Environmental Impact Assessment

report for

the Proposed Male' Port Extension Project

Maldives Ports Authority

GOVERNMENT OF MALDIVES

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Prepared by:

energy CONSULTANCY

Title	**Environmental Impact Assessment Report for the Proposed Male' Port Expansion Project**
Location	**North West Side of Male'**
Prepared for	**Maldives Ports Authority**
Prepared by	**Energy Consultancy Pvt Ltd.**
Authors	**Zahid, Ahmed Inaan, Mohamed Abdul Latheef, Mohamed Ali**
Scope	**This Environmental Impact Assessment Report forms part of the process of planning and decision making for the proposed Male' Port Expansion Project. Its purpose is to present the findings of the EIA process for review by stakeholders and Authorities. In particular, it will:** • **Identify any interactions between the proposed Port Expansion area and the environment;** • **Consider which of these aspects, if any, are likely to have a significant impact on the environment; and** • **Recommend measures that will enhance any positive impact and avoid any adverse negative impact, and if the latter cannot be avoided, to reduce its impact and ensure adequate protection during construction and operation of the proposed fish market.**
Date	**December, 2006**
Acknowledgement	**The authors would like to acknowledge the support of Mr. Ashraf Hameed, deputy director of Maldives Ports Authority.**

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8.Project Description

The capital island, Male', is the major transport hub for the country. The only international airport is located on an island adjacent to the capital while the majority of all international maritime cargo also enters and leaves the country through the Port of Male'. From the Male' the other islands are served by small crafts. Smaller ports have been established at Kulhudufushi and Hithadhoo, respectively in the north and south of the country. However, these have yet to begin large scale operations. Compared to the major ports around the world, throughput is limited at Male' port and totaled 30,000 TEU in 2005, with an additional 250,000 tons of break-bulk cargo passing through the port.

The current port facility in Male' was opened about 10 years ago and was constructed under a project financed by Asian Development Bank (ADB) to improve services and to increase port capacity at Male' Commercial Port. The project scope included (i) construction of an alongside berth to service vessels up to 6,000 deadweight tons; (ii) ancillary works covering pavement, pier reclamation, utility extension, seawall rehabilitation, and construction of a marine workshop; (iii) provision of cargo handling equipment, port service craft, workshop tools, and navigation aids; and (iv) consulting services for detailed design, preparation of tender documents, implementation administration, institutional strengthening of the Maldives Ports Authority (MPA), construction supervision, and a planning study.

The Project was implemented with an expansion in the project scope to extend construction of the alongside berth from 70 meters to 101 meters, and to purchase a 45-ton stacker and additional 25-ton forklift.

The operational performance of the project in terms of the improvement in ship turnaround times, meeting demand forecasts, capacity utilization, and effectiveness of the project in relieving congestion constraints was assessed by ADB in 2000. Before the project, all cargo was transferred through the port docks were by barges to and from ships at anchor. The introduction of an alongside shipping berth avoided the necessity for double handling between ship and the dock area.

Before the Project in 1991, the average turnaround time for foreign cargo vessels was 18.5 days. With completion of the Project in 1997, the average turnaround time was 11.5 days against an expected 13.5 days. Total cargo throughput was 273,000 freight tons in 1991 and was projected, at appraisal, to increase by 7.5

percent per annum to 420,000 freight tons in year 2000, and thereafter at a slower rate of increase to 765,000 tons in 2010. Actual cargo throughput reached 855,000 freight tons in 1999, which was more than double the forecast. The increase on projected cargo volumes was significant for both imports and exports. Exports, which were not expected to be more than 5,000 freight tons, reached 173,000 freight tons in 1997. The increase was due to the enhanced competitiveness of fish exports and the advantages of the project berth facility, which ensured temperatures in reefer containers for chilled and frozen fish, were kept within allowable limits. On completion of the Project, the number of berths available for lighterage were reduced from 8 to 5. With cargo growth, maximum handling capacity of the lighter system of around 320,000 freight tons was expected to be reached by the end of 1997. Actual cargo handled by lighter was consistent with the appraised forecasts and equivalent to 312,000 freight tons.

The increase in cargo throughput over the projected capacity limit was made possible by increasing the number of stevedore gangs and utilizing the advantages of additional lifting equipment provided under the Project. Containerized cargo as a proportion of total cargo throughput increased from 12 percent in 1991 to 27 percent in 1997. Actual container traffic in terms of Twenty-Foot Equivalent Units (TEU) grew from 2,690 TEU in 1991 to 16,230 TEU in 1999, and represented an increase of 29 percent per annum. The increase was due to the inherent advantages of freighting cargo housing containers, and improved handling operations attributable to the Project.

Associated with the increased trend to containerization, there was an increase in the number of ship calls and slight trend to larger vessels. There were 202 ship calls before the Project in 1991 and 438 ship calls in 1999. While project operating performance exceeded forecasts, congestion over the wharf area is again increasing because of the (i) limited storage areas for containers, (ii) narrowness of entry and exit roads, and (iii) lengthy dwell time between emptying and refilling containers. All shipping agents interviewed by the Operations Evaluation Mission (OEM) of ADB pointed out the need for additional alongside berthing and expansion of the storage aprons.

Capacity-handling limits of the lighter berth system have been reached at the port, and berth occupancy at the alongside berth is a high average 87 percent. Maximum handling capacity at the alongside berth had reached in 2002. The port's capacity-handling limits had deteriorated handling efficiency as storage and transfer areas on the wharf area became fully utilized.

The existing facility in Male' Port is beyond its workable capacity. In part this is due to the terminal area behind the quay is used to store containers for relatively long periods and to stuff and trip containers (***figure 3***).

Figure 3: Containers are stored for relatively long periods in the existing Port in Male'.

Project Performance Audit Report On The Second Male' Port Project In The Maldives, 2000, has pointed out that, Port handling capacity can be increased by constructing a second alongside berth, and expanding the wharf and storage areas over the commercial harbor basin. The higher cargo throughput has served to bring forward the need for further expansion of the port.

The actual cargo throughput has been much higher than forecast and the continued sustainability of Second Male' Port Project (SMPP) benefits is linked to handling capacity of the port. The engineering design for the SMPP was made bearing in mind technical expansion requirements and hence there are no serious engineering issues related to the expansion of existing port, the government of Maldives has proposed to expand the port by reclaiming the Male' Commercial Harbour basin. This decision was made by the management committee of Maldives Ports Authority and the Male' Port Expansion Project was later approved

by the President's office. According to the Maldives Ports Authority, the proposed project would provide cargo handling capacity for about 5 years.

The owner of the proposed Male' Port Expansion Project area is government of Maldives. According to MPA, all concerned stakeholders were consulted, including the Ministry of Environment, Energy and Water, Ministry of Construction and Public Infrastructure, Ministry of Planning and National Development, Ministry of Housing and Urban Development and Ministry of Fisheries and Agriculture; regarding the Male' Port Expansion Project.

The location for the project was chosen by Maldives Ports Authority's Management Committee. No other alternative location had been considered for the Male' Port Expansion Project, since the existing facility was designed and constructed keeping in mind that the port might be expanded in the future. As with the existing port, MPA will have overall responsibility to operate, maintain and monitor the project during both the construction and in operational phase.

Male' Commercial Port Expansion Project is divided into 4 phases. The phases are; Dredging, Sheet pilling, Reclamation and, Paving and Drainage. Already the dredging phase of the project has been completed. It is estimated that, it will take about 4 months for sheet pilling. Reclamation is expected to be completed within 6 months. Before paving and drainage is completed, the reclaimed area will be left for about one year. It is estimated it will take about 6 months for paving and drainage work.

Annex 2 shows the **Scaled site and Architectural plan**. The estimated cost for the proposed Male' Commercial Port Expansion Project is about MRF58, 794,495.55. ***Table 1*** shows the estimated cost for different components of the project. Reclamation of the site is expected to begin once the outcome of the EIA report is made available.

The proposed Male' port expansion project would cover an area of about 2786m^2. It is estimated that the reclamation will require 95,496.00m^3 of material (sand) to fill the area. After consulting with the Ministry of Environment, Energy and Water, it is planned to obtain filling materials (dredged sand) from Vilufushi. Major raw materials which will be used for the proposed project includes sand (dredged sand), cement, sheet piles, anchor piles, Wales, Tie rods, steel plates, timber and plywood. It is estimated that for lean concrete, it would cover an area of about 66 m^2 and for capping beam and bollard foundation it would require about 320 m^3 of concrete.

Table 1: The costs involved for different components of the project.

Description of Components	Amount (MRF)
Reclamation	8,813,782.05
Sheet pilling and coastal protection	19,100,000.00
Transport	12,800,000.00
Hydraulics and drainage	1,000,000.00
Paving	11,000,000.00
Fire fighting	3,500,000.00
Lighting	2,128,000.00
Municipality	452,713.50
Total Amount (MRF)	**58, 794,495.55**

Source: Maldives Ports Authority

The Male' Port Expansion Project (MPEP) will facilitate easy excess by the vessels to the port for loading and unloading of cargoes. In addition to this, with the completion of the project, the port will have much more space for container handling and storage capacity.

State Electric Company (STELCO) electricity is available from the site; therefore electricity from STELCO will be used for construction. Water from Male' Water and Sewerage Company Pvt. Ltd. (MWSC) will be used for construction. It is estimated that, for the construction a total 450,500 Litres and 108,400kWh of water and energy will be required respectively. During the operation of proposed expansion port area and for the existing port area, electricity will be provided by STELCO. However, MPA is planning to have own power house and would provide estimated energy for MPA premises. It is estimated that port (both existing and proposed facilities) would consume about 506,800kWh of energy per month during operation. The power house would meet the regulations of Maldives Energy Authority. During operation, the port is expected to consume about 1.9 million Litres of water, every month and will be supplied by MWSC.

The project will generate waste during construction and in operational phase. These wastes should be managed effectively. Some of the solid wastes which maybe generated from construction are shown in ***Table 2.*** The wastes which are likely to generate from operation of the port are food items (vegetables), garbage, metals, and paper and their estimated quantities are shown in ***Table 3.***

Table 2: Estimated waste generation during construction

Material	Quantity
Concrete	1 tons
Clean Wood Scrap	0.5-1 tons
Scrap Metal	0.5-1 tons
Empty cement and river sand bags	0.25 tons
All other wastes	1-2 tons

Table 3: Estimated Waste generation during operational phase of port

Material	Quantity / monthly
Food items (vegetables)	20 tons
Garbage	10 tons
Metals	5-8 tons
Paper	3-5

During construction phase, it is unlikely that the project will generate wastewater. The project will not generate wastewater directly. The only wastewater will be from runoff from rain. The project is designed in such a way that the runoff will not go to the ocean or sea directly. Instead, the runoff from the port expansion area will go to Male' drainage system. ***Annex 3*** shows the proposed drainage system for the area.

The odour condition at the existing port is not an issue. As with the existing port, it is unlikely that the port expansion project and its facilities will result in odour during both construction and operation. During construction noise will be generated from machineries and both land vehicles and sea vessels. On the other hand, during operation, noise is likely be generated from land vehicles, machineries and cargo vessels visiting the port.

As indicated in Table 1, the port expansion project also takes into consideration of fire events. The expansion port area will have fire alarm system certified by Fire Safety and Rescue Services of Maldives National Defence Force.

8.1. Waste Management Plan

Special considerations should be given to minimize generation of waste during construction and in operation. The waste which will be generated during

construction and in operational phase should be managed effectively. An efficient system for collection and delivery of waste to designated disposal facilities should be arranged.

As a general rule, during the construction and operational phase the related procedures and guidelines of Male' Municipality, Ministry of Environment, Energy and Water, and Ministry of Construction and Public Infrastructure should be strictly followed.

8.1.1 Project Waste Handling

The following charts identify waste materials expected on this project and handling procedures.

Construction Phase

Material	Quantity	Handling Procedure
Concrete	1 tons	Break up any wastes or mistakes and put in appropriate bin and dispose in designated areas
Clean Wood Scrap	0.5-1 tons	Stack reusable pieces for reuse. Place unusable clean wood in wood recycling dumpster
Scrap Metal	0.5-1 tons	Deposit all metals in metal dumpster
Empty cement and river sand bags	0.25 tons	Collect and dispose into Male' waste management centre
All other wastes	1-2 tons	Collect in clearly labeled bins and should be disposed off the site

Operational Phase

Material	Quantity / monthly	Handling Procedure
Food items (vegetables, fruits, etc.)	20 tons	Collect in clearly labeled bins and should be disposed off the site
Garbage	10 tons	Collect in clearly labeled bins and should be disposed off the site
Metals	5-8 tons	Collect in clearly labeled bins and should be disposed off the site
Paper	3-5 tons	Collect in clearly labeled bins and should be disposed off the site

In no case should waste of any kind be discharged into the water without inspection and explicit permission from relevant authorities. Food wastes, maintenance work wastes, and cargo-associated wastes can be disposed of through the local agent on the Ship Master's request.

8.2. Communication Plan

- Waste prevention and recycling activities should be discussed at the beginning of each safety meeting.
- As each new subcontractor comes on-site, the project coordinator should present him/her with a copy of the Waste Management Plan and provide a tour of the waste collection and treatment areas.
- The subcontractor should be expected to make sure all their laborers comply with the Waste Management Plan.
- All containers should be clearly labeled.
- Lists of acceptable/unacceptable materials should be posted throughout the site.

8.3. Other Features

Although there are no direct enhancement features associated with the proposed port expansion project, there are many socioeconomic benefits attributed to the project including improved working conditions for port labor and improved cargo-handling productivity. Some of the facilities would require increased skill levels and would result in increased opportunities for higher paid employment. Indirectly, this would attract investment to the Maldives, which in turn will generate spin-off benefits for gainful employment. It is expected that once the project is completed, the port would facilitate to handle throughput of 55,000 TEU's per year and would minimize turnaround time.

It is expected that the project would provide employment opportunity for about 25 people during sheet piling. During reclamation additional 35-40 will be employed. Currently a total of about 500 labours work for the MPA. It is expected that after the completion of the project, it would provide one-third of the existing workforce of MPA.

