ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Sea Water Cooling System in Addu City

Addu City

Addu Atoll, Maldives

Proponent: FENAKA Corporation Ltd.

Sandcays

May 2016

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Consultants Declaration

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

Ahmed Zahid (EIA 08/07)

Proponent's Declaration

As the proponent of the proposed development I guarantee that I have read the report thoroughly and that to the best of my knowledge all information provided here is accurate and complete.

For FENAKA Corporation Ltd.

Executive Summary

This report discusses the findings of an environmental impact study under the proposed sea water cooling system for the electrical generator sets in the central power station of Addu city.

Central Power House at Addu City requires Engine cooling by using saline water. The system will require installing three boreholes with multi stage submersible pumps, supply line for pressure header and feeding lines with valves and flanges. The proponent of this project is Fenaka Corporation Ltd. Rotary-mud drilling will be employed for the construction. The depth of borehole will be determined in accordance with the existing guidelines; i.e. if electrical conductivity of discharge water has reached 50-60mS/cm before reaching 30m depth, drilling will continue until it has reached 30m. Furthermore, if electrical conductivity of discharge water at 30m depth is measured less than 50-60mS/cm, drilling will be continued until electrical conductivity reaches to 50-60mS/cm. The extracted earth and saline water from drilling activities will be deposited on a purpose-built plastic sheet and water will be separated from the solids. The water extracted from this is proposed to be disposed off into the lagoon via the reject line in the operational phase.

The most significant impact from the proposed project would be temporary deterioration of local freshwater quality during borehole installation and seawater quality at the disposal site. The impact on groundwater during borehole construction is of low magnitude and temporary. The impact is also of little significance. The impact of seawater quality at discharge location is almost negligible given that the discharge water has similar characteristics to the lagoon water in terms of salinity although the water would be hot at the time of discharge. Since the discharge location is a reef flat area with no coral the impact is negligible. Furthermore, the area gets dry at low tide and there is no recreational value in this area as it is the rim reef flat.

Alternatives have been identified in the EIA, however it is seen that the best method to carry out the project is the proposed method of using boreholes. The alternative is to use a seawater intake, however, due to the distance of a feasible intake location with the rim reef closest to the location, boreholes are considered to be more suitable. The consultations with the Council also revealed that the proposed route for the discharge pipeline is not suitable, as there is no road in the proposed route. Therefore, as per the Council's recommendation, it is proposed to consider the alternative route that would dispose at the same location as the existing brine discharge pipe.

Since there were no significant environmental impacts identified for the proposed project, mitigation measure were general construction phase guidelines such as dust control measures and appropriate waste management. The alternative route for the discharge pipe may also mitigate some social concerns and is recommended to consider the alternative route. There would not be additional costs associated with this alternative route, and even if there is, there would not be a considerable cost difference.

Environmental monitoring is not considered necessary for this project. However, monitoring has been proposed for about one year to assess and examine changes to the environment, if any. It covers the monitoring of marine water quality at the discharge location for temperature and salinity only at 3-monthly intervals for a maximum of 2 years. This can be integrated within a monitoring programme for the powerhouse. Water quality testing that may be necessary to be performed upon completion of the borehole, which has been indicated in the Borehole Guidelines shall also be performed.

In conclusion, it appears justified from a technical and environmental point of view to carry out the proposed project to construct a cooling water system for the existing powerhouse in Hithadhoo, Addu City. However, it is recommended to consider the alternative route for discharge pipeline, as recommended by Addu City Council.

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މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާނެ ނޭދެވޭ އަސަރުތަކުގެ ތެރެއިން ފެންނާރާ އެކަށީގެންވާ ކުޑަކުރުމަށް ކުރާނެ މާލީ ކަންތަކުގެ ނަތީޖާތައް ފާހަގަކުރެވޭ ގޮތަކަށް ވުރެ ގިނައެވެ. ނަމަވެސް، އާބާދީގެ މަރުން މިފަދަ ކަންކަމުގައި ކަންކަމާ އެއްބާރުލުން ހިތަވެސް ނާރާ ގޮތަށް ކަންތައްތަކުގައި އެހީތެރި ކުރި ނަތީޖާތަކުގެ ހެދުމަށް ދާއިރާ ގޮތަށް ތާވަލް ކުރުން ވާނީ ކުރުމުގެ ކުރިން މިންވަރެވެ. އަދި ސީޖު ކުއްލިޔަކުން

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1 Introduction

1.1 Introduction

The Environmental Protection and Preservation Act (Law No. 4/93) of the Maldives emphasizes on preparation of Environmental Impact Assessment report for any development project that may cause impacts to the fragile environment of the Maldives. Particularly, clause 5 of the Act highlights the importance of Environmental Impact Assessment (EIA).

This EIA report is, therefore, prepared as per the requirements of the above mentioned national Environmental Protection and Preservation Act of the Maldives. This EIA report will identify the potential impacts of the proposed Sea water cooling system for the central power station in Addu city with emphasis on recommendation of how to mitigate the impacts and take necessary measures to minimize any impacts that arise during the project period and after completion of the project. This EIA will also discuss on project justification, alternatives to location of project components such as alternative drilling methods. The report will further, provide a mitigation plan and a monitoring program which can be implemented during and after completion of the proposed development works.

The EIA was compiled based on qualitative and quantitative data collected from Addu city during the site inspections and assessments carried out on 18 April 2016.

It has to be noted, the limitation on collecting and compiling the data on a very short period due to logistical and other issues such as unavailability of long-term base line data has made the consultants to restrict the report on data collected recently from the field, personal judgments and experiences gained from similar projects. Similarly, long-term data on some aspects such as meteorology and climate were collected from secondary sources through previously published reports and global data bases.

This report has been compiled in accordance with the EIA Regulations 2012, which is enforced by Environmental Protection Agency (EPA) of the Maldives.

1.2 Relevant Studies

There are numerous similar projects involving borehole construction carried out in Maldives. During the compilation of this EIA, few documented projects have been considered;

- EIA for Borehole Construction for the Existing Desalination Plant Facility at Maldives Inflight Catering, Male' city
- EIA for borehole drilling at Cyprea Fish Factory, K. Himmafushi
- EIA for construction of two boreholes in Hulhumale'
- EIA for construction of three boreholes in Male'
- EIA for the proposed 300 Ton Desalination plant, GDh. Thinadhoo

1.2 Background to the EIA

This EIA is prepared in accordance with the Terms of Reference (TOR) approved by the Environmental Protection Agency (EPA) on 3rd April 2016. It is a legal requirement that new projects having potential for environmental impacts gain environmental clearance or approval prior to construction and operation of such projects.

The principal environmental institution that implements EIA process in the country is Environmental Protection Agency. Additionally, the Ministry of Environment and Energy provides policy guidance and directions while Atoll Councils and Island Councils also provide approvals before projects are implemented.

1.3 Scope of the EIA and Approach

The main scope of this EIA report as per the approved TOR is to broadly assess, identify, predict and document potential environmental impacts from the proposed Sea water cooling system in Addu City. Hence importance is given to document the whole project proposal in detail, identify the main environmental impacts that are associated with the proposed development and address the legal requirements that need to be taken into consideration while implementing this project. This document also addresses the existing environmental condition of the island and foresees the ways in which potential environmental impacts will be managed, mitigated and reduced.

Hence the key aims of the report are to;

- Describe in detail the proposed project;
- Identify the need and justification for the proposed development;
- Describe the biophysical status of the existing environmental condition of the island based on the findings undertaken during the site visits;

- Assess, identify and predict potential environmental impacts of the proposed development;
- Evaluate the significance and magnitude of impacts that will be generated; and identify and predict ways in which these environmental impacts will be prevented and removed through appropriate environmental management and mitigation measures;
- Develop a mechanism to closely monitor and understand the long-term effects and changes of the proposed development on the environment with respect to the available baseline information, mostly collected from field assessments and site visits;
- Provide legal protection with regards to the proposed development activities; and
- Review the predictions and assessments made on environmental impacts that are associated with the proposed development activities.

In general, the EIA report has been based upon the following sources of information:

- Review of available project documentation;
- Discussions with involved key personnel;
- Site visits to the island;
- Baseline environmental assessments;
- Environmental Impact Assessment Regulation 2012 and other relevant regulations
- Maldives National Development Framework
- Sandcays' previous experience of undertaking EIAs for projects in the Maldives; and
- Other EIAs for similar development projects that have been carried out in the Maldives.

1.4 EIA Implementation and Methodologies

This study was based mainly on data collected during a field investigation mission on 18^{h} of April by a team from Sandcays Pvt. Ltd. and published literature on similar settings and projects. The EIA report was compiled by Ahmed Zahid, who is a registered EIA consultant with over 16 years of experience and has been involved in numerous projects in the Maldives such as resort development project, sewerage system, RO plants, reclamation, shore

protection and harbour projects. He was assisted by Mohamed Ibrahim Jaleel. Mohamed Riyaz assisted in data collection and analysis.

Established and widely accepted methods have been applied in this EIA study. Field studies have been undertaken using methods generally employed for EIA studies in the Maldives. The field assessment methodologies are briefly described in Section 4.2 of this report.

The methods used to identify, predict and assess impacts are based on matrices that have been established by the Consultants over a long period. In the matrix, the consultants assign a likert-scale number to represent the magnitude, significance, duration and spatial extent of the potential impact for each project activity against the key environmental and socio-economic components that the specific project activity may have an impact on. The product of the magnitude, significance, duration and spatial extent for each activity and component is summed up to measure the exact nature of the impacts by each activity and the overall impact of the proposed project is the sum of all activities.

The Terms of Reference (TOR) for this EIA has been attached as Appendix 1. This EIA has been prepared based on this term of reference.

2 Project Description

2.1 Introduction

The purpose of this section is to describe the project in terms of the need and justification of the project, location and boundaries of the project, project schedule, main inputs, project mobilization as well as project construction activities. In addition, this section presents materials and resources that will be used as well as the main output of the project.

2.2 Proponent

The proponent, Fenaka Corporation Limited was established on 18th June 2012 by a presidential decree under the companies Act of 10/96, as a limited liability company. The company is registered on 1st of August 2012 and it is 100% Government owned utility company with a mandate to provide island communities with electricity, water and sewerage. Today, FENAKA is a multi-disciplinary engineering organization, dealing contracts involved in civil, mechanical, electrical, water and waste water engineering.

2.2.1 Power generation services

Out of a total of 196 inhabited islands in the country, FENAKA Corporation provides electricity services to 152 islands. 24 / 7 sustainable electricity provision was not achieved to outer islands until recently FENAKA corporation started providing the services to the islands. In its short history the company has carried out numerous projects for the betterment of the service provision, one such example is the 77 Genset project which aided in the sustainable service provision. Furthermore, as electricity services were provided by the island communities themselves in the past, the location, infrastructure and operations were not ideal. This causes negative impacts and disturbance to the communities and the environment. Therefore, every year the company carries out a number of projects in power house relocation, refurbishment and generated set upgrading throughout the country.

Electricity is mainly generated through diesel, however the Company is now slowly shifting towards renewable energy as a form of power generation. The company is also an important implementing partner in the mega projects of the Governments renewable energy. Some of these projects include;

- Preparation of outer islands for Sustainable energy development (POISED), funded by Asian Development Bank
- Accelerating Sustainable Private Investments in Renewable Energy (ASPIRE), funded by the World Bank

2.2.2 *Water and Waste water services*

At FENAKA Corporation, safe water is provided to the public after desalinating sea water into potable drinking water through the process of reverse osmosis. Water produced and distributed by the Company adheres to the standards set by Environment Protection Agency (EPA) in the Maldives. Currently the company operates fully fledge system with complete RO plants, distribution networks and pipe distribution to households in 4 islands, which includes; GDh. Thinadhoo, GDh. Gahdhoo, Ha.Ihavandhoo and Ha.Thuraakunu. Out of the 3 islands, two of them are operated on the principles of Integrated Water Resource Management (IWRM) where conjunctive use of water is practised, whereby 25% of the total demand is catered by rainwater by catchment from public roof tops. This is in line with the countries global commitments of the Sustainable Development Goals where the adaptation of IWRM principles is a specified goal. Other than the fully fledged systems, the company also have standalone RO plants, some with community tap bay systems where services are mainly to the fishing vessels and any other need of the community.

Other than service provision, the company also implements one of the largest water projects of the nation, which is the provision of water supply services to the Allied islands of Addu City. The project is nearing completion and is expected to be completed within this year.

FENAKA operates the sewerage system of around 28 islands by means of a gravity collection system and effluent is discharged to the open ocean by means of pump stations and sea outfalls. Furthermore, the company has recently successfully completed the design and construction of sewer systems in Th.Buruni and Th.Madifushi and the sewer project for L.Maamendhoo is ongoing. Moreover, the construction of sewer services of Hithadhoo central area is also carried out by Fenaka Corporation.

2.3 Project Location and Boundaries

The project is proposed to take place at Addu city Hithadhoo. All the components of the project except for the reject line would be within the perimeters of the Hithadhoo central power station. The outfall line will follow the nearest pathway to the adjacent lagoon as indicated in Figure 2-2.

Figure 2-1: Location of Addu city (Google Maps 2013)

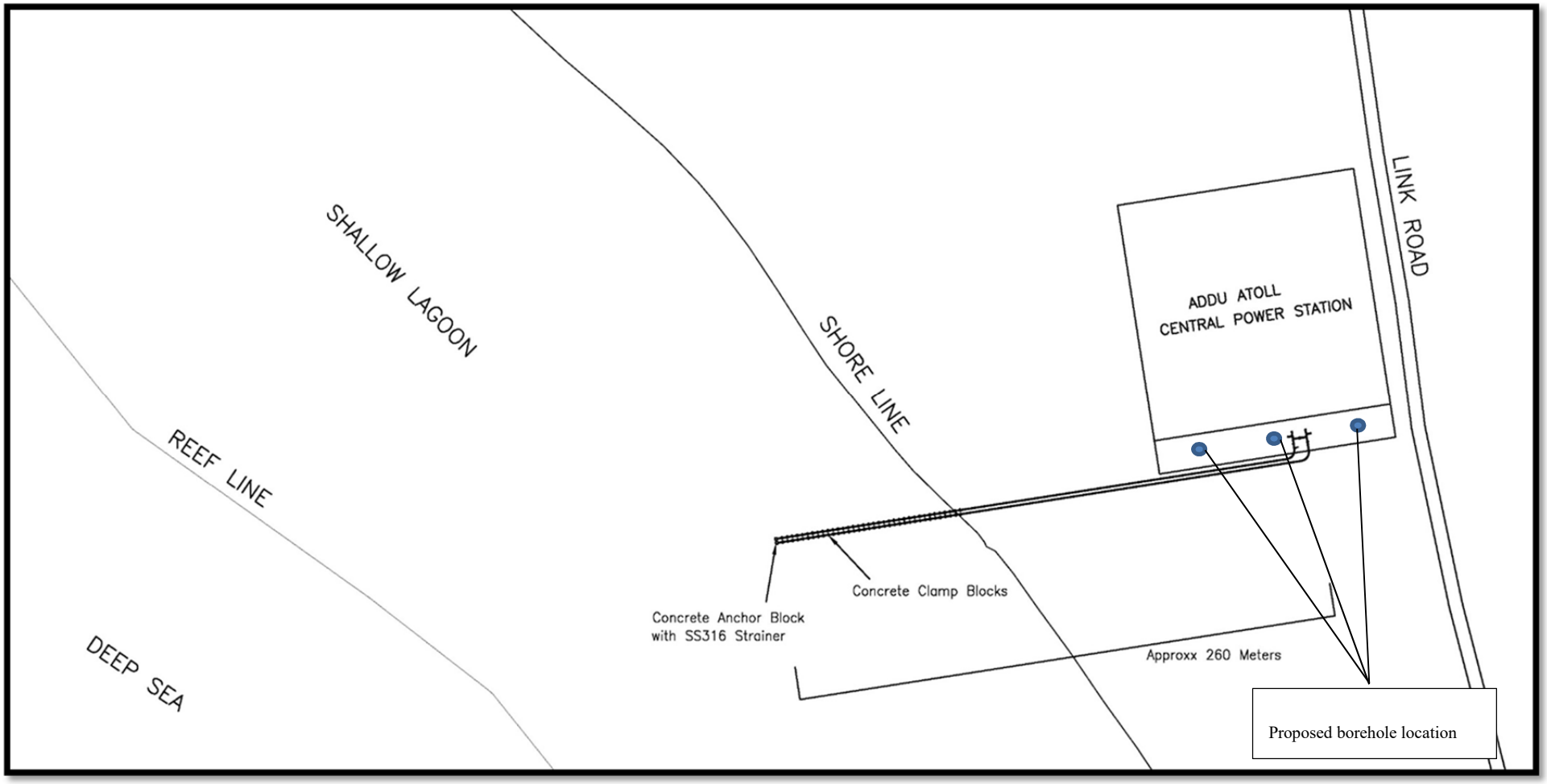


Figure 2-2: Proposed locations of the borehole

2.4 The Project

Central Power House at Addu City requires Engine cooling by using brackish water. The system will require installing three boreholes with multi stage submersible pumps, supply line for pressure header and feeding lines with valves and flanges.

