Premier Equities Pte Ltd

1st Addendum to the EIA Report

Development of City Hotel, Hospitality Institute and Resort Development at Bodufinolhu and Gasfinolhu

LAAMU ATOLL

January 2012

بسم الله الرحمن الرحيم

Declaration of the Project Proponent and commitment letter

Re: 1st Addendum to EIA report for Development of City Hotel, Hospitality Institute at L. Gan and Resort Development at Bodufinolhu and Gasfinolhu

As the proponent of the proposed project We guarantee that We have read the report and to the best of Our knowledge all non-technical information provided here are accurate and complete. Also We hereby confirm Our commitment to finance and implement all mitigation measures and the monitoring program as specified in the report

Signature:

Name:

Designation:

Date:

Declaration of the Consultant

I certify that statements made in this 1st Addendum to the Environment Impact Assessment Report for Development of City Hotel, Hospitality Institute at L. Gan and Resort Development at Bodufinolhu and Gasfinolhu, to best of my knowledge are true, complete and correct.

Name: Hussein Zahir

Consultant Registration Number: 04-07

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1 EXECUTIVE SUMMARY

This first addendum to EIA report for Development of City Hotel, Hospitality Institute and resort development at Bodufinolhu and Gasfinolhu is prepared to address the construction of a temporary causeway connecting L. Gan City Hotel area and Bodufinolhu for the duration of construction phase of Bodufinolhu.

EPA instructed the proponent to remove the temporary cause way constructed connecting the two islands during December 2011 after a complaints raised from an individual from L. Gan. A temporary cause way was constructed by the proponent using dredged material and three concrete culverts connecting the two islands (L. Gan and Bodufinolhu) for transporting construction material from L. Gan to Bodufinolhu. In consultation with EPA and Tourism ministry it was decided that temporary cause way can be constructed with environmental clearance in the form of an addendum.

The temporary cause way will be constructed at the channel area between L. Gan and Bodufinolhu (shortest length). The cause way will be constructed west of main road (to locate cause way within the City Hotel boundary) at L. Gan and connected at the southern end of Bodufinolhu.

The proposed causeway is 31.59m long and 4m wide. Culverts will be placed at 1m intervals of opening size 1.5m. The culverts will be constructed with reinforced concrete. Excavators will be used for transporting the culverts to designated locations (13 culverts will be constructed).

Water current speed measure was taken near the existing culverts to record the current speed flowing behind the causeway and at the eastern side of Bodufinolhu and Gasfinolhu. Water current at the eastern side of Bodufinolhu and Gasfinolhu is low (0.21m/s near Bodufinolhu and 0.16m/s near Gasfinolhu). Current speed just west of culvert is at an average 0.74m/s during high tide. During low tide due to the sediment build up near the culvert water flow is completely blocked.

Shoreline survey was carried out using precision GPS; recording beach toe and low tide line. Since the eastern side of L. Gan and Bodufinolhu is an intertidal area (mostly near Gan) beach toe was recorded for the eastern side.

Qualitative assessment was carried out at the proposed causeway location. Since already a causeway is construction area east of the causeway was assessed. The qualitative survey carried out at the area showed that dominant benthic substrate was sea grass. The area was sandy with few rock patches. Two species of sea grass was observed at the area these are; *Thalassia hemprichii* and *Syringodium sp*.

Impacts on the environment by the construction of temporary causeway have been identified through interviews with the project management team, field data collection surveys (survey data from initial EIA and data collected for this addendum) and based on past experience in similar development projects.

Possible impacts arising from the resort development and operation works are categorized in to reversible and permanent (irreversible) impacts. The impacts identified are also described according to their location, Extent (magnitude) and characteristics. Reversible and irreversible impacts are further categorized in to intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken.

Since the area is already modified and is planned for additional coastal modifications additional impacts in relation to construction of temporary causeway is minor to negligible.

Operational impact envisaged due to the proposed modification is change in hydrodynamic regime (which is existing condition due to present causeway) due to the reduction of flow of water through the culverts. This change in hydrodynamic regime is expected to be moderate since the new causeway is design to allow maximum flushing (32% open based on 13 culverts of opening width 1.5m).

The proposed causeway for use during the construction stage of Bodufinolhu resort development is 4m wide and 31.59m long; constructed of concrete culverts and dredged material. Alternatives are jetty structure constructed using piles or piers, barge used for transport of material across the channel and the no project scenario.

Mitigation provided in the EIA report is sufficient for mitigating impacts identified in this addendum to the EIA report. Mitigation for Solid waste handling and construction related impacts are provided in the initial EIA report.

No additional monitoring is required as a result of the proposed temporary causeway. Monitoring works proposed in the EIA report includes reef and shoreline monitoring of all three project islands (including beach profiles and mapping of shoreline using high precision GPS).

The proposed causeway is designed to allow maximum flow of water with structural integrity to allow transport of dumper trucks across to Bodufinolhu. The design of the causeway is formulated based on the consultation with EPA (during inspection visit to site by EPA personnel in regards to complaint raised by an islander from L. Gan due to the construction of causeway blocking the flow of water between Gan and Bodufinolhu) and EIA consultant. The causeway will be used only for the duration of Bodufinolhu construction work and will be removed once construction is completed (12 months).

2 INTRODUCTION AND RATIONALE

This first addendum to EIA report for Development of City Hotel, Hospitality Institute and resort development at Bodufinolhu and Gasfinolhu is prepared to address the construction of a temporary causeway connecting L. Gan City Hotel area and Bodufinolhu for the duration of construction phase of Bodufinolhu.

EPA instructed the proponent to remove the temporary cause way constructed connecting the two islands during December 2011 after a complaints raised from an individual from L. Gan (see Figure 1). A temporary cause way was constructed by the proponent using dredged material and three concrete culverts connecting the two islands (L. Gan and Bodufinolhu) for transporting construction material from L. Gan to Bodufinolhu. In consultation with EPA and Tourism ministry it was decided that temporary cause way can be constructed with environmental clearance in the form of an addendum.

The initial proposal in the EIA report was to construct a jetty connecting the two the islands during construction stage for transport of construction materials. Since Bodufinolhu is a small island and space for material storage is limited; it was not possible to store larger materials. Therefore material was proposed to be stored at L. Gan and transported to working site when required. In this regard a causeway strong enough for dump trucks to cross was vital for the timely completion of the project.

The shallow intertidal area west of the channel area was initially tested for transport of material using dump trucks but due to muddy sand it was not possible for the vehicles to operate. Only heavy machinery that was able to cross was excavators. Since material transport using excavators was time consuming and have to be limited during low tide phase this option was not feasible. Therefore the proponent of the project propose to construct a temporary causeway connecting the islands Gan ad Bodufinolhu.

Figure 1 Existing causeway constructed by the contractor for the resort development project

3 STUDY AREA

The temporary cause way will be constructed at the channel area between L. Gan and Bodufinolhu (shortest length). The cause way will be constructed west of main road (to locate cause way within the City Hotel boundary) at L. Gan and connected at the southern end of Bodufinolhu.

Figure 2 Proposed location for the cause way connecting L. Gan and Bodufinolhu.

4 SCOPE OF WORK

This addendum to the EIA is prepared to address the construction of a temporary cause way connecting L. Gan and Bodufinolhu for the duration of construction stage of Bodufinolhu. An EIA application form was submitted to EPA briefing the concept plan of cause way and location. Scoping meeting was held at EPA on 2nd January 2012 with personnel from EPA, representative from the proponent and EIA consultant. In the scoping meeting it was agreed that additional environmental data is not required since EIA already covers environmental details of the area. Also it was agreed that additional stakeholder consultation was not required. Based on the discussions at the meeting, a ToR was finalized and later approved by EPA (see Appendix 1).

Land and Marine Environmental Resource Group Pte Ltd have been engaged Premier Equities Pte Ltd to prepare the addendum to the EIA and to provide assistance in other environmental related activities. This addendum to the EIA is prepared in accordance with Environmental Impact Assessment Regulations, 2007 and the Government of Maldives environmental policy and guidelines.

4.1 DESCRIPTION OF THE PROPOSED PROJECT

The proposed causeway is 31.59m long and 4m wide. Culverts will be placed at 1m intervals of opening size 1.5m. The culverts will be constructed with reinforced concrete. Excavators will be used for transporting the culverts to designated locations (13 culverts will be constructed). The space between the culverts will be filled with dredged material (removed during entrance clearance works as stated in the EIA report). Approximately 1,300m^3 of dredged material will be used for construction of the causeway (see Appendix 2 for design of causeway). The sides of the structure will be reinforced with revetment constructed using rock debris from excavation works and construction debris.

5 EXISTING ENVIRONMENT

Existing environment data including wave, tide and marine habitats are provided in the EIA report; as agreed in the scoping meeting this section provides shoreline and water current data gathered during the field visit to the islands. Water current was measured at the existing causeway area near the culverts and eastern side of Bodufinolhu and Gasfinolhu. Shoreline survey was carried out using high precision GPS.

5.1 GEOGRAPHIC LOCATION AND GENERAL SETTING OF PROJECT AREA

L. Bodufinolhu is located in the Laam atoll which is approximately 10 km away from the Kadhdhoo domestic airport and just off the northern tip of L. Gan thundimagu. In terms of geographic coordinates, it is found at 1^{o} 56'40.6" and 73^{o} 32'45.52". These islands are located on the eastern rim of the atoll. A very shallow channel exists between these two islands (see Figure 3).

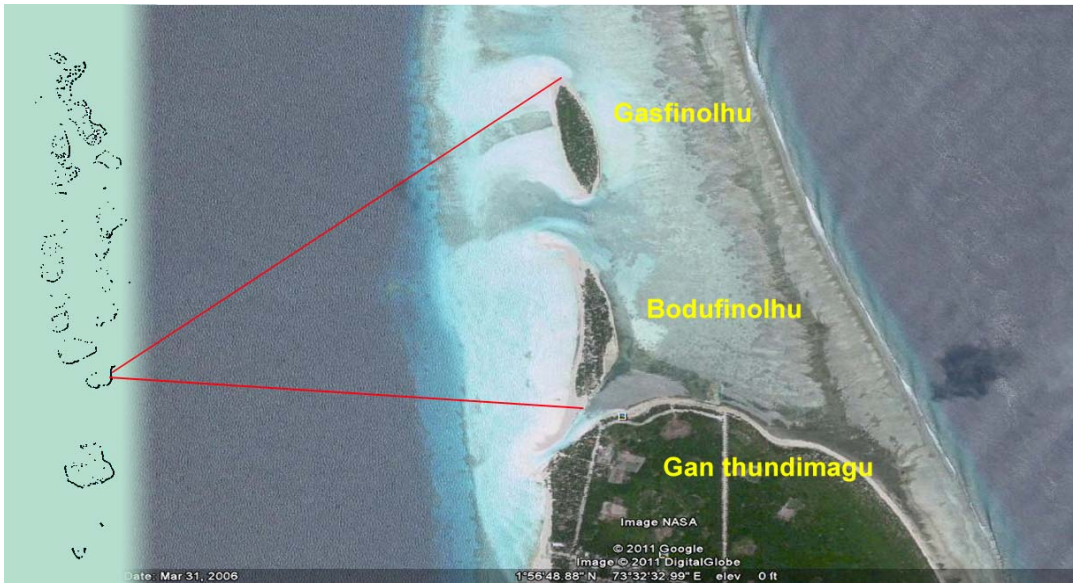

Figure 3 Location of L Atoll and satellite image of L. Gan, Bodufinolhu and Gasfinolhu.

