ADDENDUM TO THE ENVIRONMENTAL IMPACT ASSESSMENT

For the proposed coastal protection of Summer island (Ziyaaraifushi island), North Male' Atoll, Maldives

Proposed by

Kaimoo Hotels and Travel Services

Prepared by

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For Water Solutions Pvt. Ltd., Maldives

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3 Declaration of the consultants

This EIA addendum has been prepared according to the EIA Regulations 2012, issued by the Ministry of Environment. The EIA addendum report was carried out by a multidisciplinary consulting team representing Water Solutions Private Ltd. In preparing this report, no data has been manipulated. All data has been collected by field visits.

We certify that the statements in this Environmental Impact Assessment study are true, complete and correct.

Name: Abdul Aleem (EIA 09/07)

Signature:

بسم الله الرحمن الرحيم

ސާދާ ބުރާސާ

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ކަންބޮޑުވާވަރުގެ ގެއްލުން ބަޔެއް ލިބޭނެކަމަކަށް ނުފެނެއެވެ. މިމަޝްރޫއު އަދި މިހާރުވެސް ކުރިއަށް ގެންދެވިފައިވާ މަޝްރޫއުއްކަމުން ރަށުގެ އިރުމަތީ ފަރާތުން ވަނީ ވެލި ނަގާފައެވެ. ރަށުގެ އިރުމަތީ ފަރާތަކީ އެއްގޮތަކަށްވެސް ފަރުވާ ނުވޭ ސަރަހައްދެކެވެ. ދިރޭ މުރަކަތައް އަދި ގަސްތައް ހުއްޓެސް ހުންނަނީ ވަރަށް މަދުން އަދި ކުދި ކުދި އެތިކޮޅުތަކެވެ. މުޅި ސަރަހައްދުގައި ވެލިން ފުރިފައިވާ ހިލަބޮށްތަކެވެ. މިހާރުގެ ސަރަހައްދުން ދިރޭ މުރަކަތައް އެއްވެސް ގެއްލުމެއް ނުލިބޭނެއެވެ. ނަމަވެސް އެންވަޔަރަންމަންޓަލް ކަންސަލްޓަންޓް ދެއްކި ސަރަހައްދު ކިލަނބުވެ އެކަމުގެ އަސަރު ކައިރިސަރަހައްދުތަކަށް ފެތުރިގެންދާނެކަމަށް ޝަރުހުކުރެއް އޮތް ކަމުގެ ނުރެއެވެ. މިކަން ކޮންޓްރޯލްކުރުމަށްޓަކާ އެންމެ މުހިންމު ކަމަކީ މަސައްކަތްކުރާ ވަގުތު ކުޑަކުރުމާ އަދި ހިކި ދިޔައިގައި މަސައްކަތް ކުރުން. މިދެ ސަރަހައްދުން ކިލަނބުގަނޑު ވަރަށް ބޮޑަށް ފެތުރޭނެ ދިއުން ކޮންޓްރޯލް ވާނެއެވެ. ނަމަވެސް މުޅިން މިކަމުގެ ނުރައްކާތެރިކަމާ މިމަސައްކަތުގެ ދިރާސާ އަލަށް ހިންގާފައެވެ. ތިމާވެށްޓަށް ކުރާ އަސަރު އެންމެ ބޮޑަށް ކުޑަކުރެވޭގޮތަށް އެންމެ މުހިންމު އެއް ގޮތެވެ.

މި ދިރާސާކުރުމުގައި ބެލިބެލުމުން މިމަޝްރޫއުގެ ސަރަހައްދުން ތިމާވެށްޓަށް މާބޮޑު ގެއްލުމެއް ލިބޭނެކަމަކަށް ނުފެނެއެވެ. އަދި މިދެ ސަރަހައްދުން ފައިދާތަކެއް ކުރާ ފަރާތްތަކުން މިމަޝްރޫއު ކުރިއަށް ގެންދިޔުމަކީ ވަރަށް މުހިންމު އަދި އެންމެ ރަނގަޅުކުރެވޭކަމަކަށް ފެނެއެވެ. އަދި މަޝްވަރާ ގައި އެންވަޔަރަންމަންޓަލް ބޯޑުންވެސް އެންމެ ރަނގަޅުކުރެވޭކަމަކަށް ފެނެއެވެ.

