

**Format for the submission of state of conservation reports
by States Parties (Annex 13 of the Operational Guidelines)**

Name of World Heritage property - East Rennell Solomon Islands
- Identification number ()

1. Executive Summary of the report

The Lake Tegano World Heritage Site Association (LTWHSA) is considerably making progressive effort in removing the site from the danger list since it is enlisted in danger due to the logging and mining activities which has indirectly or directly impacted the OUV of the protected site. Following the RMM recommendations 2019, the Solomon Islands Government Core Team for East Rennell World Heritage Site and the Ministry of Environment have worked collaboratively with Lake Tegano World Heritage Site Association (LTWHSA) other Government Line Ministries together with National Commission for UNESCO in addressing several areas of concern regarding its OUV.

This report will provide updates on these identified areas, what measures SIG Core team undertook to address these areas of concern, achievements for the removal of the property from danger list and what other identified current conservation issues were faced by the state party.

2. Response to the Decision of the World Heritage Committee

[Note: The State(s) Party(ies) is/are requested to address the most recent Decision

of the World Heritage Committee for this property, paragraph by paragraph.]

If the property is inscribed on the List of World Heritage in Danger

Please also provide detailed information on the following:

a) Progress achieved in implementing the corrective measures adopted by the World Heritage Committee

• RMM 2019 Recommendation 1 - Protected Areas Act 2010

There is a strong request from the East Rennell Communities acknowledging the need for a legal interpretation, awareness and socialization of the Protected Areas Act 2010 towards protecting the site. This is because of the concern of customary rights must be made clear to the communities prior registering or declaration. The Non-government organization, Live & Learn is sought to support the focal point with the PA Act 2010.

- **RMM 2019 Recommendation 5- Sustainable Livelihood projects**

The successful coordination and the implementation of the East Rennell UNDP funded income generating livelihood projects implementations are shown below;

Community	Projects Type	Project status
Hutuna	Honey	complete
	Poultry	On going
	Fishing project	On going
Tegano	Poultry	Complete
	Honey	complete
Niupani	Piggery	Complete
	Fishing project	Complete
	Poultry	Fail
Tevaitahe	Piggery	Complete
	Poultry	On going
	Sanitation	On going

- NFIT project is another achievement for East Rennell World Heritage Site Program. The Netherland funds has 3 components:
 - (a) a meeting in Honiara between a delegation from East Rennell and the state party core team,
 - (b) community consultation,
 - (c) implementation.
- An ongoing dialogue and preparation is underway with the World Heritage Site Focal point, NATCOM and UNESCO headquarter office to facilitate meetings in East Rennell with the leadership of LTWHSA Chairman, George Tauika and NATCOM in Honiara for project implementation.
- Also there is a possibility of another funded project from the Japanese funds to address the livelihood issues of East Rennell Communities that is set to start in Mid-2022.

- **RMM 2019 Recommendation 2 – LTWHSA Management Plan**

There is an ongoing challenge regarding the Solomon Islands Government budget allocated for LTWHSA Management Plan completion. Since 2020, the priority for the

country has changed regarding such allocations to non Covid -19 activities and this will remain a challenge for 2022 and beyond. It is recommended / requested if NFIT project (funds) can be used to support the completion of the Management Plan and for possible assistance to the legal person for PA Act interpretation for East Rennell communities as requested.

[Note: please address each corrective measure individually, providing factual information, including exact dates, figures, etc.]

If needed, please describe the success factors or difficulties in implementing each of the corrective measures identified

b) Is the timeframe for implementing the corrective measures suitable? If not, please propose an alternative timeframe and an explanation why this alternative timeframe is required.

- The time frame to implement these measures is suitable. However, the Covid 19 threat to Solomon Islands have imposed a great financial constraint. Currently, since the community transmission have occurred since late January 2022, the implementation of these measures may not be suitable this year due to travel restrictions and Covid 19 protocols to adhere to and of course the changing priority of the Solomon Islands Government- Covid 19.

c) Progress achieved towards the Desired state of conservation for the removal of the property from the List of World Heritage in Danger (DSOCR)

The Annual General Meeting of LTWHSA in 2021 has resulted in some resolutions pertaining to achieving the Desired State of Conservation for the removal of property from danger list.

- Acknowledged and looking forward to the continuous support from stake holders for the wellbeing of the people of East Rennell 1) poor road access. 2) climate change issues. 3) food security
- Agreed to review the LTWHSA Management Plan, and educate the people to understand the Provincial Ordinance and Protected Area Act 2010
- LTWHSA has agreed and affirm in its decision to protect the world heritage status (OUV) of the property and call on present government to prioritize / assist the people of East Rennell.
- Call on the Ministry of Infrastructure and Development (MID) to prioritize East Rennell Road.
- Disregard the application from Nickel Enterprise SI limited proposal to mine East Rennell land Boundary – A possible overlap into World Heritage Site.