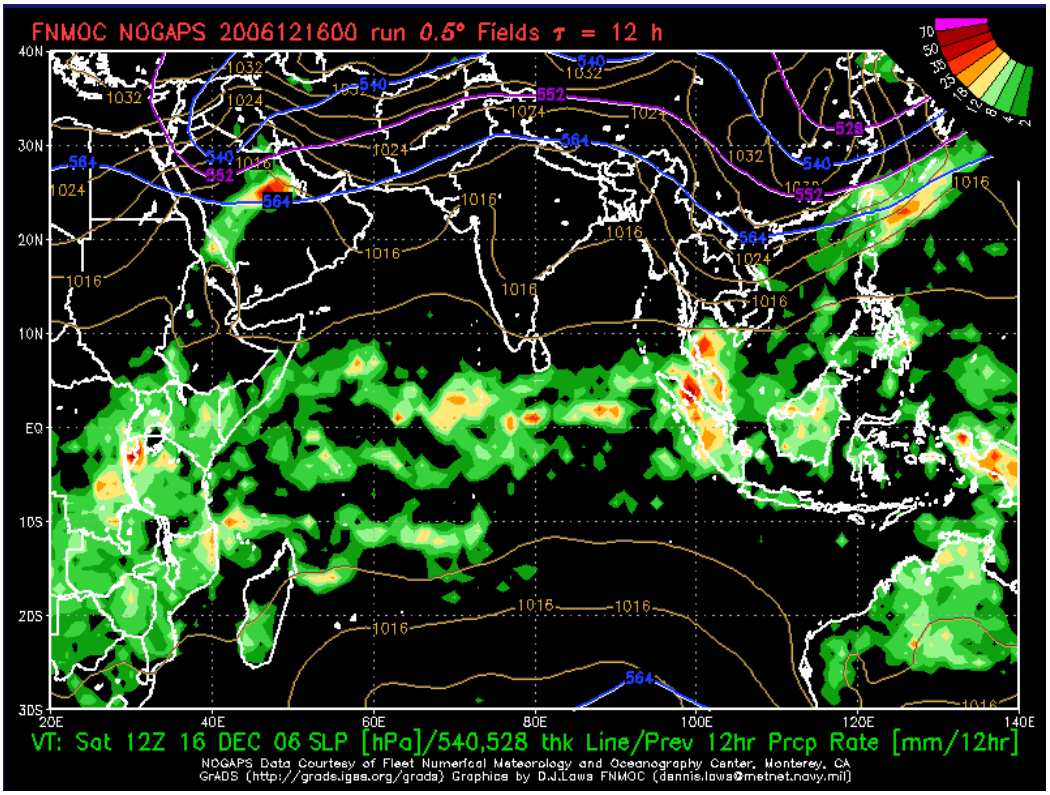
The work plan of the site preparation for the reclamation of port area is designed in a way it will have least social impact. In this regard, existing loading and unloading area of the port will be relocated to other areas (***Figure 4***) during the implementation of the project. One of the most noticeable sustainable Environment Management System adopted for the operation of the project is to use of low energy consumption utilities for lighting. On the other hand, one of the most noticeable environmental considerations which would be implemented during the construction phase is to use dredged sand which was obtained from another location.

Figure 4: Temporary loading and unloading area for construction phase.

8.4. Climate

Climatology of Central parts of the Maldives indicates that the proposed area will experience about 215mm of rainfall on average from September to November. On the other hand, from December to April the location is expected to receive 113mm of rainfall on average. Further more, the same area is expected to receive 205mm of rainfall on average from May to August. ***Figure 5*** shows the rainfall pattern for the Maldives area on 16th December, 2006.

Figure 5: Rainfall pattern for the Maldives area for 16 December 2006



Central parts of the Maldives indicate wind speed of 12 mile per hour (mph) from May to October, while other months indicate wind speed of 9mph, on average. ***Figure 6*** shows the wind pattern for Maldives area for the 16th. Current in the channels around Male' have been recorded at 4.6mph or more. Inside the Atoll, water current is more settled. During the seasonal transition months of April and November, when the wind direction and oceanic currents are less predictable, current is more likely to be influenced by the tides and similarly flow both in and out of the channels. ***Figure 7*** shows the wave height and direction for the Maldives area on 16th December, 2006. Since different phase of the project is expected to last for months, *heavy rainfall and high wind speed might delay the construction process*.

Figure 6: Wind Speed and direction pattern for the Maldives area for 16 December 2006

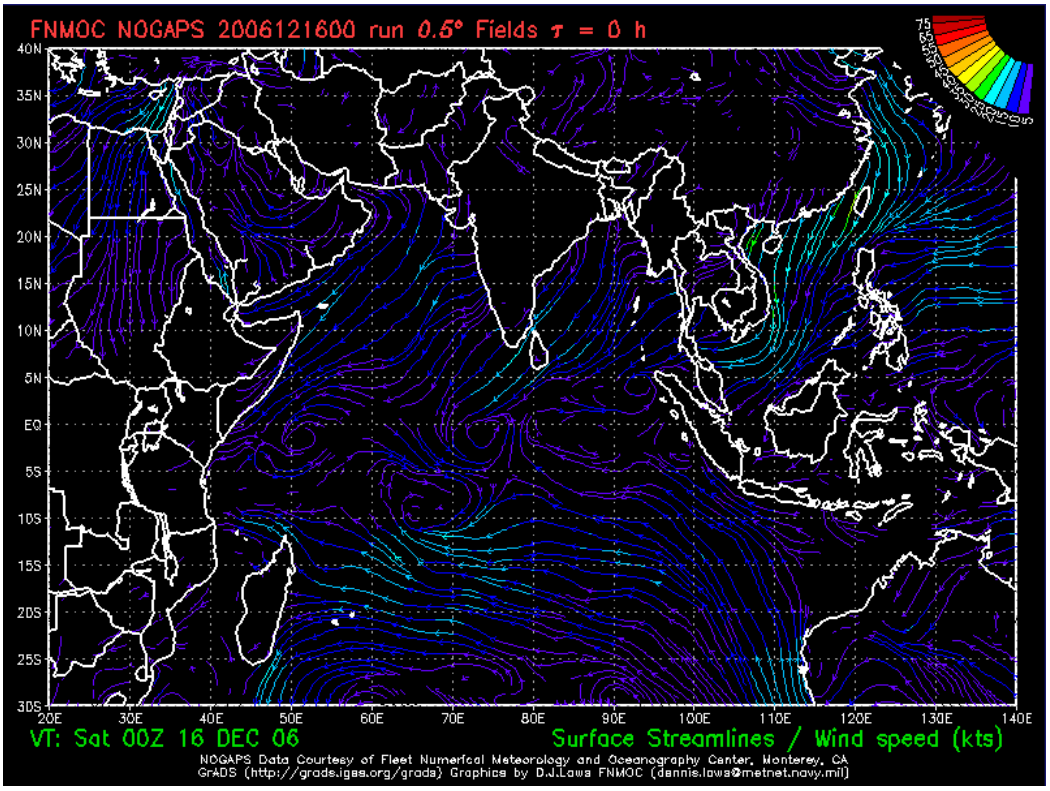
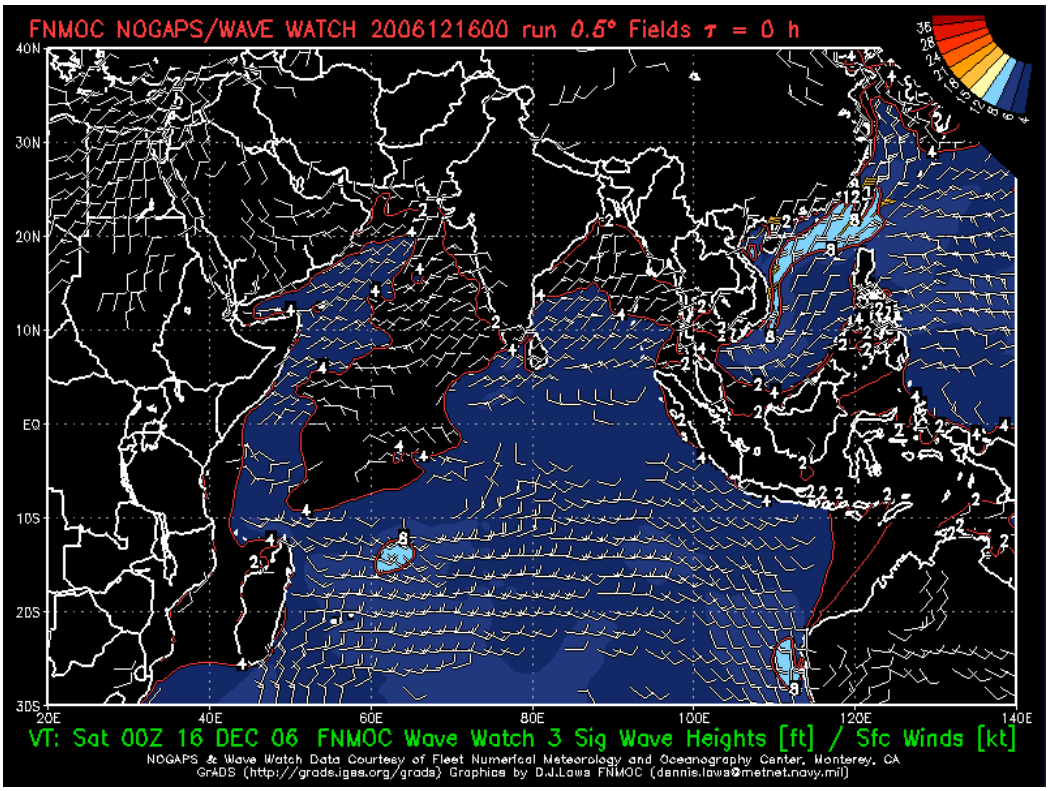


Figure 7: Wave height and direction for the Maldives area for 16 December 2006



1.Executive Summary

This Environmental Impact Assessment (EIA) report is prepared by Energy Consultancy Pvt. Ltd. for Maldives Ports Authority (MPA) for the planned expansion of their Male' port.

Male' Port is located along the Northern side of Male'. It is proposed to expand the existing port in order to cater the increasing number of cargo vessels which arrives MCP. It is planned to expand the port by reclaiming the harbour area. Extensive and unplanned development in this location will result in a variety of environmental issues such as seawater pollution, loss of marine life and habitat.

The government has made it mandatory to conduct EIA's for projects involving an extensive development in sea area (such as reclamation, dredging, etc.).

Proposed Port Expansion Project may create a wide range of impacts on the environment by dredging, construction work, landfills, discharges from, cargo operations, and other port related activities. The potential adverse effects of port development encompass water pollution, contamination of bottom sediments, loss of bottom habitat, damage to marine ecology and fisheries, beach erosion, current pattern changes, waste disposal, oil leakage and spillage, hazardous material emissions, air pollution, noise, vibration, visual pollution, and other unhealthy socio-cultural impacts.

As identified in this report most of the environmental impacts as a result of this expansion can be minimized by taking appropriate measures. Throughout the construction and operational phase, tests should be carried out to monitor seawater quality and necessary surveys should be carried out.

Some of the expected impacts are long term impacts; it is hard to quantify these impacts. It can be concluded that, if the project is to proceed with relatively minimal environmental impact, the mitigation measures identified in this report should be implemented effectively, during both construction and in operational phase.

3. Objective

The objective of the EIA process is to protect (wherever possible) and minimise the impacts on both land and marine environment during the implementation of the works through:

- Predicting the nature and extent of impacts arising from the works;
- Assessing the acceptability of these impacts;
- Identifying suitable mitigation measures, where necessary, for incorporation into the design of the works so as to avoid, minimize, and mitigate adverse impacts to acceptable levels; and
- Designing a comprehensive programme of environmental monitoring and audit (EM&A) and an action plan to ensure that the impacts are indeed kept within acceptable levels.

It is also an objective of this EIA report to give and disclosure of all relevant information that has been gathered during the consultations up to date.

6.Project Setting

Since 1972 when the United Nations Conference on Human Environment addressed the impact of environment on our life, the international has realized that environmental problems should be of common concern community. Nevertheless, rapid economic growth and the development of supporting infrastructure has caused a number of problems, including those associated with port and harbour construction and operation. Economic growth in the Asia and Pacific region has, during the past decade, exceeded that of any other region in the world. Much of this growth resulted in the expansion of international trade. Consequently, seaborne cargo throughput has increased rapidly, in the major ports of the region served by the Economic and Social Commission for Asia and the Pacific (ESCAP), to the point where port capacities need to be expanded. While expansion of port facilities can make a significant contribution to economic development and the growth of maritime transport, it may also create adverse impacts on the surrounding environment. Port development and operation should, therefore, be planned with careful consideration of their environmental impacts (A Guidebook for EIA of Port Development, 1992).

The proposed Male' Port Expansion Project is a multi-million dollar project. The project is an initiative project by the government of Maldives to improve services provided by Maldives Ports Authority. This project involves reclaiming and sheet pilling of existing port area. Unplanned development in this area will have negative impacts on the environment, particularly seawater pollution and loss of marine life habitat. Environmental Impact Assessment (EIA) is one of the main types of environmental appraisal work required by the Government of Maldives.

12. Assessment of Environmental Impacts

Checklists of adverse effects of port development for EIA have been compiled by several organizations including the World Bank, the Asian Development Bank and the International Association of Ports and Harbors. Based on a review of these checklists, the relationship between factors in port development and their impacts on the environment can be categorized into three types: (a) location of port; (b) construction; and (c) port operation, including ship traffic and discharges, cargo handling and storage, and land transport. Location of port connotes the existence of structures or landfills, and the position of the development site. Construction implies construction activities in the sea and on land, dredging, disposal of dredged materials, and transport of construction materials. Port operation includes ship-related factors such as vessel traffic, ship discharges and emissions, spills and leakage from ships; and cargo-related factors such as cargo handling and storage, handling equipment, hazardous materials, and land transport to and from the port.

Major environmental facets to be considered in relation to port expansion project are categorized as fallows:

- Water quality
- Coastal hydrology
- Bottom contamination
- Marine and coastal ecology
- Air quality
- Noise and vibration
- Visual quality
- Waste management and
- Socio-cultural impacts.

Water quality includes (a) general features such as temperature, salinity, pH, transparency, oil and grease, and organic material concentration measured by biochemical oxygen demand (BOD); (b) turbidity measured by suspended solids; (c) eutrophication-related factors measured by dissolved oxygen (DO), nitrogen (N) and phosphorus (P); (d) harmful or toxic substances including heavy metals such as lead, and cyanide and (e) sanitation-related factors determined by measuring the amount of coliform bacteria.

Bottom contamination encompasses many kinds of contamination of bottom sediments by toxic or harmful substances, oils, oily mixtures and other hazardous

materials. Contamination of bottom sediments are often measured by the pH, colour, smell, oil and grease, organic materials, and concentration of organic nitrogen, phosphorus, and toxic substances such as heavy metals.

Coastal hydrology cited here includes factors concerning currents, tidal flow, beach erosion and water drainage.

Marine and coastal ecology includes aquatic fauna and flora composed of a large number of species of bacteria, phytoplankton, zooplankton, benthonic organisms, coral, seaweed, shellfish, fish and other aquatic biota, terrestrial flora such as mangroves andwetlands. Loss of bottom habitat and fishery resources are also significant problems included in this category.

Air quality consists of two main elements: (a) soot and dust; and (b) concentration of sulfur dioxide (S02), nitrogen dioxide (N02), carbon monoxide (CO), and hydrocarbons (HC) emitted from ships, vehicles and various equipment used for port activities. Harmful substances and odour are also elements to be considered in this category.

Noise and vibration generated by road traffic, cargo operations, ship traffic and other port activities also cause nuisances to local people.

Waste management relates to all kinds of wastes, both liquid and solid, likely to be disposed of in the port area. These wastes include garbage and oily mixtures discharged from ships, wastes from cargo operations, and all types of discharges from municipal activities.

Visual quality refers to the aesthetic value of the landscape, the view of port facilities, the nuisance of bright lights used for night operations in a port, and other visual problems.

Socio-cultural impacts includes all kinds of influence on the local community and people's life style such as relocation of villages, industrialization, population growth nearby, and the formation of slums.

The following section reviews the potential impacts of port activities on each facet of the environment and possible measures against potential adverse effects.

12.1. Impacts of Location of Port Expansion

The proposed location for the port expansion project is along Male' Commercial Harbour and further west along the shore line of Male'. It is proposed to reclaim an area of about 16160m^2. This might have potential impacts on water quality, coastal hydrology, bottom contamination, marine/coastal ecology, visual quality and Socio-cultural impacts.