4 Introduction

This report is an addendum to the Environmental Impact Assessment report (EIA) that has been prepared to fulfil the requirements of the Environmental Protection and Preservation Act, law no. 4/93 for the proposed coastal protection works in Summer Island (Ziyaaraifushi island) Resort, located in North Male' Atoll.

The EIA report was prepared and submitted in January 2011. Summer island presently a resort in full operation and is faced with chronic erosion of its coastline. Various coastal protection measures have been undertaken in Summer island, most of which are damaged structures that need repair and also modification. Since the approval of the EIA in January 2011, most of the coastal protection works have been completed, except for one breakwater. The completed coastal protection works includes the following:

1- Construction of breakwaters
2- Repair of some of the damaged breakwaters
3- Partial nourishment of some of the beach

Some of the works approved in the EIA report was not completed including the dredging of a mooring area with an estimated 4560 cubic meters of sand planned to be dredged from this area. Due to budget constraints, this component was dropped. As a result, the shortage of fill material to nourish the beaches had to be obtained from the eastern lagoon.

A local environmental consulting firm, Water Solutions, has prepared this addedndum. The proponent has chosen water Solutions as the environmental consultants for this project. The team members were:

- Abdul Aleem, BSc, MPH – Mapping and GIS
- Ahmed Jameel, B. Eng (Environmental), MSc – Environmental Engineer
- Hamdhulla Shakeeb, Surveyour

4.1 Terms of Reference

Terms of Reference for this addendum has been included in the Appendix of this report.

4.2 Background and need for the addendum

Broadly, the addendum has been prepared due to the change in the methodology and machinery used in the construction. The beach nourishment work was proposed by using an 8 inch sand pump. Borrow area was proposed from the eastern lagoon and from the mooring area (not dredged due to budget constraints). There is no coral reef on the eastern side.

Work began in March 2011 as soon as the EIA was approved. Pumping of sand was undertaken from the proposed location. However, when the construction began, the developers realized that the total distance they have to pump was creating a delay due to the drop in the pump's efficiency.

The sand pumps were not able to cater adequate sand to the beaches. At the same time, the coastal protection works were undertaken but the lack of adequate sand for the beach was an issue.
In order to increase the pumps efficiency, the construction team had to pump sand to a nearby location in the lagoon and then again pump from there to the beach. This double pumping was proving to be too difficult and costly as it was not only causing delays but the stabilization of the beach by the breakwaters was proving to be ineffective. Dredging from the proposed mooring area was also dropped due to budget constraints which resulted in a shortage of fill materials as it was originally planned to obtain 4560 cubic meters from the mooring area.

As the time period originally proposed for the coastal works has passed, the operator of the resort in consultation with a contractor is proposing to expedite the unfinished process by utilizing new machinery and methods.

For reference, a copy of the original EIA report of January 2011 has been annexed.

4.3 Description of the proposed project

In order to complete the coastal works, the project team proposed to use the following machinery and methods. Their justification are also outlined below.

1- Two excavators
2- One loader
3- One floating barge to transport fill material

4.3.1 Status of the coastal protection works

Coastal protection works have already been completed except for one breakwater. This breakwater is not a new breakwater, and was originally proposed in the EIA report. The project delays caused by the sand pumping were the reason why this breakwater was not constructed. All other breakwaters have been completed. This unfinished breakwater will be constructed as outlined in the EIA report (attached for reference).

4.3.2 Methods of burrowing sand and justification of selecting the location and method

The proposed new method of burrowing sand is to use an excavator on a barge and then transporting the sand to the fill area using a floating barge. The proposed burrow area is adjacent to the original burrow area. The proposed burrow area only has fine sand. This will be adjacent to the area where sand pumping was undertaken.

However, a marine environment survey was undertaken close to this area to assess the existing condition of the marine environment in nearby lagoon. Although there is no coral reef, there are

occasional coral boulders and rubble around with small live coral patches that are very insignificant.

An excavator is proposed for dredging as this would speed up the process of obtaining the required fill material to the borrow site. As there will not be any double pumping, the borrowed sand can immediately be disposed to the beaches where filling in the shortest possible time period will allow the beach to form and shape naturally in harmony with the waves and the breakwaters already constructed. Use of excavators also avoids the issue of difficulties in dealing with small amounts of coral rubble, which is a problem for the sand pump. Sand pump operation is difficult with the presence of small quantities of rubble which creates mechanical problems and causes project delays. Excavators can dig through rubble material without any operational delays.

Hence, these two factors were determining the use of excavator and barge.

