276	0.231	0.64	0.64
	CP-A28-6	CP-A28-7	15.00	375	Upvc	0.0030	0.870	0.870	0.231	0.186	0.64	0.68
	CP-A28-7	CP-A28-8	15.00	375	Upvc	0.0030	0.870	0.810	0.186	0.141	0.68	0.67
	CP-A28-8	CP-A28	21.03	375	Upvc	0.0030	0.810	0.890	0.141	0.078	0.67	0.81
10	CP-A28-9	CP-A28-10	16.20	375	Upvc	0.0050	1.030	0.980	0.430	0.349	0.60	0.63
	CP-A28-10	CP-A28-11	15.00	375	Upvc	0.0050	0.980	0.980	0.349	0.274	0.63	0.71
	CP-A28-11	CP-A28-12	15.00	375	Upvc	0.0050	0.980	0.950	0.274	0.199	0.71	0.75
	CP-A28-12	CP-A28	14.78	375	Upvc	0.0050	0.950	0.890	0.199	0.125	0.75	0.76
11	CP-A60	CP-A61	26.20	375	Upvc	0.0050	1.200	1.260	0.600	0.469	0.60	0.79
	CP-A61	CP-A62	25.00	375	Upvc	0.0050	1.260	1.300	0.469	0.344	0.79	0.96
	CP-A62	CP-A63	25.00	375	Upvc	0.0050	1.300	1.240	0.344	0.219	0.96	1.02
	CP-A63	CP-A64	22.52	375	Upvc	0.0050	1.240	1.150	0.219	0.106	1.02	1.04
	CP-A64	LS-03	3.77	375	Upvc	0.0050	1.150	1.240	0.106	0.088	1.04	1.15

S.FEYDHOO STORM WATER NETWORK - CP-B

Profile no.	Particulars of Flood		Length	Dia. of pipe (ID)	Material	Slope	Cover Level		Invert Level		Pipe Depth	Pipe Depth
	From CP	To CP	m	mm			Upper CP	Lower CP	Upper CP	Lower CP	Upper CP	Lower CP
1	CP-B01	CP-B02	26.20	375	Upvc	0.0050	1.300	1.360	0.700	0.569	0.60	0.79
	CP-B02	CP-B03	25.00	375	Upvc	0.0050	1.360	1.350	0.569	0.444	0.79	0.91
	CP-B03	CP-B04	25.00	375	Upvc	0.0050	1.350	1.240	0.444	0.319	0.91	0.92
	CP-B04	CP-B05	25.00	375	Upvc	0.0050	1.240	1.240	0.319	0.194	0.92	1.05
	CP-B05	CP-B06	23.53	375	Upvc	0.0050	1.240	1.240	0.194	0.076	1.05	1.16
	CP-B06	CP-B07	15.60	375	Upvc	0.0050	1.240	1.120	0.076	-0.002	1.16	1.12
	CP-B07	CP-B08	15.00	375	Upvc	0.0050	1.120	1.020	-0.002	-0.077	1.12	1.10
	CP-B08	CP-B09	15.00	375	Upvc	0.0050	1.020	0.900	-0.077	-0.152	1.10	1.05
	CP-B09	CP-B10	18.05	375	Upvc	0.0050	0.900	1.340	-0.152	-0.242	1.05	1.58
	CP-B10	CP-B11	16.10	375	Upvc	0.0050	1.340	0.870	-0.242	-0.322	1.58	1.19
	CP-B11	CP-B12	15.00	375	Upvc	0.0050	0.870	0.840	-0.322	-0.397	1.19	1.24
	CP-B12	CP-B13	15.00	375	Upvc	0.0050	0.840	0.840	-0.397	-0.472	1.24	1.31
	CP-B13	CP-B14	15.00	375	Upvc	0.0050	0.840	0.930	-0.472	-0.547	1.31	1.48
	CP-B14	CP-B15	18.50	375	Upvc	0.0050	0.930	1.000	-0.547	-0.640	1.48	1.64
	CP-B15	CP-B16	14.25	375	Upvc	0.0050	1.000	1.020	-0.640	-0.711	1.64	1.73
	CP-B16	CP-B17	16.20	375	Upvc	0.0050	1.020	0.910	-0.711	-0.792	1.73	1.70
	CP-B17	CP-B18	15.00	375	Upvc	0.0050	0.910	1.020	-0.792	-0.867	1.70	1.89
	CP-B18	CP-B19	15.00	375	Upvc	0.0050	1.020	1.200	-0.867	-0.942	1.89	2.14
	CP-B19	CP-B20	15.00	375	Upvc	0.0050	1.200	1.140	-0.942	-1.017	2.14	2.16
	CP-B20	CP-B21	15.00	375	Upvc	0.0050	1.140	1.070	-1.017	-1.092	2.16	2.16
	CP-B21	CP-B22	15.00	375	Upvc	0.0050	1.070	1.200	-1.092	-1.167	2.16	2.37
	CP-B22	LS-04	17.23	375	Upvc	0.0050	1.200	1.250	-1.167	-1.253	2.37	2.50
	LS-04	CP-B24	16.20	375	Upvc	0.0050	1.250	1.260	0.650	0.569	0.60	0.69
	CP-B24	CP-B25	15.00	375	Upvc	0.0050	1.260	1.180	0.569	0.494	0.69	0.69
	CP-B25	CP-B26	15.00	375	Upvc	0.0050	1.180	1.240	0.494	0.419	0.69	0.82
	CP-B26	CP-B27	15.00	375	Upvc	0.0050	1.240	1.280	0.419	0.344	0.82	0.94
	CP-B27	CP-B28	15.00	375	Upvc	0.0050	1.280	1.270	0.344	0.269	0.94	1.00
	CP-B28	CP-B29	15.00	375	Upvc	0.0050	1.270	1.260	0.269	0.194	1.00	1.07
	CP-B29	CP-B30	5.99	375	Upvc	0.0050	1.260	1.220	0.194	0.164	1.07	1.06
	CP-B30	CP-B31	16.23	375	Upvc	0.0050	1.220	1.230	0.164	0.083	1.06	1.15
	CP-B31	CP-B32	15.00	375	Upvc	0.0050	1.230	1.290	0.083	0.008	1.15	1.28
	CP-B32	CP-B33	15.00	375	Upvc	0.0050	1.290	1.300	0.008	-0.067	1.28	1.37
	CP-B33	CP-B34	15.00	375	Upvc	0.0050	1.300	1.210	-0.067	-0.142	1.37	1.35
	CP-B34	CP-B35	8.57	375	Upvc	0.0050	1.210	1.180	-0.142	-0.185	1.35	1.36
	CP-B35	CP-B36	16.20	375	Upvc	0.0050	1.180	1.160	-0.185	-0.266	1.36	1.43
	CP-B36	CP-B37	15.00	375	Upvc	0.0050	1.160	1.160	-0.266	-0.341	1.43	1.50
	CP-B37	LS-05	22.53	375	Upvc	0.0050	1.160	1.320	-0.341	-0.454	1.50	1.77
2	CP-B6-1	CP-B6-2	16.20	300	Upvc	0.0050	1.400	1.400	0.800	0.719	0.60	0.68
	CP-B6-2	CP-B6-3	15.00	300	Upvc	0.0050	1.400	1.440	0.719	0.644	0.68	0.80
	CP-B6-3	CP-B6	15.10	300	Upvc	0.0050	1.440	1.240	0.644	0.569	0.80	0.67
3	CP-B10-1	CP-B10-2	16.20	375	Upvc	0.0050	1.040	1.030	0.440	0.359	0.60	0.67
	CP-B10-2	CP-B10-3	15.00	375	Upvc	0.0050	1.030	1.030	0.359	0.284	0.67	0.75
	CP-B10-3	CP-B10-4	15.00	375	Upvc	0.0050	1.030	1.710	0.284	0.209	0.75	1.50
	CP-B10-4	CP-B10-5	15.00	375	Upvc	0.0050	1.710	1.630	0.209	0.134	1.50	1.50
	CP-B10-5	CP-B10-6	15.00	375	Upvc	0.0050	1.630	0.790	0.134	0.059	1.50	0.73
	CP-B10-6	CP-B10	10.62	375	Upvc	0.0050	0.790	1.340	0.059	0.006	0.73	1.33
4	CP-B10-7	CP-B10-8	15.00	375	Upvc	0.0050	1.520	1.480	0.920	0.845	0.60	0.64
	CP-B10-8	CP-B10-9	15.00	375	Upvc	0.0050	1.480	1.420	0.845	0.770	0.64	0.65
	CP-B10-9	CP-B10	15.35	375	Upvc	0.0050	1.420	1.340	0.770	0.693	0.65	0.65
5	CP-B15-1	CP-B15-2	15.00	375	Upvc	0.0050	0.930	0.930	0.330	0.255	0.60	0.68
	CP-B15-2	CP-B15-3	15.00	375	Upvc	0.0050	0.930	1.000	0.255	0.180	0.68	0.82
	CP-B15-3	CP-B15	10.31	375	Upvc	0.0050	1.000	1.000	0.180	0.128	0.82	0.87
6	CP-B16-1	CP-B16-2	16.20	375	Upvc	0.0050	1.220	1.270	0.620	0.539	0.60	0.73