5.2 WATER CURRENT

Water current speed measure was taken near the existing culverts to record the current speed flowing behind the causeway and at the eastern side of Bodufinolhu and Gasfinolhu. Water current at the eastern side of Bodufinolhu and Gasfinolhu is low (0.21m/s near Bodufinolhu and 0.16m/s near Gasfinolhu). Current speed just west of culvert is at an average 0.74m/s during high tide (Figure 4). During low tide due to the sediment build up near the culvert water flow is completely blocked (Figure 5). During the initial field surveys carried out at the project area (June 2010); during NE monsoon it was noticed that the two islands join together thereby blocking the

passage between the two islands. In contrast during SW monsoon passage between the two islands was observed to be deep.

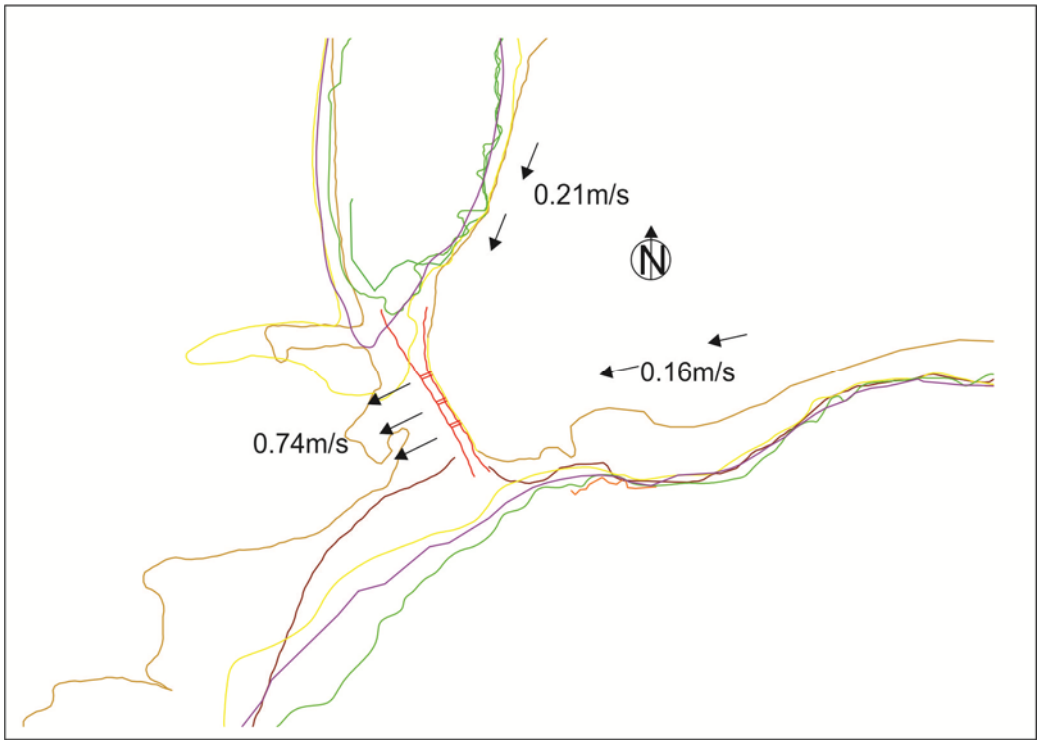

Figure 4 Current data collected at the western side and eastern side of the existing causeway

Figure 5 Western side of existing causeway during low tide

Figure 6 Western side of existing causeway during high tide

5.3 SHORELINE SURVEY

Shoreline survey was carried out using precision GPS; recording beach toe and low tide line. Since the eastern side of L. Gan and Bodufinolhu is an intertidal area (mostly near Gan) beach toe was recorded for the eastern side.

Large intertidal sand spit is observed at the western side of Gan and Bodufinolhu. During low tide area west of culvert is exposed while the eastern side near culvert is approximately 0.8m deep. Beach at the north western corner of the island is observed with accretion while the western side remains same as observed during the initial survey (June 2010). During June 2010 severe erosion was experienced at the western side of the Gan. The client in consultation with EIA consultant and EPA has constructed sand bag revetments (held together with wire mess) at the base of coconut trees that were badly impacted by erosion. The western shoreline remains same as the initial survey period with little change.

Bodufinolhu shoreline has been modified by backfilling works (scope of work covered in the initial EIA report) at the eastern side near the beach rocks found at southern side (approximately 3,200m^2 area see Figure 8). The northern tip of the island has extended approximately 104m. This extension of beach tip is possible seasonal change same as the beach tip at the southern side joining with Gan. The vegetation line recorded showed that vegetation at the northern tip area as increase in length by 66m. This change perhaps is due to increase in flow of current between Bodufinolhu and Gasfinolhu due to the existing obstruction (see Appendix 3 for shoreline survey superimposed with June 2010 shoreline survey).

Figure 7 Eastern side of cause way during low tide, L. Gan (left), eastern side of causeway during high tide, L. Gan (rigt)

Figure 8 Eastern side of Bodufinolhu, picture taken during June 2010 field trip (left), eastern side of Bodufinolhu partly back filled as part of coastal modification (right)

5.4 MARINE ENVIRONMENT

Qualitative assessment was carried out at the proposed causeway location. Since already a causeway is construction area east of the causeway was assessed. Location and GPS coordinates of the survey location is provided in Figure 9.

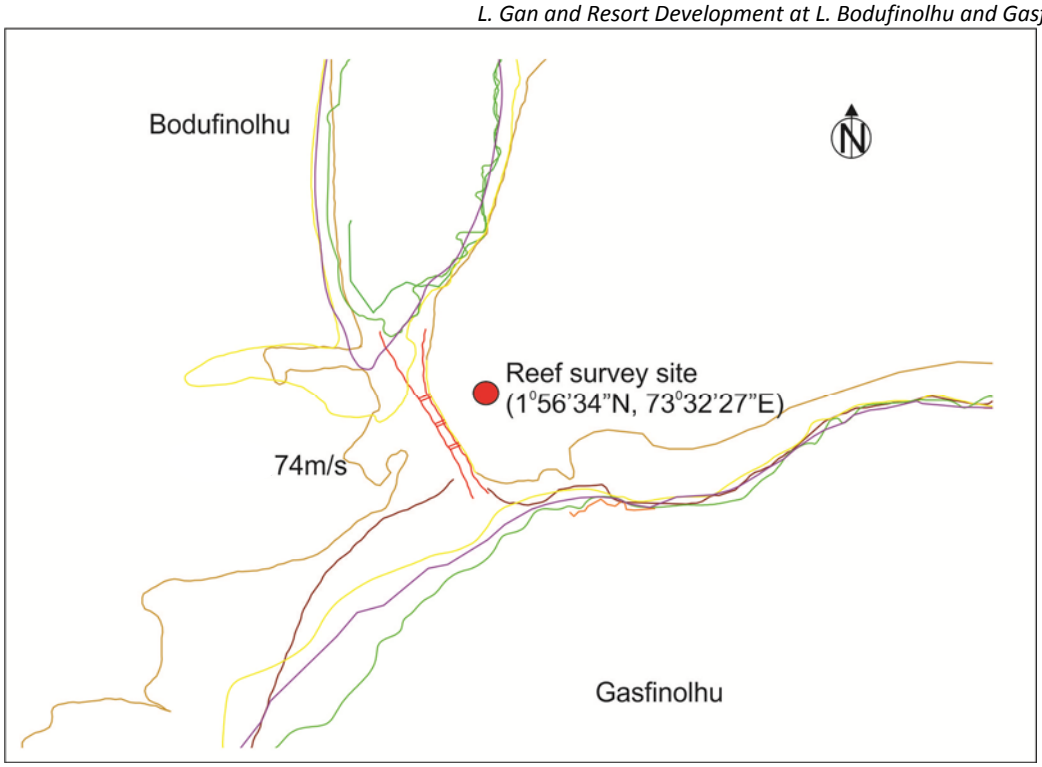

Figure 9 Location and GPS coordinates of reef survey site

The qualitative survey carried out at the area showed that dominant benthic substrate was sea grass. The area was sandy with few rock patches. Two species of sea grass was observed at the area these are; *Thalassia hemprichii* and *Syringodium sp*. Near the causeway sea grass density was observed to be low compared to survey area. No live coral was observed at the survey site.

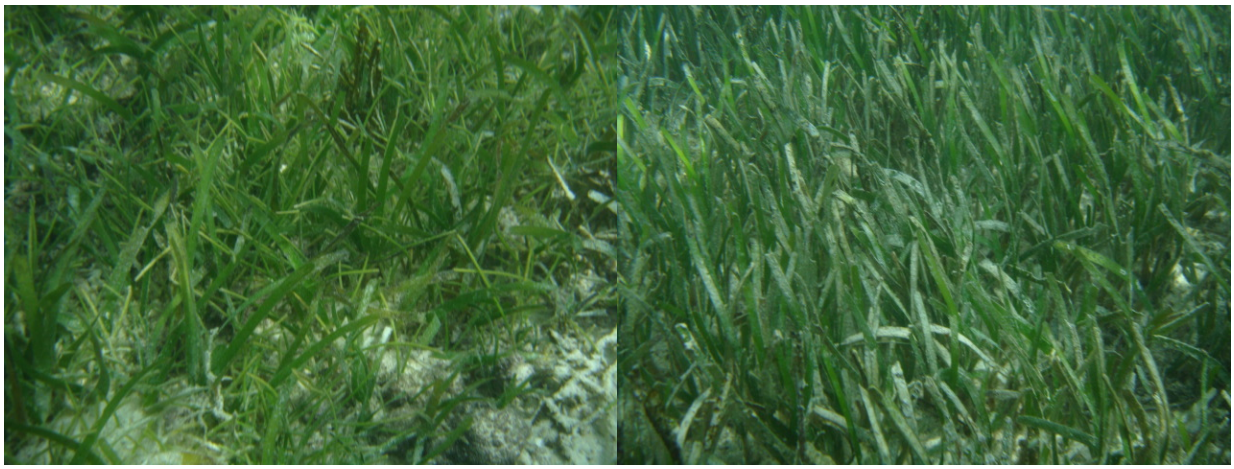

Figure 10 Two species of sea grass observed at the survey area

6 POTENTIAL IMPACTS

Impacts on the environment by the construction of temporary causeway have been identified through interviews with the project management team, field data collection surveys (survey data from initial EIA and data collected for this addendum) and based on past experience in similar development projects.

Possible impacts arising from the resort development and operation works are categorized in to reversible and permanent (irreversible) impacts. The impacts identified are also described according to their location, Extent (magnitude) and characteristics. Reversible and irreversible impacts are further categorized in to intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken. Below (Table 1) are the impact categories:

Table 1 Categorized scale of impact prediction

Impact category	Description	Reversible/ irreversible	Cumulative impacts
Negligible	the impact has no significant risk to environment either short term or long term	Reversible	no
Minor	the impact is short term and cause very limited risk to the environment	Reversible	no
Moderate	Impacts give rise to some concern, may cause long term environmental problems but are likely short term and acceptable	Reversible	May or may not
Major-	impact is long term, large scale environmental risk	Reversible and Irreversible	Yes, mitigation measures has to be addressed

The project boundary is the area between the L. Gan and Bodufinolhu. The width of the causeway is 4m while the length is 31.59m.

6.1 CONSTRUCTIONAL IMPACTS

Since the area is already modified and is planned for additional coastal modifications additional impacts in relation to construction of temporary causeway is minor to negligible.

Dominant current experienced at the channel area between Gan and Bodufinolhu is east to west through the channel. Since the area is intertidal excavators can be operated during low tide for construction of causeway.

Sediment for the causeway (filling the 1m gap between the culverts and top of the causeway) will be met by initially proposed entrance clearance work. Therefore an impact relating to sourcing material is already covered in the initial EIA report.