4.3.3 Methods of transporting sediment to the fill area

From the borrow area, the excavated sand will be loaded on to a barge and floated to the beach in the shallow lagoon. The barge will have bund walls adequate and strong enough to withstand the volume of sand loaded. Once the barge is filled, it will be towed to the beach where an excavator will dispose the sand to the beach.

4.3.4 Methods of the work including disposal of sediments to the fill site

The work will be managed by two teams. One team will work at the borrow site. An excavator will excavate sand from the borrow area and load them to the barge. Once the barge is filled, it will be towed to the beach where another excavator will unload. The beach team will also have one laoder which will spread the sand to the beach. Once the load is empty, the barge will be towed again to the borrow area and the process will continue until the entire fill area is completely filled.

4.3.5 Methods to contain sediment spillage during transport and emergency plan during spillage.

The barge will be bunded all around to ensure that the loaded sediment does not spill. However, despite these precautions, it is anticipated that some sediment spill will occur as the process cannot be totally avoided. This however is small and majority of the sand will be safe.

In case of a spill during an emergency during transport, the barge will not be completely loaded and the contractor is required to ensure that the barge is not overloaded. In addition, the bunding material will be adequately harnessed with cables running around its perimeter to ensure the safety.

4.3.6 Environmental monitoring during construction activities

The project is currently being monitored by an independent consultant and as such, this component will also be monitored as part of the monitoring. At the end of the project, the final monitoring report will be compiled.

4.3.7 Management of environmental values and factors during the project

Since the project takes place in the marine environment, the greatest threat is on the marine environment. Sedimentation caused by the excavation of sand from the sea bed will increase turbidity and will disperse sediments in a plume to a greater area. However, there is no reef on the eastern side. East of the borrow area is the deep atoll lagoon. The reef is on the western side of the island and hence it is not likely to be a threatening factor for coral reefs. Furthermore, the impacts of sedimentation are short term and will not last long. However, long term impacts such as sedimentation within the lagoon is not a factor of concern as the monitoring during the construction period of this project has not revealed sedimentation as an issue as the water flows well around the island despite the coastal protection. In addition, the eastern side of the island does not have any corals. These sediments are likely to settle within the lagoon and is not expected to reach the reef areas. During the excavation process, mitigation measures such as using bundwalls around the transport barge and undertaking the works at low tide will be used in order to protect the environmental impacts.

4.3.8 Project management

The project will be managed by an independent contractor and all the environmental aspects will be managed and overlooked by Water Solutions Pvt. Ltd. The environmental consultant, Water Solutions will provide guidance on methods to control sedimentation during work period as well as undertake the surveys necessary for the contractor including marking the borrow area and pathway for the barge to transport the sand.

4.3.9 Dredging area, depths and volumes

In this project, dredging in the form of excavation using an excavator will be used to borrow sand for beach replenishment.

Location and the size of burrow areas are indicated in the diagrammes attached in the following pages. The size of the excavation area is expected to be 100 meters by 75 feet. The existing depth in this area is 1.2 meters average at mean sea level. The total volume of sand to be excavated is estimated to be 7500 cbm.

4.3.10 Justification of the selection of this location

As sand pumping has already been taken in this location for the nourishment works, this site has been chosen. The proposed burrow area also has only sand and no coral reef nearby nor any coral patches. The change in methodology was brought not because of lack of sand, but because the san

pumps were not able to pump enough sand to the beaches due to the long distance. In addition, the presence of even minor amounts of coral rubble were proving to be a challenge for the sand pumps.

4.3.11 Quality and characteristics of the fill material

The fill material burrowed is from the eastern lagoon and constitutes fine sand with small quantities of rubble. The fine sand is characteristically same as that found on the beaches as the lagoon and the beaches constitutes the same characteristics of sand. The absence of a coral reef on the eastern side is one reason for the burrow site has fine sand as there are no corals nor any hard rock base. For details about the quantity of fill material, refer to the diagrammes attached.

4.3.12 Project Schedule

Following is a tentative schedule for the beach nourishment works to be undertaken in Summer Island. It is anticipated that the total duration of the dredging activity will be three months including time period for mobilization and demobilization.

	month 1	month 2	month 3
Submission of EIA addendum report	x		
Approval of EIA addendum	x		
Mobilization of the equipments	x		
Beach replenishment		x	x
Demobilization and decommissioning			x

Table 1: Tentative schedule for the beach nourishment works

5 Existing Environment

5.1 Existing Marine Environment surveys

For the purpose of this report, one site close to the burrow area was surveyed to assess the benthic composition of the site. Although this is not required in the TOR, the survey was undertaken as it was discussed in the scoping meeting.