	CP-B16-2	CP-B16-3	15.00	375	Upvc	0.0050	1.270	1.280	0.539	0.464	0.73	0.82
	CP-B16-3	CP-B16-4	15.00	375	Upvc	0.0050	1.280	1.280	0.464	0.389	0.82	0.89
	CP-B16-4	CP-B16-5	14.96	375	Upvc	0.0050	1.280	1.080	0.389	0.314	0.89	0.77
	CP-B16-5	CP-B16-6	15.04	375	Upvc	0.0050	1.080	1.020	0.314	0.239	0.77	0.78
	CP-B16-6	CP-B16	10.51	375	Upvc	0.0050	1.020	1.020	0.239	0.186	0.78	0.83
7	CP-B23-1	CP-B23-2	16.20	375	Upvc	0.0050	1.320	1.180	0.720	0.639	0.60	0.54
	CP-B23-2	CP-B23-3	15.00	375	Upvc	0.0050	1.180	1.350	0.639	0.564	0.54	0.79
	CP-B23-3	CP-B23-4	15.00	375	Upvc	0.0050	1.350	1.270	0.564	0.489	0.79	0.78
	CP-B23-4	CP-B23-5	14.96	375	Upvc	0.0050	1.270	1.250	0.489	0.414	0.78	0.84
	CP-B23-5	CP-B23-6	15.04	375	Upvc	0.0050	1.250	1.220	0.414	0.339	0.84	0.88
	CP-B23-6	LS-04	10.87	375	Upvc	0.0050	1.220	1.250	0.339	0.285	0.88	0.97
8	CP-B23-7	CP-B23-8	15.00	375	Upvc	0.0050	1.220	1.200	0.620	0.545	0.60	0.66
	CP-B23-8	CP-B23-9	15.00	375	Upvc	0.0050	1.200	1.200	0.545	0.470	0.66	0.73
	CP-B23-9	LS-04	10.31	375	Upvc	0.0050	1.200	1.250	0.470	0.418	0.73	0.83
9	CP-B30-1	CP-B30-2	16.20	375	Upvc	0.0050	1.390	1.310	0.790	0.709	0.60	0.60
	CP-B30-2	CP-B30-3	15.00	375	Upvc	0.0050	1.310	1.370	0.709	0.634	0.60	0.74
	CP-B30-3	CP-B30-4	15.00	375	Upvc	0.0050	1.370	1.280	0.634	0.559	0.74	0.72
	CP-B30-4	CP-B30-5	14.96	375	Upvc	0.0050	1.280	1.280	0.559	0.484	0.72	0.80
	CP-B30-5	CP-B30-6	15.04	375	Upvc	0.0050	1.280	1.220	0.484	0.409	0.80	0.81
	CP-B30-6	CP-B30	10.87	375	Upvc	0.0050	1.220	1.220	0.409	0.355	0.81	0.87
10	CP-B30-7	CP-B30-8	15.00	375	Upvc	0.0050	1.060	1.090	0.460	0.385	0.60	0.71
	CP-B30-8	CP-B30-9	15.00	375	Upvc	0.0050	1.090	1.090	0.385	0.310	0.71	0.78
	CP-B30-9	CP-B30	18.50	375	Upvc	0.0050	1.090	1.220	0.310	0.218	0.78	1.00
11	CP-B35-1	CP-B35-2	15.00	375	Upvc	0.0050	1.030	1.080	0.430	0.355	0.60	0.73
	CP-B35-2	CP-B35-3	15.00	375	Upvc	0.0050	1.080	1.250	0.355	0.280	0.73	0.97
	CP-B35-3	CP-B35	18.50	375	Upvc	0.0050	1.250	1.180	0.280	0.188	0.97	0.99
12	CP-B39	CP-B40	25.01	375	Upvc	0.0050	1.230	1.260	0.630	0.505	0.60	0.76
	CP-B40	CP-B41	25.01	375	Upvc	0.0050	1.260	1.260	0.505	0.380	0.76	0.88
	CP-B41	CP-B42	26.09	375	Upvc	0.0050	1.260	1.320	0.380	0.249	0.88	1.07
	CP-B42	LS-05	11.13	375	Upvc	0.0050	1.320	1.320	0.249	0.194	1.07	1.13

S.FEYDHOO STORM WATER NETWORK - CP-C

Profile no.	Particulars of Flood		Length	Dia. of pipe (ID)	Material	Slope	Cover Level		Invert Level		Pipe Depth	Pipe Depth
	From CP	To CP	m	mm			Upper CP	Lower CP	Upper CP	Lower CP	Upper CP	Lower CP
1	CP-C01	CP-C02	21.07	375	Upvc	0.0050	1.090	1.140	0.490	0.385	0.60	0.76
	CP-C02	CP-C03	20.00	375	Upvc	0.0050	1.140	1.180	0.385	0.285	0.76	0.90
	CP-C03	CP-C04	20.00	375	Upvc	0.0050	1.180	1.190	0.285	0.185	0.90	1.01
	CP-C04	CP-C05	20.00	375	Upvc	0.0050	1.190	1.180	0.185	0.085	1.01	1.10
	CP-C05	CP-C06	12.64	375	Upvc	0.0050	1.180	1.260	0.085	0.021	1.10	1.24
	CP-C06	CP-C07	21.20	375	Upvc	0.0050	1.260	1.180	0.021	-0.085	1.24	1.26
	CP-C07	CP-C08	20.00	375	Upvc	0.0050	1.180	1.230	-0.085	-0.185	1.26	1.41
	CP-C08	CP-C09	20.00	375	Upvc	0.0050	1.230	1.260	-0.185	-0.285	1.41	1.54
	CP-C09	CP-C10	20.00	375	Upvc	0.0050	1.260	1.810	-0.285	-0.385	1.54	2.19
	CP-C10	CP-C11	16.06	375	Upvc	0.0050	1.810	1.340	-0.385	-0.465	2.19	1.80
	CP-C11	CP-C12	24.29	375	Upvc	0.0050	1.340	1.440	-0.465	-0.586	1.80	2.03
	CP-C12	CP-C13	20.00	375	Upvc	0.0050	1.440	1.390	-0.586	-0.686	2.03	2.08
	CP-C13	CP-C14	13.89	375	Upvc	0.0050	1.390	1.310	-0.686	-0.756	2.08	2.07
	CP-C14	LS-06	20.00	375	Upvc	0.0050	1.310	1.290	-0.756	-0.856	2.07	2.15
	LS-06	CP-C15	20.00	375	Upvc	0.0050	1.290	1.630	0.690	0.590	0.60	1.04
	CP-C15	CP-C16	20.00	375	Upvc	0.0050	1.630	1.540	0.590	0.490	1.04	1.05
	CP-C16	CP-C17	23.07	375	Upvc	0.0050	1.540	1.530	0.490	0.375	1.05	1.16
	CP-C17	CP-C18	25.42	375	Upvc	0.0050	1.530	1.510	0.375	0.248	1.16	1.26
	CP-C18	CP-C19	20.00	375	Upvc	0.0050	1.510	1.500	0.248	0.148	1.26	1.35
	CP-C19	CP-C20	20.00	375	Upvc	0.0050	1.500	1.500	0.148	0.048	1.35	1.45
	CP-C20	CP-C21	20.00	375	Upvc	0.0050	1.500	1.350	0.048	-0.052	1.45	1.40
	CP-C21	LS-07	20.00	375	Upvc	0.0050	1.350	1.200	-0.052	-0.152	1.40	1.35
2	CP-C06-1	CP-C06-2	15.00	300	Upvc	0.0050	1.810	1.810	1.210	1.135	0.60	0.68
	CP-C06-2	CP-C06-3	15.00	300	Upvc	0.0050	1.810	1.780	1.135	1.060	0.68	0.72
	CP-C06-3	CP-C06-4	15.00	300	Upvc	0.0050	1.780	1.680	1.060	0.985	0.72	0.70
	CP-C06-4	CP-C06-5	15.00	300	Upvc	0.0050	1.680	1.800	0.985	0.910	0.70	0.89
	CP-C06-5	CP-C06	17.04	300	Upvc	0.0050	1.800	1.260	0.910	0.825	0.89	0.44
3	CP-C06-6	CP-C06-7	15.00	300	Upvc	0.0050	1.240	1.260	0.640	0.565	0.60	0.70
	CP-C06-7	CP-C06-8	15.00	300	Upvc	0.0050	1.260	1.260	0.565	0.490	0.70	0.77
	CP-C06-8	CP-C06-9	15.00	300	Upvc	0.0050	1.260	1.240	0.490	0.415	0.77	0.83
	CP-C06-9	CP-C06-10	15.00	300	Upvc	0.0050	1.240	1.220	0.415	0.340	0.83	0.88
	CP-C06-10	CP-C06	15.00	300	Upvc	0.0050	1.220	1.260	0.340	0.265	0.88	1.00
4	CP-C11-1	CP-C11-2	15.00	300	Upvc	0.0050	1.410	1.370	0.810	0.735	0.60	0.64
	CP-C11-2	CP-C11-3	15.00	300	Upvc	0.0050	1.370	1.380	0.735	0.660	0.64	0.72
	CP-C11-3	CP-C11-4	15.00	300	Upvc	0.0050	1.380	1.490	0.660	0.585	0.72	0.91
	CP-C11-4	CP-C11-5	15.00	300	Upvc	0.0050	1.490	1.370	0.585	0.510	0.91	0.86
	CP-C11-5	CP-C11-6	15.00	300	Upvc	0.0050	1.370	1.360	0.510	0.435	0.86	0.93
	CP-C11-6	CP-C11	17.04	300	Upvc	0.0050	1.360	1.340	0.435	0.350	0.93	0.99
5	CP-C11-7	CP-C11-8	15.00	300	Upvc	0.0050	1.350	1.240	0.750	0.675	0.60	0.57
	CP-C11-8	CP-C11-9	15.00	300	Upvc	0.0050	1.240	1.270	0.675	0.600	0.57	0.67
	CP-C11-9	CP-C11-10	15.00	300	Upvc	0.0050	1.270	1.240	0.600	0.525	0.67	0.72
	CP-C11-10	CP-C11-11	15.00	300	Upvc	0.0050	1.240	1.290	0.525	0.450	0.72	0.84
	CP-C11-11	CP-C11	13.90	300	Upvc	0.0050	1.290	1.340	0.450	0.381	0.84	0.96
6	CP-C22	CP-C23	24.99	375	Upvc	0.0050	1.330	1.260	0.730	0.605	0.60	0.65
	CP-C23	CP-C24	24.99	375	Upvc	0.0050	1.260	1.260	0.605	0.480	0.65	0.78
	CP-C24	CP-C25	24.99	375	Upvc	0.0050	1.260	1.270	0.480	0.355	0.78	0.91
	CP-C25	LS-07	26.09	375	Upvc	0.0050	1.270	1.200	0.355	0.225	0.91	0.98
7	CP-C26	CP-C27	26.23	375	Upvc	0.0050	1.190	1.320	0.590	0.459	0.60	0.86
	CP-C27	CP-C28	24.99	375	Upvc	0.0050	1.320	1.240	0.459	0.334	0.86	0.91
	CP-C28	LS-07	24.89	375	Upvc	0.0050	1.240	1.200	0.334	0.209	0.91	0.99