6.2 OPERATIONAL IMPACTS

Operational impact envisaged due to the proposed modification is change in hydrodynamic regime (which is existing condition due to present causeway) due to the reduction of flow of water through the culverts. This change in hydrodynamic regime is expected to be moderate since the new causeway is design to allow maximum flushing (32% open based on 13 culverts of opening width 1.5m). The existing causeway has only 3 culverts which is just 4% opening (percentage given as open passage length wise). Beach littoral movement will be impacted temporarily due to the proposed causeway. Considering this impact it has to be understood that shoreline of both L. Gan project area and Bodufinolhu will be modified under the development project by means of back filling and coastal stabilizing structures. Therefore impact due to hydrodynamic changes is thought to be insignificant.

Table 2 Impact matrix

Impact	Phase	Magnitude	Significance	Duration	Assumption made
Impact on live coral	Construction stage	No impact (short termed)	Not significant	12 months	No live coral observed at the project boundary. Reef slope at the western side is approximately 400m away separated with an intertidal flat. Impact due to

					sourcing of dredge material is already covered in the June 2010 EIA report.
Impact on hydrodynamic regime	operational stage (of temporary causeway)	Minor (limited to construction stage)	moderate	12 months	Approximately more than 60% of available channel width will be blocked due to the temporary causeway. Change in hydrodynamic regime (locally) will increase flow at the channel between Gasfinolhu and Bodufinolhu therefore may impact the shoreline of both islands. This impact is envisaged to be minor in the long term since coastal stabilization measures are proposed for L Gan project areas and both Gasfinolhu and Bodufinolhu.

7 ALTERNATIVES

The proposed causeway for use during the construction stage of Bodufinolhu resort development is 4m wide and 31.59m long; constructed of concrete culverts and dredged material. Alternatives are jetty structure constructed using piles or piers, barge used for transport of material across the channel and the no project scenario.

7.1 JETTY CONSTRUCTED USING PILES OR PIERS

Considering this option; a jetty over piles has to be very stable and able to carry load of a dump truck (loaded) which will need larger piers and strong substructure. This option is practically feasible if designed to carry load of a dump truck but the cost will be very high.

7.2 TRANSPORT OF MATERIAL USING A BARGE

Considering this option; material transport has to be limited to high tide only. A barge can be maneuvered using guidance ropes or wires across the channel.

7.3 NO PROJECT SCENARIO

It is vital for convenient and timely transport of construction materials to project sites for successful completion of the project. Delays due to transport and logistics can have significant finance loss for the client. The no project scenario therefore will have negative impacts of timely completion of the project that will have positive socio economic impacts on the L. Gan and L. Atoll in general. Therefore the no project scenario is not feasible.

7.4 COMPARISON OF ALTERNATIVES AND SELECTION

Considering all the alternative options, it is thought the jetty over piers and proposed method of causeway constructed using concrete culverts and dredged material. In terms of environmental impacts jetty over piers is feasible but in terms of cost it is not. The proposed causeway will have approximately 32% opening (percentage of length of causeway) allowing flow of water and sediment. Therefore considering the functionality, practical implementation and cost; the proposed causeway constructed using dredged material and a concrete culvert is selected.

8 MITIGATION AND MANAGEMENT OF NEGATIVE IMPACTS

Mitigation provided in the EIA report is sufficient for mitigating impacts identified in this addendum to the EIA report. Mitigation for Solid waste handling and construction related impacts are provided in the initial EIA report.

Change to hydrodynamic regime in terms of impact to beach littoral transport is not significant since coastal modification for the project islands are described in the initial EIA report. Therefore additional mitigations are not provided. Also it has to be noted that the causeway will be a temporary structure for the duration of construction stage of Bodufinolhu.

9 DEVELOPMENT OF MONITORING PLAN

No additional monitoring is required as a result of the proposed temporary causeway. Monitoring works proposed in the EIA report includes reef and shoreline monitoring of all three project islands (including beach profiles and mapping of shoreline using high precision GPS).

10 CONCLUSION

The proposed causeway is designed to allow maximum flow of water with structural integrity to allow transport of dumper trucks across to Bodufinolhu. The design of the causeway is formulated based on the consultation with EPA (during inspection visit to site by EPA personnel in regards to complaint raised by an islander from L. Gan due to the construction of causeway blocking the flow of water between Gan and Bodufinolhu) and EIA consultant. The causeway will be used only for the duration of Bodufinolhu construction work and will be removed once construction is completed (12 months).

Impacts envisaged due to the proposed temporary causeway is minor and mitigation measures provided in the initial EIA report is sufficient; therefore additional mitigation measures are not proposed.

EIA monitoring requirement provided in the EIA report covers the requirement for this addendum (shoreline monitoring and reef monitoring) therefore additional monitoring requirements are not proposed.

11 APPENDICES

Appendix 1 Terms of Reference

Environmental Protection Agency

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بسم الله الرحمن الرحيم

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INTERNATIONAL YEAR OF FORESTS · 2011

Terms of Reference for Environmental Impact Assessment

The following is the Terms of Reference (TOR) for the Addendum proposed for the EIA of construction of a causeway linking Gan and Bodufinolhu for the duration of the construction phase. This TOR is based on the issues raised in the scoping meeting held on Monday, 02 January 2012 at Environmental Protection Agency.

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

1. Introduction - describe the development project to be assessed including its critical components that may impact the environment in the short and long-term and explain the executing arrangements for the environmental assessment. Describe the changes proposed with respect to the originally approved concept.

2. Study Area - 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.

3. Scope of Work - The following tasks will be performed:

Task 1. Description of the Proposed concept change – *Provide description of the relevant parts of the project that is proposed to be changed, using maps at appropriate scales where necessary. Changes in size and/or shape of the reclaimed area should be clearly explained with clear scaled maps (overlay maps clearly showing the changes must be provided). The need for these changes must be justified. In addition special attention shall be given to major design and infrastructure changes.*

Task 2. Description of the existing environment – *Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area, with a special emphasis on:*

a) Coral and marine environment assessment in terms of coral cover in the areas where new developments will take place.
b) Existing shoreline of the new development area

Characterize the extent and quality of the available data, indicating significant information deficiencies and any uncertainties associated with the prediction of impacts.

Task 3. Determine the Potential Impacts of the Proposed Project *– Identify impacts related to the work in relation to their size, scale and duration. Distinguish between significant impacts that are positive and negative, direct and indirect (= triggering), and short and long term. Identify impacts that are cumulative, unavoidable or irreversible. Identify any information gaps and evaluate their importance for decision-making.*

Task 4. Alternatives to proposed project *– Describe the alternatives examined for the proposed project that would achieve the same objective including the no action alternative. Justification should be provided for the selected alternative.*

Task 5. Mitigation and management of negative impacts – *Identify possible measures to prevent or reduce significant negative impacts from implementation of the proposed activities to achieve the project objectives. Cost and commitment to mitigation measures, equipment and resources required to implement these measures should also be included.*

Task 6. Development of monitoring plan *– The monitoring plan should focus on monitoring needs prior, during construction. The report should also provide a detailed cost breakdown for implementing the monitoring plan and commitment of the Proponent to conduct the monitoring programme.*

Presentation *- The environmental impact assessment report, shall be presented in print and digital format and shall be concise, focusing on significant environmental issues. It shall contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental impact assessment report shall be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2007.*

Timeframe for the submitting the EIA report *– The developer must submit the completed EIA report within 3 months from the date of this ToR.*

ENVIRONMENTAL PROTECTION AGENCY
Malé, Republic of Maldives

....

Date

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Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

Appendix-1

1. PHYSICAL MONITORING

1.1. WATER QUALITY TESTING

These parameter guideline triggers have been adopted from the Great Barrier Reef Marine Park Authority (GBRMPA, 2009). The marine ecology in the Maldives is so vulnerable that it should be compared to that in the GBRMP. This will help maintain healthy ecosystems to preserve valuable natural resources that are directly or indirectly part of all people's livelihoods.

Take 3 control water samples away from the project site, 3 water samples from the project site and a representative number of water samples from different locations around the project site. All water samples shall be taken at a depth of 1m from the mean sea level or mid water depth for shallow areas. Record the GPS coordinates of each water sample taken. Analyze the following parameters and check the water quality standards to evaluate the status of the sample.

1.1.1. Temperature: The optimum temperature for coral reef growth ranges between 18^{0}C and 32^{0}C. Changes should not surpass 1^{0}C above the average long term maximum (GBRMPA, 2009). Temperatures above or below the local range can cause stress to coral reefs and seagrass beds.

1.1.2. Salinity: It is recommended that salinity ranges between 3.2% - 4.2% for optimum coral reef and seagrass ecosystems to blossom. Surface salinity can decrease when fresh water is added e.g. floods or pollution from industry, or increase if surface water evaporates. Changes may cause stress to corals and seagrasses (GBRMPA, 2009).

1.1.3. pH: Seawater pH is usually 8.0-8.3. Levels below 7.4 pH stress corals and calcifying seagrasses by decreasing calcification processes.

1.1.4. Turbidity: Corals and seagrasses need UV light for photosynthetic processes. If turbidity is high then these ecosystems will become stressed. Studies suggest that long term turbidity levels which are >3 NTU lead to sublethal stress. However, long term turbidity levels higher than 5 NTU cause severe stress on coral at shallow depth (Cooper *et al.*, 2008).

1.1.5. Sedimentation: Sedimentation is the sediment load that arrives onto the reef which can reduce light availability for photosynthesis, deplete dissolved oxygen and cause smothering of organisms. Sedimentation rates are measured using sediment traps. The maximum mean annual rate for coral reef and seagrass ecosystems is 3mg/cm^2/day, and a daily maximum of 15mg/cm^2/day (GBRMPA, 2009).

1.1.6. Nitrates: Nitrate is an essential nutrient for aquatic plants and seasonal fluctuations can be caused by plant growth and decay (UNESCO/WHO/UNEP, 1996). Natural concentrations, which seldom exceed 0.1 mg l^{-1} NO_3^- N, may be enhanced by municipal and industrial waste-waters, including leachates from waste disposal sites and sanitary landfills (UNESCO/WHO/UNEP, 1996). In islands where there is significant agricultural activity, the use of inorganic nitrate fertilizers can be a significant source.

When influenced by human activities, surface waters can have nitrate concentrations up to 5 mg l^{-1} NO_3^-N, but often less than 1 mg l^{-1} NO_3^-N. Concentrations in excess of 5 mg l^{-1} NO_3^-N usually indicate pollution by human or animal waste, or fertilizer run-off. In cases of extreme pollution, concentrations may reach 200 mg l^{-1} NO_3^-N.

1.1.7. Ammonia: Unpolluted waters contain small amounts of ammonia and ammonia compounds, usually <0.1 mg l^{-1} as nitrogen. Total ammonia concentrations measured in surface waters are typically less than 0.2 mg l^{-1} N but may reach 2-3 mg l^{-1} N. Higher concentrations could be an indication of organic pollution such as from domestic sewage, industrial waste and fertilizer run-off. Ammonia is, therefore, a useful indicator of organic pollution. Natural seasonal fluctuations also occur as a result of the death and decay of aquatic organisms, particularly phytoplankton and bacteria in nutritionally rich waters (UNESCO/WHO/UNEP, 1996).

1.1.1. Phosphates: Phosphates exist in three forms: orthophosphate, metaphosphate (or polyphosphate) and organically bound phosphate each compound contains phosphorous in a different chemical arrangement. These forms of phosphate occur in living and decaying plant and animal remains, as free ions or weakly chemically bounded in aqueous systems. In the marine environment, phosphorus limits algal growth therefore when in excess causes euthophication and slower reef growth (UNESCO/WHO/UNEP, 1996). In most natural surface waters, phosphorus ranges from 0.005 to 0.020 mg l^{-1} PO_4^-P (UNESCO/WHO/UNEP, 1996).