12.1.1. Coastal hydrology

The location of a port may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships maneuvering near structures.

Like all the coastal areas of Male', Male commercial port has been protected by sea walls and the other areas has been sheet pilled. It is unlikely that the proposed port expansion project will lead to major changes in current pattern and littoral drifts. Even though no major alteration of current patterns is expected from the project, it is expected that there will be more mixing of water in the port area, since the existing water area will be reduced. This may cause damages to small ships maneuvering near the structures. Taking account of sea wall and the sheet pilling of the proposed port expansion project, it is unlikely the changes in current pattern will lead to accretion or erosion in shore zones of Male' and near by islands.

12.1.2. Water quality

In many cases, associated with the port expansion and development projects may change current patterns and cause stagnation of water behind the structures due to breakwaters and landfills. Stagnant port water may deteriorate port water quality through a dramatic increase of phytoplankton and a decrease of dissolved oxygen, resulting from eutrophication of water, caused by effluents containing nutrient salts (chemical compounds including N and P). If municipal or industrial effluent flows into a port area and if stagnations occurs, water quality in ports become polluted. In many cases, the anaerobic water leads to the generation of hydrogen sulphide (H2S) and can lead to an odour nuisance. Anaerobic water

has serious effects on organisms. Municipal sewage also brings coliform bacteria into the port and may cause unacceptable contamination of the harbour.

Test results on water quality parameters for the existing port shows that the parameters are within expectable level. Reclamation of the proposed area would lead to the better circulation of water in port area. This will reduce the possibility of stagnation of water in the port. If the current port operating procedures are fallowed in future, it is expected that the proposed Male' port expansion project would bring positive impact on water quality.

12.1.3. Bottom contamination

The location of a port may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Sediment deposition covers bottom biota and physical habitat. Pile structures shade the bottom and affect habitat. Eutrophication of water induces sedimentation of dead plankton and changes chemical characteristics of bottom sediments, resulting in an increase of organic matter, hydrogen sulphide, and mobilization of harmful substances.

The existing port has been operating for more than 10 years now. Chemical results carried out for the existing port indicated that sea bottom was not contaminated. Since it is expected that the current design of the project will not lead water stagnation in port waters, it is unlikely that the bottom contamination will be a major problem in future.

12.1.4. Marine/coastal ecology

In many cases, the port development location affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination. Land reclamation from the sea destroys bottom habitat and displaces fishery resources. Terrestrial fauna and flora may also be altered by the location of a port.

Diminution of bottom biota is usually linked to a reduction of fishery resources, and occasionally to an increase of undesirable species. Deterioration of water quality usually gives rise to changes in aquatic biota: a decrease in the number of species; and an increase in the quantity of one or two specific species. Further deterioration may lead to the destruction of all kinds of aquatic biota.

Diminution of plants in a shore zone within enclosed water may degrade its aeration capability and worsen water pollution. Since the proposed area is sea, the project will not impact tterrestrial fauna and flora.

Land reclamation of proposed port expansion project will impact marine and coastal ecology. The direct negative impact from the reclamation is changes that will occur to fish species. Dumping of sand for reclamation of the site will kill some fish and others will be displaced. In the course of dumping, the suspended materials will disturb the water, thus making the fishes to shy away. Most fishes favour clear water. When they shy away from the polluted waters, their swimming route is changed, which is called “dispersion activity” in the fishing filed. This activity will inevitably bring two consequences: firstly in the breeding season the fish group that generates eggs here will leave on different route; secondly the distribution and swimming regulations of fish living here will be disturbed. With increasing number of ships, the fishing resources and the species and density of marine organism in the water area nearby will be affected directly or indirectly.

Deterioration of water quality is not expected from the proposed project. Hence, it is unlikely that there will be any negative impact on aquatic biota: a decrease in the number of species; and an increase in the quantity of one or two specific species.

12.1.5. Potential impacts on visual quality

In many cases, visual quality is affected by the creation of a port, port facilities, lighting, and other optical disturbances. The landscape may be changed into an artificial scene of industrialization. Some port facilities may give an unpleasant impression to people.

The proposed location of the project is an area where there is a port. The current project is an expansion of the existing port. Even though the sea area will be reduced and the landscape will be changed into paved areas, it is unlikely that the proposed port expansion project will have major impact on visual quality.

12.1.6. Socio-cultural impacts

Building or expanding a port often requires relocation of the local community, sometimes causing ethnic, cultural, tribal, or religious conflicts with local people. Industrialization and modernization may change the cultural traditions of the local community.

The proposed location does not involve relocation of local community. The Male' port expansion project unlikely will result in ethnic, cultural, tribal, or religious conflicts with local people.

12.2. Potential Impacts Associated with Construction

The proposed project will involve construction activities in the sea and on land, and transport of construction materials. These activities might have potential impacts on water quality, coastal hydrology, bottom contamination, marine/coastal ecology, air quality, noise and vibration and waste management.

12.2.1. Water quality

Pile driving, deposition of rubble, sand compaction and other construction work in water cause re-suspension of sediments and turbid water. Re-suspension of sediments in water leads to an increase in the level of suspended solids (SS) and in the concentration of organic matter, possibly to toxic or harmful levels. It also reduces sunlight penetration. Work vessels are a possible cause of oil spills, garbage discharge, and leakage of other substances into water. Diffusion from concrete work in water and overflows from landfills may be possible sources of water pollution.

Some of the impacts on water quality (re-suspension of sediments, increase in SS, oil spills, garbage discharge, and leakage of other substances into water) associated with the construction activities for proposed project are inevitable.

12.2.2. Coastal hydrology

The potential impacts of construction on coastal hydrology are the same as the potential impacts of the location of a port which are identified in subsection 10.1.1. Construction activities like reclamation and sheet piling may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships maneuvering near structures.

It is unlikely that the proposed port expansion project will lead to major changes in current pattern and littoral drifts. Even though no major alteration of current patterns is expected from the project, it is expected that there will be more mixing of water in the port area, since the existing water area will be reduced. This may cause damages to small ships maneuvering near the structures. Taking account of sea wall and the sheet pilling of the proposed port expansion project, it is unlikely the changes in current pattern will lead to accretion or erosion in shore zones of Male' and near by islands.

12.2.3. Bottom contamination

Construction work may disturb bottom sediments and induce re-suspension, dispersal and settlement of such sediments. Dumping of sand for reclamation directly removes bottom habitat and may lead to a loss of fishery resources and alters bottom configuration and biota and may disperse toxic or harmful chemicals.

12.2.4. Marine/coastal ecology

Disturbance from construction activities may cause displacement of fishery resources and other mobile bottom biota. Settlement of re-suspended sediments on fragile marine fauna and flora damages the ecosystem particularly coral reefs, which are formed by the extra cellular product of symbiotic plants. The great number of coral polyps attached need dissolved oxygen for respiration and the plants need sunlight for photosynthesis. Piles, concrete surfaces, rubble mounds and other similar structures in water could form new habitats, which may introduce undesirable species.

It is expected that the proposed expansion port project will re-suspend sediments. This will impact marine fauna and flora. If toxic substances and other contaminants are re-suspended through dumping, they may lead to contamination of fishery resources.

12.2.5. Air quality

During construction, emissions from construction equipment, work vessels, trucks and other vehicles used will be a source of air pollution. Dust from construction activities is also a possible source of air pollution. However, considering the scale

of the project and location of the project will have very minimal air quality impact.

12.2.6. Noise and vibration

Construction activities may create a problem of noise and vibration generated by construction equipment, truck traffic, work vessels and other similar sources. Noise and vibration associated with the proposed port expansion project construction work might not cause significant nuisance for the residents in the surrounding area.

12.2.7. Waste management

Wastes from construction activities associated with port development projects are mainly spoils generated by dredging. Disposal of dredged material on land may cause destruction of plants, loss of vegetation, leakage of contaminated materials and salt, odour, an unsightly view and other nuisances to the local community. The proposed project does not involve dredging (dredging has been done previously). Possible wastes associated with the construction phase have been identified in 6.1.1 (Project Waste Handling). The wastes generated form the project might not be a significant impact.

12.3. Impacts of port operation

Impacts associated with the port operation includes ship-related factors such as vessel traffic, ship discharges and emissions, spills and leakage from ships; and cargo-related factors such as cargo handling and storage, handling equipment, hazardous materials, and land transport to and from the port.

12.3.1. Impacts on water quality

Runoff from raw material storage, spills from bulk cargo handling, and wind-blown dust are possible sources of contamination of port water. Toxic or harmful substances may be included in runoff from sulfur, bauxite, phosphates, nitrogenous manure, metal ores and other raw materials. Organic materials in runoff are decomposed to the inorganic form, spending dissolved oxygen and increasing the nutrient level in water. Accidental spills of toxic, harmful materials, oils or oily compounds, and other raw materials are also possible sources of contamination of water. Effluent from port operation activities may include toxic

or harmful materials, unsanitary wastes, oily wastes and other hazardous materials.

12.3.2. Bottom contamination

Bottom contamination may result from runoff from storage area, spills from bulk cargo operations, and wind blown dust. Discharge from ships is a major source of contamination of bottom sediments in port areas. The test results of the water parameters indicate that bottom contamination is not an issue in the existing port. In future also, there might not be impacts due to bottom contamination.

12.3.3. Marine and coastal ecology

During port operation, cargo handling and storage may cause runoff, spills or leakage of ingredients, which possibly include toxic or harmful materials, organic matter, or oily compounds. Water pollution and bottom contamination resulting from these effluents lead to deterioration of aquatic biota and fishery resources. If toxic or harmful substances are included in dust emissions, the health of port workers and local people are endangered.

12.3.4. Air quality

Emissions of dust from bulk cargo handling and gasses from cargo handling equipment can be sources of air pollution. Liquid cargo handling may result in the release of vapour during the cleaning of storage tanks and by the breather system for ambient temperature changes. Accidental leakage of gasses may cause problems such as toxic material mission, explosions, fumes, odours and hazardous airborne emissions. However, considering the cargo handling procedures and records of accidents in the past at the existing port facilities, there might not be a significant air quality issue.

12.3.5. Noise and vibration

During port operation, cargo handling equipment and road traffic are two major sources of noise and vibration, which may be experienced by the workers and local people. Noise from road traffic is a problem in Male'. However, it is unlikely that the operation of the port facilities will cause the noise and vibration condition worse for the residents of the surrounding area.

The proposed project could potentially result in an increase in marine traffic and underwater noise. Studies have shown that because of the efficient transfer of sound in water, some species can detect noises associated with vessels at distances up to approximately 5 km. Noise disturbance interferes with communication and echolocation pulses which are used for navigation and feeding; leading to behavioural changes. There is evidence suggesting that some marine species will minimize their use of areas affected by underwater noise. In addition, increase in marine traffics may disturb fish movement patterns through potential collision with vessels, increased turbidity generated by submerged equipment.

12.3.6. Waste management

Port operation will produces wastes due to cargo handling. Cargo operations produce wastes such as the remains of bulk cargo storage, rubbish from unpacking, wood bark from log handling, floating garbage and other wastes from daily activities. Waste handling from port operation is not an issue in the existing port. With the completion of proposed port expansion project, it is expected that there will be an increase in waste production. However, if the current waste handling procedures are followed, it is unlikely that the port operation will cause waste handling as a major issue.

12.3.7. Visual quality

For night operations, powerful lights are used in many ports. This causes nuisances to the nearby community. Wastes from port-activities, smoke from ships, bulk cargo piles, and ugly materials stacked in a port may give an unpleasant impression. At present, cargo containers are stacked for a great height. The expansion of port area will provide extra space for cargo containers and would improve visual quality.

12.3.8. Socio-cultural impacts

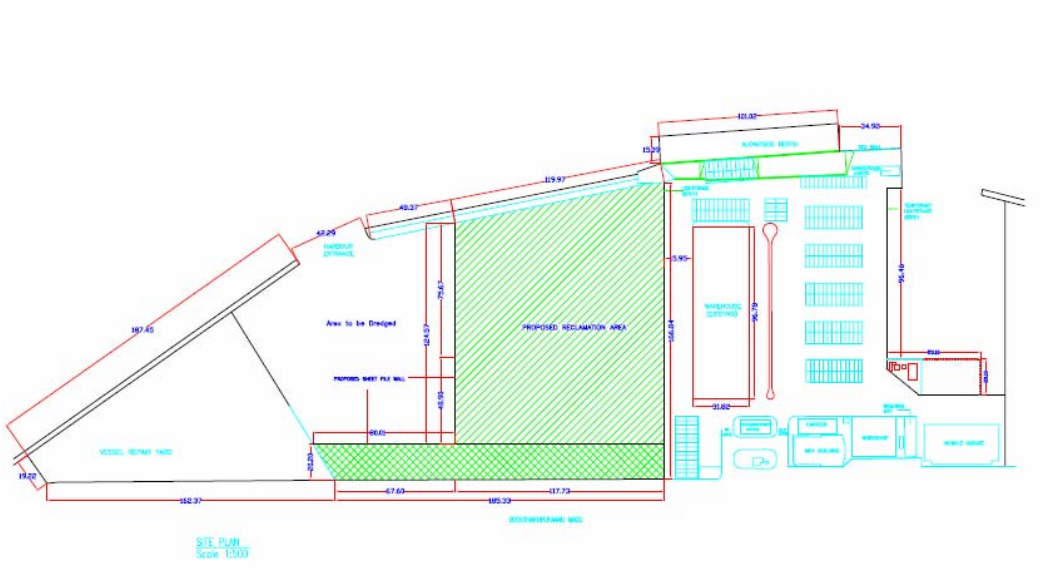
Port operation activities may result in the hiring of local labour and procurement of various commodities from a local market. The economy will be boosted by port-related activities and be greatly involved in urbanization and industrialization. After completion of the project, it is expected that it will create about 160 extra jobs for port operation activities. So the operation of the port would bring positive socio-cultural impact.

9. Description of the Natural and Human Environment

The description of the Natural and Human environmental baseline conditions are based on field observation from surrounding area (Northern side of Male'). ***Figure 8*** shows the aerial photographs of the proposed site. On the other hand, ***Figure 9*** shows the site plan drawn to scale. The width and length of the proposed site is about 120m and 150m, respectively. Site Plan drawn to scale is also attached in **Annex 4.**

Figure 8: shows the aerial photographs of the proposed site

Figure 9: Site Plan drawn to scale.



The terrestrial environment at port expansion project surrounding area is characterized by paved areas and sea. The proposed reclaim area is currently used by cargo ships. East of the proposed reclaim area is paved and used by heavy duty equipments to load and unload the cargoes from ships and cargo containers are kept in this area. The paved area is also used by Lorries and other vehicles to transport cargoes from the port area. North of the proposed reclaim are is about one metre high sea wall, which separates shallow sea area from deep sea area. There is one entrance for inner harbour; about 50m from the proposed reclamation location for the flow of water **(*Figure 10*)**. This entrance is used by ships to enter the harbour area for loading and unloading goods.