S.FEYDHOO STORM WATER NETWORK - CP-D

Profile no.	Particulars of Flood		Length	Dia. of pipe (ID)	Material	Slope	Cover Level		Invert Level		Pipe Depth	Pipe Depth
	From CP	To CP	m	mm			Upper CP	Lower CP	Upper CP	Lower CP	Upper CP	Lower CP
1	CP-D01	CP-D02	15.00	375	Upvc	0.0050	1.770	1.800	1.170	1.095	0.60	0.71
	CP-D02	CP-D03	15.00	375	Upvc	0.0050	1.800	1.780	1.095	1.020	0.71	0.76
	CP-D03	CP-D04	15.00	375	Upvc	0.0050	1.780	1.820	1.020	0.945	0.76	0.88
	CP-D04	CP-D05	15.00	375	Upvc	0.0050	1.820	1.760	0.945	0.870	0.88	0.89
	CP-D05	CP-D06	15.00	375	Upvc	0.0050	1.760	1.840	0.870	0.795	0.89	1.05
	CP-D06	CP-D07	14.18	375	Upvc	0.0050	1.840	1.930	0.795	0.724	1.05	1.21
	CP-D07	CP-D08	21.06	375	Upvc	0.0050	1.930	1.320	0.724	0.619	1.21	0.70
	CP-D08	CP-D09	20.00	375	Upvc	0.0050	1.320	1.320	0.619	0.519	0.70	0.80
	CP-D09	CP-D10	20.00	375	Upvc	0.0050	1.320	1.380	0.519	0.419	0.80	0.96
	CP-D10	CP-D11	20.00	375	Upvc	0.0050	1.380	1.240	0.419	0.319	0.96	0.92
	CP-D11	CP-D12	15.26	375	Upvc	0.0050	1.240	1.280	0.319	0.243	0.92	1.04
	CP-D12	CP-D13	21.07	375	Upvc	0.0050	1.280	1.250	0.243	0.137	1.04	1.11
	CP-D13	CP-D14	20.00	375	Upvc	0.0050	1.250	1.240	0.137	0.037	1.11	1.20
	CP-D14	CP-D15	20.00	375	Upvc	0.0050	1.240	0.980	0.037	-0.063	1.20	1.04
	CP-D15	CP-D16	20.00	375	Upvc	0.0050	0.980	1.220	-0.063	-0.163	1.04	1.38
	CP-D16	CP-D17	18.24	375	Upvc	0.0050	1.220	1.220	-0.163	-0.254	1.38	1.47
	CP-D17	CP-D18	20.00	375	Upvc	0.0050	1.220	1.230	-0.254	-0.354	1.47	1.58
	CP-D18	CP-D19	20.00	375	Upvc	0.0050	1.230	1.120	-0.354	-0.454	1.58	1.57
	CP-D19	CP-D20	20.00	375	Upvc	0.0050	1.120	1.050	-0.454	-0.554	1.57	1.60
	CP-D20	CP-D21	10.38	375	Upvc	0.0050	1.050	1.110	-0.554	-0.606	1.60	1.72
	CP-D21	CP-D22	20.00	375	Upvc	0.0050	1.110	1.130	-0.606	-0.706	1.72	1.84
	CP-D22	CP-D23	20.00	375	Upvc	0.0050	1.130	1.200	-0.706	-0.806	1.84	2.01
	CP-D23	LS-08	21.96	375	Upvc	0.0050	1.200	1.250	-0.806	-0.916	2.01	2.17
2	CP-D07-1	CP-D07-2	16.58	300	Upvc	0.0010	1.400	1.930	0.800	0.783	0.60	1.15
	CP-D07-2	CP-D07-3	15.00	300	Upvc	0.0010	1.930	1.800	0.783	0.768	1.15	1.03
	CP-D07-3	CP-D07	16.20	300	Upvc	0.0010	1.800	1.930	0.768	0.752	1.03	1.18
3	CP-D12-1	CP-D12-2	15.00	300	Upvc	0.0020	1.310	1.260	0.710	0.680	0.60	0.58
	CP-D12-2	CP-D12-3	15.00	300	Upvc	0.0020	1.260	1.260	0.680	0.650	0.58	0.61
	CP-D12-3	CP-D12-4	15.00	300	Upvc	0.0020	1.260	1.350	0.650	0.620	0.61	0.73
	CP-D12-4	CP-D12-5	15.00	300	Upvc	0.0020	1.350	1.370	0.620	0.590	0.73	0.78
	CP-D12-5	CP-D12-6	15.00	300	Upvc	0.0020	1.370	1.330	0.590	0.560	0.78	0.77
	CP-D12-6	CP-D12-7	15.00	300	Upvc	0.0020	1.330	1.230	0.560	0.530	0.77	0.70
	CP-D12-7	CP-D12-8	15.00	300	Upvc	0.0020	1.230	1.330	0.530	0.500	0.70	0.83
	CP-D12-8	CP-D12-9	15.00	300	Upvc	0.0020	1.330	1.300	0.500	0.470	0.83	0.83
	CP-D12-9	CP-D12-10	15.00	300	Upvc	0.0020	1.300	1.220	0.470	0.440	0.83	0.78
	CP-D12-10	CP-D12-11	15.00	300	Upvc	0.0020	1.220	1.320	0.440	0.410	0.78	0.91
	CP-D12-11	CP-D12	16.30	300	Upvc	0.0020	1.320	1.280	0.410	0.377	0.91	0.90
4	CP-D12-13	CP-D12-14	15.00	300	Upvc	0.0050	1.460	1.310	0.860	0.785	0.60	0.53
	CP-D12-14	CP-D12-15	15.00	300	Upvc	0.0050	1.310	1.440	0.785	0.710	0.53	0.73
	CP-D12-15	CP-D12-16	15.00	300	Upvc	0.0050	1.440	1.300	0.710	0.635	0.73	0.67
	CP-D12-16	CP-D12-17	15.00	300	Upvc	0.0050	1.300	1.370	0.635	0.560	0.67	0.81
	CP-D12-17	CP-D12	14.08	300	Upvc	0.0050	1.370	1.280	0.560	0.490	0.81	0.79
5	CP-D25	CP-D26	24.32	375	Upvc	0.0050	1.330	1.340	0.730	0.608	0.60	0.73
	CP-D26	CP-D27	25.01	375	Upvc	0.0050	1.340	1.420	0.608	0.483	0.73	0.94
	CP-D27	CP-D28	20.28	375	Upvc	0.0050	1.420	1.250	0.483	0.382	0.94	0.87
	CP-D28	LS-08	104.00	375	Upvc	0.0050	1.250	1.250	0.382	-0.138	0.87	1.39