1.1.2. Sulphate: Sulphate is naturally present in surface waters as SO_4^{2-}. It arises from the atmospheric deposition of oceanic aerosols and the leaching of sulphur compounds, either sulphate minerals such as gypsum or sulphide minerals such as pyrite, from sedimentary rocks. Industrial discharges and atmospheric precipitation can also add significant amounts of sulphate to surface waters. Sulphate can be used as an oxygen source by bacteria which convert it to hydrogen sulphide (H_2S, HS^-) under anaerobic conditions. Sulphate concentrations in natural waters are usually between 2 and 80 mg l^{-1}, although they may exceed 1,000 mg l^{-1} near industrial discharges or in arid regions where sulphate minerals, such as gypsum, are present (UNESCO/WHO/UNEP, 1996).

1.1.3. BOD: The biochemical oxygen demand (BOD) is an approximate measure of the amount of biochemically degradable organic matter present in a water sample (UNESCO/WHO/UNEP, 1996). It is defined by the amount of oxygen required for the aerobic micro-organisms present in the sample to oxidise the organic matter to a stable inorganic form. BOD measurements are usually lower than COD measurements. Unpolluted waters typically have BOD values of 2 mg l^{-1} O_3 or less (UNESCO/WHO/UNEP, 1996).

1.1.4. COD: The chemical oxygen demand (COD) is a measure of the oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant, such as dichromate (UNESCO/WHO/UNEP, 1996). The COD is widely used as a measure of the susceptibility to oxidation of the organic and inorganic materials present in water bodies and in the effluents from sewage and industrial plants. The concentrations of COD observed in surface waters range from 20 mg l^{-1} O_2 or less in unpolluted waters to greater than 200 mg l^{-1} O_2 in waters receiving effluents (UNESCO/WHO/UNEP, 1996).

Table 1. Water quality parameter optimum conditions.

PARAMETER	OPTIMAL RANGE	REFERENCE
TEMPERATURE	18^0C and 32^0C *Changes should not surpass 1^0C above the average long term maximum	GBRMPA, 2009
SALINITY	3.2% - 4.2%	GBRMPA, 2009
PH	8.0-8.3 *Levels below 7.4 pH cause stress	
TURBIDITY	3-5 NTU >5 NTU causes stress	Cooper *et al.* 2008
SEDIMENTATION	Maximum mean annual rate 3mg/cm^2/day Daily maximum of 15mg/cm^2/day	GBRMPA, 2009
NITRATES	<5 mg l^{-1} NO_3^-N	UNESCO/WHO/UNEP, 1996
AMMONIA	Max. 2-3 mg l^{-1} N	UNESCO/WHO/UNEP, 1996
PHOSPHATE	0.005 - 0.020 mg l^{-1} PO_4^-P	UNESCO/WHO/UNEP, 1996
SULPHATE	2 mg l^{-1} and 80 mg l^{-1}	UNESCO/WHO/UNEP, 1996
BOD	< 2 mg l^{-1} O_3	UNESCO/WHO/UNEP, 1996
COD	< 20 mg l^{-1} O_2	UNESCO/WHO/UNEP, 1996

1.2. BATHYMETRY AND HYDROLOGY

Waves, currents, tides: These parameters are important for understanding sediment transportation and the rate of effluent water dispersion. Ideally, presented a map illustrating the extent of sediment plumes and highlight the sites which will be affected by high sedimentation and turbidity rates. This study will complement coastal erosion monitoring.

Present bathymetric data on an A3 map. Identify the sites which have high water dispersion and dilution rates as well as intense erosion performances. State the tidal ranges in the area including neap and spring tides throughout the year. Mark the areas where wave action is more intense (e.g. where waves break).

This data is key for sewerage projects, desalination plants, dredging activities, aquaculture ventures, agriculture and all those which involve water dispersion and sediment transport activities. Sewerage outfall pipes shall be located where currents quickly disperse effluent. Brine water from desalination plants ought to be placed in high energy waters too, however, the impacts from this are still relatively unknown.

1.3. COASTAL EROSION

Monitoring should detect which parts of the shoreline change the most, where the beach migrates on a seasonal basis, and should track changes in the dynamic and vegetated shoreline on both inhabited and uninhabited. Two simple procedures are to be used to monitor change in beach volume and change in position of the edge of the dynamic beach (beach toe) and edge of vegetation: i) Beach profiling and ii) GPS mapping (Table 2). These methods are the most common form of coastal monitoring and are rapid and easily repeatable to allow a greater number of sites to be monitored.

Table 2: Key indicators and associated methods for monitoring coastal change

Indicator	Methods
Change in beach volume	Beach profiles
Change in position of toe of beach	GPS mapping
Change in position of edge of vegetation	
Decadal island change	Aerial photo analysis

Monitoring coastal erosion is important in management. Accretion sites should be identified prior to construction so that less investment is needed in protection structures (e.g. groins, breakwaters) and in beach nourishment activities in the case of touristy sites. Impacts on the environment will also be greatly reduced if no action is taken to modify natural sediment transport systems.

1.3.1. Beach profiles: Create a two-dimensional, cross-shore profile to show simultaneous removal and accumulative changes which the shoreline behaviour mapped by GPS does not express (Fig. 1). These surveys record detailed information on the elevation and distance of the shoreline from fixed benchmarks on the island. Surveys typically start at benchmarks, run across the beach perpendicular to the vegetated shoreline and terminate below low tide level on the adjacent reef flat. Such surveys allow changes in the elevation and relative position of the beach with respect to the benchmarks to be determined. Typically such surveys have an accuracy of ±0.1m (Kench 2009).

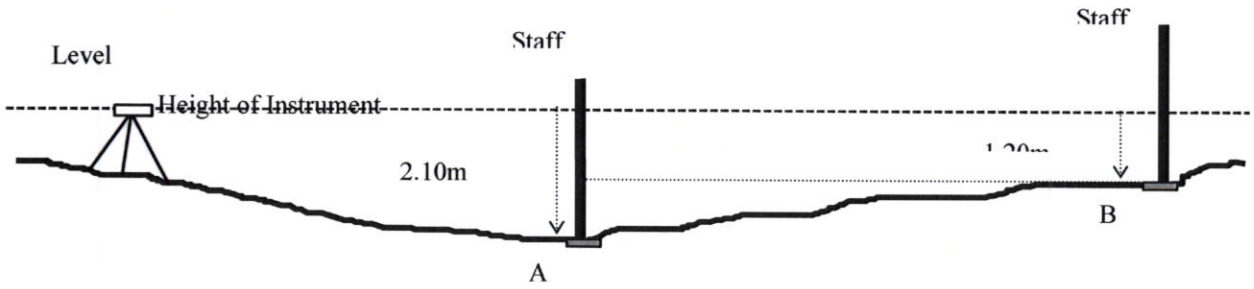

Fig. 1. Cross section of a beach profile.

Take a representative number of beach profiles from different accretion and erosion sites around

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the island, e.g. four sites. These sites should be surveyed every six months (one in SW Monsoon and one in NE Monsoon). The following should be identified:

- Edge of vegetation;
- Island scarp or berm;
- Instrument height;
- Water level (record time to standardise profiles against tide charts);
- Beach step;
- Toe of beach;
- Reef edge / seagrass / rubble

Include the superimposed beach profiles (SW and NE Monsoons) in the EIA document and state the changes in metres.

1.3.2. Toe of Beach GPS surveying: GPS mapping of shoreline change: This creates a map of the edge of the dynamic beach and vegetated interior to visualize changes over time.

GPS should be used to map the following for each island surveyed (Fig.2). Data from the different monsoon season should be superimposed on one single map to evaluate the changes in sediment accretion and erosion (in metres).

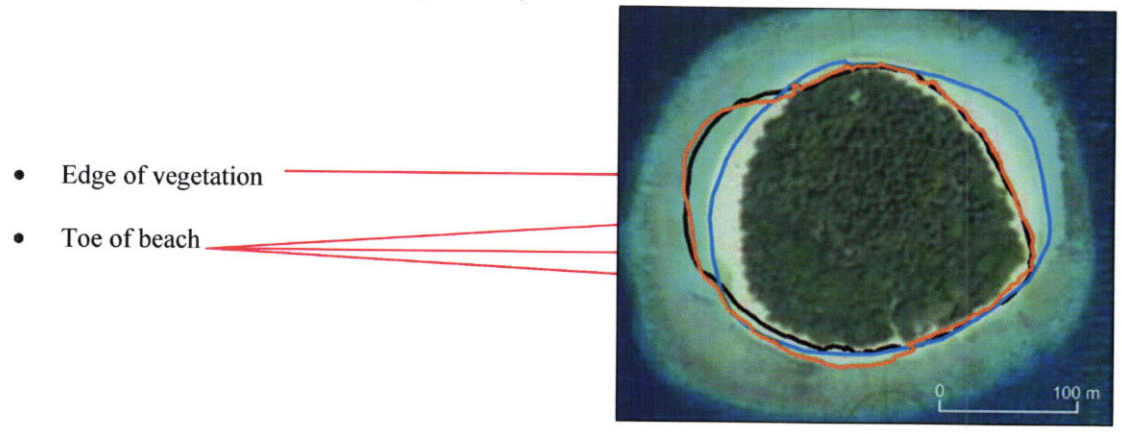

Fig 2. GPS surveying should identify the location of the toe of beach and compare data from one season to the next. Overlapping surveys from different seasons the degree of change will be easily identified.

GPS survey images should be included in the EIA report with appropriate data labels and scale.

1.3.3. Aerial photograph analysis: This will produce a map showing changes in the edge of the dynamic beach and vegetated interior over a decadal time scale. This data provides a rich source of information to establish whether reef islands have changed in size and position on reef surfaces.

1.3.4. Frequency: An annual cycle is observed in the Maldives with position of sediment dependent

on the prevailing monsoon. Timing is therefore a primary aspect in monitoring.

- *Baseline:* the first time an island is surveyed, the full seasonal cycle should be monitored requiring three visits: i) end of NE monsoon, ii) end of SW monsoon and iii) end of NE monsoon to see if sediment returned to its original position.
- *Annual:* on return visits, survey once at the end of the SW monsoon for the first five years.
- *Decadal:* monitoring every five or so years after the end of the SW monsoon.

2. BIOLOGICAL MONITORING

The first action in developing a long-term monitoring program is establishing the key questions about the study. This will guide the selection of methods, sites and times of sampling (English *et al.*, 1994). It is important to select sites for monitoring that are representative of the system as a whole, and not necessarily the closest or most pristine areas. Such "pristine" sites may be essential as "controls", if the aim of monitoring is to determine impacts at test sites (English *et al.,* 1994). All site selection should be made following a "pilot study" of the area, if the project is localized. The number of sites chosen for monitoring will necessarily be a balance between trying to achieve the maximum amount of information and the amount of resources and time available (English *et al.,* 1994). The monitoring program should be designed around a series of sites that can be visited on a regular basis, e.g. every year. Recording the GPS coordinates of the sites are really important for survey repetition. The first step is to establish a sound baseline description of the system before construction occurs.

2.1. CORAL REEF, FISH & INVERTEBRATES MONITORING

2.1.1. Pilot study: Manta tow: The manta tow technique is used to assess broad changes in the benthic communities or coral reefs where the unit of interest is often an entire reef or large portion thereof (English *et al.* 1994). Therefore this technique can be used to perform preliminary assessments to design a comprehensive monitoring study.