Figure 10: Entrance for ships

West of the project site is paved area and used by vehicles to transport cargos. This area is also used for storing cargo containers and woods (***Figure 11***). MPA workshop is also located in this area. South of the proposed reclamation area, there is about 20m wide area which had been reclaimed previously, for the easy excess to vehicles and to provide extra storing facilities for containers (***Figure 12***). South of this area is road (Marine Drive). The road and the port area had been separated by a fence. Near the fence (road side), there is parking space for Lorries and other vehicles (***Figure 13***). The parking space seems to be occupied for most of the time, especially during night. The other side of the road consists of 2-3 story buildings. Hardware shops are common in this area (***Figure 13***). Very few residential buildings can be seen in the vicinity of the project surrounding area.

Figure 11: West side of project site is paved area. This area is used for storing cargo containers and woods

Figure 12: About 20m wide area which had been reclaimed previously

Figure 13: Hardware shops found in the surrounding area and the Fence separating the port area from road.

9.1. Vegetation

As with other costal areas in Male', neither natural vegetation nor outstanding biological resources exists in the project area. However, very few planted trees exist in the surrounding area including out side the fence (on marine drive) and MPA area (***figure 14***).

Figure 14: Vegetation in the surrounding area.

9.2. Protected areas

There are 25 marine protected areas in the Maldives. In addition to these protected dive sites, an area has been declared as protected area in 2004, in Addu atoll, known as Eidhegili kilhi and this area is the first protected area that encompasses both marine and terrestrial habitats. Under the Environment Protection and Preservation Act of Maldives, additional sites have been designated as protected areas from the 14th of June 2006. They are; (www.erc.gov.mv)

- Baa Atoll's Olhugiri and surrounding environment including its reefs and lagoons: Olhugiri is the natural habitat of the protected sea bird, Great Frigate. The island is also a breeding site for turtles and natural habitat of the mangroves which are threatened species throughout the country.

- Ga Hithaadhoo and the surrounding environment including its reefs and lagoons: Hithadhoo is the natural habitat of the protected Lesser Frigate Bird.

- ADh Hurasdhoo and the surrounding environment including its reefs and lagoons: Hurasdhoo has unique geomorphological formation and a fragile environment which calls for its preservation.

- Mangrove Habitat of K. Huraa: Mangroves are a threatened species throughout the country and do not exist within the region of Male'. In addition to its mangrove, surrounding the site is also a natural habitat for variety of trees and other living organisms. The mangrove area of K. Huraa is also an educational and nature spot for students and tourists.

These sites have been mainly protected for long term conservation of biodiversity and the preservation of natural environmental habitats. None of the dive sites and recently protected sites falls into the vicinity of the proposed reclamation area.

9.3. Rare and endangered species

Under Environmental Protection Law of Maldives some bird species are protected. These includes White Tern , Lesser Noddy , Brown Noddy, Sooty Tern , Birdled Tern , Common Tern , Lesser / crested Tern , Great Crested Tern , Sterna Crested Tern , Black-naped Tern, Gull-billed Tern , Audobon' s Shearwater , Wedge-tailed Shearwater , Fiesh-footed Shearwater , Lesser Frigatebird, Great Frigatebird and White-tailed Tropicbird.

Field observations of the project site indicate no protected bird species exists in the area. Fishing and collection of Black coral, Triton Shell (Conchs), Giant Clams, Berried and small lobsters, Turtles, Napolean Wrasse, Dolphins, Whale Sharks, Whales Black coral, Triton Shell (Conchs), Giant Clams, Berried and small lobsters, Turtles, Napolean Wrasse, Dolphins, Whale Sharks and Whales are prohibited in the Maldives. These rare and endangered species are not observed from the project surrounding area.

9.4. Air quality

Emissions from the motor vehicles are already a significant issue and a concern in the capital Male'. The proposed project surrounding area is no exception to this.

Even though there is no point source of emissions in the vicinity of the project surrounding area, the port area experiences emissions from vehicles. Throughout the day (from 8am to 5pm), many vehicles enter and leave the Male' Port area (***Figure 15***).

Figure 15: Throughout the day many vehicles enter and leave the Male' Port.

Since the land area is so limited in the port area, traffic congestion occurs and emissions from vehicles affect the air quality in port area. However, the tropical climate with monsoonal winds provides an environment with good flushing. The mixing of air allows the emissions from the vehicles to be carried away from the surrounding environment and makes the air cleaner than it should be.

The air in the surrounding area is also influenced by the effects of Wind-Blown Spray and the Salt Particles. Often wind-blown spray being blown into the atmosphere leaves behind particles of salt to become condensation nucleus at a later time by each droplet. Water will sometimes condense on salt particles when the relative humidity is as low as 70%. As the wind speed increases over the sea, crests of the waves become higher, streaks of foams are blown through the air, and eventually spray begins to form from the breaking waves and the effect increases with wind speed.

9.5. Noise

Noise pollution is not a significant human health issue in most parts of the Maldives. However, due to high density of vehicles and traffic congestions, the noise is an issue in the capital island, Male'. The most significant source of noise in the project site is from the vehicles and ships.

9.6. Odour

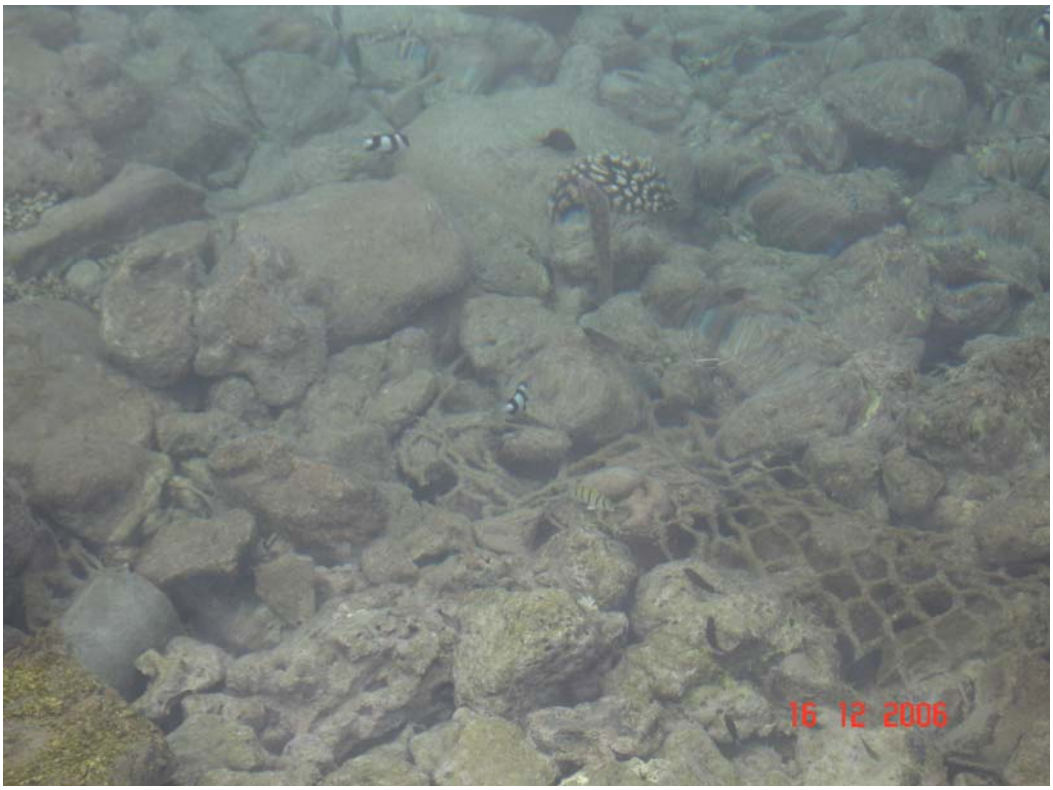
The possible sensitive receivers of odour include MPA customers, shop workers, residents in the surrounding area and the labourers. Several visits were made to the project proposed area to study the odour conditions. Field visits at different times and days indicate that the nuisance is not caused by odour.

9.7. Marine Environment

Marine environment of Maldives is highly diverse in context of coral reef environment in which the whole Maldivian island ecology is dependent. The coastal marine environment of most of the areas in the Maldives is comprised of several coral reef related marine organisms many of which are ecologically important in addition to the myriad species in the ecosystem. In the coastal environment of the Maldives, there are over 1200 species of fish, more than 200 species of corals, 13 species of mangroves, several species of sea grasses, 25 species of whales and dolphins and five species of sea turtles. Reef environment is highly important for Fisheries and Tourism industry of Maldives and hence essential for Maldives economy.

The marine environment of the project area is characterized by low productivity of fish and phytoplankton. Life forms in the coastal waters of the project area are mainly abiotics: nonliving ecosystem components such as rock and sand. Since there marine environment of the project surrounding area has been dredged recently, there are no coral reefs, seagrass beds, or algal beds in the area. However, some fish were observed (***Figure 16***) during field observation (*refer* ***Annex 5***). No endangered species or cultural heritage areas exists in the vicinity of the proposed reclamation site.

Figure 16 Some fish and corals were observed



9.8. Bathymetry

Bathymetry around the project area has been surveyed for dredging. No separate bathymetry survey for the proposed port expansion project has been carried out. The depth of water column is about 3.5m around the site. Bathymetry of the area is attached in ***Annex 6***.

9.9. Sea Water

The field observations indicate that the sea area is clean and no pollution is observed since there is good flow of sea water in the surrounding area. Average sea temperature around the area is found to be about 28 degrees Celsius.

9.10. Currents, Tides and Waves

Oceanographic currents are driven by two monsoonal winds, namely the westerly and the easterly wind. During Northeast (NE) monsoon (January to March), the westerly flowing currents tend to dominate. On the other hand, during Southwest (SW) monsoon (May to November) easterly currents dominate. The changes in current flow patterns occur in April and December. In April the westward currents are weak and eastward currents flow will slowly take place. Similarly in December eastward currents are weak and westward currents will take over slowly. These two months corresponds to transition periods of Southwest monsoon and Northeast monsoon, respectively. The ocean currents flowing through channels between the atolls are driven by the monsoon winds. Near shore currents are slightly different from the oceanic currents and are largely influenced by the location, orientation and morphology of the reefs around the area.

There are three tide stations in Maldives; one in the North (H. A. Hanimaadhoo), one at Central (Hulhule) and the other in the South (S. Gan). The nearest tide station to Male' is at Hulhule. Tide data from North and South indicates tidal variation of about 0.15m from North to South, where the tidal range is slightly larger in the Southern Atolls of Maldives. Tidal measurements from Hulhule can be applied to Male' (project site), because of the proximity of the two islands and insignificant tidal variations throughout the Maldives. Data from tide station at Hulhule indicates tidal range of about 1m in central parts of Maldives. The highest astronomical tide level is +0.64m (MSL) and the lowest astronomical tide level are -0.56m (MSL). Tides experienced in Maldives are mixed semi-diurnal and diurnal with a strong diurnal inequality. Seasonal variation in the mean sea level in the Maldives is negligible.

The waves approaching to Male' are also conditioned by the two monsoons; namely the NE and SW monsoon. The streams from Vaadhoo kandu run across Gaadhoo Koa opening and during the NE monsoon a component of the current sets Northwest (NW) through the entrance channel which directs the vessel towards the reef, fringing the east side of Male'. With the entrance, the flow turns west between Male' and Funadhoo. Strong currents have been reported during the NE monsoon within Male' harbour. During the SW monsoon, a component of the current enters Male' lagoon through Giraavaru Irumathee Kandu six (6) miles of Male'. It flows out principally through the channel East of Villingili and between Male' and Funadhoo into Wadhoo Kandu.

Wind generated waves are common in the Maldives. The swell and wind waves experienced at Male' are conditioned by the monsoons and the swells generated by the storms in the Indian Ocean. Oceanic swells and the local wind generated waves that approach the Male' has high energy since reef slope/crest and reef flat has been highly modified by human activities (Male' Sea Wall Project and Reclamation). These waves become more significant during the SW monsoon. Wave data for Male from June 1988 to January 1990 indicates that the maximum significant wave height recorded for the month of June and July 1989 were 1.23m and 1.51m with mean wave period of 7.53 and 7.74s, respectively.

7.Environmental Impact Assessment Process

Like many small island developing counties, the Maldives has urgent needs, some of which are conflicting due to the scarcity of available resources and land area. The Environmental Protection and Preservation Act require that EIAs be performed for all development projects before implementing any development activity which may have an impact on the environment. In the Maldives, EIA is relatively new.

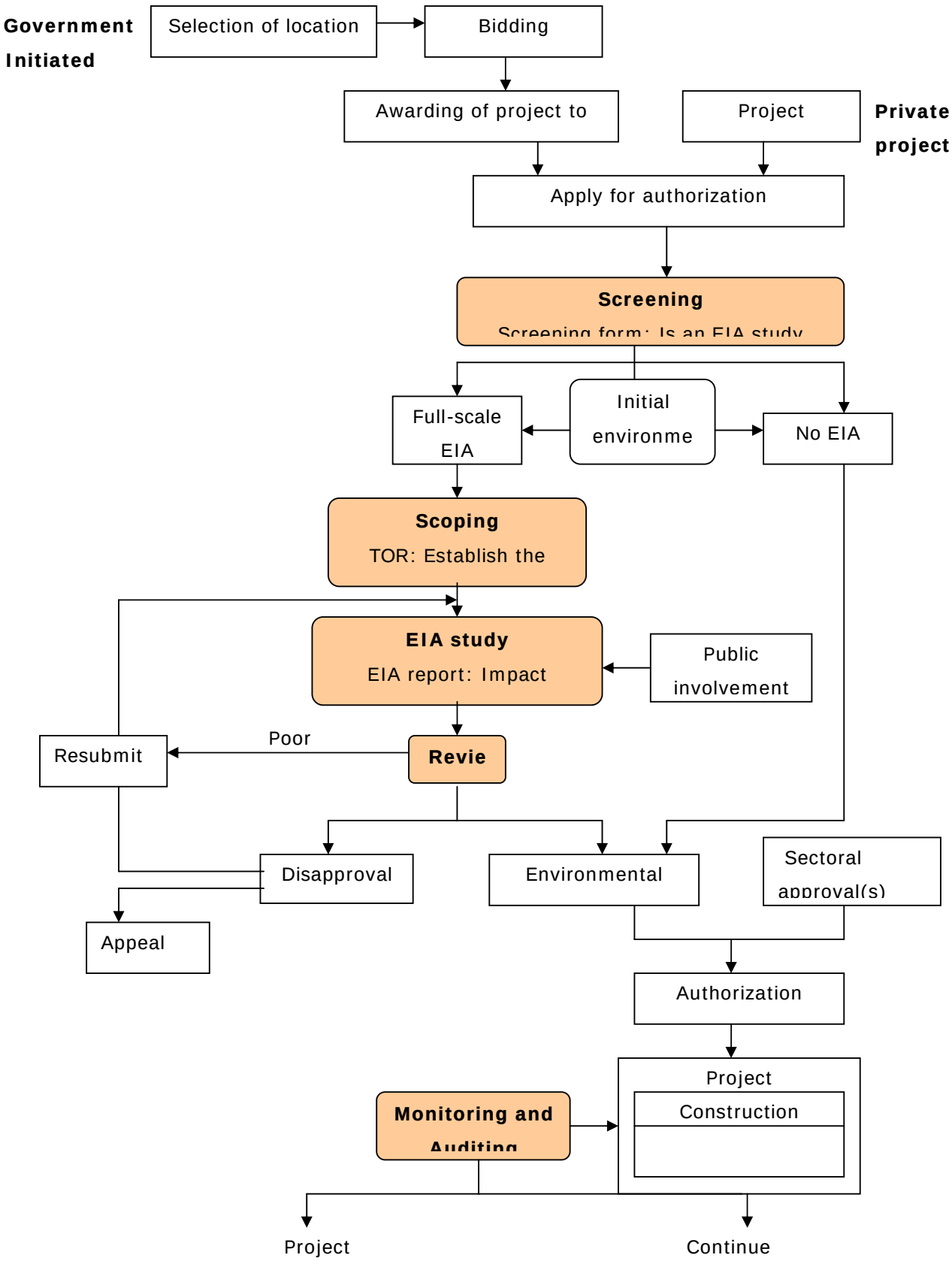
Since 2001, 76 development projects were asked to undertake EIA for the approval of Environment Ministry. Out of 76 projects, Fifty four projects were from the tourism sector and five were from the fisheries sector. EIA work has not yet been properly integrated into public sector development projects. Since 2001, without any formal Environmental Impact Assessment, 74 coastal modification projects have been undertaken in the inhabited islands of Maldives.