The discharge lines will consist of two parallel pipes to the sea at West side of power plant. Inside the compound, pipe elevation shall be 0.5m below ground level. On the road outside boundary wall pipe elevation shall be 1.2m below ground level. On the beach area pipes shall follow the contour of beach and sea bed and shall approach to the open lagoon. Routing and proper positioning shall be done with anchor blocks and anchoring to the sea bed. Both pipes shall have outlet strainers made of Stainless steel 316, connection done with flanges, bolts and nuts.

The proposed drilling method of boreholes is Rotary Mud Drilling; the drill bit is attached to the drill rod while being rotated and advanced into the borehole while pumping a drill mud consisting of bentonite or polymer slurry into the borehole.

The drilling mud is circulated into a mud pit where the cuttings from the borehole drop out and the mud is reused. As the drill bit is advanced, the drill mud is pumped down the inside of the drill rods to carry the drill cuttings out of the borehole and cool the drill bit. The rotation and downward pressure of the drill rig along with the flow of the drill mud advances the boring to the desired depth. At the desired depth the drill bit may be removed and the sample can be taken. This is the preferred method of drilling in sand and gravel formations.

2.5 Construction Phase Activities

The following sections of this report describe proposed drilling methodology and related construction phase work;

2.5.1 Temporary Works

A temporary light post will be fixed to illuminate the working area. Surrounding area will be barricaded to avoid unnecessary movement of workmen and also restrict the entry of unauthorized persons into the drilling site for safety purposes. The accessibility of.

2.5.2 Survey

Land survey will be conducted with suitable accuracy to find out the exact location of the boreholes as per engineering drawing.

2.5.3 Drilling Methodology

- Location of the bore hole shall be worked out from the approved drawing and marked on the top of the existing ground profile. Drilling shall be carried out at these marked locations.
- A 5m X 5m area surrounding the drilling location shall be cleaned before set up of drilling machine.
- Two mud pits (1.0 X 0.5 X 0.5 m) shall be made by using shovel and spade in front of drilling location and connected to each other by a drain and canvas lining shall be done to prevent fluid loss.
- Drilling mud shall be prepared by mixing of bentonite and water in a proportion of 1:2, twelve hours before starting the drilling process. Thickness of the mud shall be controlled as per the strata encountered during drilling. It is better to use bentonite as less as possible to retain the natural condition of aquifer. If there is severe caving encountered during drilling through a particular stratum then 150 gm poly-anionic cellulosic polymer shall be used by mixing with 50 kg bentonite and 100l water.
- Drilling rig is placed on the drilling spot with proper platform and verticality alignment of the machine is done by using spirit label. During the whole drilling process this is checked frequently to maintain the verticality and alignment of borehole.
- After attaching the mud pump and drilling machine with 50 mm hoses drilling shall be started with 250 mm reamer bit up to the loose formation or overburden and 200mm diameter PVC casing will be placed inside hole. The depth of outer casing shall be decided as per geological strata encountered at site.
- After placing of outer casing up to required depth drilling shall be continued with mud circulation, with the help of 200 mm drag & rock roller bit.
- Soil samples shall be collected from return water from borehole at every 2 m interval or change of strata. Soil samples will be preserved in polythene bags marked with borehole number and depth and date of collection. Bore Log shall be prepared as per

the sample received during drilling from different depth. Soil samples shall be sent to soil testing lab for grain size analysis.

- After drilling is completed up to 30m depth hole shall be reamed again by using 200 mm diameter reamer bit.
- Flushing of borehole shall be carried out after completion and water sample shall be collected in a sterilized 1liter capacity bottle from outgoing water of borehole and sample shall be sent to chemical lab within a day for further testing as per specification. The following tests of water like pH, EC, Temperature, Taste, Odour & Colour shall be conducted at site and that report shall be submitted along with drill-log.
- After reaming of the hole, 6m length (3m x 2m) 300mm diameter PVC screen pipe with bottom bail plug shall be placed inside the hole and threaded solid PVC casing pipe (300mm) shall be attached with the screen pipe & lowered one by one freely up to the depth of borehole. At least 50 cm of PVC casing shall be kept above the ground level of the borehole.
- Daily Progress Report (DPR) shall be submitted on a regular basis. After completion of borehole drilling log along with stratification, ROP, casing details and water analysis at site shall be submitted. Laboratory Water & Soil Testing reports shall be provided after completion of the relevant tests.

2.5.4 Construction of the well

With the help of 38 mm gravel feeding PVC pipe silica gravel shall be placed through the annular space between outer and inner PVC casings and the gravel shall make a layer surrounding inner PVC casing. Gravel feeding pipe shall be raised slowly till the gravel is filled up to 20 m from the bottom of the hole. After that, 3 m thick sand layer shall be placed above the gravel layer.

Outer casing shall be removed after placing the sand layer. Bentonite clay layer of 2 m is placed over the sand layer. The bentonite clay layer will act as a seal between cement sand concrete layer and gravel pack.

Above bentonite clay seal, M25 grade concrete shall be placed up to the ground level i.e. 5m. Fine aggregate for use in the production of concrete shall be of river sand and coarse

aggregate will be composed of crushed gravel of 20mm size and it will be free from salt and other organic impurities. The mixing ratio of cement, sand & coarse aggregate is 1:2:3

DPR of construction of well shall be submitted in regular basis and after completion of well construction; diagram of the same shall be submitted.

2.5.5 Developing Boreholes

Development of bore well is essential in order to obtain an efficient and long lasting well. Developing the well will also serve the purpose of rectifying damage to the aquifer from excavation activity; increasing the porosity and permeability of screened formation adjacent to the borehole and stabilizing the formation/gravel pack around the screen so that the well will yield sand in water within permissible limits.

2.5.5.1 Procedure

- **Surging with air compressor**: With the help of 12kg/sq.cm capacity compressor bore well shall be flushed. 25 mm flexible hose shall be attached with a 1m long hollow pipe and it is lowered in the hole. Now by attaching the other end of hose with compressor air will be released into bore well and flushed. After continuous flushing of 10 minutes, air compressor shall be stopped for 5 minutes and then again flushing shall be carried out by same process for 8 hours.
- **Chemical Washing:** After air flushing with compressor, borehole is washed with Sodium hexa-meta phosphate solution.
- **Bailing:** A bailer is a 1m length, 76mm dia PVC pipe with a one way valve at the bottom. It shall be lowered into the well by tripod arrangement, till it fills with water and sediment. It shall be then pulled to the surface and emptied. This process shall be continued for 12 hours or till the sand content in water shall be negligible.
- **Back Washing**: In this method with the help of a pump, water lifting from bore well shall be started and frequently switch off and switch on the pump shall be carried out, so the water in the rise pipe fall back through the screen openings with pressure and clean it.
- **Over Pumping**: In this method the well shall be pumped at a much larger rate continuously for an hour or until sand become negligible.

2.5.6 Testing

By using a pump of required capacity, the yield will be measured using a 200 lit empty barrel and stopwatch. Time taken to fill up the 200 lit drum in seconds can be converted in cubic meter per hour. For accuracy of the reading the same procedure shall be conducted three times and then average of three stop watch reading shall be taken for calculation. Water sample shall also be collected before completion of the test for chemical and biological analysis.

Step draw down test shall be carried out with the help of required capacity pump or compressor, at least five steps of 60 minutes each. Discharge rates shall be fixed on the basis of 25%, 70%, 100%, 125% & 150% of required yield and drawdown will be measured by lowering measuring tape after every 1 hour.

Constant discharge pumping test shall be carried out with the help of required capacity submersible pump or compressor at 150% of design discharge for 12 hours. Drawdown shall be measured after every 1 hour by lowering a measuring tape.

On completion of constant discharge test, 12 hours recovery test shall be carried out & water level will be measured for every one minute for first 1 hour and then every 5 minutes for the remaining hours.

All test reports will be submitted in a tabular format after completion of all tests.

2.5.1 Capping the well

After completion of yield test submersible pump is removed from the bore well and well shall be capped with threaded 12" PVC cap to protect it from contamination

2.5.2 Pressure header, pipes, joints and electric cables

Construction of Pressure Header shall have the connections and. Material for Pipe, bends, elbows, adopters, flanges shall be HDPE. Pressure headers shall be installed within a distance of 2 to 4 meters depends on the site conditions and availability of space. Supply line from Pumps, pressure header, feeder outlets, valves and fittings shall be PN10.

Construction of foundations to support Pressure Headers, Valves and pipes shall be made of Reinforced Concrete. Rigid steel structures shall be used to support the systems and eliminate vibrations.

Instruments and Cables shall comply the technical requirements and shall be suitable for harsh environment. Mechanical pressure relief valve shall be 3 inches in diameter and robust and reliable to function for the set values for an extended operational period.

Variable Frequency Drive, VFD shall be suitable in size and performance and with proven reliability. The Drive must be capable to handle these pumps with reliability and accuracy. The capacity of the VFD shall be at least 12 percent higher than the Electrical load of the pumps. These units shall be industrial type and design for hash environment. The necessary panels and other auxiliaries shall be in cooperating with the system.

2.5.3 Reject line

Warm water outfall pipes to the sea shall be made of HDPE, pipes, valves and fittings shall be PN8 and that is designed to use for saline and hot environment. Bolts, nuts and washers for flanges and valves shall be made of stainless steel, grade SS316. Strainers at the discharge end shall be made of SS316 including bolts, nuts and washers. PE pipe joints, adopter, flanges, elbow connection shall be done with heat fusing. The machines and method shall comply with the standard set for the specified works.

Pipe routing and laying shall confirm that the stresses on the pipe are even and no harm during laying and operation will envisage. Trenching and beck filling shall confirm that no boulders are in contact with pipe; only fine sand shall be used in the area up to 12 inches around the pipe. At beach side and in the lagoon two part anchor blocks shall be used with the interval of 1.5 meters. Marking tape shall be used above the pipe inside the trench to protect from other activities. A typical anchor block shall be made of reinforced concrete with sufficient weight to withstand in the rough waves condition. At the discharge end near the strainer heavier anchoring will be required. The location of the outfall faces the oceanic side and is subject to constant wave action and adequate current circulations. Therefore, it is envisaged that the warmer outflowing water would be dispersed quickly with minimal impacts to the marine environment.

Strainer shall have sufficient open space relative to pipe cross section area. Strainer can be similar diameter as pipe. Its length can be not shorter than 350 mm. SS316 plates shall be on PCD with equal space of appx. 50 mm. Plate size can be 6mm x 30 mm x length. End plate thickness shall be not less than 6 mm all the material used for strainer and welding done shall be Stainless steel 316.

2.6 Operational phase activities

In normal operation each pump and header will be run as individual systems, depend on the engines in operation, flow requirement will vary and pressure in the system shall maintain within 3 – 4 bar by regulating pump characteristics.

In the event of maintenance of one system water can be fed via interconnection line. Gen Set on both Header shall use water from common supply line, from a single pump but the flow rate will be increased to cater for the larger volume required.

In the event of raise in pressure, mechanical relief valve shall work at 6 bar pressure and an alarm shall be indicated at control room. Operator shall initiate appropriate action based on the site condition. Water discharge systems will be shared by all feeder outlets from Heat Exchanges.

2.7 Implementation schedule

The implementation of the proposed facility is expected to be started as soon as the approval including EIA has been obtained from concerned government authorities. The project is expected to be completed within 5 months from the date of obtaining approval from EPA. A detailed schedule is attached to the appendix of this report.

2.8 Environmentally Significant Activities

Amongst the project components that are expected to have a significant effect on the environment are that of temporary water quality deterioration from drilling activities, vegetation clearance, disposal of excavated material and laying of the reject line.

2.8.1 Temporary deterioration of Water Quality

The drill will pass through the freshwater aquifer to reach the saline water underneath; hence, the two layers are expected to mix around the borehole and cause a temporary salinization. Additionally, disposal of saline water extracted during operational phase into sea via reject line will also deteriorate sea water quality. Furthermore, the sea water quality may also be deteriorated due to the construction of the reject line as the turbidity of the area would

increase. This has potential to cause distress to marine life forms including live corals and other sessile organisms.

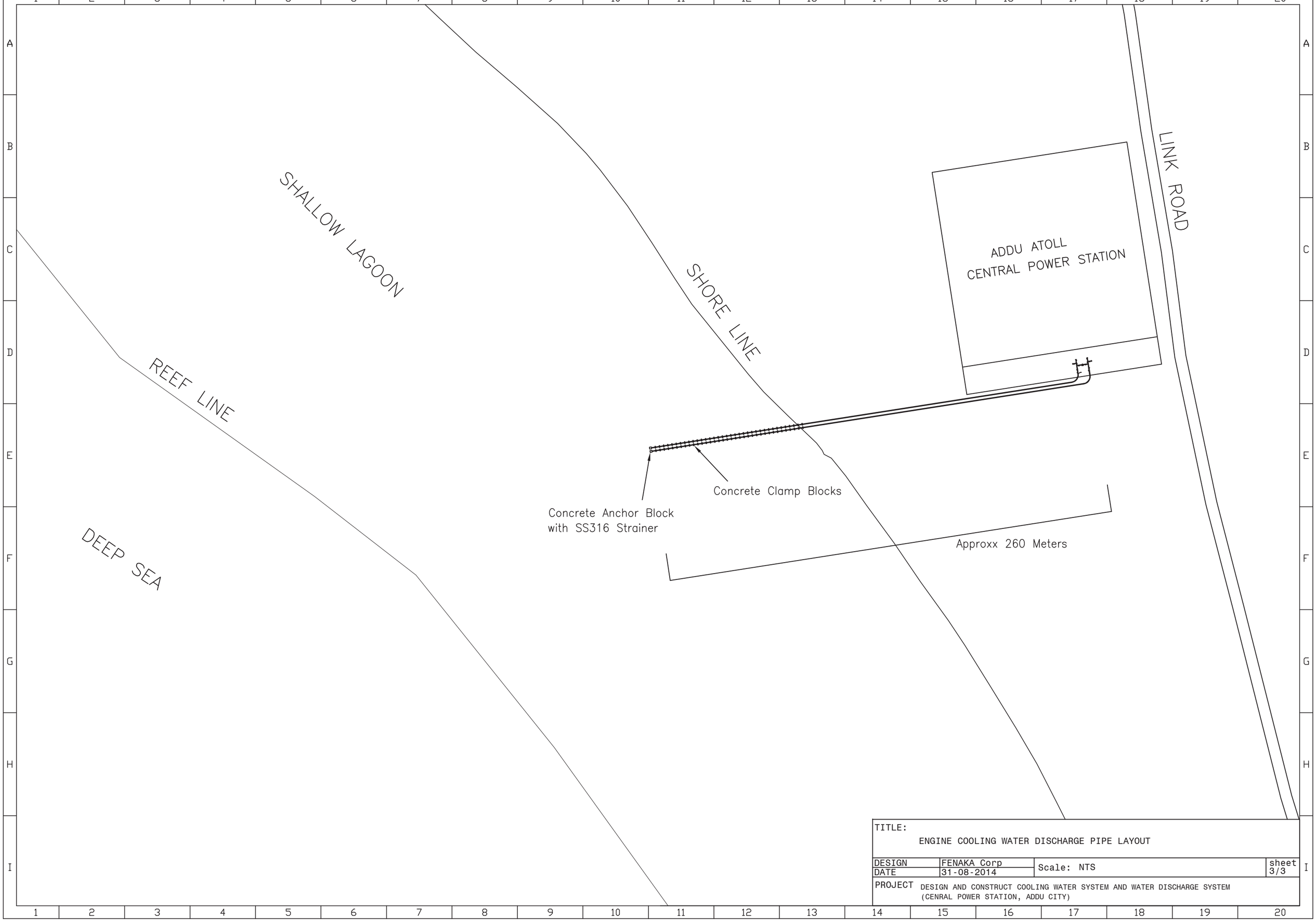
2.8.2 Vegetation clearance

Approximately 30 palm trees would be cleared which is mainly for the construction of the reject line. The road whereby the reject line is proposed to be laid has not been cleared and there for the vegetation on the foot print shall be removed and replanted elsewhere. Most of the vegetation is mature palm trees and therefore special consideration shall be given during the replantation of palms.