- Tow an observer, using a rope and manta board, behind a small boat powered by an outboard motor. Tows are carried out at a constant speed around the perimeter of a reef and are broken into units of 2 minutes duration (English *et al.* 1994).
- During each 2 minute tow, observations are made on several variables (e.g. percent cover of live coral, dead coral and soft coral). Additional information may be collected, dependent on the survey objectives, e.g. percent cover of sand and rubble.
- This technique is not recommended for fish counts. A pilot study for fish is not necessary since reef fish will inhabit the healthiest available reef. Exclusive fish and invertebrates surveys will be carried out in the main study.

2.1.2. Line Intercept Transects (LIT): It is the standard method recommended by the Global Coral Reef Monitoring Network (GCRMN) to determine percentage cover and colony size for management level monitoring, and obtains information on percentage cover of benthic communities e.g. hard coral, soft coral, sponges, algae, rock, dead coral. The community is characterized using lifeform categories which provide a morphological description of the reef

community.

- These categories are recorded on data sheets by divers who swim along lines which are placed roughly parallel to the reef crest at depths of 3 metres and 10 metres at each site (English *et al.,* 1994).
- Place 5 x 20m long replicate transects at each of the two depths (shallow: 3 m and deep: 9-10 m depths). If permanent transects are used, place metal stakes, hammered deep into the substratum (at least 0.5m). If a typical reef flat, crest and slope is present, the shallow transects will be located on the reef slope, approximately 3 metres below the crest. The deeper transects will be located approximately 9-10metres below the crest. If the site is on a reef without a well defined crest, then transect depth should be approximated to a depth below mean water mark. If there is little or no coral at 10m then transects should be laid at 6-8m and not difference.
- A representative number of sites around the island should be surveyed including those that are directly and indirectly affected by construction. A "control" site shall be selected and test sites thereafter. These shall be sufficient to make a quantitative assessment of the impacts caused by construction all around the island.
- Observers must be as consistent as possible when recording benthic lifeforms. The same observers should collect data at all sites and, where possible, during repeat surveys.

2.1.3. Coral Recruitment Plates: The larval supply of coral species is examined by estimating the number of new corals settling on replicated units of substratum (terracotta tiles). The tiles are deployed at 5 metres depth on a regular basis (e.g. monthly) and are collected after exposure for equal amounts of time, 3 months is recommended. After collection they are examined microscopically to count the new corals. Year round sampling should be undertaken to determine the period, or periods, of recruitment. When they are known, sampling effort can be concentrated in these periods.

It is ideal for EIA monitoring because it will evaluate whether the system is recovering after it has been damaged and at what rate. This will help understand the impact significance in later projects in the Maldives.

2.1.4. Settlement Quadrats: This is used to measure the growth, mortality ad recruitment of corals in a permanently marked (fixed) quadrat located at metres depth on the reef slope (English *et al.,* 1994). It complements the LIT method by providing changes in individual corals and recruitment to a mapped area. This provides abundance estimates of recruits that have survived the first year, thus giving a more reliable estimate of future coral species composition than recruitment tiles that look at newly settled recruits

- Using a 25cm x 25cm quadrat, swim in a haphazard fashion around the reef and place the quadrat on the substratum in areas lacking large (>25 cm diameter) sessile invertebrates;
- Count all small (maximum diameter 2 cm) stony corals within the quadrat. Record to genus if possible;
- Repeat 80 times.

2.1.5. Sedimentation on the reef: This is to measure direct sedimentation on the reef resulting from land clearing activities, construction, dredging, mining and drilling activities. Sedimentation reduces light availability for photosynthesis, deplete dissolved oxygen and cause smothering of

organisms. Sedimentation rates are measured using sediment traps.

- Attach sets of 3 PVC sediment traps to the reef. The base of the traps should be 20cm above the substratum. Place 4 sets n the reef slope at 3 metres, 2 on either side of the permanent quadrat at one metre intervals.
- Collect traps every month, replace traps immediately with new clean traps. Dry and weigh sediments to the nearest milligram.
- Monitor monthly for the first year and then every 3 months for the next 2 year.

2.1.6. Coral Reef Fish Census: Belt transect: The aim is to simultaneously estimate the abundance and size of fish along 50 metre transects. A visual census is conducted during daylight hours along 3 of the same transects as the line intercept but the fish census transects must be 50 m long at 2 depths (3-5 m and 8-10 m). Wait for 5 to 15 minutes after laying the line before counting to allow fishes to resume normal behaviour, then swim slowly along the transect recording fish encountered in a 5 m belt and 5 m tunnel above the transect. There are two techniques:

- Detect differences in assemblages of reef fishes at different sites using abundance categories (table 3). It provides baseline data for zoning, management and monitoring, or;
- Count individual fish and estimate their total lengths to determine the standing stock and population size structure of specific species (those that are favoured by fishermen e.g. Serranids, Siganids, Acanthurids, Lutjanids, Lethrinids, Haemulids, Balistids). This is to determine the standing stock and population size structure of specific species.

Table 3. Fish abundance categories.

Category	Number of fish
1	1
2	2-4
3	5-16
4	17-64
5	65-256
6	257-1024
7	1025-4096
8	4097-16384

2.2. SEAGRASS MONTIORING

Seagrass meadows occur in shallow, sheltered soft-bottomed marine coastlines (Kirkman, 1990). They physically help to reduce wave and current energy, help to filter suspended sediments from the water column and stabilise bottom sediments (Fonseca *et al.,* 1982). The habitat complexity attracts high biodiversity and abundance of animals. They are also nutrient sinks, buffering or filtering nutrient and chemical rich waters (Short and Short, 1984). The high primary production rates are linked to high fishery production rates.

Monitoring seagrassess consists of mapping the distribution and density of existing meadows to determine the natural variability (e.g. seasonal dieback) before estimates of loss or gain due to perturbation can

be made (English *et al.,* 1994). Percentage cover are measured within replicate quadrats placed at regular intervals along the length of a transect.

- Place transects perpendicular to the shore and that extend to the outer limits of the beds (where seagrass disappears). Transects should be parallel and separated by reasonable distances from each other (50m to 100m). Take 3 replicate transects at each site. Swim along the transect along a compass bearing, perpendicular to the shore.
- Place 25cm x 25cm quadrats at regular intervals (5m-10m) and estimate the percent cover using similar categories to those used in coral reef surveying.
- Estimate the abundance and length of fish the same way as performed in the coral reef visual census.

2.3. TERRESTRIAL MONTIORING

Terrestrial environments in the Maldives play an important role in sustaining island shapes and many indigenous species. Vegetation maintains the soil on the ground and hosts 70 bird species, many interesting reptiles and amphibians and mangrove communities. In Environmental Impact Assessments, terrestrial monitoring should include evaluating the damages caused by the project development on the following flora and fauna:

- Land clearance activities including removal of trees, shrubs, seedlings, forest litter;
- Mangroves survey including area, species, health;
- Reptiles and amphibians including species, population size, location;
- Birds including species, population size and location;
- Marine turtle tracks;
- Soil texture changes, and,
- Garbage description.

A general procedure for collecting island data is through focus group discussions where islanders can identify the major changes in flora and fauna. All stakeholders should attend this meeting.

Finally, the legislation states that:

- No trees shall be felled for tourism ventures (Regulation on the Protection and Conservation of the Environment in the Tourism Industry)
- The maximum area for construction allowed for tourism ventures is 20%.
- The buffer zone between the high water mark and the first construction is 20 metres minimum.

3. SOCIO-ECONOMIC MONITORING

Public consultation is an important part of the project assessment since stakeholders will influence the success or failure of the project. If stakeholders and members of the public fully support the development activities will process much easier and benefits by both parties will be apparent. The following is important in all consultations:

- List of stakeholders and key informants, describe chronological plan of interviews and meetings

and key points of discussions;

- Apply for all the necessary permits for project development;
- Census of the economic activities in the area (project island and neighbouring islands);
- Employment and economic opportunities and diversification in the area;
- Impacts on ground water from construction and operational phase and water availability for locals;
- Increased demands for natural resources and services in the area, e.g. water supply, energy, waste water treatment, solid waste generation, health services, population pressure, space availability, food and nutrition security –fisheries, agriculture, other- etc.
- Impacts on tourism, and
- Social destabilization of the island community.

The key outcomes from each stakeholder and key informant consultation ought to be included in the EIA. Follow up consultation will validate the success of the project, failures and suggest improvements.

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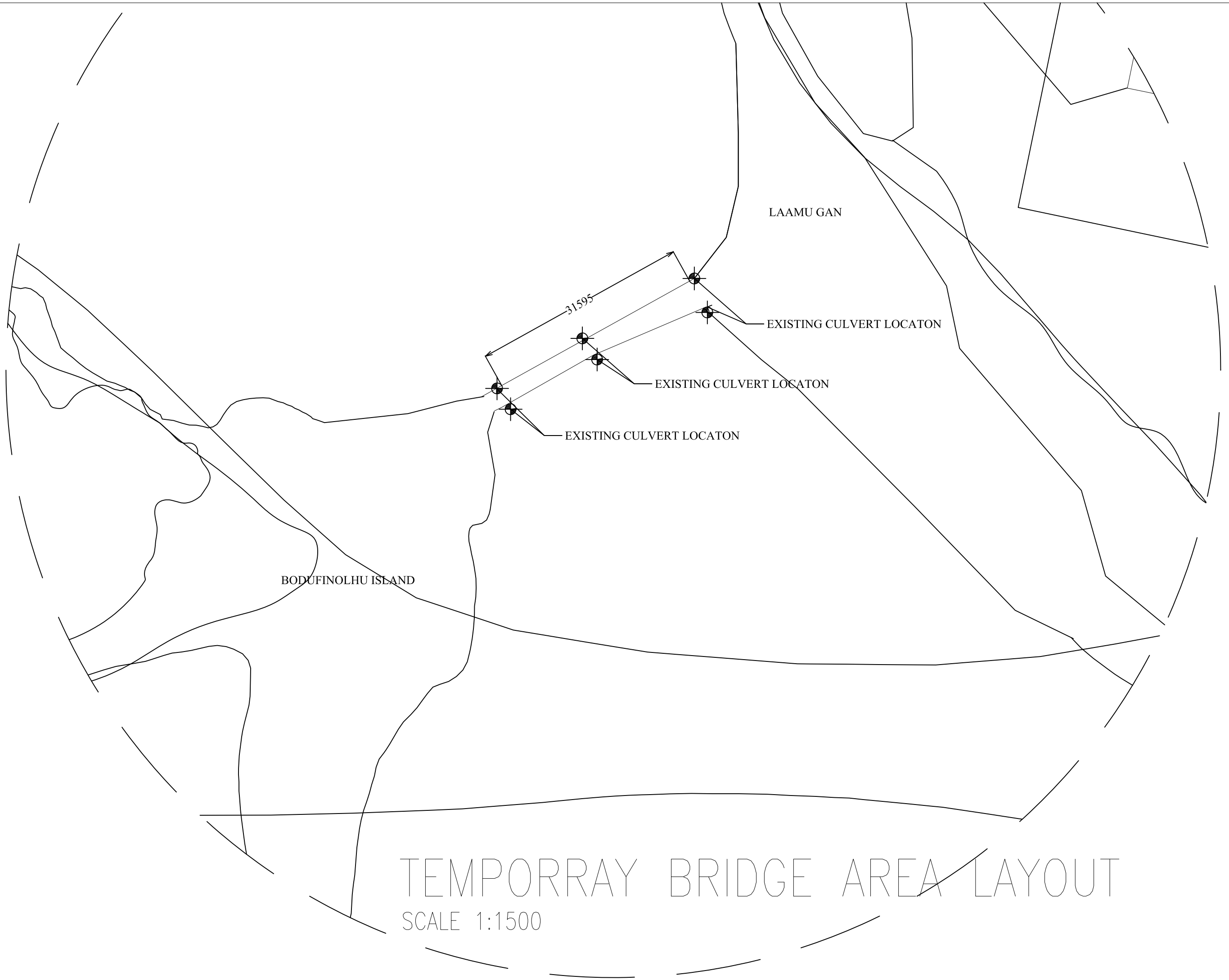
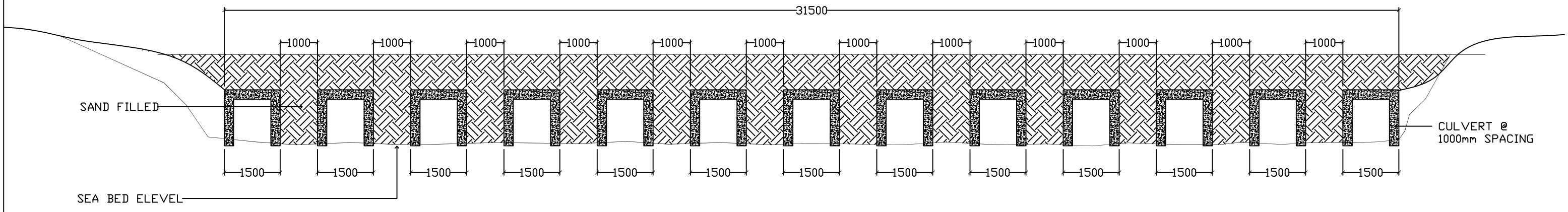
Appendix 2 Detail of Culvert