7.1 Objectives of Environmental Policies in Maldives

The Sixth National Development Plan (SNDP), 2001 states the following objectives of environment policy.

- Promote sustainable resource management through preservation of natural resources and biodiversity.
- Minimize dangers to the natural resource base and environment due to economic development and the rapid population growth.
- Contribute to the international efforts to find solutions to global environment threats, especially those pertaining to the vulnerable Small Island Developing nations.
- Promote integrated planning and administrative practices by developing meaningful principles and procedures for sustainable resource use and environmental protection

7.2 Environmental Impact Assessment Process in Maldives



7.3 National Institutions related to Environmental Issues

The Environmental Impact Assessment System in the Maldives was established through the Environmental Protection and Preservation Act of Maldives (4/93), which came into effect in April, 1993. The Ministry of Environment, Energy and Water is the focal point for the implementation of this Act. The legislation provides the basic framework for the EIA process in the country and the EIA procedures are laid out in the form of guidelines. The Act states that, an impact assessment study shall be submitted to the Ministry of Environment, Energy and Water before implementing any activity that may have an impact on the environment. The Act 4/93 consists of:

- Concerned government authorities shall provide necessary guidelines and advice;
- Environment Ministry responsible for formulating policies as well as rules and regulations;
- Environment Ministry shall identify and designate protected areas and nature reserves;
- Environment impact assessment mandatory for any new projects;
- Power to terminate developments causing significantly detrimental environmental impacts;
- Disposal of waste, oil and poisonous substances shall be regulated;
- Disposal and transboundary movements of banned hazardous wastes;
- Fines for damage to the environment;
- Compensation for environmental damage that may take place

7.4 Ministry Environment, Energy and Water (MEEW)

The Ministry of Environment plays the main role within the Government for Environmental matters. It has central control over environmental protection and related issues. This is mainly manifested at the level of policy, but since environment law is essentially about the taking of discretionary decisions, this means that the MEEW has enormous responsibilities, which is apparent from the statements of the Law. Generally the Ministry is responsible for monitoring the activities of the public and private sector to ensure that their activities and their management are consistent with government policies and developed guidelines and procedures. Under MEEW umbrella Environmental Research Centre acts as a focal point for all EIA related matters.

7.5 Ministry of Fisheries, Agriculture and Marine Resources

The Fisheries Ministry is mandated to ensure the sustainable management of all marine resources in the Maldives. The Ministry as part of its mandate in general adopts an integrated reef resources management programme to assist in the sustainable exploitation of reef resources in the Maldives. A Marine Research Centre (MRC) has been established under the Fisheries Ministry to provide the basis for identifying and managing protected marine areas and species in the Maldives. As such several marine protected areas have been established in the Maldives in collaboration with several other relevant government departments and agencies. The 25 marine protected areas, under the Law on Protection and Preservation of the Environment are: North Maalhosmadulu Vilingili Thila, South Maalhosmadulu Dhigali Haa / Horubadhoo Thila , Faadhippolhu Fusheevaru Thila , Kureddhoo Kandu Olhi , Male' Atoll Makunudhoo Kandu Olhi , Rasfaree and the enclosed reef , Thamburudhoo Thila , Gaathugiri / Ad' dhashugiri , Giraavaru Kuda Haa , Dhekunu Thilafalhuge Miyaruvani , Kollavaanee in the centre of Gulhifalhu , Emboodhoo Kandu Olhi , Guraidhoo Kandu Olhi , Lankan Thila , Ari Atoll Maayaa Thila , Orimas Thila , Mushimasmigili Thila , Kudarah Thila , Karibeyru Thila , Faruhuruvalhibeyru , Felidhu Atoll Miyaru Kandu , Vattaru Kandu , Mulaku Atoll Lhazikuraadi , North Nilandhe Atoll Filitheyo Kandu and South Nilandhe Atoll Fushi Kandu.

7.6 National Commission for the Protection of the Environment

The National Commission for the Protection of the Environment (NCPE) was appointed by the President of the Maldives in 1989 and restructured in 1993. The NCPE is mandated to advise the government on environmental assessment, planning and management to ensure that environmental protection is a vital component of all developmental projects.

General Environmental Protection Measures taken by Maldives are; (SoE, 2002 and www.presidencymaldives.gov.mv)

- Establishment of the National Commission for the Protection of the Environment – 1984
- Formulation of the National Environment Action Plan – 1989

- Establishment of an Environmental Research Unit – 1990
- Enforced a new system of licensing for coral mining from specified areas – 1990
- Enacted the Law on the Protection and Preservation of Environment – 1993
- Public awareness campaigns with the help of the media and NGOs
- Formation of environment clubs (ECO Clubs) in schools
- Workshops and seminars for increasing awareness on environmental issues
- Transfer of people from islands with extensive coastal erosion to better protected ones
- Formulation of the Second National Environment Action Plan - 1999
- Marking an annual "Walking Day" in Male', within the Environment Day activities.
- The State of the Environment 2002 report was issued in October 2002
- A National Air Pollution Action Plan for the Maldives has been developed under the project to implement Male' Declaration on Transboundary Air Pollution in South Asia

International Environmental Agreements signed by the Maldives

- 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)
- 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)

- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994)
- Washington Declaration on Protection of the Marine Environment from Land-Based Activities
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997)
- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (22 April 1998)
- Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002)
- United Nation Convention to Combat Desertification (Maldives acceded on 3 September 2002)

13. Evaluation and Selection of Preferred Alternatives

The proposed Male' port expansion project is an initiative from government of Maldives. The proposed location is regarded as the most appropriate location for port expansion (reclamation) to provide extra space for cargo container handling and storage with least disruption to other facilities. For the proposed project, no alternative location has been considered by the government since the proposed site is close to the existing port and port facilities.

The main purpose of the proposed expansion project of port area is to provide extra space for cargo handling since the space in the existing port is far beyond its handling capacity. One alternative way to overcome the space constraint is to provide space for cargo container from another location of Male'. However, this option has its limitations. Moving containers in and out of the port and through the streets of Male' is not possible given the restricted width of the street network. Hence, this option can be regarded as no alternative option.

The second option could be expansion of port from two side of the existing port. However, there is no other land available for further expansion on any side of the current port. Since the existing port is located on the edge of deep-water channel, further reclamation is also not possible on the sea ward side of the facility.

One another alternative for the problem is to develop a new port in Male'. In this regard, government of Maldives has identified three alternative sited for a new port. These are Hulhulmale', Thilafushi and Gulhi Falhu. However, to develop a new port at one of these sites will take some time.

The higher cargo throughput has brought the urgent need for further expansion of the port. The engineering design for the Second Male' Port Project (SMPP) was made bearing in mind that the port might be required to expand in future. Since there are no serious engineering issues related to the expansion of existing Commercial Port along the western basin, the proposed Male' port expansion project can regarded as the preferred short term solution for the problem.

2. Introduction

Among three commercial ports (Male', Kuludhufushi and Hithadhoo Port) the Male' port is the biggest and busiest port in the Maldives. Prior to the development of the Kuludhufushi Port and Hithadhoo Port, the port of Male' was the only port of the country where international cargo was handled. Still the Port of Male' retains its status as the central and the most important port of the country.

The capital island of Maldives (Male') is the centre for trade, commerce, business, health and education. More than one third of Maldives population (104,000) lives in Male' (land area of 1.8 square kilometers), which makes it the busiest and most populous island of the Republic. Male' being the Capital, as well as the Commercial Center, Male' Commercial Port (MCP) is an important part of the country's infrastructure, connecting internal and external transportation system. The Male' Port represents as one of the most important infrastructure in the development of the Nation and can be regarded as the gateway to Maldivian Economy.

Male' Commercial Port is located on the North shore of Male' (North West side of Male') (***Figure 1***). The port terminal has three berths; namely Magathufaalan (101.3m in length and the water draught is 10.5m), Eastern Lighterage Berth (85m in length and a water draught of 3.5m) and Western Lighterage Berth, which has a length of 150m and water draught of 3.5m.

Figure 1: Male' Commercial Port - gateway to Maldivian Economy

Cargo ships arriving at the port of Male' are presently anchored about half a mile off shore on the Northern side of Male' and cargo is loaded and unloaded by lighters towed by tugs. The length of the wharf used is about 60m, the depth at low tide varied from about 3m at the breakwater to less than one meter at the wharf. With these physical limitations, only one lighter can usually be handled at a time. Currently, the average ship turn around time is about 9 days and annually the port handles about total 70,000 tons.

In an effort to improve Male' Commercial Port operations, Government of the Maldives had conducted various studies on the current situation of the port. From these studies it became apparent that the only effective solution to the problem is to relocate and expand the existing commercial harbour to a place further west along the shore line.

In this regard, it is proposed to expand port area by reclaiming the sea area to improve and to provide better services to Maldives Ports Authority (MPA) customers. The key objectives of the port expansion project are to:

Provide easy excess to port for loading and unloading of cargoes.
Increase container handling and storage capacity
Reduce ship turnaround time
Minimise land and marine traffic congestion
Reduce cargo damage
Increase Government revenue
Provide safe working environment

Since the proposed location is sea area, the project involves reclaiming and sheet piling the area. ***Figure 2*** shows the proposed reclamation area and the surrounding area. The present study seeks key environmental issues related to project location, construction (reclamation, sheet piling and paving) and operation of port and also provides the direction to solve the problems in terms of policy and operation sides as well as effective mitigation options to secure the environmental soundness of coastal reclamation for the project. This would facilitate to keep the existing aesthetic value of the area with its beauty, value, safety, and to direct sustainable development of the project.

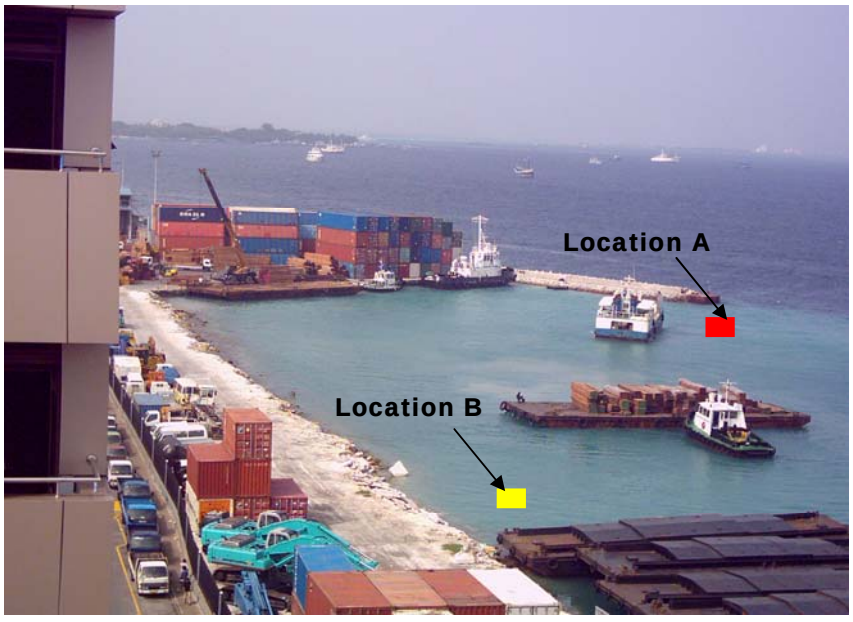
Figure 2: Proposed reclamation area for Male' Port Expansion Project.

10. Marine Survey Methodology

Major indicators of Water pollutions are Biological oxygen demand (BOD), Suspended solid (SS), Dissolved oxygen (DO), Nitrate, Phosphate, Oil content and heavy metals. A survey of these pollutants and other parameters were undertaken as part of this study. Several visits were made to the project site for observation and to collect data. The project proposed marine area was surveyed for transparency, fish species and coral species. In addition to this, sea water samples were collected from two locations of the proposed surrounding area. ***Figure 17*** shows the locations where samples were taken. Tests were carried out for the following:

1. **Biological oxygen demand (BOD)**
2. **Suspended solid (SS)**
3. **Dissolved oxygen (DO)**
4. **Oil**
5. **Total Coliform**
6. **pH**
7. **Turbidity**
8. **Salinity**
9. **Cyanide**
10. **Lead (Pb)**
11. **Phosphate**
12. **Nitrate**

Figure 17: Sample collected locations



Data on environmental indicators of water pollution change greatly depend on season, time of day, tidal currents, local characteristics, place, layer in the sea, and even by the sample. Some of the errors in analysis are unavoidable. To get more corrective measures of the parameters, data should be collected for a long time and tests should be carried out for a long time period. Since the water column is 3.5m deep, it was assumed that the water column is homogeneous. In order to get the existing fish and the coral species in the project proposed area, dive surveys were carried out along the project site. The dive survey and field observation reveals that the area some fish and corals in the area (***Figure 16***). List of fish species found in the area is attached at the ***Annex 5***. Diving of the project surrounding area also indicates that the surrounding marine environment is quite transparent.

10.1. Test Results and Discussion

The results of the tests are presented in ***Table 4*** and in **Annex 7.**

Table 4: Sea water sample test results

Parameters	Test Results	
	Location A	**Location B**
DO	4.8 mg/L	4.5 mg/L
BOD	14 mg/L	18 mg/L
Turbidity	1 NTU	1 NTU
SS	0 mg/L	0 mg/L
Salinity	32500 mg/L	32600 mg/L
Oil	0.000 mg/L	0.000 mg/L
pH	6.9	7.2
Phosphate	0.03 mg/L	0.04 mg/L
Nitrate	0.44 mg/L	0.89 mg/L
Cyanide	0.00 mg/L	0.00 mg/L
Lead	0.001 mg/L	0.000 mg/L
Total Coliform	---	70/100mL

10.1.1. DO and BOD

One of the key water quality parameter that is intimately linked with the health of marine biota is Dissolved Oxygen (DO). This is the amount of oxygen available to the fish in the water. The oxygen dissolved in water is as vital for most aquatic organisms as oxygen in air for terrestrial animals. A safe level of dissolved oxygen in sea water is 7 - 9 mg/L (*Murdoch et al 2001*). The saturation point of DO in water is dependent on the temperature (*Kegley and Andrews 1998*). The results (***Table 4***) indicates that the, DO levels were not within a healthy range for both locations (***Figure 17-sample collected locations***). Low DO concentration levels can have adverse effects of fish health including respiratory stress, tissue hypoxia and eventually death. In most cases, if dissolved oxygen concentrations drop below 5mg/L (5 ppm), fish will be unable to live for very long.