2.8.3 Determination of Borehole depth

The depth of proposed boreholes will be determined as per the borehole drilling guidelines of EPA. If electrical conductivity of discharge water has reached 50-60mS/cm before reaching 30m depth, drilling will continue until it has reached 30m. Furthermore, if electrical conductivity of discharge water at 30 m depth is measured less than 50-60mS/cm, drilling will be continued until electrical conductivity reaches to 50-60mS/cm.

Figure 2-3: Concept Diagram of the proposed project in Addu city



TITLE:
ENGINE COOLING WATER DISCHARGE PIPE LAYOUT

DESIGN	FENAKA Corp	Scale: NTS	sheet 3/3
DATE	31-08-2014		

PROJECT DESIGN AND CONSTRUCT COOLING WATER SYSTEM AND WATER DISCHARGE SYSTEM (CENRAL POWER STATION, ADDU CITY)

2.9 Project Duration

As the proposed project is fairly small, the system are expected be operational by October of 2016. The detailed tentative work schedule can be found in the Appendix of this report.

2.10 Project Inputs and Outputs

The project has inputs in terms of human resources and natural resources such as water and fuel. The main output of the project is warm water from the reject line. These inputs and outputs are summarised in Table 2-1 and Table 2-2.

Table 2-1: Main inputs of the proposed project

Input resource(s)	How to obtain resources
Construction workers	FENAKA staff
Management and maintenance staff	Appointed by proponent
Construction materials:- cement, river sand, aggregates, PVC pipes, diesel…etc.	Import and purchased where locally available at competitive prices
Bentonite and other chemical used for drilling	Imported
Water (during construction)	bottled
Machinery and equipment	Any equipment FENAKA does not have in possession could be rented from elsewhere
Fuel (e.g. diesel, petrol)	Locally purchased

Table 2-2: Main Outputs of the proposed project

Products and waste materials	Anticipated quantities	Method of disposal
Waste oils from machinery	Minute	Re-used to other applications
Wastewater effluent (from drilling activity and operational phase)	major	Disposed into sea where dilution and dispersion happens
Gunny bags and scrap metals (construction site waste)	minute	Recovered, reused , recycled
Used oil (waste oil), grease	minute	Reused
Solid waste (during construction)	minute	Taken for disposal to Thilafushi
Water from boreholes	Major	Used for cooling engines which provides sustainable electricity to community

2.11 Need and Justification

Addu city is the second most populated part of the country, out of which the bulk of the population resides in the connected islands of Hithadhoo, Maradhoo, Maradhoo-Feydhoo and Feydhoo to which the CPS provides electricity. The city is experiencing growth in economic and in developmental terms with the inclusion of a number of ongoing mega projects such as the water supply while the sewerage system construction is estimated to be started this year. Therefore, to cater for the ever growing need for electricity, the city's utility service provider Fenaka Cooperation is undertaking expansion of its power supply capacity. With the increased power supply capacity, the engines of the higher capacity generator sets in central power supply station requires cooling for optimum operational conditions which is proposed to be achieved through the establishment of the sea water cooling system. Furthermore, as per the Article 8.6 of the regulation of electricity provision to Male and outer islands it is stated that the ventilation of the powerhouse must be such that when all the engines are operational, the difference in temperature inside and outside the powerhouse must be less than 10C compared to ambient temperature. To achieve this, the proposed project aims to regulate the temperature by establishing a sea water cooling system which will circulate water around the generator sets

3 Legislative and Regulatory Considerations

This section will identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. The proposed project is expected to conform to all of the policy and regulatory aspects outlined here. This section outlines and summarizes key policies, applicable laws and regulations and regulatory bodies regarding environmental protection, air transportation in the Maldives. Also, it outlines some international and regional obligations that the country has to meet in terms of sustainable development, environmental management and protection.

The proposed project will be subject to the key regulations including Environmental Protection and Preservation Act (No. 4/93) of Maldives.

3.1 Policy Guidance

The policy guidance on the development of the proposed project is taken from a number of policy documents prepared by the Government of Maldives on sectoral developments. Key documents outlined in this EIA are currently being implemented towards sustainable development of the country.

3.1.1 National Framework for Development 2009-2013

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

Policy 1: Strengthen EIA process with an emphasis on EIA monitoring.

Policy 2: Conserve and sustainably use biological diversity and ensure maximum ecosystem benefits.

Policy 3: Develop resilient communities addressing impacts of climate change, disaster mitigation and coastal protection.

Policy 4: Strengthen adaptation and mitigation responses for beach erosion and develop a system to assist communities where livelihood and property are affected by beach erosion.

Policy 5: Ensure management of solid waste to prevent impact on human health and environment through approaches that are economically viable and locally appropriate.

Policy 6: Ensure protection of people and the environment from hazardous waste and chemicals.

Policy 7: Improve air quality to safeguard human health.

Policy 8: Enable a fully functional decentralized environmental governance system.

Policy 9: Develop a low carbon economy to achieve Carbon Neutrality by 2019.

Policy 10: Inculcate environmental values in the society and enable environmentally friendly lifestyle.

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

An integrated transport network is a top priority of the Government in order to foster regional development. The Government recognizes transport and connectivity as pivotal in fostering economic growth and social cohesion. In this regard the following policies in relation to civil aviation and air transport development have been identified SAP;

Policy 1: Regulate, facilitate and provide incentives to encourage private sector investment in the development of airports and regional ports and other transport related infrastructure

Policy 2: Promote and facilitate the development of transport related infrastructure through private sector participation

Policy 3: Develop a sustainable transport system that provides a safe and secure service

These policies related to civil aviation and air transport development in the country is currently being implemented by the Ministry of Transport and Civil Aviation and Maldives Civil Aviation Authority.

3.1.2 Third National Environment Action Plan

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

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

The key principles of the NEAP 3 are:

Principle 1: Environmental protection is the responsibility of every individual

Principle 2: Achieve results

Principle 3: Promote and practice sustainable development

Principle 4: Ensure local democracy

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

Principle 6: Informed decision making

Principle 7: Precaution first

Principle 8: Continuous learning and improvement

Principle 9: Right to information and participation

Principle 10: Environmental protection complements development

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

3.1.3 Maldives National Strategy for Sustainable Development 2009-2013

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

The guiding principles outlined in the NSSD are:

Principle 1: Promotion and protection of fundamental human rights

Principle 2: Equity within and between generations

Principle 3: Democratic and open society

Principle 4: Full participation of businesses and civil society

Principle 5: Policy coherence and coordination

Principle 6: Use best available knowledge

Principle 7: Precaution first

Principle 8: Make polluters pay

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

3.2 Relevant Regulatory Bodies

3.2.1 Ministry of Environment and Energy

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

3.2.2 Environmental Protection Agency (EPA)

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

3.2.3 Maldives Energy Authority

MEA is the key regulator for Energy including the provision of electricity. As the purpose of the proposed cooling system is to provide adequate operational temperatures for the generator sets of Addu City, the role of MEA as a regulatory body for the project cannot be overlooked. Throughout the years it has developed and implemented many of the existing electricity standards, regulations and guidelines. These standards, regulations and guidelines will be thoroughly understood and abided to in the proposed project.

3.2.4 Atoll/City Councils and Island Councils

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

copy of the final draft of the EIA Report be submitted to Addu City Council and receipt provided to EPA or attached to the EIA report.

3.3 Laws and Regulations

There are a number of laws and regulations relating to environment in the country. Only relevant laws and regulations have been outlined in this section.

3.3.1 Environmental Protection and Preservation Act

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

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

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

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

Clause 7 of the EPPA refers to the disposal of oil, wastes and poisonous substances in to the Maldivian territory. According to this clause, any type of waste, oil, toxic gas or any substance that may have harmful effects on the environment should not be disposed within the Maldivian territory. If, however, the disposals of such substances become absolutely necessary, the clause states that they should be disposed only within the areas designated for that purpose and if incinerated, appropriate precautions should be taken to avoid harm to the health of the population.

Furthermore, clause 9 sets a fine between five and five hundred Rufiyaa for minor offenses in breach of this law and a fine of not more than one hundred million Rufiyaa for major

offenses. The fine shall be levied by the Ministry of Environment or by other government authorities designated by that Ministry in case of minor offenses.

Finally, Clause 10 of EPPA gives the government of the Maldives the right to claim compensation for all damages caused by activities that are detrimental to the environment.

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

3.3.2 Act on general public services (4/96)

Under this law the general public services are electricity, telephone, water and sewerage services.

Article 3 states that any party can provide general public services only after getting registered in the competent authority and according to its regulations.

Article 4 states that any public service must be provided after a contract agreement has been made between the service provider and the customer. The agreement must be made according to the regulations put forward by the competent authority.

Article 5 states that a transfer of service between customers must be made only after a contract has been made between the customers according to the service providers regulations. If the customer fails to comply with the agreement, the service provider can discontinue service only after approval from competent authority.

Article 7 states that the service provider can permanently discontinue its services according to regulation mentioned in article 3 of this law. However temporary discontinuation can be made after giving prior notification to the customers and according to the agreement made between the service provider and the customer.

Article 8 states that the tariffs for the services must be approved from the competent authority prior to implementation. Further, any amendments to tariff structure also must be approved from the competent authority before implementation.

Article 9 states that any damage made to service provider's facilities by anyone, he can be charged with 10 prison penalty or banishment. Further any action against this law (excluding what is mentioned in article 9(a) of this law) can be charged between MVR 100 to MVR 5000 by the competent authority

3.3.3 Environmental Impact Assessment Regulation 2012

The EIA Regulation, which came into force in 2007, has been recently revised and the revised EIA Regulation 2012 is currently in force since May 2012. This EIA is subjected to the EIA Regulations 2012.

The EIA Regulation 2012 is currently only in Dhivehi and an official translation is awaited. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulations defines the type of projects that would be subject to Environmental Impact Assessment. Establishing large scale manufacturing facilities, constructing boreholes and laying out discharge pipes to the sea are amongst these.

The main purpose of this Regulation is to provide step-by-step guidance for proponents, consultants, government agencies and general public on how to obtain approval in the form of an Environmental Decision Statement.

3.3.4 Regulation on Environmental Damage Liabilities

Under the Environmental Protection and Preservation Act (No. 4/93), the Ministry of Environment formulated the Environmental Damage Liabilities Regulation in February 2011, which encompasses the basis to avoid environmental deterioration, extinction of biological resources, environmental degradation and avoid wastage of natural resources. The main purpose of this regulation is to stop unlawful activities on environment and adequately implement a fining procedure for violations as well as implement a compensation mechanism on environmental damages. Its Schedules form the basis for levying fines on various environmental components and activities. Hence, the proposed project will be subjected to this Regulation for any activity outside of the EIA scope and EIA Decision Statement.

3.3.5 The Borehole Guideline

Borehole Drilling Technical Specifications and Guidelines were issued by EPA dated 25 September 2011. The Guidelines covers drilling of boreholes and installation of electric pumps for source water extraction for various water supply development projects. The Guidelines state that boreholes shall be drilled at the location(s) designated by the client in consultation with Environmental Consultant and Environmental Protection Agency (EPA). It is also stated that care must be taken in handling and storage of all drilling fluids, oils, greases and fuel on site, to avoid any environmental pollution, damage and degradation. Any toxic materials, drilling fluids and other additives, cuttings and discharged water shall be disposed in a manner that do not cause damage to the environment, public and private property.

According to the Guidelines, the in-land borehole depth shall be more than 30m even if the electrical conductivity of discharge water has reached 50-60mS/cm before reaching 30m depth. If electrical conductivity of discharge water at 30m depth is measured less than 50-60mS/cm, drilling shall continue until electrical conductivity reaches to 50-60mS/cm. This aspect of the Guidelines has raised concerns especially with reference to boreholes at the periphery of the island where, according to renowned hydro-geologists, the freshwater lens may not exist and therefore shallower depths may be considered. Further studies are proposed under the scope of the proposed project in order to determine the exact nature of this.

The Guidelines also provide guidelines for the different records that ought to be made during the drilling process. For monitoring purpose, boreholes drilled shall provide water sampling tubes at the interval of 5m from top to bottom. Water quality testing that may be necessary to be performed upon completion of the borehole has also been indicated in the Guidelines.

3.3.6 Regulation on provision of Electricity to Male and outer islands

The regulation details all the aspects of electricity services provision which includes the registration of the service provider, agreement between service provider and customer, sub-contracting the service provision, breaches to the agreement, discontinuation of electricity services, fines with regard to any breach of regulation, tariff formulation, technical specification for power house construction, control room, switch board, distribution feeder, distribution network, house connections and wiring standards. Relative to the proposed project, it is mentioned in the Article 8.6 that the ventilation of the powerhouse must be such

that when all the engines are operational, the difference in temperature inside and outside the powerhouse must be less than 10C compared to ambient temperature. To achieve this, the proposed project aims to regulate the temperature by establishing a sea water cooling system which will circulate water around the generator sets. All the articles of the regulations are understood and will be abided to throughout the project cycle.

3.3.7 Waste Management Regulation

The objective of Waste Management Regulation is to implement the National Waste Management Policy through that protects the environment by minimizing the impact of waste on the environment including, in particular, the impact of waste so far as it directly affects human health, establishing and integrated framework for minimizing and managing waste in a sustainable manner and putting in place uniform measures to seek to reduce the amount of waste that is generated, when and where waste is generated and to ensure that waste is reused, recycled and recovered in an environmentally sound manner before being safely treated and disposed. This regulation will be effected from 6 January 2014 and EPA would be responsible agency to implement this regulation.

3.4 International and Regional Context

3.4.1 Environment Sector

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

- UN Convention on the Law of the Sea – UNCLOS (1982)
- International Convention for the Prevention of Pollution of the Sea by Oil (1982)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989)

- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990)
- Agenda 21 and the Rio Declaration of the United Nations Conference on Environment and Development (1992)
- Convention on Biological Diversity (1992)
- United Nations Framework Convention on Climate Change (1992)
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992)
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997)
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999)
- Washington Declaration on Protection of the Marine Environment from Land-Based Activities
- Kyoto Protocol to the UN Framework Convention on Climate Change (1998)

The Maldives is also a key player in formulating and adopting various regional plans and programmes to protect the environment by continuously participating in various activities organized by regional bodies such as SACEP, ESCAP and SAARC. As a result, the Maldives is committed to the following;

- SAARC Environment Action Plan adopted in 1997 in Male'
- SAARC Study on Greenhouse Effect and its Impact on the Region
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994)
- SAARC Study on Causes and Consequences of Natural Disasters, and
- South Asian Seas Programme initiated by SACEP
- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998)

4 Existing Environment

4.1 Introduction

Conditions of the existing environment of the study area were analysed by using appropriate scientific methods. Field surveys were undertaken to get further understanding of the existing environment at the study area. The survey was carried out during field visit to the study area on 18 April 2015 to collect baseline data.

The following components of the existing environment were assessed;

- Vegetation
- Ground water quality
- Aesthetics
- Marine water quality
- Marine biota

4.2 Methodologies

This section covers methodologies used to collect field data on the existing environment surrounding the proposed site.

4.2.1 Vegetation Assessment

The proposed boreholes will be constructed in clear spaces without any removal of mature vegetation. However, vegetation removal including coconut palms in the way of the reject line would occur. Therefore, a tree survey of the area was done to understand the type of vegetation cover in the area, especially mature vegetation. The results are presented in Figure 4-8.

4.2.2 Groundwater Quality

Water quality at the three proposed site for boreholes were tested. The sample was tested in-situ for all relevant parameters. The parameters analysed include temperature, pH, electrical conductivity/salinity/TDS and dissolved oxygen (DO).

4.2.3 Noise level

The noise levels at the site were determined using a Type II noise meter.

4.2.4 Marine environment

The marine environment in the cooling water discharge location is mainly dead reef flat with bedrock and fine sand with some amount of rubble. There is no live coral cover and fish was hardly observed at the time of the survey. Spot depths in the area were also measured.

4.3 General meteorological conditions

The Maldives has a warm and humid tropical climate with average temperatures ranging between 25°C to 30°C and relative humidity ranging from 73 per cent to 85 per cent. The country receives an annual average rainfall of 1,948.4mm (MHHE 2001).