5.2 Methodology of survey

To assess the benthic composition of the survey site, an LIT transect of 100 meters were undertaken. The transect line was divided in to 4 segments, and between each segment, a 5 meter zone was left as blank. This is the methodology used globally under the Reef Check protocols. The emphasis on benthic composition categorizing such as hard corals, sand, rock and others. The emphasis is not on recording corals to their species levels, but rather the general coral and other life forms such as hard and soft corals. This method is more accurate as the percentage of healthy coral cover and other life forms can be more accurately recorded even by a non experienced surveyor. Recording corals to their species levels will pose difficulty if the surveyor is not familiar with the different coral types. This method is also universally used throughout the world by Reef Check surveyors and hence it has been used.

5.3 results of the marine environment survey

The location of the survey site is indicated in the diagrammes attached in the following pages. The results of the LIT survey is also attached in the following page.

The bottom substrate categories and their acronyms are indicated in the following table.

Acronym	Name	Percentage
HC	Hard corals	4%
SC	Soft corals	0%
RKC	Rock	0%
NIA	Nutrient indicative Algae	0%
SP	Sponges	0%
RC	Rock	31%
RB	Rubble	16%
SD	Sand	48%
SI	Silt	0%
OT	Others	1%

Table 2: Tentative schedule for the beach nourishment works

The above table outlines the results of the LIT survey. The survey indicates that the majority of the constituent is sand and living components account to only 4%, which is hard corals. Most of the hard corals were small colonies of coral massives and Acropora digitate species. These results indicate that the dredging activity will have very little impacts on the reef health as the percentage of living components is very small.

6 Environmental mitigation and management

As this component of the project only brings a change in methodology of dredging, mitigation and management options have been proposed for this component. The overall project impacts and mitigation measures have been outlined in the EIA report of January 2011.

The following table outlines the environmental impact mitigation plan proposed for this component.

7 Alternative borrow site

Alternative borrow sites have been proposed in the EIA (refer to the EIA attached as an annex). A third alternative burrow site has been proposed in this addendum on the south east lagoon. This area is dominated by sand and it is a shallow area with average depths of 0.8 m at mean sea level. The area is completely dominated with sand and occasional rubbles. It is unlikely that this area would be dredged as the proposed burrow area has ample sediment to fulfil the nourishment needs. The borrow site is indicated in the

Table 3: Summary of the impacts and their characterization

Activity	Potential Impacts	Mitigation measures	Cost of Mitigation
Dredging of the entrance burrow site using excavator	Impact of dredging In this component of the project, excavators will be used to dredge burrow material and therefore sedimentation will be an ultimate outcome which will be unavoidable. The sedimentation will be more than what is expected during a sand pump operation as the excavator will disturb the sandy seabed more than a sand pump during excavation. Despite this, it has to be noted that this is only a short term effect and will only last during the dredging period. The burrow site will be dredged to a depth of maximum 3m. The predominant currents during SW monsoon, mainly wind generated from north to north-west side will ensure that sediment dispersion take place towards east in to the north Male' Atoll lagoon. Therefore, during dredging, sediment dispersal will be the most significant impact resulting from the excavation work. Sediment dispersal will be affected by tide, wind and current movement on the day of excavation. In addition, sediment dispersion will vary according to the changes in weather, that is have more potential for dispersion in rough weather to a greater area.	It is not feasible for this project to use silt curtains, hence mitigation measures are more management options. However, it is encouraged to use silt screens to contain the sediment plume from dispersing in to other areas if it is feasible for the contractor. Secondly, the contractor has to time the majority of excavation to low tide or mid tide hours as this will reduce the dispersal of sediment. Hence, a 7 day tidal data will be provided by the consultant to time the excavation works.	There is no direct cost as these measures will be briefed to the contractor and required to comply.
Transport of sediment on a barge	Impact of this activity would again be the potential for sedimentation in case of sediment spillage during transport. No coral reef damage will occur directly as the barge will be towed to the beach and the pathway of the lagoon is clear of live corals as this is the lagoon. Spillages can be an issue in this project if adequate measures are not taken. In order to maximize the amount of excavated material on hold in the barge and to save time, excavated materials will be held on the barge before disposing them on to beach. As excavated	The potential for this to happen is very low, since the barge will have bund walls to prevent sediment spillage.During sediment transport process, bund walls will be placed around the barge to contain the sediment. This is the most common method of containing sediment dispersion while transporting them on a barge and this method is also the most cost effective.	There is no direct cost as these measures will be briefed to the contractor and required to comply.