The level of DO decreases as the temperature and salinity of the water increase. Biological Oxygen Demand (BOD) is the measure of demand for DO in the water. BOD can increase due to introduction of nutrients from boats and run-off from the land and this would quickly deplete DO needed by organisms. The increase in BOD in the water from boating or other human activity often coincides with warmer temperatures, exacerbating the depletion of DO. BOD levels measured across the area indicated BOD of 14-18 mg/L. In India and Indonesia, the permissible level of BOD in marine environment is lees than 5mg/L and 20mg/L, respectively (A Guidebook for EIA of Port Development, 1992). Areas with a high BOD and low DO will not support much life.

10.1.2. Turbidity and Suspended Solids

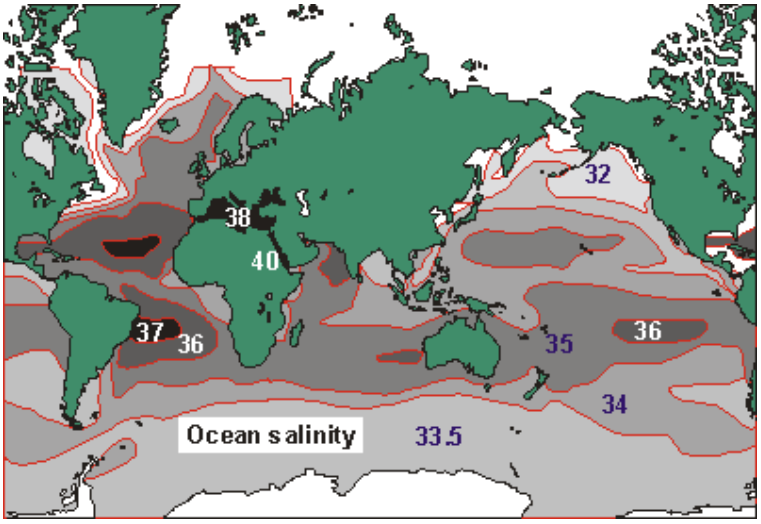
Turbidity is the result of suspended sediments and is a relative measure of the clarity of water: the greater the turbidity, the murkier the water. A turbidity level of less than 5 units is considered permissible level (*Water Quality Research Council Water Review, 1990*). On the other hand, when the Suspended Solids (SS) is less than 20mg/L is considered as normal. This indicates that the potential impacts of turbidity and suspended solids to the marine environment in the vicinity of the project site are anticipated to be minimal (*refer* ***Table 4***). However, during reclamation and construction, these parameters might change. Increased SS in the water column combines with a number of other factors reduce Dissolved Oxygen (DO) concentrations in water. Elevated SS (and turbidity) reduces light penetration, lowers the rate of photosynthesis of phytoplankton (primary productivity) and thus lowers the rate of oxygen production in the water column. This has a particularly adverse effect on the eggs

and larvae of fish, as at these stages of development high levels of oxygen in the water are required for growth due to high metabolic rate.

10.1.3. Salinity

The salinity of seawater is usually 35,000mg/L or ppm (parts per million) in most marine areas. This salinity measurement is a total of all the salts that are dissolved in the water. Although 35,000ppm is not very concentrated, variations occur in ocean salinity due to several factors. The most common factor is the relative amount of evaporation or precipitation in an area. If there is more evaporation than precipitation then the salinity increases (since salt is not evaporated into the atmosphere). If there is more precipitation (rain) than evaporation then the salinity decreases. Many marine organisms are highly affected by changes in salinity. This is because of a process called osmosis which is the ability of water to move in and out of living cells, in response to a concentration of a dissolved material, until equilibrium is reached. Table 4 shows that the salinity is lower than the normal levels. This might be due the fact that heavy rain was experienced over the project surrounding area for a week prior to the sample collection. The world map (***Figure 18***) shows how the salinity of the oceans changes slightly from around 32ppt (3.2%) to 40ppt (4.0%). Low salinity is found in cold seas, particularly during the summer season when ice melts. High salinity is found in the ocean 'deserts' in a band coinciding with the continental deserts.

Figure 18: The world map showing mean salinity across the globe.



10.1.4. Oil

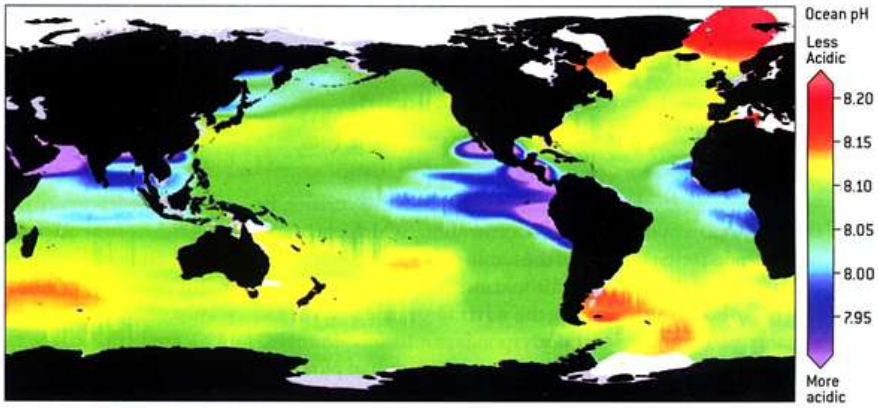
Concentration of oily compounds in water is an important indicator of water quality. An indicator of oil pollution commonly expressed as milligrams of normal-hexane extracts per liter. In port areas, oil pollution is usually caused by a damaged oil tanker, oil spill from ships (bilge water, oily ballast water, etc.) and other facilities on land. The fact that the result shows 0.000 mg/L oil in the project surrounding area indicates that the sea water was not polluted by oily substances. However, site observations shows that oil presents on the sea surface (***Figure 19***). The difference between test results and the site observation could be due to the time and the day when samples were collected. However, the observed oils are not significant in terms of their coverage area.

Figure 19: Oil observed from the water surface during field visits.

10.1.5. pH

Measuring the pH level in water bodies is an important factor for determining aquatic life. This is a measure of the concentration of hydrogen ions of a substance, which ranges from very acid (pH = 1) to very alkaline (pH = 14). pH 7 is neutral and most waters range between 6 and 9. When pH is high, it can limit the ability of gills to transport ions essential to the fish, which can lead to osmoregulatory failure or death (Murdock et al 2001). From the results in (***Table 4***), it is clear that the pH is in the normal level for sea water. Ocean water has an excellent buffering system with the interaction of carbon dioxide and water so that it is generally always at a normal pH range. ***Figure 20*** shows the mean pH map for the globe.

Figure 20: pH map for the globe



Ocean pH Source: Scott C Doney, SciAm March 2006

10.1.6. Phosphate, Nitrate, Cyanide and Lead

Phosphate and Nitrates are major indicators of nutrient salts for growth of aquatic plants. They play an important role to increase the biomass of plankton and lead to eutrophication. Existing in both organic and inorganic forms, and converted to the other form through the nitrogen cycle and the phosphorus cycle. For sea water analysis, 1.75 to 437.5 mg/L of phosphate is considered as normal range (Strickland and Parsons, 1968). Although nitrate concentrations in the reclaimed water are typically less than 2 mg/l and rarely exceed the 10 mg/l, natural concentrations of nitrate (concentrations unaffected by human activity) are typically are below 1 mg/l-N. The results obtained from proposed reclaim area and the existing port area suggests that the nitrate levels are in normal level.

Cyanide is a chemical group consisting of one atom of carbon connected to one atom of nitrogen by three molecular bonds (C≡N) and cyanides are compounds (substances formed by the joining of two or more atoms) that contain a cyanide group (typically shown as CN). Cyanides can both occur naturally or be man-made and many are powerful and rapid-acting poisons. When the substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. Exposure to cyanide occurs when come in contact with it. It can happen in many ways; maybe exposed by breathing, eating, or drinking the substance which contain cyanide. The factors which determines the level of exposure is harmful are the dose (how much), the duration (how long), and cyanide come in contact with it. . The concentration of cyanide found in sea water in proposed project area is 0.00mg/L. The concentration of cyanide in drinking water ranges from 0.001 to 0.011 mg/L in the United States and Canada.

Lead is a natural element that is persistent in water and soil. Most of the lead in environmental media is of anthropogenic sources. Overt symptoms of subencephalopathic Central Nervous System (CNS) effects and peripheral nerve damage occur at blood lead levels of 0.4-0.6 mg/L, and symptoms, such as peripheral nerve dysfunction, occur at levels of 0.3-0.5 mg/L in adults. The causes of death most often associated with exposure are cardiovascular disease, renal disease, and cancer (*Cooper, 1988; Agency for Toxic Substances and Disease Registry, 1997*). The test results (***Table 4***) shows that the lead concentration for the 2 locations were lower than harmful to CNS.

10.1.7. Total Coliform

In many ports, Municipal sewage brings coliform bacteria into the port and may cause unacceptable contamination of the harbour. Numbers of Escherichia in water, expressed as most probable number per 100 mL. Escherichia is a group of bacteria commonly found in faeces, and its occurrence in water indicates the pollution by sewage, although Escherichia itself may not cause any illness. Less than 1000/100mL of total coilform is considered as safe level in Japan for bathing. On the other hand, if the coliform bacteria are less than 2500/100mL in harbour areas in India, it is considered as safe. From the tests carryout for Male' commercial port surrounding water indicates the coliform bacteria is well below harmful level.

10.1.8. Seawater temperature

Water temperature has profound physiological effects on organisms, and if the water temperature goes too far above the tolerance range of an organism, the organism's ability to survive will be compromised. As temperature increases, the amount of dissolved oxygen decreases. Corals are particularly vulnerable to increased seawater temperature as they live within a relatively narrow temperature range, and positive or negative temperature anomalies of only a few degrees can induce bleaching. The most extensive and intensive coral bleaching events on record occurred in 1998 and 2002. In 1998 event, about 90% of corals in Maldives experienced coral bleaching. Sea temperature measurements around the area indicated that the temperature of sea water is about 28 degree Celsius in the project area. It is unlikely that there will be any changes to seawater temperature due to proposed project.

The permissible levels of pollution in port environments vary from port to port, according to their geographical location and the requirements of the local community. The permissible levels of one port are not necessarily appropriate for another port because of differences in the environmental situations. Each port

should have its own environmental objectives and permissible pollution levels in view of the existing levels of pollution, types of pollution sources, and future development plans.

14. Mitigation Measures

Number of impacts from the proposed port expansion project has been identified. These impacts are associated with port expansion project location, construction and operation of port facilities. The most noticeable impacts related to project location, construction and operation are presented in table 5, 6 and 7, respectively. The tables also identify mitigation measures for each impact due to location, construction and operation of port.

Table 5: Impacts and Mitigation measures associated with project location

Facet of the Environment	Impacts	Magnitude	Mitigation Measures
Coastal hydrology	Changes in water current pattern and wave action might have impacts on small ships	medium	Sheet pilling and port design should take account of alteration of wave refraction, diffraction and reflection to minimize the damaged which maybe caused to the small ships maneuvering near the structures.
Water quality	Water pollution	low	Regulations on discharges of effluents into water and provision of sanitary treatment facilities are indispensable for reducing pollutants from port activities. It could be effective to dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water.
Bottom contamination	Water pollution and contamination of chemicals	low	Removal of contaminated sediments, capping- Careful site selection and port design should be carried out, focusing on the possibility of water stagnation. Regulations on discharges of effluents into water and provision of sanitary treatment facilities are indispensable for reducing pollutants from port activities. It could be effective to dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water.
Marine and coastal ecology			Adverse effects on marine and coastal ecology usually result from: deterioration of water and air quality; current pattern changes; bottom contamination; physical loss of water

			area; and changes in natural land habitat. Careful site selection and port design should be carried out, focusing on the possibility of water stagnation. Dredge (Removal of contaminated sediments or capping) or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water should be carried out if there is high level of contamination. Careful survey of the ecological characteristics of a project area is indispensable if the welfare of endangered and fragile species is to be considered and disruption of their spawning seasons and areas and migration is to be minimized. Planting of green plants around a port may be an effective means to mitigate adverse effects on terrestrial habitat
Visual quality	Lighting and other optical disturbances. The landscape may be changed into an artificial scene	low	The design of port should cause it to blend with its surroundings. Special attention to the colors of port facilities and landmarks helps improve port scenery. A green belt zone around a port may block an unpleasant view of the port and be a more pleasant sight.
Socio-cultural impacts	Building or expanding a port often requires relocation of the local community, sometimes causing ethnic, cultural, tribal, or religious conflicts with local people.	low	An appropriate resettlement plan could minimize the disturbance to the local community and ensure smooth transition to industrialization. Survey of archaeological heritage sites should be undertaken well in advance and a preservation plan included in any port development plan.

Table 6: Impacts and Mitigation measures associated with construction activities

Facet of the Environment	Impacts	Magnitude	Measures
Water quality	Water pollution	low	The adverse effects of construction work could be minimized by appropriate selection of equipment in pile driving, proper use of silt curtains, and suitable transport of construction materials material.
Coastal hydrology	Changes in water quality and current	low	When ever possible, the reclamation and sheet piling should be carried out when there is in ward water flow, to minimize the

			turbidity and sediment being carried to surrounding area.
Bottom contamination	Water pollution and contamination of chemicals	low	Disposal sites for removal of contaminated sediments should be identified and. Silt curtains, as well as careful selection of the dredging method, could be effective in minimizing dispersal of re-suspended sediments.
Marine/coastal ecology	Disruption to ecosystem	low	Careful survey of a fragile marine and coastal ecology is essential for appropriate planning of construction work, dredging, and disposal of bottom contaminated material. Since adverse effects usually result from bottom contamination and deterioration of water quality, Dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water. Planting of green plants around a port may be an effective means to mitigate adverse effects on terrestrial habitat
Air quality	Health impacts associated with air pollution	low	Methods for controlling dust emission are water scattering in the construction site, use of proper transport methods, such as a conveyor belt, for excavated material and screens around the construction site. A green belt zone or open space between the construction site and the surrounding could be an effective buffer.
Noise and vibration	Noise pollution for workers and near by residents	low	Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier. Limitation of working hours may be a possible means to mitigate the noise and vibration nuisances dye to port construction activities.
Waste management	Smell and health impacts	low	The adverse effects of disposal of contaminated dredged material or other wastes from construction activities could be offset by including them in land reclamation. Garbage from port activities can be handled by a municipal treatment system or by the port's own treatment facilities.