- A call to Climate change funding/ program to assist East Rennell. Currently ECD is discussing with Climate Change Division to seek support to conduct an Integrated Vulnerability Assessment with East Rennell.

3. Other current conservation issues identified by the State(s) Party(ies) which may have an impact on the property's Outstanding Universal Value (Note: this includes

conservation issues which are not mentioned in the Decision of the World Heritage Committee or in any information request from the World Heritage Centre]

- **RMM 2019 Recommendation 9 – Proposed Developments**

EIA on Shipwreck East Rennell.

The Min. Environment Climate Change and Disaster Management (MECCDM) was able to conduct an Environmental Impact Assessment (EIA) on the ship wreck on the coast of East Rennell. This assessment verifies and assesses the wreckage and quantify the environmental damages on the marine ecosystem. This assessment allows for the evaluation of the ecosystem damages and to give a monetary value for the damage resulted from the wreckage based on scientific approach and most importantly to inform Solomon Islands Government of important decisions to be taken.

- **RMM 2019 Recommendation 7 -Food Shortage**

The continuous food shortage that affects people's livelihood due to Covid 19 community transmission and Climate Change is still an ongoing threat to the livelihood of East Rennell people.

- **RMM 2019 Recommendation 8 – Invasive Species**

Bird Life International (Darwin Initiative)

Bird Life International for invasive species through the Darwin Initiative calls for the resubmission of the project proposal for stage 2. The Chairman of LTWHSA is currently working on this.

4. In conformity with Paragraph 172 of the *Operational Guidelines*, describe any potential major restorations, alterations and/or new construction(s) intended within the property, the buffer zone(s) and/or corridors or other areas, where such developments may affect the Outstanding Universal Value of the property, including authenticity and integrity.

- Environment Impact Assessment (EIA) on road construction proposal –The road construction proposal was submitted by the Rennell and Bellona Provincial executive). It is an initiative from the Rennell and Bellona Provincial Government hence, the proposal was pending due to changes of new provincial government elected into the executive. However, there are no EIA undertaken for the road as it was purposely for road maintenance and upgrade only.
- *Cancellation of the OTC logging company proposal to log the Agapogavu strip.* The cancellation to log the strip between the western tip of the lake and the World Heritage site boundary with a 40-meter width road proposal (detouring somewhere along the main road a few km from the World Heritage Site boundary with West Rennell) through to Kiakoe Lodge. This is a new proposed road submitted by Lence Tango which is also pending through public/ private partnership with SIG line Ministries.

5. Public access to the state of conservation report

[Note: this report will be uploaded for public access on the World Heritage Centre's State of conservation Information System (<http://whc.unesco.org/en/soc>). Should your State Party request that the full report should not be uploaded, only the 1-page executive summary provided in point (1.) above will be uploaded for public access].

6. Signature of the Authority




Annexures:

Nukuma'anu Assessment Report



ENVIRONMENT ASSESSMENT FOR NUKUMA'ANU COASTAL MARINE AREA, EAST RENNELL RENBEL PROVINCE



September 2021

**Environment and Conservation Division
Ministry of Environment, Climate Change, Disaster Management
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1.0 INTRODUCTION

1.1 Background

Following a complain raised by the landowners of East Rennell (Lake Tegano) concerning a wreckage at the World Heritage coastal area, a team from the Ministry of Environment, Climate change, Disaster management and Meteorology (MECDM), Environment and Conservation Division (ECD) was deployed on site to verify and assess the wreckage and the damage to the marine environment. The environment team were accompanied to the site by land owners and the World Heritage committee chairman.

The barge (SAPOR 2302) has been grounded early this year 2021. During the grounding event nobody has any idea about it except the company itself but was never revealed. It was later discovered by villagers, however, on their fishing trip to their normal fishing ground. The information was then channeled through to the Environment and Conservation Division within MECDM.

The assessment was undertaken on the 23rd of June 2021. Prior to the assessment the team had interviewed few locals at the village especially those who own the coastal area where the wreckage is. It was clear that from the information they provided that, the area which has been impacted by the wreckage is an important fishing ground of the local communities of Lake Tegano. What so significant about the coastal area of Nukuma'anū that has been impacted by the wreckage is that, the communities normally used the that fishing ground when there is a special event or occasion in the communities such as new year party of church programs, owing to the high catch of fish and other seafood which they often get.