Monsoons of Indian Ocean govern the climatology of the Maldives. Monsoon wind reversal plays a significant role in weather patterns. Two monsoon seasons are observed: the Northeast (*Iruvai*) and the Southwest (*Hulhangu*) monsoon. Monsoons can be best characterized by wind and rainfall patterns. The southwest monsoon is the rainy season which lasts from May to September and the northeast monsoon is the dry season that occurs from December to February. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November. However, according to Elliot *et al.* (2003) due to proximity to the equator, the monsoon seasons in Maldives are not as well defined as they are in Sri Lanka. The monsoons in Maldives are best defined in the northern part of the country where a distinct monsoon seasons including the strong southwest monsoon from June through September and a noticeable northeast monsoon from December through February occurs.

Table 4-1: Key meteorological characteristics of the Maldives

Parameter	Data
Average Rainfall	9.1mm/day in May, November 1.1mm/day in February 1900mm annual average
Maximum Rainfall	184.5 mm/day in October 1994
Average air temperature	30.0 ^{0}C in November 1973 31.7 ^{0}C in April
Extreme Air Temperature	34.1 ^{0}C in April 1973 17.2 ^{0}C in April 1978

Parameter	Data
Average wind speed	3.7 m/s in March 5.7 m/s in January, June
Maximum wind speed	W 31.9 m/s in November 1978
Average air pressure	1012 mb in December 1010 mb in April

The climate of the Maldives varies slightly from South to North of the country. As pointed out by Elliot *et al.* (2003) the monsoon in north region is more pronounced and distinct. In Maldives, meteorological data are not recorded in all islands across Maldives. It has been recorded at islands where regional airports operated. General meteorological conditions prevailing in the region based on meteorological data for S.Gan have been used to understand climatic factors affecting FENAKA site. The table below shows summary of seasons in Maldives.

Table 4-2: Summary of Monsoons in Maldives

Season	Months
North East-Monsoon (Iruvai)	December to February
Transition Period - 1 (HulhanguHalha)	March to April
South West Monsoon (Hulhangu)	May to September
Transition Period - 2 (IruvaiHalha)	October to November

4.3.1 Temperature

The temperature of Maldives varies little throughout the year with a mean daily maximum temperature of about 32°C and mean low of 26°C and are rarely below 25°C or above 33°C. The highest temperature ever recorded in the Maldives was 36.8°C, recorded on 19 May 1991 at Kadhdhoo Meteorological Office. Likewise, the minimum temperature ever recorded in the Maldives was 17.2°C, recorded at the National Meteorological Centre on 11th April 1978. The highest recorded temperature for Male' was 34.1°C on 16th and 28th of April 1973. The hottest month of the year is usually April reaching a peak around 24 April.

The figure below represents daily average low (blue) and high (red) temperature with percentile bands: inner band from 25th to 75th percentile and outer band from 10th to 90th percentile (source: weatherspark.com) based on the historical records from 1998 to 2012 at Hulhulé weather station.

The hottest day of the last 12 months was January 5, with a high temperature of 38°C. For reference, on that day the average high temperature is 30°C and the high temperature exceeds

31°C only one day in ten. The hottest month of the last 12 months was April with an average daily high temperature of 32°C.

The longest warm spell was from January 9 to January 30, constituting 22 consecutive days with warmer than average high temperatures. The month of June had the largest fraction of warmer than average days with 93% days with higher than average high temperatures.

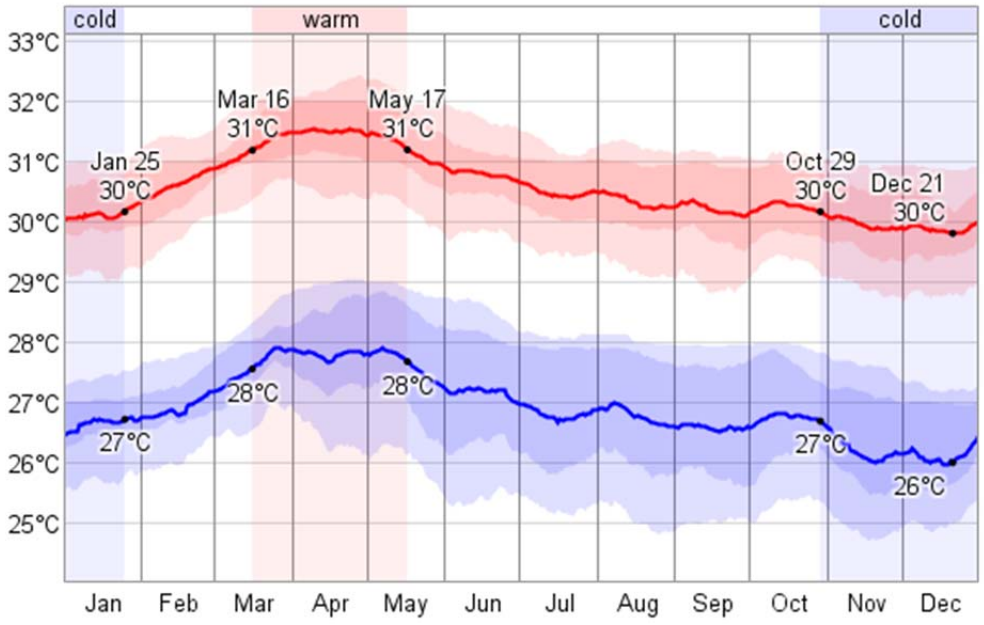


Figure 4-1: Daily average temperature for Central Maldives with percentile bands

The coldest day of the last 12 months was July 9, with a low temperature of 24°C. For reference, on that day the average low temperature is 27°C and the low temperature drops below 25°C only one day in ten. The coldest month of the last 12 months was November with an average daily low temperature of 27°C.

The longest cold spell was from February 24 to March 5, constituting 10 consecutive days with cooler than average low temperatures. The month of December had the largest fraction of cooler than average days with 48% days with lower than average low temperatures.

4.3.2 Wind

Wind has been shown to be an important indirect process affecting formation development and seasonal dynamics of the islands in the Maldives. Winds often help to regenerate waves that have been weakened by travelling across the reef and they also cause locally generated waves in lagoons. Therefore, winds are important here, as being the dominant influence on the

sediment transportation process (waves and currents). With the reversal of winds in the Maldives, NE monsoon period from December to March and a SW monsoon from April to November, over the year, the accompanying wave and current processes respond accordingly too. These aspects have ramification on the seasonal sediment movement pattern on the islands and also the delivery/removal of sediments from the reef platform/island.

The two monsoon seasons have a dominant influence on winds experienced across the Maldives. These monsoons are relatively mild due to the country's location close to the equator and strong winds and gales are infrequent. However, storms and line squalls can occur, usually in the period May to July; gusts of up to 60 knots have been recorded at Male' during such storms.

Wind was uniform in speed and direction over the past twenty-plus monsoon seasons in the Maldives (Naseer 2003). Wind speed is usually higher in central region of the Maldives during both monsoons, with a maximum wind speed recorded at 18 m/s for the period 1975 to 2001. Maximum wind speed recorded in the south was 17.5 m/s during the period 1978 to 2001. Mean wind speed was highest during the months January and June in the central region, while wind speed was in general lower and more uniform throughout the year in the southern region. Wind analysis indicated that the monsoon was considerably weaker in the south (Naseer, 2003). During the peak months of the SW monsoon, southern regions have a weak wind blowing from the south and south-eastern sectors.

Figure 4-2 summarizes the wind conditions in the region throughout the year and Figure 4-3 provides the wind-rose diagram typical to Addu City (windfinder.com). This analysis represents wind data from Gan International Airport taken between 07/2002 and 04/2016 from 0700 to 1900hrs local time.

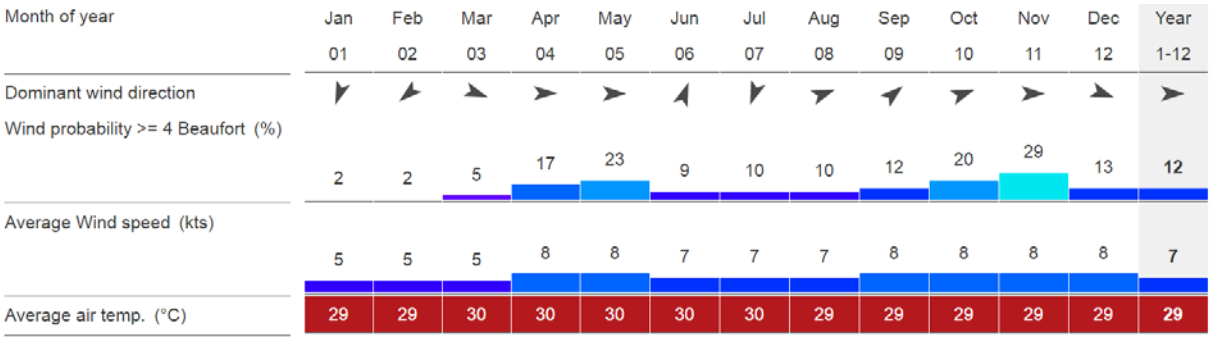


Figure 4-2: Summary of general wind conditions in Addu City

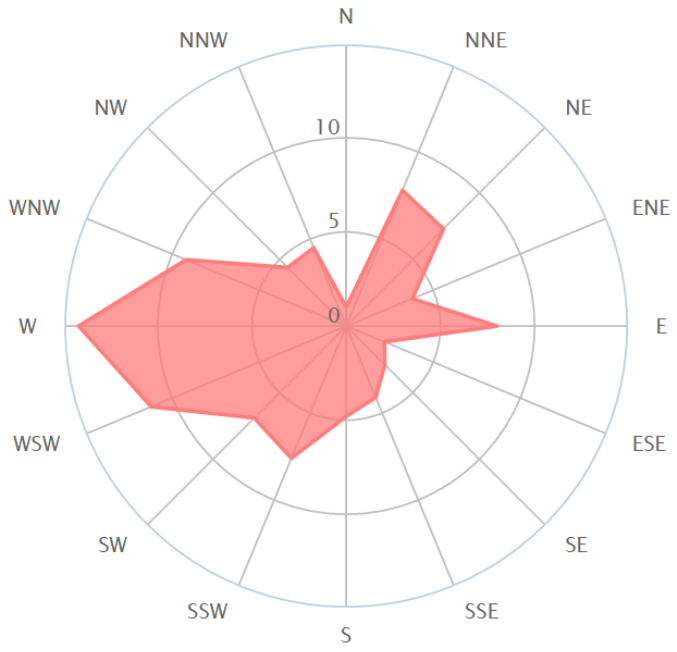


Figure 4-3: Windrose diagram based on data from Gan International Airport

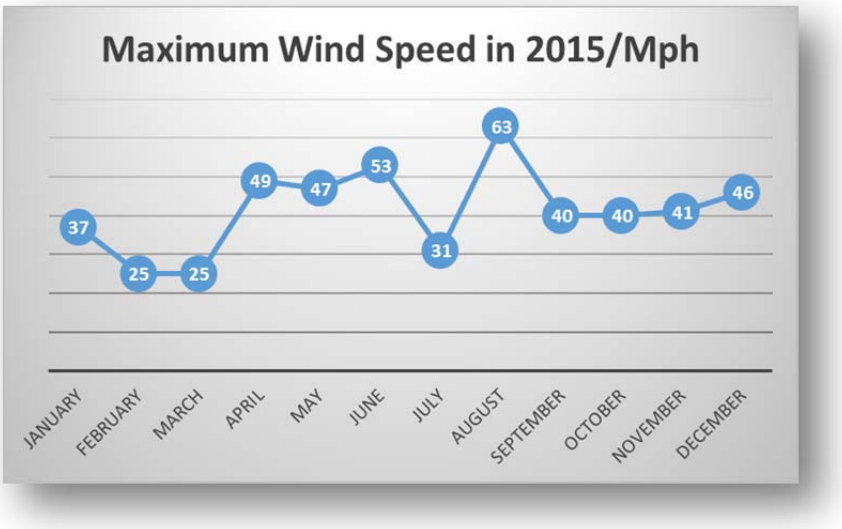


Figure 4-4: Maximum monthly wind speeds for the southern side of the Country

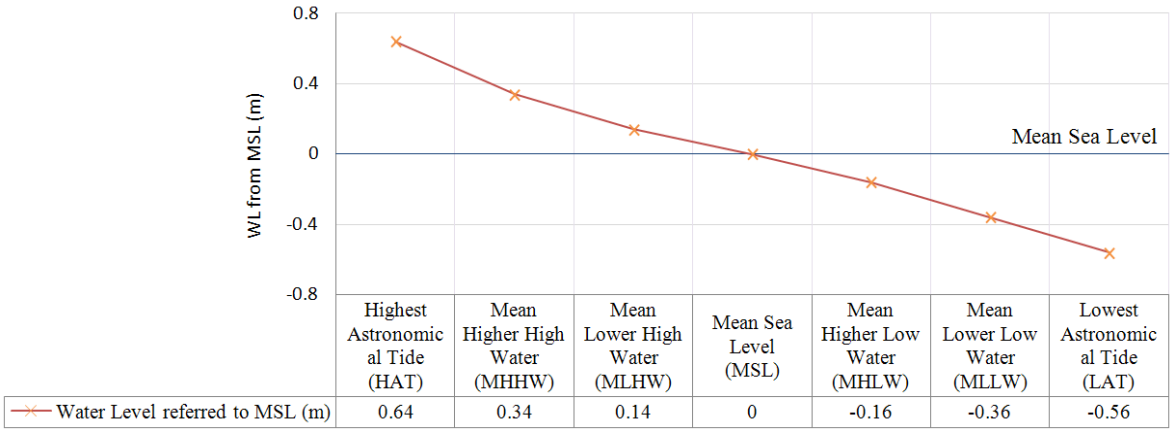
4.3.3 Tides

Tides affect wave conditions, wave-generated and other reef-top currents. Tide levels are believed to be significant in controlling amount of wave energy reaching an island, as no wave energy crosses the edge of the reef at low tide under normal conditions. In the Maldives where the tidal range is small (1m), tides may have significantly important influence on the formation, development, and sediment movement process around the island. Tides also may

play an important role in lagoon flushing, water circulation within the reef and water residence time within an enclosed reef highly depends on tidal fluctuations.

Semidiurnal tides are experienced in the Maldives, that is two high tides and two low tides a day. The tide varies slightly from place to place, depending on the location and on the shape and depth of the basin, channels and reefs and also time of the year.

The following figure shows the astronomical tidal variation recorded in the country with respect to mean sea level. Astronomical tides are related to the motion of the earth-moon-sun system, and have a range of periodicities. The highest astronomical tide was recorded as 0.64 cm above the mean sea level and the lowest astronomical tide was recorded as 0.56 below the mean sea level. Tidal variation of 1.2m from lowest to the highest tide levels were recorded in the country.



	Highest Astronomical Tide (HAT)	Mean Higher High Water (MHHW)	Mean Lower High Water (MLHW)	Mean Sea Level (MSL)	Mean Higher Low Water (MHLW)	Mean Lower Low Water (MLLW)	Lowest Astronomical Tide (LAT)
Water Level referred to MSL (m)	0.64	0.34	0.14	0	-0.16	-0.36	-0.56

Figure 4-5: Astronomical tidal variation in the Maldives

Based on the above tide table, the proposed location where effluent from the cooling water system is discharged is generally flushed at all tides except low tide when the reef flat at the area is dry. Therefore, good flushing occurs at mean and high tides.

4.3.4 *Rainfall*

The northeast monsoon is known as the dry season with average monthly rainfall of 50-75 mm. The intensity of rainfall is a concern in the Maldives since intensity is high with low frequency. It is sometimes believed that the interval of rainfall (frequency) is important in considering the groundwater recharge potential from precipitation.