Activity	**Potential Impacts**	**Mitigation measures**	**Cost of Mitigation**
	materials increase in volume, the chances of spillage will increase. This can lead to over flow of excavated material from the barge in to the lagoon. In such instances, fine sediments will enter the lagoon resulting in high turbidity of the surrounding water, which could then be transported by surface water currents over a larger area and ultimately to the sensitive areas such as coral reef.	In addition, appropriate controls and disposal site records will be in place. Thus, this practice can ensure the spillage control with obvious financial benefits as the contractor is paid for the volume. Therefore, the contractors selected for the project will be required to keep careful logs of excavated material, disposal trips and therefore, this potential impact is not expected to be significant.	
Nourishment of the beach	The proposed disposal location on the northern and western side has breakwaters and groyns in place constructed as part of the project. Excavated materials will be disposed in between these groyns to create a beach. Average depth of at this location is less than 1 meters at mean sea level. Groyns and breakwaters will help to trap the sediments from dispersing.There is the possibility of sediment movement in the medium to long term and cause sedimentation in the lagoon as it takes some time for the beach to stabilize fully. The shorelines will be monitored regularly to assess the changes.	The following mitigations measures are proposed 1. Nourishment should be done in the shortest possible period and adequately the fill material must be disposed off in order to give time for the beach to stabilize in harmony with the breakwaters. 2.Proper timing of reclamation works, most importantly the filling to be carried during low tide and in good weather conditions. 3. Undertake regular monitoring to assess the changes to the shoreline.	Cost to be included in the contract document. Contractor to follow the mitigation measures, including bund wall and silt curtain.

8 Environmental Monitoring

8.1 Introduction

The environmental monitoring schedule proposed in the January 2011 EIA will be followed as the parameters and aspects of the monitoring do not change. Hence, the monitoring table outlined in the original EIA is provided in the following page.

8.2 Cost of Monitoring

The proponent has committed fully for the monitoring programme outlined in this report. A commitment letter has been attached as an appendix in the EIA report and also in this addendum.

8.3 Methods of Monitoring

Environmental monitoring will be undertaken using standard methods described in the Methodology section of the EIA report. Monitoring is only recommended for marine and coastal environment.

8.4 Monitoring Responsibility

Monitoring responsibility will be with the client and financial provisions will be made in the project to undertake the monitoring.

8.5 Monitoring Report

A detailed monitoring report will be compiled after the completion of the civil works.

The following table outlines the monitoring scheduled proposed.

8.6 Monitoring Schedule

The monitoring schedule is as follows.

Monitoring Attribute	Indicator	Methodology	Monitoring Frequency		Cost during (construction phase)	Cost Per annum (operational phase)
			Construction stage	**Operational stage**		
Marine environment						
Marine water visibility at site 1, 2, and 3	Visibility	Secchi Disc & Tow line distance or using qualitatively	Every other day during construction period.	-	No cost. Contractor to undertake this during construction period.	
Coral cover at survey sites 1, 2, 3 and 4 (refer to the marine environment section for the location).	Percentage live cover	Qualitative & Quantitative	No need	Annually	-	$2,500.00
Coral recruitment at survey sites 1, 2, 3 and 4 (refer to the marine environment section for the location).	Recruit/m^2	Qualitative & Quantitative	No need	Annually	-	$1,500.00
Marine water quality at survey sites 1, 2, and 3	Physical appearance, turbidity, nitrates, phosphates, pH, DO,COD, Salinity, Suspended Solids, Temp & EC	Onsite or Lab analysis	Every two months during period.	Twice annually	$600.00	$200.00
Siltation	Sediment deposited on reef substrate	Qualitative & Quantitative	No need	Four times annually	No cost. Contractor to undertake this.	$2,000.00
Social Environment						
Guest satisfaction about the beach	Feedback	Interviews/Questionaire	No need	Annually	-	$200.00
Proponent consultation	Feedback	Interviews/Questionaire	No need	Annually	-	$200.00
Coastal Environment						
Sand transport	Beach profiles	Levelling from specific BMs	Every three months	Every three months	$1,200.00	$800.00