Appendix C: Bathymetry

Legend

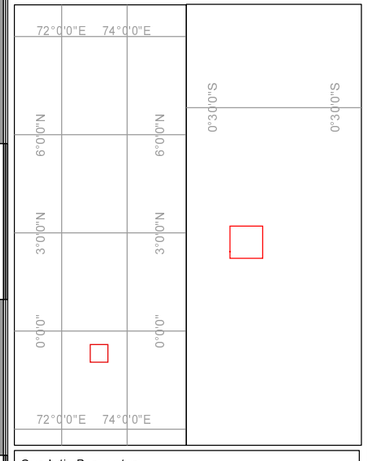
- High Tide 28 July 2017
- Low Tide 28 July 2017
- Island

Bathymetry

Value

Shallow: -2.11

Deep : -30



Geodetic Parameters

Coordinate Systems :Universal Transverse Mercator (UTM) Zone: 43 North
Projection :Transverse Mercator (TM)
Datum : WGS 1984
Longitude of Origin :0.000000000
Central Meridian:75 W
Scale Factor :0.999600000000000040
False Easting :500000.000
False Northing :0.00000000
Semi-Major Axis (a) (Meters): 6378137.000
Semi-Minor Axis (b) (Meters): 6356752.314245179 3

Scale:

0 50 100 Meters

Project:

Feydhoo Flood Mitigation

Client:

Ministry of Environment and Energy

Contractor:

Water Solutions Pvt Ltd
Ma.Fas Eri 1st Floor, Ameenee Magu, Male', Maldives
Tel: +(960)334643, Fax: +(960)337643
www.water-solutions.biz

EIA PURPOSES ONLY

Appendix D: CV of unregistered consultants

Abdul Aleem (Amooo) – Curriculum Vitae

Personal and contact details

Full name: Abdul Aleem (Amu)
Common Name: Amooo
Date of birth: 2nd November 1973
Nationality: Maldivian
Sex: Male'

Permanent address
M.Dhonumaruge Dhekunubai, Jahaamuguri Goalhi, Male', Republic of Maldives

Tel: 960 960 3324088
Mobile: 960 7793502
Web: www.amooo.com
Email: info@amooo.com

Safety of Rainwater harvesting in Maldives
Data analysis and reporting of a pilot survey conducted for the 12th International Rainwater Catchment Systems Conference, New Delhi 2005.

Occupational Health Injury Situation Analysis (December 2002)
Joint study on assessing occupational injuries and its situation in Maldives. Study done for Ministry of Health with Ahmed Zahid.

Environmental Health Review (November 2001)
A review of Environmental Health status in Maldives done for Ministry of Health

Health and Safety Aspects (October 2001)
Joint study on the Feasibility of a Poultry Farm in Maldives. Feasibility study done for a private firm.

Environmental Impact Statement (December 2000)
Undertaken for the RO plant at ADK Hospital, Male', Maldives.

Healthy Islands Plan of Action for Maldives: (2000)
Prepared for Environmental Health Unit of Ministry of Health, Maldives

Critique on Hawkesbury Healthy City Project (1999)
One year research project undertaken at WHO Collaborating Center for environmental Health, University of Western Sydney, Hawkesbury, Sydney, Australia

Healthy River: Water Quality Study of Nabukalau Creek, Suva, Fiji Islands; 1998
Third year research project report undertaken at Department of Environmental Health, Fiji School of Medicine, Suva, Fiji

Groundwater assessment of Noonu Atoll Manadhoo, Maldives (Jan 2007)
Data collection including assessing groundwater quality and setting baseline parameters for the preparation of an EIA for the establishment of sewerage system in the island.

Groundwater assessment of Raa atoll Ungoofaaru, Maldives (Jan 2007)
Data collection including assessing groundwater quality and setting baseline parameters for the preparation of an EIA for the establishment of sewerage system in the island.

EIA for the establishment of sewerage system in Daalu atoll Meedhoo, Maldives (Jan 2007)
Data collection including assessing groundwater quality and setting baseline parameters. Preparation of the full EIA report based on field data collected.

EIA for the establishment of sewerage system in Laamu atoll Dambidhoo, Maldives (Dec 2006)
Preparation of the full EIA report based on field data collected.

EIA for the establishment of a resort in Naridhoo island, Haa Alif atoll, Maldives (Dec 2006)
Assessment and reporting of the groundwater and terrestrial aspects of the EIA.

Shoreline survey of Cocoa Palm island Resort, Maldives (Oct 2006)
Mapping the island's shore line, vegetation line, high tide line, reef line and the extent of erosion. Setting up baseline GIS maps to assess the extent of coastal damage.

Survey of Royal Island Resort and Spa, Baa atoll, Maldives (Oct 2006)
Mapping the island's shore line and setting up baseline GIS maps to assess the extent of coastal damage.

Addendum to EIA for the resort development in Noonu Maavelaavaru, Maldives (Sep 2006)
Preparation of the full EIA report based on field data collected.

EIA for the establishment of sewerage system in Vaavu Felidhoo, Maldives (Sep 2006)
Preparation of the full EIA report based on field data collected.

EIA for the redevelopment of villivaru resort in Male' Atoll, Maldives (Sep 2006)
Baseline data collection, assessment and reporting of the groundwater and terrestrial aspects of the EIA. Mapping the island including, broad bathymetric survey of the island's lagoon and reef extent .

EIA for the establishment of a resort in Medhafushi island, Noonu Atoll, Maldives (Sep 2006)
Baseline data collection, assessment and reporting of the groundwater and terrestrial aspects of the EIA. Bathymetric survey of the island's lagoon using differential GPS and echosounder.

EIA for the establishment of a resort in Gaakoshibi island, Maldives (Sep 2006)
Assessment and reporting of the groundwater and terrestrial aspects of the EIA.

EIA for the establishment of a resort in Vagaru island, Shaviyani Atoll, Maldives (Aug 2006)
Baseline data collection, assessment and reporting of the groundwater and terrestrial aspects of the EIA. Mapping the island and setting up baseline GIS maps for monitoring purposes. Broad bathymetric survey of the island's lagoon.

Bathymetric survey of Giraavaru Island resort, Male' atoll, Maldives (June 2006)
Broad bathymetric survey of the islands lagoon system using GPS and ecosounder. Mapping the limits of the reef line.

Mapping and bathymetric survey of Halaveli Island resort, Alif atoll, Maldives (May 2006)
Mapping the island including shore and vegetation line and generating maps including the islands existing coastal infrastructure and entrance channel. Broad bathymetric survey of the islands lagoon system using GPS and ecosounder.

Workshop on Drinking Water quality monitoring and surveillance (May 14 - 16, 2006, Meemu atoll)
Presentation on water quality monitoring and surveillance, including ground water and rainwater. Teaching community members on how to assess water quality and undertake surveys and do monitoring work. Managing and leading the workshop

Workshop on Drinking Water quality monitoring and surveillance (Jan, 2006, Raa atoll)

Presentation on water quality monitoring and surveillance, including ground water and rainwater. Teaching community members on how to assess water quality and undertake surveys and do monitoring work. Managing and leading the workshop

Mapping newly renovated Olhuveli Island resort and spa, South Male' atoll, Maldives (April 2006)
Mapping the island including shore and vegetation line and generating maps including newly reclamated land mass.

EIA for the establishment of a resort in Seenu Villingilli, Maldives (March 2006)
Baseline data collection, assessment and reporting of the groundwater and terrestrial aspects of the EIA. Mapping the island and setting up baseline GIS maps for monitoring purposes.

Mapping and baseline groundwater survey of Kurendhoo Island in Lhaviyani atoll, Maldives (April 2006)
Mapping the entire island including shore and vegetation line and setting up GIS base maps for water quality for a sewerage system design.