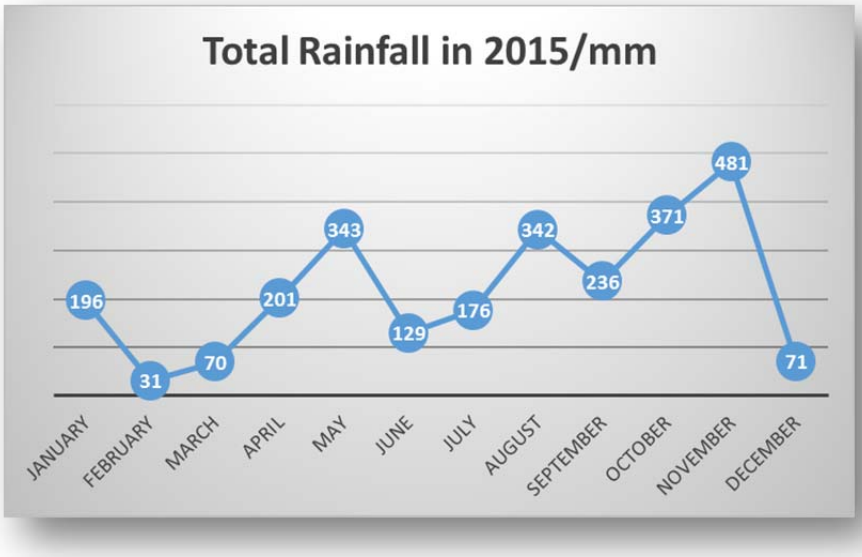
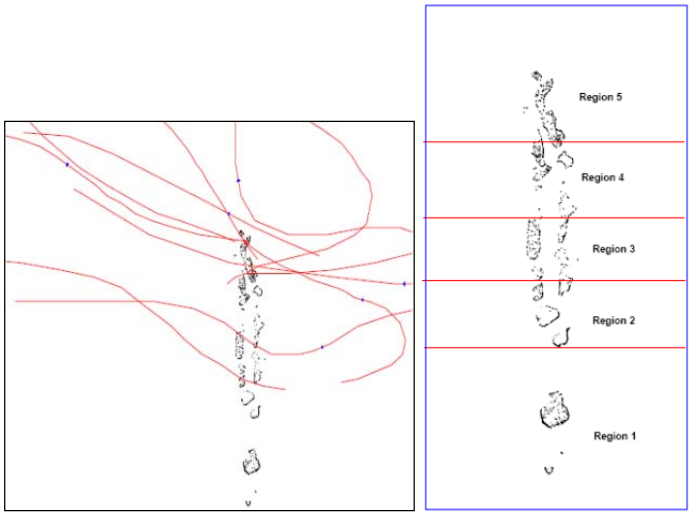


Figure 4-6: Monthly total rainfall for year 2015, Addu City

4.4 Natural Hazard Vulnerability

An island's natural vulnerability depends on geographic and geomorphologic characteristics of the island. These include geographic features of the island and location of the island with respect to the country, the formation of the island, location of the island respect to the atoll, orientation of the island, region of the country where island is located, level of protection to the island from the reefs and other islands; area of the inland lake found on the island, width of the island's house reef, coastal defence structures on the island, shape of the island and the area of the island. Although Maldives is generally considered to have moderate risk to natural hazards or disasters, islands across Maldives experience varying degree and magnitude of natural disasters.

Referring to Suffir-Simpson Scale, FENAKA site is considered fairly safe zone when cyclonic winds and storm surges over the Maldives are concerned and also low risk when tsunamis and earthquakes are concerned (RMSI/UNDP 2005).



Hazard Zone	Probable Maximum Wind Speed (knots)	Saffir-Simpson Scale
1	0.0	0
2	55.9	0
3	69.6	1
4	84.2	2
5	96.8	3

Figure 4-7: Natural hazard map of Maldives (after UNDP, 2005)

The stormy weathers around the world are affecting coral reef systems directly and indirectly due to global climatic changes. Intense storms can wipe out the natural coral "recruitment" process (Daily Science, April 29, 2008) as a direct effect of climatic change. Healthy coral reef systems are vital assets to many economies around the world on which large numbers of island communities depend on range of fisheries activities including Maldives. In Maldives for instance according to NAPA (2006) local demand on reef fishery has increased in recent years. Therefore, the concern of natural hazard vulnerability on coral reefs in Maldives is very high, which needs a solution through local and global effort.

4.5 Noise levels

The noise levels were taken at each site by measuring the ambient noise levels for at least one minute. The table below shows the time averaged noise levels in the area.

Table 4-3: Noise levels at site

Site	Minimum
Outside powerhouse	81
At the boundary	67

The noise levels are high because the powerhouse door was open as it was damaged. As a result, the background noise levels in the area was quite high.

4.6 Water quality

4.6.1 Ground water quality

Groundwater quality was tested in-situ for relevant parameters. In addition, since the area is the location of a powerhouse, groundwater sample was brought and sent to laboratory for testing hydrocarbons in groundwater. This may be out of the scope of this EIA, however, results may be provided upon receipt from the laboratory.

Table 4-4: Ground water quality

Table 4-5: In-situ water quality results

Parameter	Unit	Site 01
GPS Location		
Temperature	°C	29.3
pH		8.35
E. Conductivity	uS/cm	8.23
Total Dissolved Solids	mg/l	5.45
Salinity	ppt	4.48
Dissolved Oxygen	mg/l	9.16

4.6.2 Marine water quality

Marine water quality was also tested at the proposed discharge location as well as the alternative location recommended. The results are given below.

Table 4-6: In-situ water quality results

Parameter	Unit	Site 01	Site 02
GPS Location			
Temperature	°C	30.2	29.6
pH		8.96	8.19
E. Conductivity	uS/cm	52.21	51.1
Total Dissolved Solids	mg/l	24300	25600
Salinity	ppt	33.2	32.1
Dissolved Oxygen	mg/l	6.75	6.85

4.7 Socio economics

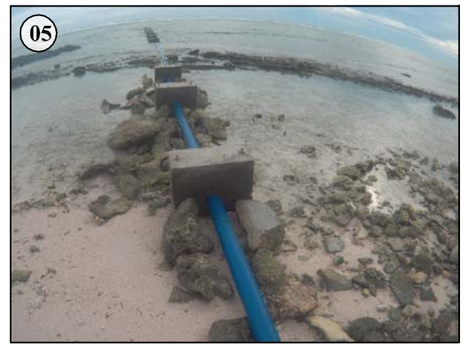
According to the latest census data (2014), the total resident population in Addu city is 21,275. Out of which 10975 are males while 10300 are females. This is inclusive of Foreigners. The exclusive Maldivian population in Addu City is 19319. Furthermore, a total of 7315 citizens were enumerated in Male whose place of birth is Addu city. Looking back at the the data of census 2006, the population in the year 2006 was 17862. The growth rate of Addu city is at 1.23. Therefore with reference to the aforementioned demographic data, Addu city is currently experiencing a population increase and is expected to increase further with the better development of facilities. The total employed population of Addu City is 4325. The main occupations are government jobs, private business, resort jobs and fisheries. There are a number of shops, mosques, educational centres, banks and health facilities available throughout the City. Furthermore, the Addu City is one of the most developed areas in the country after taking the capital of male'.

There are some large scale projects already taking place at Addu City, which includes the supply of water supply project for all the islands of Addu City and Hithadhoo central area sewerage project contracted to FENAKA Corporation by the Ministry of Environment and Energy. Reclamation of land in Feydhoo island. The sewerage services for the rest of the islands are in the tendering process.

Figure 4-8: Survey locations and findings

Proponent: Proponent: FENAKA Corporation Ltd.
Consultant: Sandcays Pvt. Ltd.

Figure 4-9: Photographic summary of conditions of the terrestrial environment



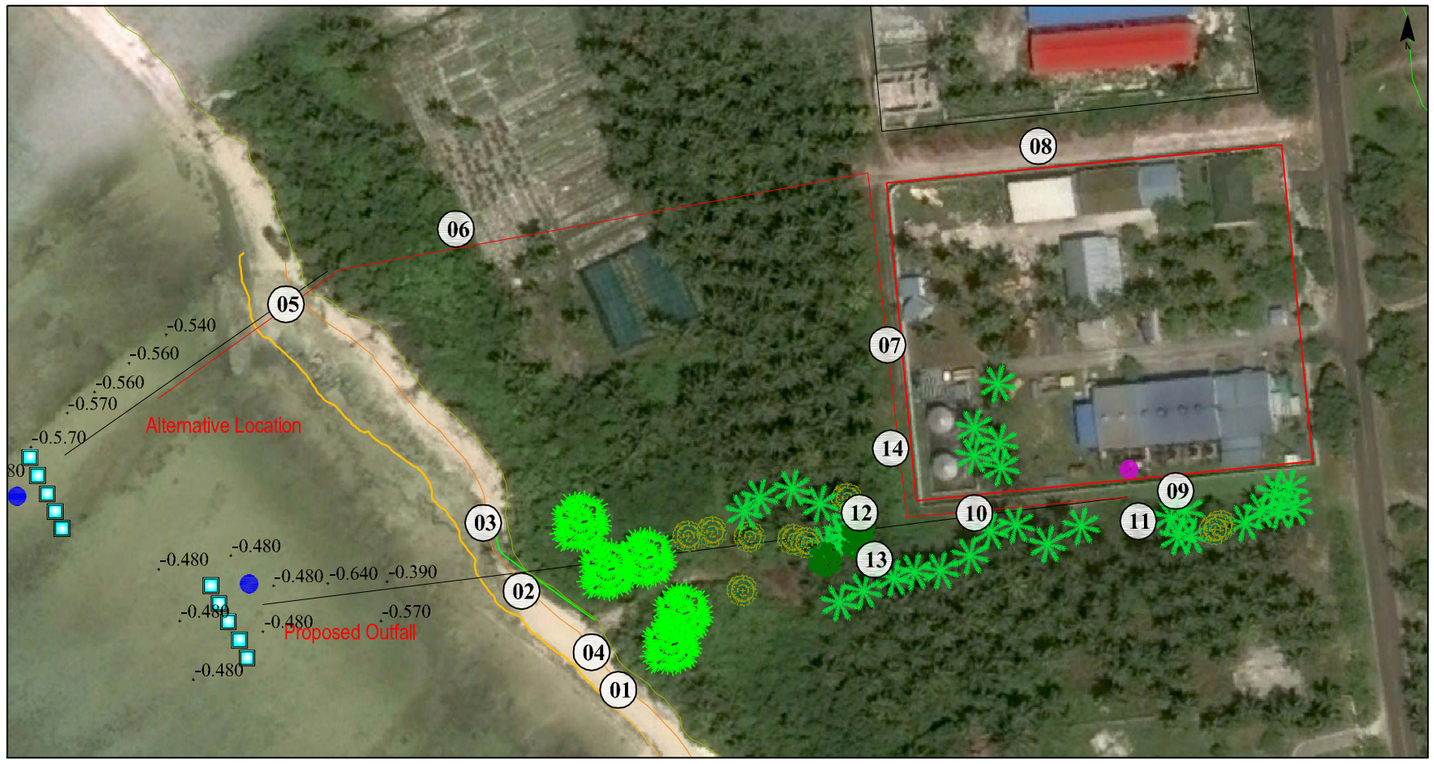
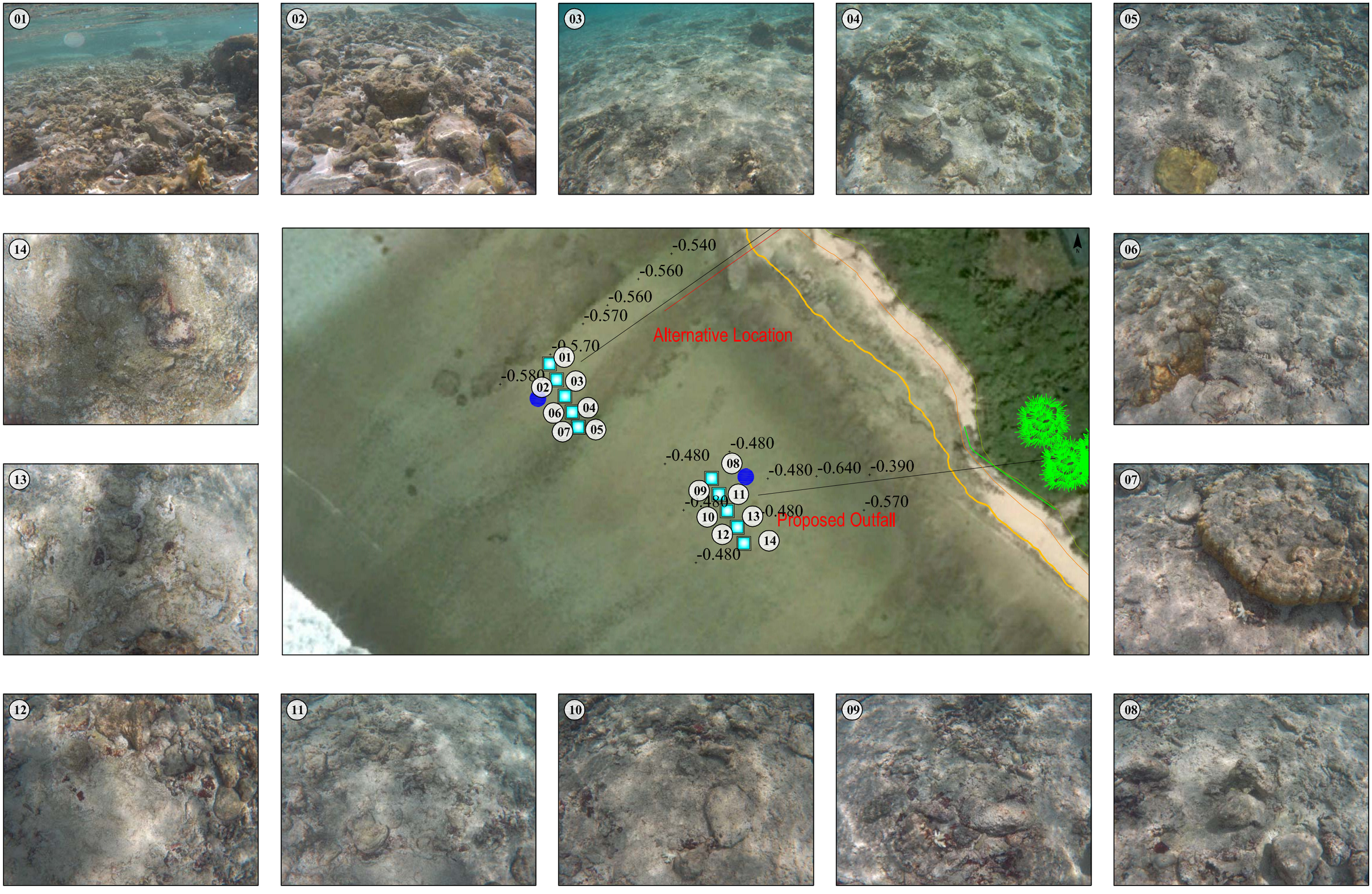


Figure 4-10: Photographic summary of conditions of the marine environment



5 Stakeholder Consultations

The key stakeholders of the project include the Ministry of Environment and Energy, Environmental Protection Agency, Proponent (FENAKA), Addu City Council, Contractor, Project Engineers and Consultants. Most of these stakeholders were present in the Scoping Meeting. The stakeholders that participated in the Scoping Meeting have extensively discussed on the issues relating to the project. A meeting was held with the Addu City Council during the field visit.

The Scoping Meeting was held on 3 April 2016. The meeting was attended or represented by the following.

Table 5-1 : Participants of the Scoping Meeting

Name	Designation	Office
Hussain Fizah	Consultant	Sandcays
Mohamed Yasrif	Councilor	City Council
Abdulla Nashith	Director	FENAKA Corporation
Abdullah Mauroof	Deputy Director	FENAKA Corporation
Aminath Fizna	Asst. Environmental Officer	EPA
Fathimath Reema	Director	EPA

Once a brief overview of the project was given by the proponent, the discussions followed were mainly based on why boreholes were chosen as the method of obtaining feedwater for the cooling system and the details of boreholes including locations. The discharge locations and the characteristics of the area were also discussed. According to the Proponent, sea water cooling is efficient, environment-friendly and cost-effective. These are the reasons why a seawater cooling system was chosen over a freshwater system. The Proponent indicated that there is a proposed 2MW genset, but only cooling system is done during this phase.

EPA said that there is a small seawall as a defense against waves and the construction of the proposed discharge line may cause damage to the seawall and to take care during the installation of the reject pipeline. EPA also raised concern over the high temperature of the effluent reject water. The Proponent responded that the reject water will be released to area which is dry during low tide.

Addu City Council requested that EPA (EPA Office in Addu) monitors the works during the construction to ensure that the project is undertaken in the most suitable manner.

The scope or Terms of Reference of the EIA report was finalized after the issues were discussed. The scope of the field investigations were considered to cover water resources and vegetation in the area as well as noise levels. The Consultant was requested to propose most suitable alternative location for the reject line.

Discussions were also held with Addu City Council during the field visit that followed the Scoping Meeting. Some of the members of the Council were kind enough to discuss about the project. They identified that the main issue is the route of the discharge pipeline, which passes through plots that have been allocated. They suggested re-routing the pipes towards the existing brine discharge pipeline and disposing at the same location. This will address the issue of the damage to existing breakwater, identified in the Scoping Meeting as well.

The following members of the Council contributed to the discussions during the field visit.