Table 7: Impacts and Mitigation measures associated with port operation

Facet of the Environment	Impacts	Magnitude	Mitigation Measures
water quality	Water pollution	low	Countermeasures against runoff are: (a) covering or enclosing raw material storage areas; (b) sprinkling water on raw material except anti-humid materials like grains or cement; (c) providing special equipment for cargo handling and transport (e.g., covered conveyor or pneumatic unloader); and (d) other methods to reduce the influence of wind and rain. A reversed slope apron is an effective means to avert rainfall from washing away from the apron and pouring into the sea directly. The drains from the apron are led to a settling drainage system and remove suspended materials.
bottom contamination	Water pollution and contamination of chemicals	low	Same as above
Marine and coastal ecology	Impacts on ecosystem	low	Appropriate regulations on ship discharges and provision of reception facilities are indispensable for proper control of emissions and effluent from ships. Detection of spills is also important for regulating ship discharges. Since accidental spills are unavoidable, recovery vessels, oil fences, and treatment chemicals should be prepared with a view to minimizing dispersal. Proper contingency plans and a prompt reporting system are keys to prevention of oil dispersal. Periodical clean-up of floating wastes is also necessary for preservation of port water quality.
Air quality	Air pollution-health impacts		Monitoring of air quality is indispensable to ensure acceptable levels of emissions. Dust emission can be reduced by covers, screens, enclosures, sprinkling water or other similar methods. Regulations on emissions from vehicles should be introduced in accordance with a environment management plan.
Noise and Vibration	Noise pollution for workers and near by residents	medium	Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or

			installation of sound insulation fences. Green belt of plants can be a good barrier. Limitation of working hours may be a possible means to mitigate the nuisances of construction activities.
Waste management	Smell and health impacts	low	Facilities for the waste management should be provided at the port site (such as clearly labeled waste bins). Remains of bulk cargo storage wastes which are not considered hazardous can be deposited in land reclamation sites where retaining walls are designed against leakage of toxic or harmful substances. Garbage from port activities can be handled by a municipal treatment system or by the port's own treatment facilities.
Visual quality	Exposure to bright light at night and Unpleasant view for the residents and workers	low	Appropriate selection of cargo container storage areas and handling areas can mitigate adverse effects on visual quality. It may be possible to design storage areas blinded from roads or the nearby community. A green belt zone around a port may lock an unpleasant view and moderate unpleasant sight. Relocation of busy area is a possible means to reduce excess lighting.
Socio-cultural impacts	Positive impact (such as extra space, better and safer working environment)	Medium	Associated with the operation of the project, it is expected that there will be positive socio-cultural impacts. No mitigation measures are recommended

15. Monitoring Plan

Management actions and requirements for operational best practice must be incorporated into the Environmental Management Plan (EMP) for the design of the proposed structure, its construction, and mitigation measures proposed for addressing possible pollution. The EMP should be designed so that it will monitor the effectiveness of management actions. It will include regular auditing and reporting, and the monitoring programmes will promote continuous improvement and identify any negative trends that need to be managed effectively.

15.1. Institutional Monitoring Arrangements

The Project Executing Agency (Maldives Ports Authority), will have overall responsibility for both operational monitoring and environmental monitoring of the Project. The cost of both environmental and operational monitoring must be covered under the project budget.

15.2. Environmental Monitoring Program

To monitor environmental impacts during construction phase, site-based Project Implementing Unit (PIU) to be established at the port expansion site. The PIU should be headed by Site Managers and staffed by personnel from Maldives Ports Authority. The PIU should have adequate and qualified technical staff. The PIU should carry out the day-to-day environmental monitoring work for all the project components within their areas of coverage. With inputs from PIU, Maldives Ports Authority should be responsible for preparing consolidated environmental monitoring reports as part of the regular project monitoring and they should prepare monitoring and assessment reports for submission to the Ministry of Environment, Energy and Water. Reporting should be done annually and summary reports should be prepared every two months.

The monitoring program should be a continuing program of data gathering and analysis to ensure the effectiveness of the mitigation measures for potentially adverse environmental impacts arising from construction and operation of port facilities. The following should be monitored during constrution:

- Water quality (water quality during reclamation particularly for key parameters including suspended solids, biological oxygen demand (BOD),

dissolved oxygen (DO), pH, salinity, turbidity and oil)- once every 2 months

- Coastal hydrology (changes in current pattern should be monitored once every 3 months)
- Bottom contamination (test should be carried out for DO, BOD, Turbidity, SS, Salinity, Oil, pH, Phosphate, Nitrate, Cyanide and Lead)-every 2 months.
- Marine and coastal ecology- survey should be done for marine flora and fauna once every 4 months.
- Air quality- should be monitored throughout the construction phase.
- Noise and vibration- should be monitored throughout the construction phase
- Visual quality - should be monitored throughout the construction phase
- Wastes- types and quantities of waste generated from construction should be monitored throughout the construction phase

The samples should be collected from at least 2 locations (from the port entrance and from the working area).

The most important role of monitoring in operation stage is to validate the impact predicted in environmental impact assessment (EIA). If the monitoring reveals higher impact compared to the prediction in EIA, the additional mitigation measures should be established. Conversely, the mitigation measures established in the EIA process could be lightened when the monitoring shows lower impact relative to the prediction. Also the monitoring result can be used for feedback to other similar marine reclamation project, which results in more accurate prediction. Thus the monitoring of construction stage should be planned to meet this objective.

15.3. Operational Monitoring Program

During operational phase, MPA should monitor port facilities to meet the Standard Operational Standards (SPS). A staff should be designated for operational monitoring of the premises. The monitoring program should be continuous to ensure the effectiveness of the mitigation measures for potentially adverse

impacts arising from operation of port facilities. The following should be monitored regularly:

- Water quality (water quality during reclamation particularly for key parameters including suspended solids, biological oxygen demand (BOD), dissolved oxygen (DO), pH, salinity, turbidity and oil)- once every 2 months
- Coastal hydrology (changes in current pattern should be monitored once every 3 months)
- Bottom contamination (test should be carried out for DO, BOD, Turbidity, SS, Salinity, Oil, pH, Phosphate, Nitrate, Cyanide and Lead)- every 2 months.
- Marine and coastal ecology- survey should be done for marine flora and fauna once every 4 months.
- Air quality- should be monitored throughout the construction phase.
- Noise and vibration- should be monitored throughout the construction phase
- Visual quality - should be monitored throughout the construction phase
- Wastes- types and quantities of waste generated from construction should be monitored throughout the construction phase
- water consumption, requirements and water supply during operation (every 6 months)
- Energy consumption, requirements and supply during operation (every 6 months)
- Lighting-should be monitored throughout the operation
- Fire Alarm Systems (every 2 months)
- Fire exits (every 6 months)-should not blockage fire exits
- Check for tripping of MCB and Circuit Breaker for any damages and electrical shortage (Monthly)
- Check drainage system for blockages (Monthly)

MPA should take necessary actions if the monitoring reveals the operation of port and its facilities are below Standard Operational Standards. Special considerations should be given to minimize fire, oil spills and labour accidents and loss of life and property during operational phase. During an emergency, following contingency plans should be implemented effectively.

15.4. Emergency Procedures-Contingency Plans

Annex 8 shows existing communication and reporting procedures to act in case of an Emergency by MPA.

15.4.1. Contingency Plan for Fire hazards

15.4.1.1. General Operational Procedures

- Proper housekeeping including the prompt removal of wastes and limiting storing of unnecessary combustible materials will help to prevent or reduce the severity of fires.
- Limited quantities of flammable liquids may be stored in the premise.
- Storage of combustible materials such as cardboard boxes, etc. should be kept to a minimum.
- Electrical wiring should be maintained in good condition.
- The emergency numbers should be posted on the walls in each level.
- Fire alarms and extinguishers should be maintained in good condition at all times.
- Exits should be labelled and maintained.

15.4.1.2. Fire Emergency Response

Personal at sight of the fire and on the ship

Should respond quickly as follows (same as existing Fire/Explosion at Port of Male Emergency Procedures):

- Continue ringing fire alarm or siren
- Call Harbour Control on VHF CH. 10, or telephone to 3328624/3327883 giving the name of the area, and whether any casualties have occurred or are likely to occur.

Action by Port Authority

1. Ringing fire alarm
2. Inform Ministry of Defense and National Security (MDNS), Maldives National Defense Force (MNDF)/ Coast Guard/Police

3. Fire brigade
4. Inform Ministry of Transport and Communication
5. Inform Managing Director (MD)/Assistant Managing Director/MPA Emergency Planning Team (see the ***Annex 9*** for details)
6. Inform IGMH if required

Upon hearing emergency signal, all staff to assemble at Muster Point (see the ***Annex 10*** for Muster Point). After receiving instruction, emergency squared assemble at the site of fire with equipments. If National fire brigade has not arrived, start dealing with the fire under the supervision of fire fighting in-charge. Control of the area will be exercised by MNDF Port Security and the person's in-charge of MPA. The person in-charge of MPA will declare an emergency of necessary to ensure all persons concerned is alerted.

The MNDF Port Security may answer all the enquiries from the general public. Once MNDF Fire brigade is arrived, operation will be handed over to MNDF. The MPA Emergency Control Centre is Harbour Control Port Security (HCPS) Department. Orders and information received from overall command/authorities to MPA staff will be transmitted from this station.
A senior officer of the Port Authority will establish a control post on the jetty and set up a casualty clearance post and control of all shipping/craft movement.

Ministry of Defense and National Security

Once National security arrives PMA will hand over all operations to MDNS with MD's approval and MPA will act as a back-up team.

Removal of vessel

Vessels in danger of sinking at alongside berth or anchorage must be removed from the berth to a safer place, after consulting with the government authorities concerned. If any circumstances dictated that beaching is necessary to avoid sinking, the vessel must be moved to shallow water as quickly as possible.

Marine Department

Marine department shall carry out communication, evacuation of general public, casualty clearance and dealing with bodies.

Cargo Operations

Man power and assistance should be provided by cargo operations.

Technical Department

Should provide transport and equipments

Marine Craft

Adequate means of escape from over side to be provided by arranging tugs and launch.

15.5. Contingency Plan-collision and spills

15.5.1. General Guidelines and procedures

First priority in the event of a spill is protecting human health and safety. It is imperative that the safety of rescuers is ensured before attempting to rescue any victims. Therefore it is important that nearby personnel are alerted of the situation before action is taken.

In order to respond rapidly and successfully to Hydrocarbon spill, personnel responsible for containing and cleaning up the spill must know the steps that need to be followed during and after the spill. When used properly by trained personnel, a well-designed contingency plan enables oil spill response efforts to proceed smoothly and effectively, minimizes danger to cleanup personnel, reduces the overall costs of cleanup by avoiding unnecessary effort, and ensures that sensitive habitats are protected.

15.5.2. Response Techniques

A number of advanced response mechanisms are available for controlling oil spills and minimizing their impacts on human health and the environment. The key to effectively combating spills is careful selection and proper use of the equipment and materials best suited to the type of oil and the conditions at the spill site. Most spill response equipment and materials are greatly affected by such factors as conditions at sea, water currents, and wind. Damage to spill-contaminated shorelines and dangers to other threatened areas can be reduced by timely and proper use of containment and recovery equipment.

Mechanical containment or recovery is the primary line of defence against oil spills. Mechanical containment is used to capture and store the spilled oil until it can be disposed of properly.

Chemical and biological methods can be used in conjunction with mechanical means for containing and cleaning up spills. Dispersants and gelling agents are most useful in helping to keep spill from reaching shorelines and other sensitive habitats. Biological agents have the potential to assist recovery in sensitive areas such as shorelines.

Physical methods are used to clean up shorelines. Natural processes such as evaporation, oxidation, and biodegradation can start the cleanup process, but are generally too slow to provide adequate environmental recovery. Physical methods, such as wiping with sorbent materials, pressure washing, and raking and bulldozing can be used to assist these natural processes.

Where there is threat to birds and animals, scare tactics can be used to protect birds and animals by keeping them away from oil spill areas. Devices such as propane scare-cans, floating dummies, and helium-filled balloons are often used, particularly to keep away birds. Scare tactics is not necessary for port area, since no birds and animals can be found in the area.

15.5.3. Collision and Spill Control and Cleanup Procedure

Small spills of non-ignitable, low toxicity liquids should be handled by trained staff. High hazard spills will be handled by an outside, licensed hazardous spill response contractor.

15.5.4. Collision and Spill Response Actions

In the event of a collision and spill, the following action should be taken by the personal on a ship:

- Continuous sounding of any signal apparatus
- Report the event by calling Harbour Control Port Security on VHF CH. 10, or telephone to 3329339/Ext. 201/202/246/3327883 giving details of the event.

Action by Port Authority

1. Ringing fire alarm
2. Inform Ministry of Defense and National Security (Coast Guard) and Maldives Police Service
3. Inform Ministry of Transport and Communication
4. Inform Managing Director (MD) and MPA Emergency Planning Team (see the ***Annex 9*** for details)
5. Inform Ministry of Environment, Energy and Water.

Upon hearing emergency signal, all staff to assemble at Muster Point (see the ***Annex 10*** for Muster Point). After receiving instruction, emergency squared assemble with equipments. Start dealing with the collision and spill under the supervision of MPA the person in-charger.

Overall control of the area will be exercised by the person in charge of MPA. His instruction will usually be passed through Harbour Control. The person in-charge MPA will declare an emergency of necessary. The purpose is to inform all persons concerned are alerted.

The MNDF Port Security may answer all the enquiries from the general public. The Emergency Control Centre is MPA Harbour Control Port Security (HCPS) Department. Orders and information received from overall command/authorities from this station.

A senior officer of the Port Authority will establish a control post on the jetty and set up a casualty clearance post and control of all shipping/craft movement.

15.6. Contingency Plan- Labour Accidents

15.6.1. General Guidelines and Procedures

An accident is an unplanned event. Sometimes it injures people or damages property, sometimes not. By recognizing and eliminating the cause, it is possible to avoid repeat performance of an accident. Accidents and illnesses on the job result in a no win situation. Employees suffer from injury at workplace. It is for this reason, it is important to prevent accidents whenever possible. However, when an accident occurs, a contingency plan should be in place to follow. The following contingency plan outlines emergency procedures for work related accidents.

All accidents, no matter how minor, shall be reported promptly to the immediate supervisor for evaluation and investigation. Since every accident includes a sequence of contributing causes, it is possible to avoid a repeat performance of the first event by recognizing and eliminating the contributing causes. The removal of just a single cause can prevent a recurrence.

During the supervisor's evaluation and investigation, he/she must determine the possible consequences that could take place if the situation is not correct. Supervisors must take appropriate action based upon their findings; e.g., initiate corrective action, additional training, possible counselling and follow-up.

15.6.2. Near Misses:(Likelihood of personal injury or property damage)

A near-miss accident is defined as an unplanned event where damage resulted to equipment but there was no personal injury to employees, OR where damage did not result but the likelihood of personal injury to the employee was great.

If the conditions which permitted the near-miss or "close call" to exist are not eliminated, they will continue to be available to cause additional accidents which could eventually result in personal injury to an employee.

To the greatest extent possible, "near-miss" accidents shall be investigated by the employee's supervisor and reported to the appropriate authorities. Documentation should be made on the Accident Report form.

15.6.2.1. Accident Investigation

A careful and complete accident investigation should reveal the entire major contributing causes in the sequence of events. An attitude of fact-finding, not fault finding, should prevail.

15.6.2.2. Accident Reporting

If a work related injury is sustained, the following steps are to be followed:

- Report the injury immediately to supervisor, whether or not medical attention is required.
- The accident is logged on to an accident report.

11. Public Consultation

Because of its strategic location in the middle of the Indian Ocean straddling the equator, the Maldives has been a crossroads of world trade and travel for centuries. Consequently, its ports and the sailors who visited them have played an important role in the formation of the Maldivian economy and culture. Hence any infrastructure redevelopment with regarding the ports is of a concern for many people. In this regard a public consultation can be viewed as mandatory for this EIA.