Erosion study for Royal Island Resort and Spa, Maldives (February 2006)
Baseline data collection and assessment of the coastal aspects of the study. Mapping the islands shore line and setting up baseline GIS maps for monitoring erosion.

EIA for the establishment of Kaafu Maafushi island's sewerage system, Maldives (November 2005)
Baseline data collection and assessment of the groundwater and terrestrial environment.

EIA for the establishment of Kaafu Guraidhoo's sewerage system, Maldives (November 2005)
Baseline data collection and assessment of the groundwater and terrestrial environment .

EIA of Viligilimathidahura reclamation and development, Maldives (October 2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna and socio-economic impacts.

EIA of the Fourth Power Project for STELCO (August 2005)
Assessment and reporting of the health impacts of the project.

EIA of Boduhithi Resort redevelopment, Maldives (2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna.

EIA of Kudahithi Resort redevelopment, Maldives (2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna.

EIA of Maavelavaru Resort redevelopment, Maldives (2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna.

EIA of Kalhufahalafushi Resort Development, Maldives (2005)
Surveying, assessment and reporting of the terrestrial and water quality aspects.

EIA of Alidhoo Resort Development, Maldives (2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna.

EIA of Horizon Fisheries Complex, Laamu Atoll, Maldives(2005)
Surveying, assessment and reporting of the marine and beach water quality, land contamination and coastal aspects.

EIA of Lonudhoohutaa Resort Development, Maldives (2005)
Surveying, assessment and reporting of the terrestrial aspects, including groundwater, flora and fauna.

Rapid Assessment of groundwater and rainwater in selected islands of Gaafu Alif and Gaafu Dhaal atoll, Maldives (March 2005)
Rapid assessment and reporting of the groundwater and rainwater conditions to assess the impact of tsunami in seven islands.

Rapid Assessment of groundwater and rainwater status in selected islands of Gaafu Alif and Gaafu Dhaal atoll, Maldives (March 2005)

Rapid assessment and reporting of the groundwater conditions to assess the impact of tsunami in two islands.

Rapid Assessment of groundwater in selected islands of Laamu atoll, Maldives (Jan 2005)
Rapid assessment and reporting of the groundwater conditions to assess the impact of tsunami in seven islands

Presentation on Waste management and recycling opportunities in the Maldives (27-29 October 2002). Local Consultant for CDE Pvt Ltd.
International Workshop on Environmental Management and Sustainable Tourism
27-29 October, Paradise Island, Maldives. Presentation on Waste management and recycling opportunities in the Maldives given at the workshop held jointly by Villa Hotels and International Finance Cooperation. The aim of the workshop was to adopt Environmental Management Systems at Villa Hotels.

Publicity campaign for the First Regional Development Project, Maldives (March 29 - 30, 2002). Local Consultant for Business and Financial Services (BFS) Pvt Ltd.
Presentation on water resource management, especially on protecting ground water and application of various methods to protect groundwater pollution, Waste management with special emphasis on the first regional development project in the Maldives and environmental protection, especially wetlands and their relationship to groundwater.

Workshop on Drinking Water safety and sanitation (Jan 14 - 18, 2002)
Presentation on water resource management, especially on protecting ground water and application of various methods to protect groundwater pollution. Workshop held to provide information to the community and school children at A.dh Dhangethi island, Dhaal Ribudoo Island, Meemu Muli and Vaavu Keyodhoo Island, Maldives

Workshop on Water and Sanitation (Jan 5 - 7, 2002)
Presentation on Environmental protection given at the Workshop held to provide information to leaders of islands, teachers, health workers in Ari Atoll, Maldives A.dh Mahibadhoo, Maldives

Comparative Study on Indoor Air pollution (Nov 28-Dec 2, 2001)
Assessment of the status of Indoor air pollution in Addu Atoll, Maldives to compare data with Male', conducted by Ministry of Health, Maldives

Joint ground water research of Maamigili island, Maldives (October 20, 2001)
Ground water quality assessment survey of the island of Maamigilli island in Ari Atoll, Maldives conducted by MWSA, Maldives.

Joint ground water research of Fuvah Mulaku Island, Maldives (November 2000)
Ground water quality assessment survey of the Island of Fuvah Mulah, Maldives
Conducted as part of the V & A assessment study by Ministry of Home Affairs, Housing and Environment.

Joint ground water research survey of Bodu Rehaa island, Maldives (November 2000)
Ground water quality assessment survey of the Island of Bodu Rehaa, Gaafu Dhaalu Atoll, Maldives.
Conducted as part of the V & A assessment study Ministry of Home Affairs, Housing and Environment.

Joint ground water research survey of Hithaadhoo Island, Maldives (November 2000)
Ground water quality assessment survey of the Island of Hithaadhoo Island in Baa Atoll, Maldives. Conducted as part of the V & A assessment research. Ministry of Home Affairs, Housing and Environment.

Project Officer (Sep 2001 – 24 Feb 2003)
Maldives Water and sanitation Authority, Republic of Maldives

Project Officer (Aug 2000 – Sep 2001)
Health Education Unit, Ministry of Health, Republic of Maldives

Project Officer (Dec 1999 – Aug 2000)
Environmental Health Unit, Ministry of Health, Republic of Maldives

General Secretary (December 1999 – August 2001)
Tennis Association of Maldives, Male', Republic of Maldives

Secretary (Jan 1993 - Feb 1996)
Planning and Coordination Section, Ministry of Health and Welfare, Republic of Maldives

Secretary (1992- December 1995)
Soft Tennis Association of Maldives, Male, Maldives

Public Health Officer (May 1993 - Dec 1993)
Food Safety and Epidemic Control Section, Department of Public Health, Republic of Maldives

Appendix E: List of Stakeholders Consulted/details of attendances and details of invitations sent for consultation meetings

Person	Title	Organisation
Abdullah Ziyad	Minister of State	Ministry of Environment and Energy
Adnan Haleem	Executive Coordinator	Ministry if Environment and Energy
Abdullah Zuhair	Executive Coordinator	Ministry of Housing and Infra structure
Ali Haris	Project Coordinator	MTCC
Hassan Abdul Samad	Engineer	FENAKA
Abdullah Sadiq	Mayor	Addu City Council
Ahmed Anwar	Assistant Direcotr	EPA
Hissan Hussain	Project Director	NDMC

Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas Eri, Ameenee Magu, Male', Maldives

ނަންބަރު: WS/LTR/2107/171

ފެނަކަ ކޯޕަރޭޝަން ލިމިޓެޑްގެ މެނޭޖިންގ ޑިރެކްޓަރ [illegible] އަށް،
ފެނުން ސަރވިސަސް ޑިވިޜަނަށް.

ސ. ހުޅުދޫ ފެނުގެ މަޝްރޫޢުގެ [illegible]

[illegible] (93/4 [illegible]

[illegible]

[illegible]

[illegible] (3341643/9930606/umar@water-solutions.biz) [illegible]

[illegible]

13 ޑިސެމްބަރ 2017 މ.

Received by:
Name: Samaha
Sign:
Date: 13/12/17
Stamp:

FENAKA CORPORATION LIMITED

[illegible]

[illegible]

ފެނަކަ ކޯޕަރޭޝަން [illegible]
[illegible]

Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas Eri, Ameenee Magu, Male', Maldives

ނަންބަރު: WS/LTR/2017/172

މާލެ ވޯޓަރ އެންޑް ސީވަރޭޖް ކޮމްޕެނީ ޕްރައިވެޓް ލިމިޓެޑް، ޕްރޮކިއުމަންޓް ޑިޕާޓްމަންޓް ހިންގާ ހިސާބު އެން،
ފަރުން ސަޕްލައިރޒް ޓެންޑަރުތަށް.