1. Abdulla Sodiq
2. Abdulla Thoib
3. Mohamed Yasrif
4. Hussain Hilmy
5. Ali Fahumee

6 Environmental Impacts

6.1 Introduction

Development projects involving infrastructure development in island environments are believed to generate a series of environmental impacts, of which some can be felt immediately on the surrounding environment while others can be felt continually and can be far reaching. By far and large the most significant environmental impacts are those that are felt on the immediate environment. Terrestrial environment is directly affected from removal of vegetation resulting in loss of habits. Also coral reef environments are sensitive and highly susceptible to immediate changes that will be incurred from most of the development activities. Therefore, all the development activities must take into consideration the understanding of the environment and changes as well as implications that it will bring about to the environment and surrounding.

The following account describes potential environmental impacts that will be associated with the proposed Sea Water Cooling System for the central power station in Addu City, both during construction and operation phases of the development.

6.2 Methods and Limitations

The methods used to predict and evaluate the environmental impacts that may be associated with the proposed borehole drilling project may not be the most comprehensive methods as they are quite simple prescriptive methods. The main shortcoming of these methods is that only assumptions have been made to predict the impacts which may or may not be accurate. Also, the degrees at which these impacts are either accurate or inaccurate as well as uncertainties and natural variability are the key factors that affect the accuracy of these methods. Nonetheless, the methods used are concise and provide a general overview as well as the range of impacts that can affect the environment. Also, the EIA report has taken into consideration similar studies undertaken in the Maldives as well as expert judgment in identifying the main environmental impacts that may be associated with the proposed borehole construction project.

6.3 Impact Identification

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

- A consultative process within the EIA team and the Proponent
- Purpose-built checklist
- Existing literature and reports on similar developments in small island environments and other research data specific to the context of the Maldives
- Baseline environmental conditions described in Chapter 0.
- Consultant's experience of projects of similar nature and similar settings

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

- Magnitude (or severity): the amount or scale of change that will result from the impact
- Significance: importance of the impact. Reversibility is considered part of its significance
- Duration: the time over which the impact would be felt
- Extent/spatial distribution: the spatial extent over which the impact would be felt
- The scales associated with the above criteria are given in the table below.

Table 6-1: Impact evaluation scale

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

Based on the above scale, an impact matrix was developed for the proposed development to determine the overall impact of the proposed project. This matrix is given in table 8-2.

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

Table 6-3 represent the impact potential indices for the proposed project.

6.4 Overall impacts of the proposed project

The environmental impacts that maybe associated with the proposed sea water cooling system for the central power station of Addu city are summarised by using a simple matrix. The matrix given in the following Table 6-2 shows the types of environmental impacts that may be associated with the proposed development works throughout the project period including implementation and operation. As described in Section 6.3 values were given to every impact based on its magnitude, duration, significance and spatial distribution.

Table 6-2: Score of all the impacts in each category

	KEY COMPONENTS									
	Environment					Socio-Economic				
PROJECT ACTIVITIES	Reefs incl. live bait/ terrestrial flora & fauna	Soil and groundwater	Lagoon/seawater	Hydrodynamics	Air/Noise/land or seascape	Services and Infrastructure	Health and Safety	Employment	Property Value	Costs to consumer/tax payer
Construction										
Temporary facilities, machinery and workforce	-1 0 1 2	-1 0 1 2	-1 0 1 1	0	-1 1 1 1	-1 0 1 2	-1 1 1 1	0	-1 0 1 2	-1 1 1 2
Construction of outfall (inclusive of vegetation clearance of pathway)	-1 1 1 1	0 	-2 1 1 1	0	-1 1 1 1	1 0 1 2	-1 0 1 1	1 1 1 1	-1 0 1 1	-1 1 1 1
Drilling	0 0	-2 1 1 1	0 	0	-1 0 1 1	1 0 1 2	-1 1 1 1	0	-1 0 1 2	-1 1 1 2
Construction of Borehole	0 	-2 1 1 1	0 	0	-1 0 1 1	-1 1 1 2	-1 0 1 1	0	-1 0 1 1	-1 1 1 2
Disposal of waste water and mud	-2 1 1 1	-1 1 1 1	-2 1 1 1	0	-2 0 1 1	-1 1 1 1	-1 0 1 1	0	-1 0 2 1	-1 1 1 2
Operation										
sea water cooling of gensets for better electricity service	0 	-1 1 3 1	0 	0	1 0 3 2	3 3 3 3	0	0	2 2 3 3	-2 2 3 2
Discharge of water	0 	0 	-2 1 1 2	0	-1 0 3 3	1 0 3 3	-1 0 3 2	0	0	-1 1 3 2
KEY:	M S D E		Magnitude Duration			Significance Extent (spatial)				

The overall impact of the proposed development is moderately positive due to its insignificant negative impacts on the environment and major positive social components. The negative impacts on the environment from this project would be mostly during construction phase of the project including temporary water quality deterioration around the drilling area and reject water disposal area. Both of these are temporary and limited to a small spatial area. Hence they are all considered as minor and resulting score from impact matrix is overall positive.

Table 6-3: Overall score of individual components and the project

PROJECT ACTIVITIES	Reefs incl. live bait/ terrestrial flora & fauna	Soil and groundwater	Lagoon/seawater	Hydrodynamics	Air/Noise/land or seascape	Services and Infrastructure	Health and Safety	Employment	Property Value	Costs to consumer/tax payer	TOTAL API
Construction											
Temporary facilities, machinery and workforce	0	0	0	0	-0.01	0	-0.01	0	0	-0.02	-0.04
Construction of outfall (inclusive of vegetation clearance of pathway)	-0.01	0	-0.02	0	-0.01	0	0	0.01	0	-0.01	-0.04
Drilling	0	-0.02	0	0	0	0	-0.01	0	0	-0.02	-0.05
Construction of Borehole	0	-0.02	0	0	0	-0.02	0	0	0	-0.02	-0.06
Disposal of waste water and mud	-0.02	-0.01	-0.02	0	0	-0.01	0	0	0	-0.02	-0.08
Operation											
sea water cooling of gensets for better electricity service	0	-0.04	0	0	0	1	0	0	0.44	-0.3	1.1
Discharge of water	0	0	-0.05	0	0	0	0	0	0	-0.07	-0.12
TOTAL CPVI	-0.03	-0.09	-0.09	0	-0.02	0.97	-0.02	0.01	0.44	-0.46	0.71

API = Activity Potential Impact Index
CPVI = Component Potential Vulnerability Index

6.5 Project Specific Impacts – Construction Phase

Implementation phase will have the most significant, direct short-term impacts on the environment. As the project components are minor and will be completed within a short period, most of the impacts on the environment are minor to negligible.

6.5.1 Production of Waste during Construction

The only waste materials that will be generated during construction phase of the project are small amounts of construction waste such as leftover PVC pipes, cement, gravel and similar material. Additionally, a large quantity of sand and water mixed with drilling mud and other chemicals used in drilling process will also be generated. Construction waste will be taken to the nearest waste facility for proper disposal; as for excavated material, water from the mixture will be separated. Water will be collected and disposed off into the sea beyond the reef and the earth will be send to waste facility for disposal.

Disposal of water into the sea will cause temporary deterioration of water quality at the location; despite being mixed with few drilling chemicals, it is not expected to cause significant pollution due to small amount of these components. Some amount of sediment is

also expected to remain in the mixture. However, the currents and wave action is expected to dilute the mixture greatly; reducing the impact on the environment greatly. The overall impact of this aspect of the project is considered to be minor.

6.5.2 Temporary deterioration of groundwater quality

The drilling activity is expected to cause temporary mixing of freshwater and saline water layers during the construction phase. Salinization is expected to be limited around the drilling area and would return to normal after sometime. This has potential to impact the vegetation around location to some degree.

6.5.3 Construction of the reject line

The construction of the reject line will have both inland and marine impacts. Firstly the route of the outfall is not cleared as of yet and will require removal of vegetation to some extent. It is estimated that around 30 palm trees would be removed and these would be replanted elsewhere. The excavation of the earth for both the vegetation removal and laying of the reject line will cause temporary deterioration of groundwater and soil quality. However these impacts are small in magnitude as they are localized to the work area. Furthermore, as the vegetation is going to be replanted elsewhere, the long term impacts to air quality due to the vegetation removal will be minimized. The pipe laying works on the lagoon side will cause impacts to marine water quality as the works will give rise to some extent of sediment plumes. However, the impacts that may arise from these works are deemed minor and temporary as the lagoon does not seem to be rich in marine life and the coral cover is at minimal. Furthermore,

6.5.4 Health and safety

The main health and safety issues during the construction stage would be in the operation of heavy machinery and equipment such as drilling machine with the risk of toppling. Falls and accidents due to carelessness in the project site has been a concern in many construction sites and must be addressed during the planning and implementation stages.

Noise levels felt by workers can be a health issue too. However, noise levels at the project site would not be too high and would be intermittent and not continuous. Therefore, acceptable average daily exposure levels would not be exceeded for construction workforce.

The effect of high noise levels on the operating personnel has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90dB(A) affects the hearing acuity of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by the US Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited as in Table 6-4.

Table 6-4: Maximum Exposure Periods specified by OSHA

Maximum equivalent continuous Noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/week
90	8
95	4
100	2
105	1
110	½
115	¼
120	No exposure permitted at or above this level

Workers will be provided with noise cancelling headsets if noise levels are higher than acceptable levels (Table 6-4).

6.6 Project Specific Impacts – Operational Phase

6.6.1 Reject water

The main difference between the ambient surrounding lagoon waters and the water from the reject line is just an increase of temperature. The location of the outfall faces the oceanic side and is subject to constant wave action and adequate current circulations. Therefore, it is envisaged that the warmer outflowing water would be dispersed quickly with minimal impacts to the marine environment. Moreover, the lagoon does not cater for a rich marine life and has minimal coral cover. Furthermore, the area is not used by local communities for any purpose such as swimming and therefore would not cause any social impacts.

6.6.2 Raw water intake

Increased raw water intake will consume more power for pumps used. More energy generation would mean more fuel consumption; releasing pollutants such as carbon dioxide. The increased fuel consumption from the proposed project component will be small and in

itself negligible. However, given the cumulative nature of this impact globally over time, it can be regarded as a minor negative impact.

The increased capacity to cater for larger sized generator sets means that the electricity services can be improved for the community. This is a major positive social impact from the proposed project.

6.7 Uncertainties in Impact Prediction

Environmental impact assessment involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. The level of uncertainty, in the case of the proposed development, may be expected to be low due to the experience of similar projects in similar settings in the Maldives. Also, where such projects have been undertaken, there is little project specific monitoring data available which may be usefully applied to the proposed as well as future projects.

Given that environmental monitoring is lacking for most of the projects implemented in the country, as a result of which uncertainties in impacts of similar projects still exist, it is proposed that the Proponent shall undertake voluntary monitoring as described in the monitoring programme given in the EIA report.

7 Project Alternatives

7.1 Introduction

This section looks at alternative ways of undertaking the proposed project. There are two basic options: (1) leave the problem as it is (no project option), or (2) take measures to resolve the problem (undertake the project options). If the project were to continue, it would be necessary to take economic, ecological and social aspects of the project into consideration and ensure that these concerns exist within a delicate balance. Neither the economic benefits nor the social and ecological concerns can be avoided. Therefore, it is important to consider all options and ensure that the best available option(s) is/are chosen to solve the issues/problems.

Not all the impacts of a project can be completely prevented, however, with the use of appropriate technology and management measures; the magnitude of most of these impacts can be either reduced or minimized. Nevertheless, the effectiveness of these technology and mitigation measures highly depends on the environmental condition and procedures in which they are applied in the field. On the other hand, there are complex and sophisticated procedures of minimizing environmental impacts by means of alternative methods to some of the activities. Often, alternative means are not economically competent with the extent of the project itself. However, to some of the activities where predicted impacts and its magnitudes on the environment are very adverse, alternate means must be applied considering long-term benefits from use of alternatives, as short-term environmental restorations can become very costly.

The following section describes and evaluates some alternatives in terms of locations and various project activities and methods of construction for the proposed project.

7.2 No project option

It should be noted that the **"no project" option** cannot be excluded without proper evaluation. In this report this alternative was considered as the baseline against which to evaluate the other options. The no project option takes the following into consideration:

- Existing setup is sufficient for the proponent
- There is no need to increase capacity of the generator sets which would nullify the need for the sea water cooling system

The no project option has few disadvantages for the proponent. The initial cost for establishing the proposed project is fairly high. Additionally, operating cooling system will also incur a small economic cost. However, in terms of social issues that would arise from producing lower than demand electricity supply would be extremely high (in case of not establishing the cooling system, the higher capacity generator sets cannot function without the cooling component).

Hence, in case of this project "No project" option is not recommended given the huge socio-economic gain and minor negative impacts from the proposed project.

7.3 Alternative borehole drilling methods

7.3.1 Boreholes drilling methodology

A number of different types of borehole drilling are used worldwide; some of which are described below.

7.3.1.1 Hand-auger drilling

Auger drills, which are rotated by hand, cut into the soil with blades and pass the cut material up a continuous screw or into a 'bucket' (bucket auger). Excavated material must be removed and the augering continued until the required depth has been reached. Auger drilling by hand is slow and limited to a depth of about 10 metres (maximum 20 metres) in unconsolidated deposits (not coarser than sand), but it is a cheap and simple process.

7.3.1.2 Jetting

A method whereby water is pumped down a string of rods from which it emerges as a jet that cuts into the formation. Drilling may be aided by rotating the jet or by moving it up and down in the hole. Cuttings are washed out of the borehole by the circulating water. Again, jetting is useful only in unconsolidated formations and only down to relatively shallow depths, and would have to be halted if a boulder is encountered.

7.3.1.3 Percussion drilling

Drilling by percussion is done by simply dropping a heavy cutting tool, of 50 kilograms or more, repeatedly in the hole. This may well be the original method of drilling for water,

pioneered by the Chinese (probably using bamboo) 3000 years ago or more. The drilling tools are normally suspended by a rope or cable; and – depending on the weight of the drill string, which, for manual operation, is obviously limited – it is possible to drill to considerable depths in both soft and hard formations. Basic percussion drilling systems are still widely used in Pakistan to drill shallow boreholes for hand-pumps. They consist of a strong steel tripod, cable and power winch, percussion tools, and a baler. These systems are seriously hindered when the ground is hard, and can accidentally change direction along weaker zones, causing boreholes to become crooked or tools to jam. Unconsolidated materials, although easy to drill with cable tool, become very obstructive when boulders are present. Sticky shales and clays are also difficult to penetrate with cable tool rigs, and loose sand tends to collapse into the hole almost as fast as it can be bailed.

These manual shallow drilling techniques might be used as low-cost alternatives in groundwater investigations for dug well sites, particularly if geophysical surveys prove to be ineffective, unavailable or impracticable because of ground conditions. In such instances, when the drilling is done solely for the purpose of prospecting, only small holes are drilled, rapidly.

7.3.1.4 Rotary drilling

Most borehole applications in the field will require rotary drilling. True rotary drilling techniques allow much deeper boreholes to be constructed, and use circulating fluids to cool and lubricate the cutting tools and to remove debris from the hole. Circulating fluids usually take the form of compressed air or of pumped water with additives, such as commercial drilling mud or foams. This is the proposed method (bentonite is used as the drilling mud) for the project and most suitable for Maldives.

7.4 Alternatives for Raw Water Intake

There are two potential alternatives to raw water intake for the sea water cooling system;

- Ground water
- Salt water obtained from the lagoon

As for the first option, the existing regulations in the Maldives do not allow operations such as the proposed sea water cooling system in Addu city to use ground water aquifer to extract

raw water. Furthermore this option will also deteriorate the aquifer greatly. Therefore, this option is neither viable nor recommended.

However, the second option of using a lagoon intake is viable for this project. Nonetheless, there are some major disadvantages of using a lagoon intake in comparison to a borehole. Intake pipes from the lagoon tend to clog up from growth of fouling organisms or other marine debris frequently. Hence maintenance would be difficult and costly. In case of boreholes, issues like that would not occur hence maintenance is relatively easier. Therefore opting for a lagoon intake is not preferable for this project. .

7.5 Reject line (route and location)

7.5.1 Eastern side harbour

The alternative outfall location is the harbor on the eastern side of the power house. However the distance between the existing powerhouse and the eastern side harbor is considerably greater than the lagoon of the western side. Furthermore, as this option should pass the tar road/link road on the western side, it would increase the project cost and duration. Furthermore, as the link road is the only way of travel at the site, it would cause disturbances to the public during the construction phase

7.5.2 Northwest of the proposed location

Due to the proposed reject line passing through some of the land plots to be allocated, Addu City Council recommended to re-route the line to the northwest of the proposed location, where the existing brine discharge line is present. Therefore, this is considered as the recommended alternative, as shown in Figure 4-8.