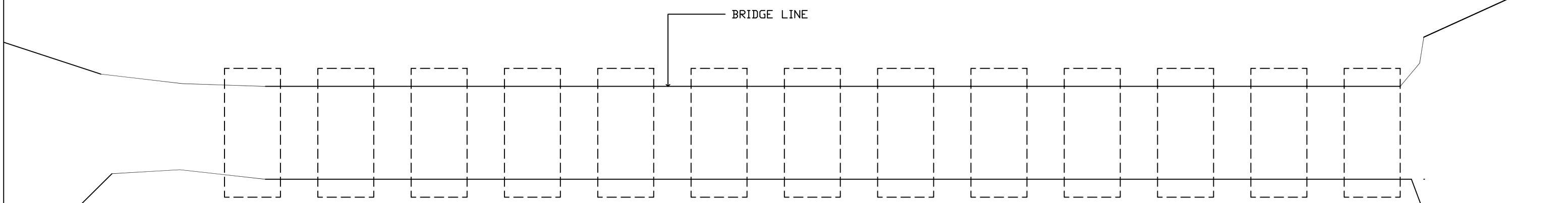


TEMPORRAY BRIDGE AREA LAYOUT

SCALE 1:1500



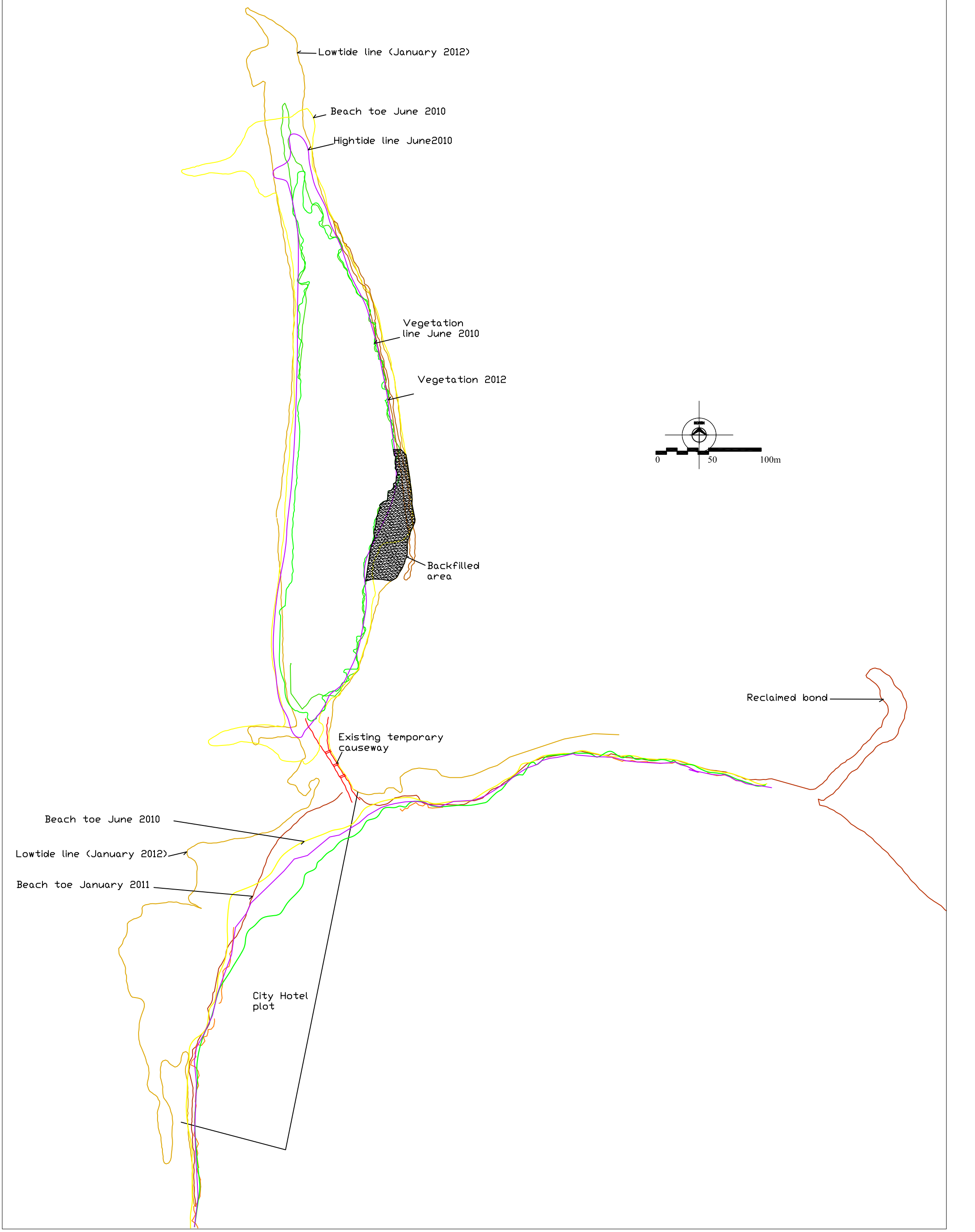
SECTIONAL VIEW OF TEMPORARTY BRIDGE
SCALE 1:100



PLAN VIEW OF TEMPORARY BRIDGE
SCALE 1:100

PROPOSED TEMPORARY BRIDGE LAYOUT

Appendix 3 Shoreline map


Lowtide line (January 2012)
Beach toe June 2010
Hightide line June2010
Vegetation line June 2010
Vegetation 2012
Backfilled area
0
50
100m
Reclaimed bond
Existing temporary causeway
Beach toe June 2010
Lowtide line (January 2012)
Beach toe January 2011
City Hotel plot

Appendix 4 CVs

بسم الله الرحمن الرحيم

CURRICULUM VITAE

1. POSITION: Environmental Specialist/EIA Consultant

2. NAME OF FIRM: LaMer Group

3. NAME: Hussain Zahir

4. DATE OF BIRTH: 10th February 1966

5. NATIONALITY: Maldives

6. EDUCATION:

Masters of Philosophy (MPhil) in Coral Reef Ecology
University of Newcastle upon Tyne. Newcastle Upon Tyne, United Kingdom
2006

Marine Biology B.Sc. (Hon)
University of Newcastle Upon Tyne.
Newcastle Upon Tyne,
United Kingdom
1993-1996

7. MEMBERSHIP OF PROFESSIONAL SOCIETIES:

8. OTHER TRAINING:

1988. Marine Science Institute, University of Philippines
Certificate of completion of training course on Scleractinian Coral Taxonomy

1989. Chulalongkorn University. Bangkok. Thailand
Certificate of Completion of training Course on Coral Taxonomy, Ecology and Management

1998 Okinawa International Centre, Okinawa, Japan
Certificate of participation on training course on Conservation and Sustainable Management of Coral Reefs

1999 Korean Research and Development Institute, Seoul, South Korea
Certificate of Completion of the Training Course on marine coastal zone conservation and management

1990. Department of Marine Sciences. Chulalongkorn University. Bangkok. Thailand
Workshop on Taxonomy of Soft Bottom Invertebrates (ASEAN-Australian Coastal Living Resources Project)

1991. Mc Master University, Hamilton, Ontario. Canada.
Training on Boring Sponges of Coral reefs in Maldives

1996 Turtle Specialist Group, Convention on the Conservation

of Migratory Species of Wild Animal (CMS) and government of India. Bhubaneshwar, India

Workshop and Strategic Planning Session for the Conservation of Sea Turtles of the Northern Indian Ocean

1999. United Nations Environment Program. Environment for South Asia and Pacific, organized by SACEP and Ministry of Home Affairs, Housing and Environment.

National Training for State of the Environment and Data Collection and Reporting

9. COUNTRIES OF WORK EXPERIENCE:

10. LANGUAGE AND DEGREE OF PROFICIENCY:

Dhivehi -Mother Tongue
English -Proficient

11. EMPLOYMENT RECORD:

Nov 2007- Present	Senior Reef Ecologist Marine Research centre, Ministry of Fisheries Agriculture and Marine Resources Male', Maldives.
Feb 2006- October 2007	Reef biologist Marine Research centre, Ministry of Fisheries Agriculture and Marine Resources Male', Maldives.
July 2001- January 2006	Senior Research Officer Marine Research centre, Ministry of Fisheries Agriculture and Marine Resources Male', Maldives.
June 2000 to Present	Marine Biologist/ Director (Part Time) Land and Marine Environmental Resource Group of Pte Ltd
July 1996 to July 2001	Research Officer Marine Research Centre , Ministry of Fisheries Agriculture and Marine Resources
1988 to 1992	Biological Aid Marine Research Centre , Ministry of Fisheries Agriculture and Marine Resources
1986 to 1988	Marine Research Centre , Ministry of Fisheries Agriculture and Marine Resources Trainee

12. DETAILED TASKS ASSIGNED:	WORK UNDERTAKEN THAT BEST ILLUSTRATES CAPABILITY TO HANDLE TASKS:
Marine Research Centre, Ministry of Agriculture and Marine Resources	**National coordinator of Global Coral Reef Monitoring Network** *Responsibilities:* Including Implementation and management of the programme activities in the country through the GCRMN Regional Node for south Asian Region in Srilanka. Current programme of activities include, establishing and monitoring of coral reefs to assess the recovery processes after the 1998 Bleaching and to monitor the temporal changes to the reef system. Responsibilities also include coordination and implementation of socioeconomic monitoring at designated pilot sites to asses the livelihood and their dependence on coral reef resources. Coordinating the establishment national reef database to share information at national, regional, and global level is also part of the program of activities. **Coral Reef Degradation in the Indian Ocean (CORDIO) Programme** *Responsibilities:* include implementation and management of the identified projects/ Studies funded by CORDIO. Currently involved biophysical studies designed to understand the reef recovery processes after a severe disturbance in coral reefs **Catalogue of Common Coral Reef of Maldives, 1996** *Year: 1996* *Location:* Maldives.
Task Undertaken Independent Consultant	**Initial Environmental Evaluation, Tsunami Emergency Assistance Project, Maldives** *Year: 2006* *Location:* Ha. Filladhoo, HDH. Nolhivaranfaru, Sh. Maroshi, N. Maafaru, DH. Meedhoo, M. Kolhufushi and Th. Madifushi, Maldives *Client: ADB* *Project features:* Rehabilitation of damaged infrastructures (electricity)due to the tsunami of December 2004 in the Maldives financed by ADB under Tsunami Emergency Assistance project *Positions held:* Domestic Environmental Specialist *Responsibilities:* Initial Environmental Evaluation for the Repair and Reconstruction of Diesel powered generator housed in the above 7 island communities. Environmental issues specific of diesel power generation in the local and national context were addressed following ADB environmental guidelines. I **Initial Environmental Evaluation, Tsunami Emergency Assistance Project, Maldives** *Year: 2005* *Location:* Ugoofaaru, Manadhoo , Dhidhdhoo, Maldives *Client: ADB* *Project features:* Rehabilitation of damaged infrastructures (harbours)due to the tsunami of December 2004 in the Maldives financed by ADB under Tsunami Emergency Assistance project *Positions held:* Domestic Environmental Specialist *Responsibilities:* Initial Environmental Evaluation of the project sites; Ugoofaaru, Manadhoo and Dhidhdhoo for the tsunami

emergency assistance project: TA-0001 (MLD). Specific Task include rapid environmental assessment of the project sites, prepare environmental evaluations based on filed data and community Consultants, predict environmental impacts and propose an environmental monitoring plan for the project activities.