<u>ސ. ހުޅު ފެނުގެ މިކްސިންގ ޓޭންކު އިސްތިހާރު ބާބު</u>

ސ. ހުޅުދޫ ފެނުގެ ޕްލާންޓް ބަދަލުކުރުމުގެ މަސައްކަތް ހިންގުމަށް ހޯދުމަށް " ކޮންސްޓްރަކްޝަން ސުޕަރވިޝަން ސާވިސަސް
ފޯރ ކޮންޓްރެކްޓަރސް ޕްރޮޖެކްޓް އިންސްޓޯލޭޝަން ފޯރ އެސްޓިމޭޝަން ޕްރޮސެސް ފެނުގެ މިކްސިންގ ޓޭންކް އޮފް ސ. ހުޅު"
ޑިޒައިން އެންޑް އިންސްޓޯލޭޝަން ސަރވިސަސް ސިސްޓަމް ޓެސްޓިންގ އާއި މިކޮމިޝަނިންގ ހިމެނޭ އެއްބަސްވުމެއް ހަދާ އިން ތަނީ
މިކަންތައްތަކަށް ކުރިމަތިވާ ބަދަލުތަކެވެ. މިމަސައްކަތުގެ ތަފްސީލް އަދި ފެންވަރު މިނިވަން ޚިދުމަތް (އީ.އައި.އޭ) ރިޕޯޓަށް މި ރިޕޯޓް
ރިވިއުކުރުމަށް ރިޕޯޓް ތައްޔާރުކުރުމަށް ފޯރުކޮށްދޭ ފަރާތް (ޖޫން 93/4 ގެ ދަށުން ކުރިއަށް ރިވިއު ކޮށް
ފޯރުކޮށްދިނުމަށް ބޭނުންވާ އެއްބަސްވުން ހަދާފައިވާ ހިސާބުގެ ކުރީން ބައެއް ތަކެތި ހުށަހެޅުމަށް ރިޕޯޓްކޮށް.

ސ. ހުޅުދޫ ފެނުގެ ޕްލާންޓް ބަދަލުކުރުމުގެ މަސައްކަތް ހިންގުމަށް ހޯދުމުގެ ކޮމިޝަނިންގ ކުރިއަށް
ގެންދިއުމަށް އަދި ފެންވަރު ކޮށްފައިވާ މަސައްކަތްތައް ބަލަހައްޓާ ކޮންޓްރެކްޓަރުން މަސައްކަތްކުރުން ކުރިއަށް ގެންދިއުމަށް އީ.އައި.އޭ ހަދާފައި
އެކުލަވާލެވިފައިވާ ޕްރޮޖެކްޓް އެއްބަސްވުން އިން ފޮނުވިފައިވާ އީ.އައި.އޭގެ ރިޕޯޓްތައް އަދި ކުރިއަށްގެންދާ މަސައްކަތްތަކުން ލިބެން
ބޭނުން ކޮންސަލްޓަންޓް ކުރުމަށް އެދިވަޑައިގަންނަވަމެވެ. އަދި ލިބިފައިވާ މަސައްކަތްތައް ވަގުތު ފޮނުވުމަށް ކަމަށްވެސް ބަލައި
އީ.އައި.އޭ ރިޕޯޓު ފޮނުވުމަށްފަހު ވަކި އެދިވަޑައިގަންނަވަމެވެ.

މިއީ ތިޔަ ފަރާތުގެ ކޮންޓްރެކްޓަރުން ކޮންސަލްޓަންޓް ބަދަލުކުރުމުގެ އީ.އައި.އޭ ރިޕޯޓް ބަލައިގަތުމުގެ މުއްދަތުގައި
ކުރި ވަގުތު ތިޔަ ފަރާތުން ފޯރުކޮށްދެވޭނެ ޚިދުމަތްތަކަށް އެއްބަސްވާ ކަމުގެ އެއްގޮތް އެއް މި އަދި އެކަށް ފޯރުކޮށްދިނުމުގެ ބަދަލުގައި
އަގުގަބޫލުކުރެވޭނެ އެއްބަސްވުމެއްގެ ބައިގައި. މިއާ ބެހޭގޮތުން ބޭނުންވާ މަޢުލޫމާތު އިތުރު މަޢުލޫމާތު ބޭނުންފުޅުވާނަމަ
ކަމާބެހޭ އީ.އައި.އޭ ރިޕޯޓް ފޮނުވާ މުޙައްމަދު އުމަރު (3341643/9930606/umar@water-solutions.biz) އާއި
ގުޅުއްވުން އެދެމެވެ.

އިޙްތިރާމާއެކު ދަންނަވަމެވެ.

13 ޑިސެމްބަރ 2017 މ.

ހާދިމްކުމް

Received by:
Name: Ifuaf
Sign:
Date: 14/12/17
Stamp.

މުޙައްމަދު އުމަރު
އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ

Name:
Sign:
Date:
Time:

މާލެ ވޯޓަރ އެންޑް ސީވަރޭޖް ކޮމްޕެނީ
މާލެ
ދިވެހިރާއްޖެ

WS

Water Solutions Pvt. Ltd. Reg No: C-344/2005

Ma. Fas Eri, Ameenee Magu, Male', Maldives

ނަންބަރު: WS/LTR/2017/173

މޯލްޑިވްސް ރޯޑް ކޯޕަރޭޝަންގެ މެނޭޖިންގ ޑިރެކްޓަރ އަލްފާޟިލް ... އަށް،

ވަރަށް ސަލާމަށްފަހު ދަންނަވަމެވެ.

__ސ. ހިތަދޫ ފެނުގެ ނިޒާމް ހިންގުމުގެ ބ.އަ.އައިމް ބާރު__

ސ. ހިތަދޫ ފެނުގެ ... "ކޮންސްޓްރަކްޝަން ސުޕަރވިޝަން" ...

... ސ. ހިތަދޫ" ...

... (ބ.އަ.އައި) ...

... (93/4 ... ...

...

ސ. ހިތަދޫ ފެނުގެ ... ބ.އަ.އައި ...

...

...

ބ.އަ.އައި ...

... ބ.އަ.އައި ...

...

... ބ.އަ.އައި ... (3341643/9930606/umar@water-solutions.biz) އާއި

ގުޅުއްވުން އެދެމެވެ.

އިޚްލާޞްތެރި ޚާދިމް ކަމުގައި އެދެމެވެ.

13 ޑިސެމްބަރު 2017 އަދި

Received by:
Name: Isoha Moosa
Sign: [signature]
Date: 13/12/17
Stamp:

[signature]

މުޙައްމަދު މުޖުތަބާ

އެގްޒިކިއުޓިވް އޮފިސަރ

MALDIVES ROAD DEVELOPMENT CORPORATION LIMITED
MRDC

މޯލްޑިވްސް ރޯޑް ކޯޕަރޭޝަން

މާލެ

ދިވެހިރާއްޖެ

Water Solutions Pvt. Ltd. Reg No: C-344/2005

Ma. Fas Eri, Ameenee Magu, Male', Maldives

ނަންބަރު: WS/LTR/2017/174

ނޭޝަނަލް ޑިޒާސްޓަރ މެނޭޖްމަންޓް ސެންޓަރ ސަޕޯޓް މިނިސްޓަރ އޮފް ސްޓޭޓް މުޙައްމަދު ޝާހިދު އަށް،

ވެރިން ސަލާމަތުން ގަބޫލުކުރައްވާށި،

ސ: ފޯނު ފީފާ ޑީޕޮސިޓްގެ ވާހަކަ ދެއްކުމާއި އެ.އެމް.އެސް.ޕީ ވެސް

ސ: ފުރަތަމަ ފާސްކުރި ފޮނުވާ ފަހުން އަޅުއްވާ ކޮންޓްރެކްޓެއް ހިންގި ޕްރޮޖެކްޓް " ކޮންސްޓްރަކްޝަން ސަޕަވިޝަން ވާރ ކޮންޓްރެކްޓްގެ ޑިޒައިންގެ އިންސްޓޮލޭޝަން ވާރ އެސްޓިމޭޓިންގްގެ ފޯނު ޑީޕޮސިޓްގެ ފަހުގެ ވާހަކަ ސ: ފޯނު" އެއީ ބޭނުން އެންމެހައިކަމެއް އިމުގައި އެސްޓިމޭޓްތައް ތައްޔާރު ކުރިކަމުގައި އަދި އެންމެހައި ކަމެއް އެކަން އެކުލެވޭ ހިސާބު ވަކި ކުރިހިސާބުން އެއްވެސް ޝަރުތެއް. މިސާލަކަށް ފުރަތަމަ ފޮނުވާ ޑީޕޮސިޓް އެއްކޮށް ދިޔަ ކޮންޓްރެކްޓު (އެމް.އެން.ޑީ.ސީ) ތަރުޖަމާކޮށް. މި ޕްރޮޖެކްޓް ތަކުގެ ތަފްސީލު ބައެއް ކޮންޓްރެކްޓް ހިސާބުކޮށް ފައިސާ (ފައިސާ ނަންބަރު 93/4) ގެ ދަފްތަރު ބަޔާންގެ ތަފްސީލުގައި ފުރަތަމަ ކޮންޓްރެކްޓް އެއްބަޔާން ފުރަތަމަ ޕްރޮޖެކްޓްގެ ހިސާބުގެ ކުރީން ތަފްސީލުކުރުމަށް ދަންނަވަމެވެ.