In order to keep the high temperature discharge away from impacting any live corals in the area, it is also recommended to keep the discharge slightly closer to the shoreline than the existing brine discharge line. It shall also be noted that due to the constant swell induced wave activity in the area, the area has movement towards the shore that will reduce the temperatures to normal levels before it may flow towards the reef areas.

7.5.3 Waste mud disposal alternatives

There are two options for mud disposal, i.e. on-site burial (proposed) or offshore disposal. When disposed to soil or buried on-site, the bentonite mud may affect soil pH and plant growth in the vicinity. However, this impact is low. Offshore disposal in the deep sea, on the other hand, involves a cost and may not be suitable due to the cost involved and having to move the mud, thereby causing aesthetic and other nuisances. Offshore disposal also can have impacts on marine fauna.

7.5.3.1 On-site burial

When disposed to soil or buried on-site, the bentonite mud may affect soil pH and plant growth in the vicinity. However, this impact is low.

7.5.3.2 Disposal offshore

Offshore disposal in the deep sea involves a cost and may not be suitable due to the cost-involved and having to move the mud in trucks on roads, thereby causing aesthetic and other nuisances.

7.6 Preferred Alternative

Of the alternatives described in this report, the most appropriate method to go forth is seen to be the proposed method that is with reference to the increases in project cost, timelines, maintenance works and the existing regulatory standards. For the reject line, as proposed by Addu City Council, the preferred alternative is to re-route the pipeline to the northwest location indicated by the Council. It is also preferable to keep the discharge end as close to the shore as possible although there would not be any impact of the high temperature waters on the marine environment given that it is at a considerable distance from the live reef areas.

None of the alternative methods of drilling considered in the report are preferred over the proposed. The alternative method of disposal of waste mud from borehole drilling into an offshore location is not recommended due to aesthetic and cost consideration and due to the greater environmental impact compared to the low impact the bentonite mud has on soil and groundwater.

8 Mitigation Measures

8.1 Introduction

It is evident that island and coral reef environments are susceptible to changes and implications that will be brought about from the construction of the proposed boreholes. As described earlier, some impacts are felt largely while others are localized. However, most of the environmental impacts associated with the proposed construction of boreholes are minor and with proper environmental management can be reduced even further. It should also be noted, even though some of the impacts are regarded as minor, without proper monitoring and management they can escalate into significant environmental impacts.

The following section describes key environmental mitigation measures that will be undertaken during the construction and operation of the proposed domestic aerodrome.

8.2 General Construction Phase Mitigation Measures

8.2.1 Re-routing the reject pipeline

The recommended alternative route for the discharge or reject pipeline is considered as an important mitigation measure that needs to be considered. This alternative route is not expected to have much of an effect on the total price of this component and can be considered without much of a cost implication.

The additional cost of this component would be just a fraction of the total cost.

8.2.2 Waste Management

Waste management procedures will be implemented to minimize potential impacts to the environment. This may be achieved by consideration and application of the following:

- Avoid and/or minimize waste generation wherever practical by altering the site procedures
- Maximize the opportunity for reusing/ recycling/ recovering materials and thereby negate/minimize the disposal requirements (e.g. by waste segregation according to type, separation of recyclable materials such as metal, maximize reuse of timber

framework wherever possible, utilization of excavated material for filling or landscaping); and

- Ensure that all treatment and disposal options comply with all relevant guidelines and standards.

The following measures will be implemented to mitigate the likely adverse impacts to the environment.

- Stockpile material and sites will be covered to prevent washout and erosion during heavy rainfall.
- Dust suppression techniques will be adopted;
- Designated areas for stockpiling will be fenced.

A temporary refuse collection facility will be set-up by the contractor and wastes will be stored in appropriate containers prior to collection and disposal.

8.2.3 Disposal of mud or sludge extracted during drilling

The mitigation measures include:

- To ensure appropriate supervision and monitoring.
- Complete the work as soon as possible.
- Keep the workers informed of material safety to minimize the impacts.

8.2.4 Air

One of the most effect ways to minimize emissions from machinery and vehicles related to the project including mobilisation and operational phase include:

- Use light fuel (with low sulphur content) as much as possible.
- Avoid unnecessary operation of vehicles, machines and boats.
- Keep in place appropriate transport management system.
- Minimize mobilisation by planning the mobilisation. In most of the projects undertaken near residential areas, several mobilisations happen to not only increase the cost of the project but also the environmental impact. Appropriate planning is the key.
- Keep in place appropriate logistic management system during construction and operation phase.

8.3 Mitigation Measures – Operational Phase

As there are no noticeable negative impacts on the environment during operational phase of the project, no mitigation measures for operational phase is needed.

It is recommended to continue to undertake monitoring of groundwater at the borehole location and marine water quality at the discharge location for about a year. This is to assure compliance and understand negative impacts.

9 Environmental Monitoring

9.1 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 project are included in the monitoring plan.

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

The 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. This will help to minimize environmental impacts of projects in future.

The monitoring plan shall target to measure:

- groundwater quality
- water quality and visibility
- impacts are accurate and mitigation measures taken are effective
- the thresholds are kept within the baseline limits predicted

9.2 Recommended Monitoring Programme

Outlined in Table 9-1 is a project specific monitoring programme. This monitoring programme for the proposed project includes three monthly and six monthly monitoring.

9.3 Monitoring Report

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

The 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. The report will also include fuel and water consumption data and greenhouse gas emission calculations.

The monitoring report would be according to the requirements of the EIA Regulations 2012 found on page 66-67. The schedule in EIA report lists parameters and their frequency along with locations to be used for monitoring. Report format and other details are listed in EIA Regulations.

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

Table 9-1: Proposed annual monitoring programme

Parameter	Phase	Method	Indicators	Frequency	Cost / MRF
Groundwater quality	Construction	Test of groundwater parameters	Salinity, turbidity	Every 3 months	600
Marine water quality	Operation	Test of seawater parameters	Salinity, turbidity	Every 3 months	600
Benthic substrate	Operation	Photo transect	Percentage coral cover	Every 3 months	3500

Monitoring report schedule

Description	Date
EIA Decision statement released	May 2016
Monitoring report during construction- 1	August 2016
Monitoring report after project completion- 4	December 2016
Monitoring report after project completion - 5	March 2017
Monitoring report after project completion - 6	June 2017
Monitoring report after project completion - 7	September 2017
Monitoring report after project completion - 8	December 2017

10 Conclusions

In conclusion, the project of constructing the sea water cooling system in Addu city is justified in terms of environmental impacts. There are no major negative environmental impacts from the proposed project. The only negative impact from the proposed project would be release of warm water (with some degree of sediment and other components) to the marine environment and some minor disturbances such as noise pollution in the construction phase. However, there are no sensitive receptors in the area, therefore, noise impacts are considered insignificant.

There are several operational benefits associated with the proposed project and hence it is recommended to carry out the project as proposed.

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12 References

Bell, P. (1992), Eutrophication and coral reefs: some examples in the Great Barrier Reef lagoon, *Water Research* **26**: 553-568

Brown, B. E. and J. C. Ogden (2003). Coral bleaching. Scientific American 268:64-70.

Brown, et al (1990), Effects on the degradation of local fisheries in the Maldives. Final Report to Overseas Development Administration.

Choi, B. H., Pelinovsky, E., Kim, K. O., and Lee, J. S. (2003), Simulation of the trans-oceanic tsunami propagation due to the 1883 Krakatau volcanic eruption. In *Natural Hazards and Earth System Sciences* **3**:321-332

Clark, S., Akester, S. and Naeem, H. (1999). Conservation and Sustainable Use of Coral Reefs: Status of Coral Reef Communities in North Male' Atoll, Maldives; Recovery Following a Severe Bleaching Event in 1998, MacAlister Elliot and Partners Ltd.

Dawson, B. and Spannagle, M. (2009), *The Complete Guide to Climate Change*, Routledge

Dean, R. G. (1978), Coastal Structures and their interaction with the shoreline. In Shen and Kikkawa (ed), *Application of Stochastic Processes in Sediment Transport*, Water Resources Publications, Littletion

DHI (1999), Physical modelling on wave disturbance and breakwater stability. Fuvahmulah Port Project, Port Consult, Denmark

Edmondson, C. H. (1928). *The ecology of a Hawaiian coral reef*. Bull. Bernice P. Bishop Mus. 45: 1-64.

Elliott, D., Schwartz, M., Scott, G., Haymes, S., Heimiller, D., George, R (2003), *Wind energy resources Atlas of Srilanka and Maldives*, National Renewable Energy Laboratory, USA

English, S., Wilkinson, C. and Baker, V. (1997). *Survey Manual for Tropical Marine Resources* (2nd edition), Australian Institute of Marine Science

Environmental Protection Agency (EPA) (2009), *List of Environmentally Sensitive Areas-Version 1*, EPA, Maldives

Falkland,T.(2001) Report on Integrated Water resources management and sustainable sanitation for 4 islands republic of Maldives, Male': Maldives Water and Sanitation Authority and UNICEF Maldives.

Goda, Y. (1988), *Causes of high waves at Male' in April 1987*, Dept. of Public Works and Labour, Male, Maldives,

GoM (2008), The Strategic Action Plan, National Framework for Development 2009-2013, Government of Maldives

Jokiel, P.L., Coles, S.L., Gutther, E.B., Key, G.S., Smith, S.V. and Townley, S.J. (1974) *Final Report,* EPA Project No. 18050 DDN

Kenchington, R.A., (1990) *Managing Marine Environment*, Taylor and Francis New York Inc. The Republic of Maldives, pp 184-204.

Kroon A., Ruessink B.G., Quartel S. (2008), Sediment accretion and erosion patterns of a micro-tidal sandy beach, *Journal of Marine Geology*, Vol. 250, pp. 19-33.

Loya, Y. 1978. Plotless and transect methods. In: Stoddart, D.R. and R.F. Johannes (eds). *Coral Reefs: research methods*. UNESCO, Paris: pp197-217.

Luthfee, M.I. (1995) Dhivehi rajjegeh geographygeh vanavaru (Trans: An account on geography of Maldives), Male': Novelty Printers and Publishers Maldives

Maniku, H. A. (1990) Changes in the Topography of the Maldives, Forum of Writers on Environment (Maldives), Malé

MEE (2012), Environmental Impact Assessment Regulations 2012, Maldives

MEEW (2006), Handbook on Compilation of Laws and Regulations on Protecting the Environment of Maldives, Maldives

Ministry of Environment, Energy and Water (2007), *National Waste Management Policy*, Maldives

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

Ministry of Housing, Transport and Environment (2009), *Third National Environment Action Plan - 2009-2013*, Maldives

Morner et al (2004), New Perspectives for the future of the Maldives. In *Global and Planetary Change* **40:**177–182

Naseer, A. (2003), The integrated growth response of coral reefs to environmental forcing: morphometric analysis of coral reefs of the Maldives, Halifax, Nova Scotia, Dalhousie University

Riyaz, M., Park, K.H., Ali, M., and Kan, H. (2010) 'Influence of geological setting of islands and significance of reefs for tsunami wave impact on the atoll islands, Maldives', *Bulletin of Engineering Geology and the Environment*, 69 (3), pp.443-451.

Roe D, Dalal-Clayton & Hughes, R (1995), *A Directory of Impact Assessment Guidelines*, IIED, Russell Press, Nottingham, UK

Terrados et.al. (1998). Changes in the community structure and biomass of seagrass communities along gradients of siltation in SE Asia, *Estuarine Coastal and Shelf Science* **46**, 757-68.

Salvat, B (1997). Dredging in Coral Reefs. In *Human Impacts on Coral Reefs: Facts and Recommendations*. B. Salvat, ed. Antene Museum . E.P.H.E., French Polynesia.

The United Kingdom Hydrographic Office (2005), *Admiralty Tide Tables – Indian Ocean and South China Sea*, Vol3 (NP203)

UNDP (2006), Developing a Disaster Risk Profile for Maldives, UNDP Maldives

UNEP (2005), *Maldives: Post-Tsunami Environmental Assessment*, United Nations Environment Programme

United States Environmental Protection Agency (2013), *Basic Information about regulated Drinking water Contaminants*. Updated: March 06, 2012. Viewed: August 8, 2013. < http://water.epa.gov/drink/contaminants/#Byproducts>

13 Appendices

Appendix 1: Terms of Reference

Appendix 2: Commitment letter

Appendix 3: Communication of final draft with Council

Appendix 4: Work Schedule

Appendix 5: CVs of unregistered EIA Consultant

Appendix 6: Council receipt

203-EIARES/FNK/2016/29

Terms of Reference for Environmental Impact Assessment for Seawater Cooling System for Generators at Addu Central Power Station, Hithadhoo, Addu City

The following is the Terms of Reference (ToR) following the scoping meeting held on *3/04/2016* for undertaking the EIA for Development of Seawater Cooling System for Generators at Addu Central Power Station at *Hithadhoo* , Addu City. The Proponent of this project is **Fenaka Corporation Limited.** While every attempt has been made to ensure that this TOR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report.

1. **Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project.

2. **Study area** – Submit a minimum A3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). 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 categorised 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):

   - Sea water cooling system design
   - Submit an A3 size plan with appropriate labels and scale;
   - Describe technology to be used for the cooling system
   - Water quality monitoring
   - Describe operations of borehole construction and pipeline installation
   - Specify materials, equipment, heavy machinery, staff estimate (quantity and period of time), key personnel positions, technical expertise required;
   - 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, waste management from construction operations (mainly dredged materials), power and fuel supply;

Outfall pipeline

- Justify outfall site selection including the distance from shore using oceanographic and ecological information. Currents and waves ought to disperse the discharged water with minimum impacts on marine ecosystems and economic activities.
- Describe equipment needed and construction methods for laying the offshore pipeline including handling transportation.

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

The baseline data will be collected before construction and from at least two benchmarks.

All 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.

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

- Rainfall data to measure infiltration and wind including extreme situations, and

Geology and geomorphology

Offshore/coastal geology and geomorphology (use maps);

- Bathymetry(at the proposed outfall location)
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction.

Hydrography/hydrodynamics (localized maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents (north, south, east, west, NE, SW, NW, SE);
- Wind induced (seasonal) currents;
- Sea water quality measuring these parameters: temperature, pH, salinity TSS, TDS and Turbidity.

* The overall outcome of collecting this data is to find the optimum site selection for the outfall pipeline. Sediment transport patterns estimated through hydrologic data is essential for predicting the extent of discharge plume. Maps indicating the extent of sediment plumes are required and. included should be the potential marine ecosystems which could be impacted.

**All survey locations shall be referenced with Geographic Positioning System (GPS) including sampling points and reef transects. All water samples shall be taken at a depth of 1m from the mean sea level or mid water depth for shallow areas. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

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). Include description of commercial species, species with potential to become nuisances or vector. Include map;
- Marine habitat status including coral reef health, seagrass beds and benthic and fish community description around the island. Select a control site far from the outfall location and a test site at representative distances from the outfall discharge site;

- Include ground water monitoring (See appendix for parameter healthy ranges);
- Vegetation Clearance;

Socio-economic environment

- Demography: total population, sex ratio, density, growth;
- Economic activities of both men and women (e.g. fisheries, home gardening, fish processing, employment in industry, government);
- Community needs;
- Sites with historical or cultural interest or sacred places (mosques, graveyard).

Groundwater Aquifer

- Assess the quality of aquifer for physical, chemical and biological parameters such as pH, Salinity, E. Conductivity, Total Hydrocarbon

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

- Ground water quality;
- Vegetation Clearance;

Impact from installing the outfall pipe

- Impacts from marine habitat destruction which may affect fish stocks and species diversity and density of invertebrates.
- Increased turbidity and changes in sediment transport due to pipe introduction when pipe is on the sea bed;
- Equipment, technical and spillage impacts during construction;

Operational phase impacts from outfall discharges

- Marine ecosystem impacts from changes in temperature at outfall site

Social impacts:

- Odor and noise impacts;

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

Task 5. Alternatives to proposed project – Describe alternatives including 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 was determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. This should include alternative location and pipe length for brine discharge.

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. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for:

- Physical parameters such as ground and sea water quality assessments and oceanographic studies. (See appendix for acceptable water quality ranges and suggestions on oceanographic monitoring required).
- Biological parameters such as terrestrial monitoring, coral reef and benthic monitoring, fish community census and terrestrial monitoring (See appendix to follow guidelines).

Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – EIA report should include a list of people/groups consulted and what were the major outcomes.