Marine Biodiversity assessment, Faafu atoll, Maldives,
Year: 2003
Location: Faafu atoll, Maldives
Client: ADB
Project features: Identification of potential biodiversity hotspots (sites/species) as part of identifying priority areas for an MCPA planning project funded by ADB. Project involves assessment of socioeconomic and biophysical assessment of the short listed sites identified for the project.
Positions held: Biodiversity Environmental Specialist
Responsibilities: Marine Biodiversity assessment Faafu atoll Maldives. ADB regional technical assistance for coastal and Marine resource management and poverty reduction in south Asia. (ADB RETA 5974). A project implemented by Ministry of Fisheries, Agriculture and Marine Resources. Assignment involves detail preparation of marine biodiversity and Coastal management issues with special reference to grouper fishery and resource management.

Environmental Impact Assessment Report for the Development of Fish Processing Plant at Ha. Huvahandhoo, Maldives,
Year: 2002
Location: Maldives
Client: Jausa Fishery Links
Project features: Construction of a tuna processing plant
Positions held: Marine Biologist
Responsibilities: The EIA report involves collection and assessment of baseline and secondary environmental data both at the marine and terrestrial environment of the project site. It also involved a risk assessment and evaluation report. An environmental management plan was also developed as part of the EIA.

Task Undertaken as an employee o f Land and Marine Environmental Resource Group Pte Ltd

Replacement of wastewater collection, septic tanks and disposal systems in Ga.Villingili, Ga.Dhaandhoo, Gdh.Gahdhoo
Year: 2007-Ongoing
Location: Ga.Villingili, Ga.Dhaandhoo, Gdh.Gahdhoo
Client: American Red Cross
Project features: Design and construction of wastewater disposal systems in the specific islands
Positions held: EIA Specialist
Responsibilities: Environmental Impact Assessment research and analysis.
Preparation and submission of the Environmental Impact Assessment Report.

Environmental Impact Assessment for Reethi Rah Resort Redevelopment
Year: 2005
Location: Reethi Rah Resort
Client: Kersner International, Hotel Group
Resort development at Reethi Rah Resort
Positions held: Marine Biologist
Responsibilities: The EIA involves collection and assessment of baseline and secondary environmental data and marine and terrestrial environment of the project site. This is one of the largest reclamation project for resort development and assessment of impact of dredging and reclamation on the coastal marine habitats was a major component of this study

Environmental Impact Assessment Report for Villa Hakatha at Thilafushi, Male Atoll
Year: 2001
Location: Male Atoll
Client: Villa Hakatha,Maldives
Positions held: Project Biologist
Responsibilities: The EIA report involves collection and assessment of baseline and secondary environmental data both at the marine and terrestrial environment of the project site. It also involved a risk assessment evaluation report. An environmental management plan was also developed as part of this EIA.

Development at Baa. Landaagiraavaru, Maldives
Year: 2000
Location: Baa. Landaagiraavaru, Maldives
Client: Club mediterranee *Project features:*
Positions held: Project Biologist
Responsibilities: The EIA involved collection of Oceanographic data, Study of the beach environment, Vegetation, reef quality and reef water quality. The study examined the impacts of the island and mitigation measures where appropriate. The study also forms the baseline data for future monitoring of the environmental changes due to the resort development

Environmental state for the proposed channel dredging & associated Barrier Island at Sun Island Resort.
Year: 2000
Location: Sun Island Resort, Maldives
Client: Tekton Design Associates Pvt. Ltd
Positions held: Project Biologist
Responsibilities: The Study involved assessment of the potential environmental impact on the coastal shoreline of the island and on to the reef environment within close proximity of the proposed project site.

Tasks undertaken as an employee of Riyan Design and Management Pte Ltd

Environmental Statement for the Proposed Redevelopment of Reethi Rah Resort
Year: 2000
Location: Reethi Rah Resort
Client: Reethi Rah Resort
Positions held: Project Biologist
Responsibilities: This Study Involved assessment of the existing

status of the islands environment and identification of potential environmental impact areas related to the proposed redevelopment plans. Formulation of an environmental monitoring plan that would enable the client to record the environmental changes that may be related to anthropogenic activities or natural.

Environmental Statement for the Proposed Redevelopment of Reethi Rah Resort
Year: 2000
Location: Reethi Rah Resort
Client: Reethi Rah Resort
Positions held: Project Biologist
Responsibilities: This Study Involved assessment of the existing status of the islands environment and identification of potential environmental impact areas related to the proposed redevelopment plans. Formulation of an environmental monitoring plan that would enable the client to record the environmental changes that may be related to anthropogenic activities or natural.

Proposed Beach Nourishment at M. Medhufushi. An assessment of Environmental Design Parameters
Year: 2000
Location: M.Medhufushi
Client: Vaaly Brothers Pte.Ltd
Positions held: Project Biologist
Responsibilities: The study involved examination of the beach characteristic
Including the sediment properties, beach profiles. Identification of a borrow site by Comparing the borrow sediment characteristics of the borrow site and the native beach sand.

Environmental Evaluation of Small-bore Sewer System (SBS) in Lh. Hinnavaru and K. Gulhi
Year:1999
Location: Lh. Hinnavaru and K. Gulhi
Client: Maldives Water and Sanitation Authority
Project features: The Study Involved ground water/ Seawater analysis of sewage pollution; reef surveys hydro graphic /oceanographic surveys and survey of the slopes of the sewage lines.
Positions held: Project Environmental Analyst

Assessment of Oil Contamination in Male' Groundwater from Vehicle Garages and Petrol Stations.
Year:1999
Location: Male', Maldives
Client: Maldives Water and Sanitation Authority
Positions held: Project Environmental Analyst
Responsibilities: The study involved Ground water analysis of oil contamination and assessment of general working conditions and practices in the vehicle garages and petrol stations in male'.

Environmental Impact Statement for the Proposed Beach Protection Works at Nika Island Resort
Year:1999

Location: Male', Maldives
Client: Nika Island Resort
Positions held: Project Biologist
Responsibilities: The project involves assessment of physical environmental condition such as the wave, current sediment characteristics, bathymetry at the project site (Nika Island Resort). Assessment of the status of the reef at the project site and an evaluation of the possible impacts on the reef and the physical environment as a result of the proposed beach protection work.

Environmental Monitoring of F. Filitheyo Resort Development
Year:1999
Location: F.Filitheyo
Client: AAA Trading Company Pvt.Ltd
Positions held: Project Biologist

Environmental Monitoring of M. Medhufushi Resort Development
Year:1999
Location: M. Medhufushi, Maldives
Client: Vaally Brothers Pte Ltd
Position Held: Project biologist

Environmental Monitoring of Lh. Kanuhuraa, Maldives
Year:1999
Location: Lh. Kanuhuraa
Client: SIMDI Hotel Management Pte Ltd
Positions held: Project Biologist

Environmental Monitoring of R. Meedhupparu Resort Development
Year:1999
Location: R. Meedhupparu
Client: Cowrie Investment Pvt Ltd, Maldives
Positions held: Project Biologist
Responsibilities: The Monitoring programmes involved periodic measurements of the beach profiles around the islands, reef quality surveys, ground water/ seawater analysis and environmental auditing

Tasks Under Taken as a Freelance Consultant

Environmental impact Assessment for the F. Filitheyo Resort Development
Year:1998
Location: F.Filitheyo
Client: AAA & Trading Company, Maldives
Positions held: Project Biologist

Environmental Impact Assessment for Lh. Madhiriguraidhoo Resort Development
Year:1997
Location: Lh. Madhiriguraidhoo
Client: Guardian Agency Pte Ltd
Positions held: Marine Biologist

Environmental Impact Assessment for B. Fonimagoodhoo Resort Development
Year:1997
Location: B. Fonimagoodhoo, Maldives
Client: Thasmeen Ali, M. Sheeraazeege, Maldives
Positions held: Marine Biologist

Environmental Impact Assessment for M. Hakuraahuraa Resort Development
Year:1997
Location: M. Hakuraahuraa
Client: Fantasea Pte Ltd, Maldives
Project features:
Positions held: Marine Biologist
Responsibilities: The EIA studies Involved collection of oceanographic data studies of the beach environment, vegetation, reef quality and ground water / Seawater quality. These studies examined the impacts of the development on the island and mitigation measures where appropriate. The studies also form the baseline data for the future monitoring of the environmental changes due to the resort development

13. Certification:

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to my disqualification or dismissal, if engaged.

_____ Date: 7 May 2008
[*Signature of staff member or authorized representative of the staff]* *Day/Month/Year*

Full name of staff member Hussain Zahir
Full name of authorized representative:

Shahaama Abdul Sattar

Personal Information

Date of birth:	30 September 1980
Address:	G. Helengeli Aage, Apt 2 B Rahdhebai Magu Male' Republic of Maldives
Contact No:	+ 960 7904985 (m)
Email:	shahaama@lamer.com.mv (LaMer Pvt Ltd) shahaama.sattar@gmail.com
Work Address:	Currently working independently

Education

Graduate and Postgraduate

Aug 2004 - Jun 2006 Master of Science in Fisheries Biology and Fisheries Management
University of Bergen
Department of Biology
Postbox 7800
N-5020 Bergen, Norway

Feb 1999 - Dec 2001 Bachelor of Science
The Flinders University of South Australia
GPO Box 2100
Adelaide 5001, South Australia

Secondary

Apr 1997 – Jul 1998 G.C.E A'Level (London)
Kolej Damansara Utama
Damansara Jaya
Selangor,
Malaysia

Jan 1994 – Dec 1996 G.C.E O'Level (London)
Aminiya School
Male',
Republic of Maldives

Work experience

Feb 2002 Volunteer work at Seal Bay, Kangaroo Island, South Australia.
Work involved helping researchers with catching seals and removing tracking devices from the seals.

Dec 2001 – Feb 2002 Work experience at the South Australian Aquatic Sciences Centre
Work involved dealing with sea urchins, mainly cleaning their tanks, doing dissections on sea urchins and helping researchers with different aspects of the research.

May 2008 Participated in the Biodiversity Valuation survey of Baa Atoll Maldives carried out by AEC project and IUCN

Employment Record

May 2011 - Present Consultant, Darwin Reef Fish Project
Marine Research Centre, Maldives / Marine Conservation Society, UK

- Consultant to the Darwin Reef Fish Project (4 year joint collaboration between MRC and MCS, UK), which assesses the various reef fisheries (grouper, aquarium and food fisheries) of the Maldives and aims to establish management plans for these fisheries. Provision of technical support and assistance to the project staff and MRC in implementing the project and formulation of the management plans.