Since MPA was established in September 1986 under a Presidential decree, to manage and operate all ports within the country. It is wholly (100%) owned by the government of the Republic of Maldives and functions under the Ministry of Transport and Communication. In this respect it can be assumed the government may have done all the necessary consultation with relevant stakeholders before undertaking this venture. It can be also argued since this port expansion project is confined within boundary wall of MPA and is isolated from the residential areas and other business in the vicinity, no public consultation is necessary.

However, the need was felt to do a preliminary analysis to see if there is any reason for concern. Hence on 16 December 2006 consultants visited the site to conduct an interview with relevant stakeholders for the purpose of identifying and weighing the views of the "affected communities," "beneficiaries and "other stakeholders."

In this study consultation is treated as a two-way communication process by which the knowledge and views of affected peoples, the private sector and other interested parties are taken into account. In the Maldives the assumption is often made that such involvement is not necessary.

Nevertheless, it is becoming increasingly clear that the knowledge of affected communities can contribute to the quality of EIA, as well as provide a better understanding of the social impacts which accompany development interventions. It is apparent from the past experience in the Maldives if public consultation does not take place early in the project, it often leads to public misunderstandings, and unnecessary delays in project processing and implementation. Hence, what follows is the analysis from the extensive interviews carried out on site.

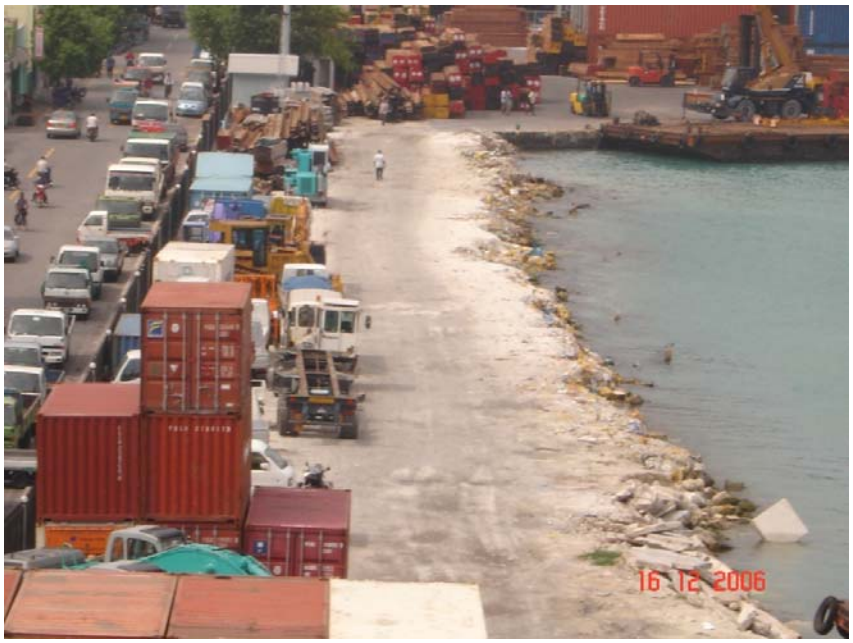
The Yard Supervisor and key personals on site were interviewed (***Figure 21***) including customs officers, cargo clearance people and vehicle operators. Additionally, shop owners in the Boduthakurufaanu magu, opposite the port redevelopment area were interviewed. They all seem to have the common concerns and issues; hence individual descriptions of the interviews are found unnecessary. A more general approach is adopted here encapsulating all their concerns.

The Yard Supervisor seems to have a very broad and through understanding of the management of the port area. He has given some valuable inputs.

Figure 21: Consultants interviewing the yard supervisor

According to him the planned extension is necessary as they are incurring both financial and technical difficulties because of the lack of space in the port. The other option left was to take the empty containers to Hulhumale'. According to him at the moment Hulhumale' can accommodate 900 containers but transport cost per container is MRF 400.00. This cost according to him is prohibitive and the management has considered another option, that is to stock pile the empty containers in the area adjacent to the main road. (***Figure 22***).

Figure 22: area adjacent to the main road.



It was realized this area is not sufficient to house the empty containers while it is used as road for heavy duty vehicles. So it is understood the management has exhausted all the viable options and found non to be feasible except the planned extension of the existing port by land reclamation.

The most important question of course for the purpose of this EIA is whether the redevelopment will have any impact on the ports operation during construction and operational phase. The public opinion it seems is overwhelmingly positive. The general consensus remains that any such development will have time bound difficulties during construction phase but in the long term it will definitely improve things for better.

When asked whether the planned reclamation of the land and operation of the port would have any significant negative impacts on the environment and health of the people, they all seems to take a common stand that it would in fact provide a much better working environment for the people and hence increase the productivity and health of the workers.

The most prominent concern seemed to be the lack of space in the current port for loading and unloading of containers. They all agree the present environment is not suitable and poses great dangers for the labours and heavy duty vehicle operators. However, they do not have much information or were reluctant to

answer when the question was put forward whether there are routine accidents at the site because of lack of space. It was observed the movement of vehicles and peoples behaviour are fairly ad hoc and the possibility of a grave danger occurring is imminent within the port premises.

The need was also felt to understand their confidence level of the MPA capacity to keep the port area clean and environment friendly. Apart from the yard supervisor others were indifferent to environmental concerns such as oil spillages and throwing of non-bio degradable materials into the sea. For obvious reasons, the yard supervisor claimed the MPA maintains a stringent procedures and ensure those procedures are adhered to at all times. He also claimed from his understanding and experience MPA will ensure that the contractor follows the same guidelines during the construction phase. However, close supervision showed a thin layer of oil accumulated in the surrounding rocks (***Figure 23a***). There is also evidence that the labours and harboured vessels throw empty bottles into the sea (***Figure 23b***).

The evidence of environmental issues we have found are minimal considering the scale of operation of the port and the number of people using the facilities. This substantiates the yard supervisor's claim that MPA cleans up the surrounding environment on regular basis.

Figure 23a: A fine layer of oil observed near the rocks.

Figure 23b: Bio-non degradable materials observed floating in the area.

For the shop owners the noise and the possibility a road blockage (***Figure 24***) during the operational and construction phase is a concern. This we found is a legitimate concern and there is greater need to ensure that the business is not affected during the construction and operational phase. But from the observations and the past experience with the contractor MTCC such disturbances will be

minimal. The recent project in the same road the New Fish Market project had no substantial public complaints due to the road blockages and noise during the construction. Therefore it is safe to assume this project would follow the same trend.

Figure 24: Road congestion may occur during the construction phase

As a final question interviewers asked if people have been given general information regarding this project. Here again except for the yard supervisor all other are non responsive. We have also observed quite number of people interviewed did not actually know the exact reclamation area. Therefore, it is apparent MPA has not made an effort to educate the people who would be using this facility. It is also observed public is generally hesitant to give information and voice their opinion and has shown indifference to environmental issues.

11.1. Conclusion

In sum, the consultation has given some insights into the concerns which the public may have and this analysis would enable MPA to take pro active measures to address these concerns. Generally, the stakeholders have a very positive attitude and appear to be enthusiastic about this project. However, they have not been educated about the potential dangers during the construction phase and the importance of keeping the surrounding areas clean and environment friendly. The public in general seems to understand that this project is conceived out of absolute necessity and for the benefit of the country. Given the scarcity of land in Male', the reclamation is the only viable option and one which this country could not avoid especially for a project of this nature.

5. Terms of Reference

Terms of Reference (TOR) and Scope of work for the proposed Male' Port Expansion Project were defined through consultation with the project implementing agency, Maldives Ports Authority. Based on consultation, the following was defined as Terms of Reference and Scope of work.

1. Identify the development project to be assessed and describe the rationale for the development and its objectives.
2. Describe the major components of the proposed project, the implementing agents, a history of the project and its current status.
3. Specify the boundaries of the study area for the assessment as well as any adjacent or remote areas that should be considered with respect to the project.

Detailed description of the following should be given in the report:

1. Description of the Proposed Project
2. Description of the Environment
    - Physical environment
    - Biological environment
3. Legislative and Regulatory Considerations
4. Determine the Potential Impacts of the Proposed Project
5. Analysis of Alternatives to the Proposed Project
6. Mitigation and Management of Negative Impacts
7. Development of a Monitoring Plan

17.3. Reference

- A Guidebook for EIA of Port Development, 1992. United Nations, New York.
- Agency for Toxic Substances and Disease Registry, 1997. Toxicological Profile for Lead, Atlanta, GA: Department of Health and Human Services.
- Cooper, W.C., 1988. Deaths from chronic renal disease in US battery and lead production workers. Environ. Health Perspectives, 78, 61-63.
- Kegley, S. and J. Andrews, 1998. The Chemistry of Water. Sausalito, CA: University Science Books.
- Murdoch, T., M. Cheo, and K. O'Laughlin, 2001. Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods. Adopt-A-Stream Foundation, Everett, WA. 297 pp.
- Strickland, J.D.H., and Parsons, T.R. (1968). Determination of reactive phosphorus. In: A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada, Bulletin 167, 49–56
- State of Environmental Report, 2002. Maldives.
- Water Quality Research Council Water Review, 1990. Water Testing...Option or Necessity?, Vol. 5, No.2.
- www.erc.gov.mv
- www.presidencymaldives.gov.mv
- http://www.seafriends.org.nz/oceano/seawater.htm

17.4. Definitions

1. **Current:** water moving continuously in a certain direction.

2. **pH:** is simply a measurement of dissolved hydrogen ions in the water (the symbol stands for the logarithm of the reciprocal of the hydrogen ion concentration)

3. **Salinity:** Salinity is the salt content of the ocean. Salinity (S) may be defined as "the total amount of solid materials in grams contained in one kilogram of seawater when all the carbonate has been converted to oxide, the bromide and iodide replaced by chlorine and all organic matter completely oxidized."

4. **Dissolved Oxygen:** Dissolved oxygen measures the quantity of oxygen available for respiration in a water body.

5. **Biological Oxygen Demand:** Biochemical Oxygen Demand (BOD) refers to the amount of oxygen that would be consumed if all the organics in one liter of water were oxidized by bacteria and protozoa.

6. **ppm:** parts per million

7. **mg/L:** milligram per litre

Abbreviations

MCP	Male' Commercial Port
TOR	Terms of Reference
ESCAP	Economic and Social Commission for Asia and the Pacific
EIA	Environmental Impact Assessment
SNDP	Sixth National Development Plan
MEEW	Ministry Environment, Energy and Water
MRC	Marine Research Centre
NCPE	National Commission for the Protection of the Environment
ADB	Asian Development Bank
MPA	Maldives Ports Authority
TEU	Twenty-Foot Equivalent Units
SMPP	Second Male' Port Project
MPEP	Male' Port Expansion Project

STELCO	State Electric Company
MWSC	Water from Male' Water and Sewerage Company Pvt. Ltd.
NE	Northeast
SW	Southwest
MSL	Mean Sea Level
NW	Northwest
BOD	Biological oxygen demand
SS	Suspended Solid
DO	Dissolved Oxygen
PIU	Project Implementing Unit
SPS	Standard Operational Standards

4.EIA Consultants

This Environmental Impact Assessment report was prepared by Energy Consultancy Pvt Ltd. The company portfolio in similar assignments include preparing EIA for Male' Munispalty for their Male' New Fish Market Project and preparing the EIA for Ministry of Home Affairs for the Solidarity Memorial Monument Project. Both projects included land reclamation. The leading environmental consultant of the company is Mr. Zahid. Zahid is assisted by Mr. Mohamed Abdul Latheef, Mr. Mohamed Ali and Mr. Ahmed Inaan.

Mr. Zahid has obtained a masters degree in the field of Environmental Science from University of Wollongong, Australia and is presently working at the Department of Meteorology as a Senior Meteorological Forecaster. He obtained his first degree in Atmospheric Science (Climatology) from Macquarie University, Australia.

Mr. Zahid is one of the key figures in Department of Meteorology, especially in the field of climate change, environment and natural disasters. He has represented Government of Maldives in international seminars, workshops and conferences and presented papers on climate change and natural disasters. He is also actively involved in conducting training workshops locally to educate people on environment related issues. He is also the coordinator and the lecturer for the Meteorological Observer's course conducted by the Department of Meteorology. Mr. Zahid's special areas of expertise include Environmental Planning, Environmental Management, Costal Management, Environmental Impact Assessment and Solid Waste Management.

Mr. Mohamed has obtained a Bachelors degree in Electrical & Electronic Engineering from Islamic University of Technology, Bangladesh and is presently working at the Maldives Airports Company Ltd. as an Assistant Electrical Engineer. The responsibilities of Mohamed includes, but is not limited to; planning, development, implementation, operation and maintenance of electrical and mechanical equipments.

In addition to these, Mr. Mohamed provides technical direction to staff responsible for execution of projects and acts as focal point for technical and business liaison with other program/project engineers.

Mr. Mohamed Ali has a Bachelors Degree in Mechanical Engineering from Islamic University of Technology, Bangladesh and is presently working as an Assistant Engineer in the Maldives Energy Authority (MEA). His present responsibilities includes; evaluation of technical proposals, inspection of installed power systems, supervision of power supply approval process, keeping record of licensed power suppliers, supervision of the power license approval process, research and be aware of new technologies related to power systems.

Mr. Ahmed Inaan has a Bachelors degree in Electrical and Electronic Engineering from Islamic University of Technology, Bangladesh and is presently working as an Assistant Engineer in the Department of Meteorology and is currently the Head of Technical and Information Technology Services Unit of National Meteorological Centre (NMC). His main responsibilities include but not limited to install, repair and the maintenance of all meteorological equipments.

He is currently fulfilling the role of Project Manager for the construction of new building at NMC and also acting as the senior consultant for establishing National Early Warning System in the Maldives. This project involves establishing a Doppler Weather Radar, six automatic weather stations and a seismometer. In addition to his professional career as an electrical engineer, he has worked in the Construction industry where he has obtained extensive experience in load calculations, drawing single line diagrams and site supervision of various construction projects. He is also working as lecture at College of Higher Education. Curriculum Vitae of all the consultants are included in ***Annex 1.***

16. Conclusion

Male' Commercial Port acts as the transport hub for cargo ships. Majority of all international maritime cargo also enters and leaves the country through the Port of Male'. Compared to the major ports around the world, throughput is limited at Male' port and totalled 30,000 TEU in 2005, with an additional 250,000 tons of break-bulk cargo passing through the port. The cargo handling and storage existing facilities in Male' Port is beyond workable limits. In part this is due to the terminal area behind the quay is used to store containers for relatively long periods.

Due to increasing pressure for the urgent need for extra space for cargo containers and cargo handling, Government of Maldives has proposed to expand the existing Male' commercial port by reclaiming western side of the port to increase efficiency of the Male' commercial port.

Based on environmental, social and technical analysis the proposed location for the expansion of the port is most suitable for the land scarce Male'.

The proposed project is highly unlikely to have major negative environmental impacts on global, national and regional scale. The proposed design of the project is expected to have local environmental impacts confined to that area only. However, if the mitigation measures are taken, it is quite certain that the project will have very minimal environmental impact on the local environment.

Maldives Ports Authority should monitor the local environment and tests should be carried out on water parameters during both construction and operational phase. If the monitoring reveals adverse impact compared to the prediction in EIA, additional mitigation measures should be established. On the other hand, if the monitoring reveals that there are no significant impacts, the monitoring established in the EIA process could be lightened.

17. Appendices

17.1. Annex

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