-Addu City Council

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

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

....

03rd April 2016

Environmental Protection Agency
Green Building, 3rd Floor, HandhuvareeHingun
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

بسم الله الرحمن الرحيم

FENAKA CORPORATION LIMITED

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ފިލާލީ ބާގު

FNK-F/203/2016/

Environmental Protection Agency
Male'
Republic of Maldives

16th May 2016

Dear Mr. Ibrahim Naeem,

Re: Environmental Impact Assessment for Adducity Hithadhoo Seawater cooling system

As per the requirements of the EIA regulation, we hereby confirm our commitment to implement the mitigation measures according to what is proposed in the EIA report attached herewith.

Yours Sincerely,

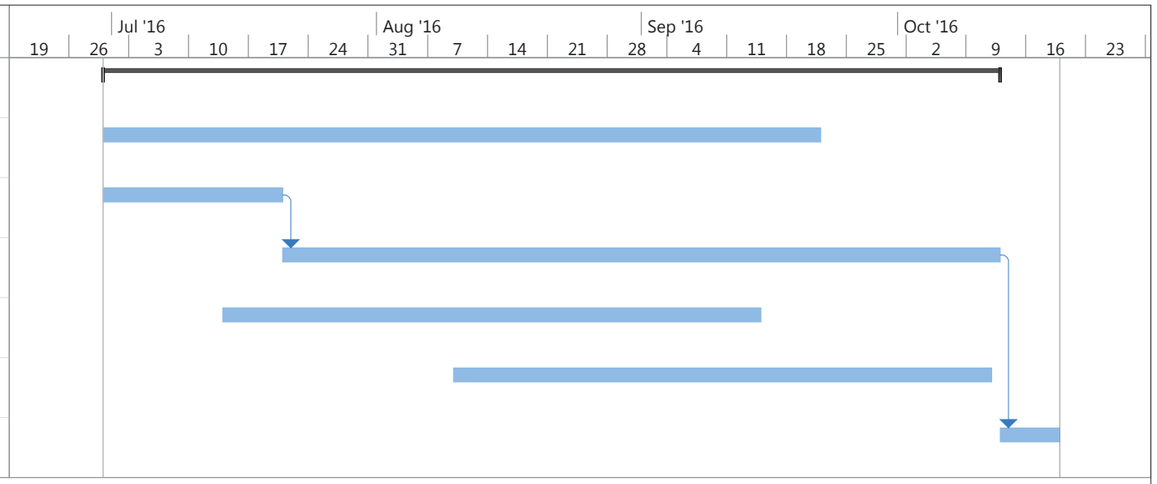
Abdulla Nashith

Director

Fenaka Corporation Limited
Ports Complex Building 7th Floor, Hilaalee Magu
Male' 20307, Republic of Maldives
Tel: [960] 300 7555 : ގުޅުއްވުން
Fax: [960] 332 7555 : ފެކްސް

ފެނަަކަ ކޯޕަރޭޝަން ލިމިޓެޑް
ފޯރޓްސް ކޮމްޕްލެކްސް ބިލްޑިންގ، 7 ވަަނ ފަންގިފިލާ، ފިލާލީ ގަ
ގުދު 20307 ، ދިވެހިރާއްޖެ
Email: info@fenaka.com.mv : ބްރައުޒް
Website: www.fenaka.com.mv : ވެބްސައިޓް

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			**Sea water cooling system for the central power station in Addu City**	**75 days**	**Thu 6/30/16**	**Wed 10/12/16**	
2			Procurement of materials	60 days	Thu 6/30/16	Wed 9/21/16	
3			Mobilisation	15 days	Thu 6/30/16	Wed 7/20/16	
4			Borehole works	60 days	Thu 7/21/16	Wed 10/12/16	3
5			Pipe line	45 days	Thu 7/14/16	Wed 9/14/16	
6			Reject line works	45 days	Wed 8/10/16	Tue 10/11/16	
7			Testing and Comissioning	5 days	Thu 10/13/16	Wed 10/19/16	4



Project: Project1
Date: Wed 5/11/16

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

1.	**NAME**	:	Mohamed Ibrahim Jaleel
2.	**DATE OF BIRTH**	:	9 May 1991
3.	**CITIZENSHIP**	:	Maldivian
4.	**PERSONAL ADDRESS**	:	V.Edhuruvehi Male'
5.	**TELEPHONE NO.**	:	(960)9768999
	E-MAIL ADDRESS	:	Mohamed.ibrahimjaleel@hotmail.com
	EDUCATION	:	General Certification of Education, (GCE) Ordinary Level. In 2007 (Science stream) General Certification of Education (Edexcel), in Advance Level. In 2010 (Science stream) Certificate in Project Management from Clique collegue Bachelor's Degree on Environmental Management from the Maldives National University. Masters in Research Studies from Villa College (Ongoing)
6.	**OTHER TRAINING**	:	Graphics designing short course from IBI Took part in lecture series held by IUCN Maldives on various conservation issues and opportunities in the Maldives Training on preparation of EMMP under the MGCC project of USAID

7. **LANGUAGE & DEGREE OF PROFICIENCY** :

	Speaking	**Writing**	**Reading**
English	Excellent	Excellent	Excellent
Dhivehi	Mother tongue	Mother tongue	Mother tongue

8. **MEMBERSHIP IN CIVIC AND PROFESSIONAL SOCIETIES** : Registered EIA consultant (T01/15)

9. **Referees** :

- Hussain Hameez – Director, Fenaka Corporation.
- Ahmed Zahid – Managing Director of Sandcays Pvt. Ltd. (7781535)
- Aishath Ali – Registrar of the Maldives National University (7786167)
- Shaheeda Adam Ibrahim – Director General of Water and Sanitation department, MEE. (3018381)

10. EMPLOYMENT RECORD :

FROM: **Jan 2015**
EMPLOYER
POSITION HELD AND
DESCRIPTION OF DUTIES

TO: **Present**
Fenaka Corporation, Utilities Services Division
Assistant Director.

- Overseeing all the water and sanitation related projects under the company
- Overseeing all the water and sewer systems operated under the company.
- EIA consultant for the company.

FROM: **Jan 2015**
EMPLOYER
POSITION HELD AND
DESCRIPTION OF DUTIES

TO: **May 2015**
Ministry of Environment and Energy, Water and Sanitation Department
Assistant Director.

- Overseeing all the donor related water and sewerage projects.
- Manage and supervise the implementation of project work on a daily basis.
- Administrative and Policy related works of the sector.

FROM: **Feb 2014**
EMPLOYER
POSITION HELD AND
DESCRIPTION OF DUTIES

TO: **January 2015**
Sandcays Pvt. Ltd.
Research assistant. Assisting in environmental research, environmental surveys and monitoring, drafting of EIA/ESIA reports and other documentation.

FROM: **2011**
EMPLOYER
POSITION HELD AND
DESCRIPTION OF DUTIES

TO: **2011**
Ministry of Health and Gender
Child care supervisor (full time). Monitoring and reporting the actions of the child care officers and the needs of the children in Kudakudhinge hiyaa. Carrying out and planning various activities that are necessary for the growth and development of the children. Formulating the annual and the monthly schedule for the children and the child care workers. Attending to emergencies and accidents that occur within the kudakudhinge hiya sector.

FROM: **2011**
EMPLOYER
POSITION HELD AND
DESCRIPTION OF DUTIES

TO: **2012**
Maldives National University
Admission and Registration officer. Carrying out the respective works of the admission and registration section of the Maldives National University.

12. RELEVANT WORK EXPERIENCE

Project Name	:	**Study and EIA for proposed Reclamation and Resort Development on K. Tholhimarahura**
Client	:	**J Lagoons pvt. Ltd.**
Period	:	**Sep** 2014 Time Spent: 4 week
Position Held	:	Research assistant
Duties	:	Assisted in drafting/compiling of report

Project Name	:	**Study and EIA for proposed STP for Alimatha Aquatic Resort, Vaavu Atoll**
Client	:	**Alimatha Aquatic Resort**
Period	:	**Aug** 2014 Time Spent: 3 week
Position Held	:	Research assistant
Duties	:	Assisted in drafting/compiling of report

Project Name	:	**Survey and EIA for proposed STP for Mayaafushi Island Resort, Alif Alif Atoll**
Client	:	**Mayaafushi Island Resort**
Period	:	**Aug** 2014 Time Spent: 3 week
Position Held	:	Research assistant
Duties	:	Assisted in drafting/compiling of report

Project Name	:	**Study and EIA for proposed STP for Diggiri Tourist Resort, Vaavu Atoll**
Client	:	**Dhiggiri Tourist Resort**
Period	:	**Aug 2014** Time Spent: **3 week**
Position Held	:	Research assistant
Duties	:	Assisted in surveying activities and drafting/compiling of report.

Project Name	:	**Survey of Ensis RO plant Registration, Hulhumale'**
Client	:	**Ensis Pvt. Ltd.**
Period	:	**Aug 2014** Time Spent: **2 days**
Position Held	:	Research assistant
Duties	:	Assisted in surveying activities

Project Name	:	**Study and EIA for proposed Resort development project in Kanbaalifaru, Shaviyani Atoll**
Client	:	**Kanbaalifaru Investments Pvt. Ltd.**
Period	:	**June 2014** Time Spent: **4 weeks**
Position Held	:	Research assistant
Duties	:	Assist in the drafting/compiling of the EIA report based on previous work

Project Name	:	**Study and EIA for the proposed Water Supply system in HA. Thuraakunu**
Client	:	**Upper North Province Council**
Period	:	**June 2014** Time Spent: **3 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in the drafting/compiling of the EIA report based on previous work

Project Name	:	**As built Survey of B. Kihaadhufaru Resort**
Client	:	**Ibsun pvt.ltd**
Period	:	**May 2014** Time Spent: **1 week**
Position Held	:	**Research assistant**
Duties	:	Responsible for the survey equipment, assisted in all surveying activities

Project Name	:	**Survey of H.Marvel EIA**
Client	:	**Adam Saleem**
Period	:	**May 2014** Time Spent: **1 day**
Position Held	:	**Research assistant**
Duties	:	Assisted in survey of the EIA report based on previous work

Project Name	:	**Study and EIA for proposed Coastal protecton of Paradise Island Resort, North Male' Atoll**
Client	:	**Diza Travels and Trade Pvt.Ltd**
Period	:	**April 2014** Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in the drafting/compiling of the EIA report based on previous work

Project Name	:	**Study and EIA for proposed Resort development project in Maareha, Gaaf Alif Atoll**
Client	:	**Moving International Pvt.Ltd**
Period	:	**April 2014** Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in the drafting/compiling of the EIA report based on previous work

Project Name	:	**ESIA for five schools under Enhancing Education Development Project**
Client	:	**Ministry of Education**
Period	:	**February 2014** Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in compiling socio-economic profiles of islands and review of ESIA report

Project Name	:	**EIA for proposed harbour rehabilitation in Holudhoo, Noonu Atoll**
Client	:	**Maldives Transport and Contacting Company (MTCC)**
Period	:	**March 2014** Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in the drafting/compiling of the EIA report based on previous work

Project Name	:	**EIA for proposed harbour Construction in Dhangethi, Alif Dhaal Atoll**
Client	:	**Maldives Transport and Contacting Company (MTCC)**
Period	:	**March 2014** Time Spent: **2 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in drafting/compiling the EIA report

Project Name	:	**EIA for proposed Airport Development at Dh.Kudahuvadhoo**
Client	:	**Reollo Investments**
Period	:	**March 2014** Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in drafting/compiling the EIA report. Carried out monitoring surveys in the implementation phase.

Project Name	:	**Survey for L. Maamendhoo Sewerage project**
Client	:	**Fenaka**
Period	:	Time Spent: **1 weeks**
Position Held	:	**Research assistant**
Duties	:	Carried out the survey for the initial concept design of the project, which included taking the block level survey of as built and the levels (elevation) survey for the island.

Project Name	:	**OFID (Phase 1) Provision of Water Supply Facilities 04(Four) Island and Sewerage Facilities in 05 (Five) Island, Maldives**
Client	:	**OFID**
Period	:	Time Spent: **2 weeks**
Position Held	:	**Research assistant**
Duties	:	Team leader responsible for overseeing all the project activities and issues

Project Name	:	**EMP for the proposed project to update the STP in Dhiggiri Resort**
Client	:	**Aqua Solutions**
Period	:	Time Spent: **2 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in drafting/compiling the EIA report. Carried out monitoring surveys in the implementation phase.

Project Name	:	**Survey and EMP for the proposed project to update the STP in Mayaafushi Resort**
Client	:	**Aqua Solutions**
Period	:	Time Spent: **2 weeks**
Position Held	:	**Research assistant**
Duties	:	Assist in drafting/compiling the EIA report. Carried out monitoring surveys in the implementation phase.

Project Name	:	**Survey and EIA for the proposed Phase (2) of Niyaama Resort**
Client	:	**Niyaama Resort**
Period	:	Time Spent: **4 weeks**
Position Held	:	**Research assistant**
Duties	:	Was involved in the survey activities and carried out all the respective works of drafting/compiling the EIA report.

Project Name	:	**OFID Loan phase 2 – Water Supply and Sewerage Project (04 Island Sewerage, 10 Island Water Supply Facilities and 29 Island RO Installation and Storage Enhancement)**
Client	:	**OFID**
Period	:	Time Spent: **To May 2015**
Position Held	:	**Assistant Director**
Duties	:	Managing the project as team leader, preparation and review of bids and proposals, evaluation reports and drafting of contract documents.

Project Name	:	**IDB – Sanitation in Five Island Project**
Client	:	**IDB**
Period	:	Time Spent: **To present**
Position Held	:	**Assistant Director**
Duties	:	Managing the project as team leader, preparation and review of bids and proposals, evaluation reports and drafting of contract documents.

Project Name	:	**Water supply project (UNOPS) in Lh. Hinnavaru with the inclusion of awareness component (CHEMONICS)**
Client	:	**USAID**
Period	:	Time Spent: **To May 2015**
Position Held	:	**Assistant Director**
Duties	:	Team leader responsible for overseeing all the project activities and issues

Project Name	:	**KUWAIT FUND water supply project in Gn.Fuvahmulah**
Client	:	**KUWAIT FUND**
Period	:	Time Spent: **To May 2015**
Position Held	:	**Assistant Director**
Duties	:	Managing the project as team leader, preparation and review of bids and proposals, evaluation reports and drafting of contract documents.

Project Name	:	**National water awareness campaign**
Client	:	**MEE**
Period	:	Time Spent: **To May 2015**
Position Held	:	**Assistant Director**
Duties	:	Team leader responsible for overseeing all the programme activities and resolve any setbacks.

Project Name	:	**Establishment of water supply services in all the islands of Addu city**
Client	:	**MEE**
Period	:	Time Spent: **To present**
Position Held	:	**Assistant Director**
Duties	:	Responsible for overseeing all the project activities and issues

Project Name	:	**Design and Built of Sewer Systems in the islands of Th.Buruni, Th.Madifushi**
Client	:	**MEE**
Period	:	Time Spent: **To present**
Position Held	:	**Assistant Director**
Duties		Responsible for overseeing all the project activities and issues

Project Name	:	**Design and Built of Sewer Systems in the islands of L.Maamendhoo**
Client	:	**MEE**
Period	:	Time Spent: **To present**
Position Held	:	**Assistant Director**
Duties	:	Responsible for overseeing all the project activities and issues

Project Name	:	**Provision of Sewer service in Addu city, Hithadhoo, central area**
Client	:	**MEE**
Period	:	Time Spent: **To present**
Position Held	:	**Assistant Director**
Duties		Responsible for overseeing all the project activities and issues

13. CERTIFICATION:

I, THE UNDERSIGNED, confirm that to the best of my knowledge, this CV correctly describes me, my qualifications and my experience

Mohamed Ibrahim Jaleel

Print | Close Window

Subject: EIA for Addu sea water cooling system
From: faiha@sandcays.com
Date: Mon, May 23, 2016 6:45 am
To: secretariat@adducity.gov.mv, hilmy@adducity.gov.mv, mayor@adducity.gov.mv
Cc: "Ahmed Zahid" <zahid@sandcays.com>, azmeel@sandcays.com
Attach: EIA for Addu Powerhouse Cooling System.pdf

Dear Sir/ Madam,

Attached please find the EIA for Addu sea water cooling system for your kind perusal.

Kind Regards,
Faiha

Faiha Ahmed
Sandcays Pvt. Ltd.
H. Alihuras
Lonuziyaaraiy Magu
Malé, Maldives
Mobile: (960)7908900/ 3307675
Fax: (960)3009799