June 2011 – Present LaMer Pvt Ltd

- Work part time in report writing for the various Environmental Impact Assessment projects conducted by the group.

July 2011 – Present BOBLME Sharks Working Group Coordinator, Bay of Bengal Large Marine Ecosystem Project

- Coordinator for the Sharks WG of BOBLME project, and work with the focal points in the member countries, to assist in the formulation and implementation of their National Plans of Action for Sharks.

June 2002 – May 2011 Fisheries Biologist (At time of resignation)
Marine Research Centre
Ministry of Fisheries and Agriculture
Male', Republic of Maldives

Line of work at MRC included:

- Conduct field surveys to monitor the reef fishery and fish species behaviour
- Compilation and analyses of the reef fisheries data, in particular the grouper and food fishery data
- Write reports and regular reviews on the status of fisheries including recommendations for management.
- Focal point for the IUCN funded project on identification of reef fish spawning aggregations in the Maldives through fishermen interviews (2007)
- Secretariat – Indian Ocean Cetacean Symposium 2009
- Project Partner for Maldives for the Darwin Initiative Coral Reef Fish Project, Maldives
- MRC Focal point for the Atoll Ecosystem Conservation Programme, Ministry of Housing and Environment (2009 – 2011)

Workshops/Seminars Participated

15-21 March 2003 - Training Workshop on the Implementation of Multilateral Agreements in the Conservation of Biodiversity with special focus on Marine Biodiversity. Kushiro, Japan

14-16 November 2006 – Sixth William R. and Lenore Mote International Symposium – Life history in Fisheries Ecology and Management. Sarasota, Florida

03-05 March 2008 – Olhugiri and Dhigalihaa Protected Areas Management Planning Workshop. Eydhafushi, Maldives

11 March 2008 – Applying the Ecosystem Approach to managing Atoll Ecosystems in the Maldives. Hulhule Island Hotel, Maldives

24-26 March 2008 – Regional Consultation on Preparation of Management Plans for Shark Fisheries. Beruwela, Sri Lanka

17-19 June 2008 – Workshop on Assessment and Management of the Offshore Resources of South and Southeast Asia. Bangkok, Thailand

22-23 March 2009 – BOBP-IGO National Workshop on Monitoring, Control and Surveillance in Marine Fisheries. Male', Maldives

18 – 20 July 2009 – Indian Ocean Cetacean Symposium 2009. Paradise Island Resort and Spa, Maldives.

09-11 August 2009 – Second Regional Consultation on Preparation of Management Plans for Shark Fisheries. Kulhudhuffushi, Maldives

24-25 February 2010 – BOBLME Project – National Inception Workshop, Male', Maldives

2-3 June 2010 – BOBP-IGO Technical Advisory Committee – 5th Meeting, Male', Maldives

13-14 September 2010 – BOBLME Fisheries Assessment Working Group – 1st Meeting, Bangkok, Thailand

14-16 December 2010 – EWS-WWF 2nd Marine Conservation Forum for the Gulf Region In partnership with the Pew Environment Group – Local Actions for Global Challenges, Abu Dhabi, United Arab Emirates

18-19 January 2011 – Bay of Bengal Large Marine Ecosystem Project – Workshop on the Status of Marine Managed Areas in the Bay of Bengal, Penang, Malaysia

5-7 July 2011 –Bay of Bengal Large Marine Ecosystem Project – First meeting of the BOBLME Sharks Working Group, Male', Maldives

7-8 September 2011 – Workshop to formulate the Grouper Fisheries Management Plan, DRFP/MRC, Male', Maldives

15-17 September 2011 – SEAFDEC Special Meeting on Sharks Information Collection in Southeast Asia, Bangkok, Thailand

Publications

Sattar, S. A., Amir, H. and Adam, M. S. (2011) Reef fish tagging programme – Baa Atoll Pilot project (in press)

Sattar, S. A., Andréfouët, S., Ahsan, M., Adam, M. S., Anderson, R. C. and Scott, L (2011) Status of the Coral Reef Fishery in an Atoll under tourism development: the case of Central Maldives (in press)

Saleem, M., Sattar, S. A. (2009) Study on post-tsunami restoration and conservation projects in Maldives, *Prepared for the International Union for Conservation of Nature*.

Tamelander, J., Sattar, S., Campbell, S., Hoon, V., Arthur, R., Patterson E. J.K., Satapoomin, U., Chandi, M., Rajasuriya, A. and Samoilys, M. (2009) Reef fish spawning aggregation in the Bay of Bengal: Awareness and Occurrence, *Proceedings of the 11th International Coral Reef Symposium, Ft. Lauderdale, Florida, 7-11 July 2008,* Session 22

Sattar, S. A., Jørgensen, C., Fiksen, Ø. (2008) Fisheries Induced Evolution of Energy and Sex Allocation. *Bulletin of Marine Science*, 83(1): 235-250

Sattar, S. A. (2008) Review of the Reef fishery of the Maldives, Marine Research Centre, Male', Maldives. 62 pp

Sattar, S. A. and M. S. Adam (2005) Review of the Grouper fishery of the Maldives with additional notes on the Faafu Atoll fishery. Marine Research Centre, Male', Maldives. 54 pp

Referees

Dr. Mohamed Shiham Adam, PhD
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MARIYAM ZARANA RASHEED

PERSONAL DETAILS

NAME: MARIYAM ZARANA RASHEED
SEX: Female
DATE OF BIRTH: 03 May 1981
NATIONALITY: Maldivian (Maldives)
ID CARD NO. : A 064700
PASSPORT NO.: G 0300450
PERMANENT ADDRESS: Ma. Dhunbuge, Saimaa Goalhi,
Male', 20245, Republic of Maldives.
CURRENT ADDRESS: Ma. Kosheege, Kudhiraiymaa Goalhi,
Male', 20199, Republic of Maldives.
TEL: +9607750254
EMAIL: mxarar@hotmail.com

EDUCATION

MASTERS DEGREE - January 2010 till present – Completed and awaiting for results
Master of Science (Environmental Science) by full research
University of Malaya, Kuala Lumpur, Malaysia

HONOURS DEGREE - April 2009
Bachelor of Science Honours (Biological Sciences)
University of KwaZulu-Natal, Republic of South Africa

BACHELORS DEGREE - April 2008
Bachelor of Science (Biological Sciences)
University of KwaZulu-Natal, Republic of South Africa

HIGHER SECONDARY - June 2000
General Certificate of Education, Advanced Level
University of London, United Kingdom
/ Science Education Centre, Male', Republic of Maldives

ENGLISH LANGUAGE - December 1999
First Certificate in English
University of London, United Kingdom
/ Science Education Centre, Male', Republic of Maldives

HONOURS AND AWARDS

- Merit Certificate
  For outstanding performance during 2008 in Biology/Ecology Research Project

- Poster Award
  Honorable mention at the 51st IAVS Conference - Frontiers of vegetation science: an evolutionary angle - 07 to 12 September 2008 - Stellenbosch, South Africa.
  Title : Host specificity and bird dispersal in the parasitic mistletoe *Tapinanthus natalitius* (Loranthaceae). (Author: Desale Okubamichael. - Co-authors: D. Ward, M. Griffiths-Ward, M.Z. Rasheed, University of KwaZulu-Natal, Scottsville, South Africa)

- Merit Certificate
  For outstandingly good work during 2006 in Education Studies 224

WORK EXPERIENCE

May 2010 to April 2011

Research Assistant

Institute of Biological Science, University of Malaya, Kuala Lumpur, Malaysia

Work Profile:

The main responsibilities of the research assistant (RA) to Associate Professor Dr. Rozainah Mohamed Zakaria, include providing intellectual and physical assistance on the research projects on coastal protection and rehabilitation; mangrove biodiversity and ecology; and assess climate change impacts on mangrove ecosystems of west Malaysia.

January 2008 to Dec 2008

Demonstrator

School of Biological and Conservation Science, University of KwaZulu-Natal, South Africa

Work Profile:

As a demonstrator, first year students at under graduate level was assisted and supervised during practical sessions at various field sites and laboratory. Demonstrators work with the supervision and explicit guidelines from the lecturers to ensure that the students gain maximum subject knowledge during practical session. Marking and assessing the academic reports presented by the students was also part of the job.

July 2001 to December 2004

Clinical Assistant

Indhira Gandhi Memorial Hospital, Male', Republic of Maldives

Work Profile:

Major responsibilities include assisting doctors at the Out Patient Department and casualty consultations with translation and minor clinical procedures.

February 1998 to May 1998

Clinical Assistant

ADK Hospital, Male', Republic of Maldives

Work Profile:

Assist doctors at the Out Patient Department with translation and minor clinical procedures.

Part Time Work Experience

June 2004 to December 2005

Tutor

Kieveni Tuiton Center, Male', Republic of Maldives

Work Profile:

Teach Biological Science to grade 8 and 9 students.

PROFESSIONAL EXPERIENCE

- Participated in the Klang Island Expedition, 2010. Organized by the University of Malaya and the Mangrove Research Centre in Carey Island – Malaysia to assess biodiversity and ecology of the mangrove forests of Klang Islands.

- Poster presentation at the 51st IAVS Conference - Frontiers of vegetation science: an evolutionary angle - 07 to 12 September 2008 - Stellenbosch, South Africa.

  Title: Host specificity and bird dispersal in the parasitic mistletoe *Tapinanthus natalitius* (Loranthaceae). (Author: Desale Okubamichael. - Co-authors: D. Ward, M. Griffiths-Ward, M.Z. Rasheed, University of KwaZulu-Natal, Scottsville, South Africa)

PUBLICATIONS

- Okubamichael, D. Y., Rasheed, M. Z., Griffiths, M. E. & Ward, D. (2010). Avian consumption and seed germination of the hemiparasitic mistletoe *Agelanthus natalitius* (Loranthaceae) Journal of Ornithology, 1-7.

LANGUAGES

English (fluent spoken and written) and Dhivehi (Mother Language - fluent spoken and written)

INTERESTS AND ACTIVITIES

Gardening, Traveling and Hiking.

Appendix 5 References

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Kench, P.S. and Cowell, P.J. 2001.The Morphological Response of Atoll Islands to Sea Level Rise. Part 2: Application of the Modified Shoreline Translation Model (STM). Challenges for the 21st Century in Coastal Sciences, Engineering and Environment, Journal of Coastal Research, Special Issue, 34: 645-656.

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Leopold, L. B., Clarke, F. E., Hanshaw, B. B. and Balsley, J. R. (1971) A procedure for evaluating Environmental Impact. Geological Survey Circular 645. U.S. Geological Survey, Washington. 30 pp

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

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Naseer, A. and Bruce, G. H. (2004). Inventory of the Maldives coral reefs using morphometrics generated from Landsat ETM+ imagery. Coral Reefs.

Naseer, A. and Bruce, G. H. (2004). Inventory of the Maldives coral reefs using morphometrics generated from Landsat ETM+ imagery. Coral Reefs.

Ohlhorst SL, Liddle WD, Taylor RJ and Taylor JM.(1988). Evaluation of reef census techniques. Proceedings of 6th International Coral reef Symposium. Australia. 2: 319-324

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Segal, B. and Castro, C.B. (2001). A Proposed Method for Coral Cover Assessment: A case study in Abrolhos, Brazil. Bulletin of Marine Science 69 (2): 487-496.

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Veron, JEN (John Edward Norwood) (2000). Corals of the World

Woodroffe, C.D. (1992). Morphology and evolution of reef islands in the Maldives.Proc 7th Int Coral Reef Symp. 2: 1217 – 1226.