Monitoring Attribute	Indicator	Methodology	Monitoring Frequency		Cost during (construction phase)	Cost Per annum (operational phase)
			Construction stage	**Operational stage**		
	Near shore currents	Drogue at profile locations	Every three months	Every three months	$600.00	$400.00
	Shore line mapping. Once the beach is re-profiled and the breakwaters ad headlands are in place, the shoreline will change and need to be mapped.	Using DGPS	No need	Every two months	-	$3,000.00
	Erosion from sensitive areas	Physical inspection and shoreline mapping	No need	Every two months	-	$3,000.00
					$2,400.00	**$13,000.00**

9 Conclusion

In January of 2011, an EIA was undertaken to obtain approval to proceed coastal protection works (shore protection structures and beach nourishment) in Summer island. Approval for the EIA was given on 20th February 2012. Since then, the project has been ongoing for the past 18 months. However, the beach replenishment component has not been completed fully. As the project has passed its approved duration, the proponent wishes to extend the time period to complete the project by utilizing an excavator to complete the dredging works.

Hence, the aim of this report is to obtain the necessary approval to undertake the dredging works in Summer Island resort (Ziyaaraifushi) using an excavator. No additional or new works are proposed than those works outlined in the EIA report.

The change in the methodology had to be adopted as sand pumping is proving to be financially not viable due to many factors. Most importantly, the distance from the burrow site to the beach reduces the efficiency of the pumps and thus double pumping is required. This is a time consuming and costly exercise. Due to this, delays are caused in the beach replenishment component.

In order to complete the project in a timely manner, adequate fill material needs to be supplied from the borrow site to stabilize the beach and allow the beach to form itself in harmony with the nature (waves and currents).

Annex: TOR

Terms of Reference for Environmental Impact Assessment for Coastal Protection at K.Ziyaaraifushi, an Addendum

The following is the Terms of Reference (ToR) following the scoping meeting held on *4 September 2012* for undertaking an addendum to the EIA for the coastal protection and beach replenishment at Summer island at Kaafu (K) Atoll Ziyaaraifushi.

This TOR addresses the major issues associated with proposed amendments and changes to the project that has been approved and is currently undergoing at K.Ziyaaraifushi.

1. **Introduction and rationale** – Describe the purpose of the addendum and the proposed amendements and changes to the project and, if applicable, the background information of the project/activity and the tasks already completed. Reference should be made to the previous EIA and Decision statements issued for records. Objectives and justification of the project components should be specified.

2. **Study area** – Submit an minimumA3 size scaled plan of the original project concept and the proposed amendments and changes to the project with indications of all the major changes. Specify the agreed boundaries of the study area for the addendum

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

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the proposed changes to the coastal protection works, using maps at appropriate scales where necessary. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

- Whether new coastal protection structures are proposed or not. If yes, the coastal defence construction methods and justification;
- Methods of borrowing sand and justification of selecting the location and method.
- Method of transporting sediment to the fill area.
- Management of the work including disposal of sediments to the fill site.
- Methods to contain sediment spillage during transport and emergency plan during spillages;
- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and operation phase i.e. sedimentation control;
- Project management

Dredging (if included as part of the project):

- Location and size of sand burrow areas (s) on a map;
- Justification for the selection of this location;
- Quantity, quality and characteristics of fill material;
- Indication of guarantees for sufficient availability of fill material;
- Method and equipment used for dredging, including description of positioning system, depth control system and operational control procedures;
- Justification for selecting the methods and equipment;
- Duration of dredging activity;

Task 5. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include environmental mitigation measures with particular attention paid to sedimentation control. Mitigation measures to avoid or compensate habitat destruction caused by dredging will have to be considered, e.g. temporal sediment control structures, coral reconstruction and MPA replacement areas. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included.

Task 6. Development of monitoring plan (see appendix) – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided. Reference can be made to the monitoring program in the original EIA report.

- Impacts from sedimentation on nearby coral reefs, benthic system, seagrass beds and fish and invertebrates communities;
- Condition of the sensitive ecosystems and marine resources;
- Re-colonization of the benthic organisms in the borrow areas;

* This TOR contains an outline of the parameters that have to be tested (see appendix). All projects are different, therefore additional or less data will be collected for recovery and impact assessments.

Presentation- The environmental impact assessment report, to be presented in digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations f or any references used in interpreting those data. The addendum report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations 2012.

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

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10th September 2012

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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

Annex