ސ: ފުރަތަމަ ފާސްކުރި ފޮނުވާ ފަހުން އަޅުއްވާ ކޮންޓްރެކްޓެއް ހިންގި ޕްރޮޖެކްޓްގެ ތަފްސީލު ކަނޑައަޅާ ގަވާއިދުން އަދާކުރު. ފޯނުގެ ކޮންމެ ފައިސާ ބަދަލުކުރި ގެންދިއުން ތަފްސީލުކޮށްދޭން އެމް.އެން.ޑީ.ސީ ހުށަހެޅި އެންމެހައި ޕްރޮޖެކްޓް އެއްބަޔާން އިން ފުރަތަމަ ފޮނުވާ އެމް.އެން.ޑީ.ސީގެ ޓެންޑަރ ކަމެއް ތަފްސީލު ހިސާބުގައި ކުރިއަށްގެންދިއުމަށް ބަދަލު ކޮންޓްރެކްޓް ކުރުމަށް ހުށަހަޅައިދިނުމަށް. އަދި މިހާރު ފުރަތަމަ ކޮށްފައި ފޯނު ގެން ފުރަތަމަ ކޮންޓްރެކްޓް ކުރެވޭ އެމް.އެން.ޑީ.ސީ ދަފްތަރު ފުރަތަމަ ހުށަހެޅުން ވާނީ ހުށަހަޅައިދިނުމަށެވެ.

މިއީ ތިޔަ ފަރާތުގެ ކޮންމެ ބަޔަކު ބަދަލުކުރުން ކޮންސްޓްރަކްޝަން ކުރުމަށް ފުރަތަމަ ޕްރޮޖެކްޓްގެ އެމް.އެން.ޑީ.ސީ ޑީޕޮސިޓް ބަދަލުކުރުމަށް ފުރަތަމަ ގެން ފުރަތަމަ ކޮންޓްރެކްޓް ބަދަލުކުރުމަށް ކުރިއަށްގެންދިއުމަށް ކަމެއް އަދި މި ފަރާތުން ފުރަތަމަ ބަދަލުކުރެވޭ ކަމަށް ދަންނަވަމެވެ. މިއަދު ތިޔަ ފަރާތުގެ ކޮންސްޓްރަކްޝަން ތަފްސީލު އިތުރު މަޢުލޫމާތު ބޭނުންފުޅުވާނަމަ، އެމް.އެން.ޑީ.ސީ ޖަވާބު ފޮނުވާނީ މުޙައްމަދު އުމަރު (3341643/9930606/umar@water-solutions.biz) އާއި ގުޅުއްވުން އެދެމެވެ.

ދަންނަވަމެވެ.

އިޚްލާޞްތެރިކަމާއެކު ދަންނަވަމެވެ.

13 ޑިސެމްބަރު 2017 މ.

ސޮއި:

މުޙައްމަދު އުމަރު

އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ

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Sign: [signature]
Date: 14/12
Stamp: [stamp]

ނޭޝަނަލް ޑިޒާސްޓަރ މެނޭޖްމަންޓް ސެންޓަރ

މާލެ

ދިވެހިރާއްޖެ

Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas Eri, Ameenee Vagu, Male', Maldives

WS/LTR/2017/175 ނަންބަރު:

ފެންވަށަށް ޕައިޕް ލައިން ގެންދިއުމާ ގުޅިގެން ކައުންސިލްގެ ތަކުރާރު ނަމަ ތިރީގައި ލިޔެ ދަންނަވާ ފަދަ ކަންތައް ކުރަންވާނެ ކަމަށް ދަންނަވަމެވެ.

ހ. ކުއްލި ވިލާތަކުން ދިގުކޮށްގެން ދަތުރުކުރާ ވ.ގަދ.ދ.ދ ބަހައްޓާ ގޮތް

ހ. ކުއްލި ވިލާ ދިގުކޮށް ދަތުރުކުރާ ވ.ގަދ.ދ.ދ ބަހައްޓާ ގޮތް " ގައިސަންކްޝަންކުރާ ކަންތައް ކުރުމަށް ކުއްލި ވިލާ ދިގުކޮށް ދަތުރުކުރާ ވ.ގަދ.ދ.ދ ގެ ގޮތުގައި ބަހައްޓާ ގޮތް ތަފާތު ކަމަށް ވާތީ،

Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas Er, Ameenee Magu, Male', Maldives

WS/LTR/2017/176 :ނަންބަރު

ސްޓޭޓް އިލެކްޓްރިކް ކޮމްޕެނީ ލިމިޓެޑްގެ ސީއީއޯ އަލްފާޟިލް އަޙްމަދު ޝާކިރު އަށް
ފެނަކަ ކޯޕަރޭޝަން ލިމިޓެޑް.

<u>ސ. ފޭދޫ ފެނުގެ މަޝްރޫޢުގެ މުއްދަތު އިތުރުކުރުމާ ބެހޭ</u>

ސ. ފޭދޫގައި ފެނާއި ނަރުދަމާ ޚިދުމަތް ފޯރުކޮށްދިނުމުގެ މަޝްރޫޢު " ކޮންސްޓްރަކްޝަން އޮފް ވޯޓަރ ސަޕްލައި ސިސްޓަމް އިން ފޭދޫ " އާއި ގުޅިގެން ކުރިއަށް ގެންދާ ކުރީގެ މަސައްކަތް ހުރީ ސ. ފޭދޫ
އެއީ ވަރަށް އެކިއެކި ސަބަބުތަކާހުރެ ތަފާތު ގޮތްގޮތުން ކުރިމަތިވި ދަތިތަކާ ހެދި އިތުރު މުއްދަތެއް ބޭނުންވާ ކަމެވެ
މިކަމުގެ ތެރެއިން ކުރިމަތިވި ދަތިތަކުގެ ތެރެއިން ފެނާއި ނަރުދަމާގެ ކޮންޓްރެކްޓަރުން (އެސް.ޓީ.އޯ) ޖަހަމުންދާކަން. މި މަޝްރޫޢު
ނިމުމަށް ކަނޑައެޅިފައިވާ މުއްދަތު (93/4 ދުވަސް) ހަމަވުމުގެ ކުރިން ސ. ފޭދޫ ފެނުގެ މަޝްރޫޢުގެ
މަސައްކަތް ނިންމުމަށް އިތުރު މުއްދަތެއް ބޭނުންވާކަމަށް ދެކެމެވެ.

ސ. ފޭދޫގައި ފެނާއި ނަރުދަމާ ޚިދުމަތް ފޯރުކޮށްދިނުމުގެ މަޝްރޫޢުގެ މަސައްކަތަށް ކުރިމަތިވި
ގޮންޖެހުންތަކާއި ދަތިތަކާ ހެދި މަސައްކަތް ލަސްވެފައިވާ ކަމާއި ގުޅިގެން މަސައްކަތް ނިންމުމަށް އެސް.ޓީ.އޯ އިން
އެދިވަޑައިގަތުމުން ހޯދުނު އިތުރު މުއްދަތު އެސް.ޓީ.އޯގެ ލިޔުމުން އެންގެވުމަށް ދަންނަވަމެވެ
އަދި މިކަމާ ގުޅޭގޮތުން ކޮންމެ ކަމެއް ކުރުމަށް ބޭނުންވާ ލިޔެކިޔުން ފޮނުވައިދެއްވުން އެދެމެވެ
އެސް.ޓީ.އޯ އިން ދެއްވާ ލަފައާއެކު ކަންކަން ކުރިއަށް ގެންދާނަމެވެ.

މީގެ އިތުރުން ކުރިއަށް ގެންދާ މަސައްކަތުގެ ތަފްޞީލު އެސް.ޓީ.އޯގެ ޙަވާލާއިއެކު ފޮނުވާނަމެވެ
މިކަމާ ގުޅޭ ގޮތުން ޢަމަލުކުރުމަށް ބޭނުންވާ މަޢުލޫމާތު ހޯދަން އެދޭނަމަ ދީބައި ހުށަހަޅުއްވާނެ ކަމަށް
އެދިދެއްވުމަށް ދަންނަވަމެވެ. މިކަމާ ގުޅޭ މަސައްކަތުގެ ތަފްޞީލު ބޭނުންވާނަމަ ގުޅުއްވާނީ
ވޯޓަރ ސޮލިއުޝަންސްގެ ޢުމަރު މުޙައްމަދު އަށް (3341643/9930606/umar@water-solutions.biz) އެވެ
ކަމަށް ދަންނަވަމެވެ.

އިޙްތިރާމް ގަބޫލު ކުރެއްވުން އެދެމެވެ.

13 ޑިސެމްބަރު 2017 މ.

ޚާދިމުކުމް

[signature]

ޢުމަރު މުޙައްމަދު
އޮޕަރޭޝަންސް މެނޭޖަރ

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Date: 14/12/17
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ސްޓޭޓް އިލެކްޓްރިކް ކޮމްޕެނީ ލިމިޓެޑް
މާލެ
ދިވެހިރާއްޖެ

Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas En, Ameenee Magu Male', Maldives

WS/LTR/ 2017/170 :ނަންބަރު

މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންފްރާސްޓްރަކްޗަރގެ ، މަސައްކަތު ފާއިޒް އަށް،
ފުރިހަމަ ސަލާމަކާއެކު ދަންނަވަމެވެ.

ސ. ހުޅުދޫ ފޭދޫ މީޓަރ ގެސްޓްހައުސް ޕްރޮޖެކްޓުގެ އިޢުލާނާ ބެހޭ

ސ. ހުޅުދޫ މީދޫ ހިތަދޫ ފޭދޫ އަދި މަރަދޫ ސަރަހައްދުގައި ހިންގާ ޕްރޮޖެކްޓުގެ " ކޮންސްޓްރަކްޝަން ސުޕަރވިޝަން ކޮންސަލްޓަންސީ ސާވިސަސް ފޯ ސްޓޯމް ވޯޓަރ ޑްރެއިނޭޖް އެންޑް ރޯޑް ޑިވެލޮޕްމަންޓް ޕްރޮޖެކްޓް އިން އެޑިއުކޭޝަން ސެންޓަރ ފޭދޫ" އާއި ބެހޭ އިޢުލާނުގެ ދަށުން ސަބްމިޓް ކުރެވިފައިވާ ލަފާ ދިނުމުގެ ހުށަހެޅުމާ ގުޅިގެން ...

[illegible]

ސ. ހުޅުދޫ މީދޫ ހިތަދޫ ފޭދޫ އަދި މަރަދޫ ސަރަހައްދުގައި ހިންގާ ޕްރޮޖެކްޓުގެ ...

[illegible]

(3341643/9930606/umar@water-solutions.biz) އާއި ގުޅުއްވުން އެދެމެވެ.

އިޙްތިރާމް ގަބޫލު ކުރެއްވުން އެދެމެވެ.

13 ޑިސެމްބަރ 2017 ވަނަ

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މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންފްރާސްޓްރަކްޗަރ
މާލެ
ދިވެހިރާއްޖެ

Environmental Protection Agency
Male', Rep of Maldives

Meeting: Consultancy service for Conducting Detailed Investigation for Establishing Flood Mitigation Measures in S.Feydhoo

Date: 10/12/2017

Time: 10:00hrs.

MEETING ATTENDANCE

	Name	Designation	Office	Email	Phone No.	Signature
01	Ahsan Hafeeza	EC	MEE		778922	
02	Ali Fahmee Ahmed	Addu City Council	City Council		9996602	
03	HASSAN SHAH	CONSULTANT	WS	shah@water-solutions.biz	7778941	
04	Ahmeed Anwar	Asst. Director	MEE		348362	
05	A. ZIYAD	S.M.	MEE		7781502	
06	Adam Mubeen	Asst. Engineer	EPA	adam.mubeen@epa.gov	7588970	
07	Hussain Ibrahim	Asst. Unit officer	EPA	hussain.ibrahim@epa.gov	3335949	
08	Isaac		EPD	Isaac.naseer@epa.gov.mv	333.5949	
09						
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Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Shaah, Dhidhi Goalhi, Male' Maldives

Project: Feydhoo Flood Mitigation Project

Date: 2017-07-12
Time : 11:00 - 12:00
Venue : ADDU CITY COUNCIL Office

Stakeholder Meeting Attendance Form

	Name	Designation	Office	Contact No.	Email	Signature
1	Abdulla Sodiq	Mayor	Addu city Council	7926030	mayor@addcity.gov.mv	
2	Mohamed Yasrif	Deputy Mayor	"	7781342	yasrif@addcity.gov.mv	
3	Ali fahmy Ahmed	Councillor	"	9996602	fahmy@addcity.gov.mv	
4	Jamsheeda Mohamed	Councillor	"	7772284	jamsheedha.mohamed@addcity.gov.mv	
5	HASSAN SHAH	CONSULTANT	WATER SOLUTIONS	7778941	shah@water-solutions.biz	
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Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Fas eri, Ameenee magu, Male', Maldives

ތާރީޚް: ٢٥ ڈިސެންބަރ ٢٠١٧

ތާރީޚް ކަނޑައެޅުނު ދުވަހުން ފެށިގެން ދެ ދުވަހުގެ ތެރޭގައި ތާރީފުކުރާ ބަޔަކު ހޯދުމަށް ކުރާ ގަޑުކުރުން

ލިބުނު	ފޯނު ނަންބަރ	ސޮއި	ތާރީފު	ތަކެއްޗާ ގުޅުން	ނަން	
21/12/2017	#3300 2	Ibrahim Hassan	HOME	ފާޚަތުން ގެންދާ ތަކެއްޗަށް	ދ.ގުރައިދޫ	1
25/12/2017	7941316		Housing feydhoo	ތަކެއްޗާ ގުޅުން ކަނޑައެޅުނު ދުވަހުން	ދ.ގުރައިދޫ	2
25/12/2017	9664783	Ahmed	Housing feydhoo	ތަކެއްޗާ ގުޅުން	ދ.ގުރައިދޫ	3
25/12/17	7913022		ހައުސިންގ ފެލްދޫ	ތަކެއްޗާ ގުޅުން	ދ.ގުރައިދޫ	4
25/12/17	7771950		ހައުސިންގ ފެލްދޫ	ތަކެއްޗާ ގުޅުން	ދ.ގުރައިދޫ	5
〃	7778541	Hussain Shahan	ފެލްދޫ ހައުސިންގ	ތަކެއްޗާ ގުޅުން	ދ.ގުރައިދޫ	6
〃	9930600		ފެލްދޫ ހައުސިންގ	ތަކެއްޗާ ގުޅުން	ދ.ގުރައިދޫ	7
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CONSULTATION MEETING

VENUE: ADDU CITY COUNCIL OFFICE
DATE: 25-12-2017
TIME: 9:00 – 10:00

NO	NAME	DESIGNATION	CONTACT NO	OFFICE	SIGNATURE
1	Abdulla Sodig	Mayor	7924030	City Council	
2	Faisal Ibrahim	councilor	7777716	addu city counil.	
3	Ali Fahmee Ahmed	"	9996602	"	
4	HASSAN SHAH	CONSULTANT	7778947	WS	
5	MOHAMED UMAR	CONSULTANT	9930606	WS	
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Water Solutions Pvt. Ltd. Reg No: C-344/2005
Ma. Shaah, Dhidhi Goalhi, Male', Maldives

ތާރީޚް: ـــــ ވާހަކަ ދެކެވޭ ބަޔާން ލިޔުއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް

ތިރީގައި ބަޔާން ދެއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް ބަލައި ގަތުމަށް ބޭނުންވާ ތަފާސީލު ދެއްވުން ފުރިހަމަ ކުރައްވާށެވ

ލ.ނ	ތަރުތީބު	ތަފާސީލު	ދުވަހު	ސޮއި	ދުވަހު
1	ބަޔާން ދެއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް	ކުރިއަށް ގެންދާ ކަންތައް		ـــــ ވާހަކަ	12-7-2017
2	~~ބަޔާން ދެއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް~~	~~ކުރިއަށް ގެންދާ ކަންތައް~~		~~ـــــ ވާހަކަ~~	12-7-2017
3	ބަޔާން ދެއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް	″		ـــــ ވާހަކަ	″
4	ބަޔާން ދެއްވުމަށް ކުރިއަށް ގެންދާ ކަންތައް	″		ـــــ ވާހަކަ	11-7-2017
5	ބަޔާން	ـــــ ވާހަކަ		ـــــ ވާހަކަ	12-7-17
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CONSULTATION MEETING

VENUE: FEYDHOO WARD OFFICE
DATE: 18-11-2017
TIME: 8:30 - 9:30

NO	NAME	DESIGNATION	CONTACT NO	OFFICE	SIGNATURE
1	Adhan Khaleel	EC	7715922	MEE	
2	Mahesvaran	Engineer	9563601	MTCC	
3	Ali Haris	Project coordinator	9647030	MTCC	
4	Mohamed Muzumin	D. Director	7787120	Female	
5	Hassan Abdul Samad	Engineer	7722956	"	
5	Mohamed Jaleel	Dep. Director	7781787	Housing Min.	
7	Adam Hamza	Senior Admin Offr.	7961314	"	
8	Ahmed Rasheed	Asst Prot Dir.	7772955	Feydhoo Ward Office	
9	Aminath Azeeza	A. program offr.	7783295	"	
10	Fathimath Shiyana	Asst Director	7926048	"	
11	HASSAN SHAH	CONSULTANT	7778947	WATER SOLUTION	
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Appendix F: Letter from the City Council