The Nukuma'anū reef located in the eastern part of Rennell Island is a customary land owned by one of the tribes at Lake Tegano known as Tehakagaba tribe. The coastal area has been used throughout time for many generations as a fishing ground until when the Barge got on shore and caused substantial damages to the coral reefs and the marine ecosystem at large. Ever since, villagers had stop using the coastal area or do any fishing activities like they used to due to the pollution caused by the wreckage and the fear of any health issue which might have occur. Similarly, as a precautionary measure, they were being advice to keep up with that until the area has been tested and verify safe to be reuse.

Currently, the barge seats at the back-reef at Nukuma'anū, it had passed the reef crest all the way through the reef flat to the back reef where it finally settled down. It is confirmed in this report that the wreckage had caused acute damages to the local fishing grounds and the marine ecosystem. The coastal area is not only rich in marine life but is highly diverse. Found within the reef system are different genera of corals. Out of which there were six main coral genera which were found to dominate the reef system in this locality and these are Acropora, Hard coral (or Massive and Boulder), soft coral, mushroom coral, branching coral (or fire coral) and staghorn coral. These coral species have been severely damaged by the wreckage and it showed the path with which the barge had entered through the reef crest to where it finally rested with in the reef. The barge was measured along with the location of its resting place were recorded. It was discovered that it had travel quite a long distance from where it entered the reef to where it finally settled. The reef within Nukuma'anū have been fully surveyed by the team, however, close attention was placed particularly on the path which the barge had been dragged upon to where it currently stationed at. It is the aim of this report to produce a succinct and comprehensive description and information of the wreckage at the World Heritage coasts to inform decision makers as well as for resource owners on issues pertaining to it. Any claim regarding the environmental damages of the wreckage at East Rennell coastal area should not be derived from any other reports apart from this.

1.2 Aim and Objectives

The aim of this environmental damage assessment is to verify the wreckage being reported as well as to assess any likely damage to any significant sites and the marine environment at large. Valuing any damages to the marine ecosystem is one of the main aims of this report.

In addition, this assessment wishes to find out whether or not the company comply is complying to legal requirement of the country or not particularly its development consent.

1.3 Scope of Assessment

This assessment seeks to verify and assess the wreckage at the coast of East Rennell the World Heritage site and to quantify the environmental damages to the marine ecosystem. Tribes of the affected area were consulted to provide reliable information concerning the ownership of the area. This assessment allows for the evaluation of the ecosystem damages and to give a monetary value for the damage resulted from the wreckage based on scientific approach. Besides, it also allows to check the company whether or not it follows robust logging operation practices of Solomon Islands.

It is a statutory obligation for the Ministry of Environment, Climate Change, Disaster Management and Meteorology to ensure that prescribed developments such as logging operation are conducted in accordance with environmental standards and best practices and under rigorous operating conditions. These practices and conditions are specified in various environmental reports, approvals and legal documents provided by and to the companies by respective agencies.

In general terms, the scope of the audit was to assess the wreckage of a barge in Rennell island belonging to a logging company in ensuring that the company is in;

- Compliance with conditions attached to the development consents granted to the companies;
- Compliance with mitigation measures contained in the environmental management plans (EMP) submitted by the companies;
- The environmental performance of the operations in the context of international mining practice and effectiveness and relevance of the EMP;

As indicated above compliance in this case refers to compliance with corporate environmental policies though it has bearing on legal compliance as well, as traditionally approached.

1.3 Assessment Team

The assessment team consists of senior environment officers and was assisted by land owners and the world Heritage committee chairman.

- i. Trevor Maeda (Principal Conservation Officer)
- ii. Heartly Tepai (Senior Environment Officer)
- iii. Melvin Zama (Conservation Officer)
- iv. George Tauika (World Heritage Committee Chairman)
- v. John Mana (Land Owner)

1.4 Assessment process

Generally, the approach used for this environmental damage assessment involved the commonly practiced techniques and steps applied in the assessment process. Specific steps used in the assessment include:

- Interview and information gathering from resource owners.
- Site visit to the actual site where the wreckage had occurred i.e. coastal area.
- Data collection onsite
- Production of a draft report for presentation to appropriate authorities within the government.

Some of the commonly used techniques in any environment audit includes questioning, observation and capturing of photos in the field.

1.5 Methodology

The area being impacted was separated into two both surface and underwater. The surface area was assessed through taking photos and collection of data points or coordinates as well as site observation. Similarly, the underwater area has been thoroughly assessed through snorkeling and taking underwater pictures of the reef system. The underwater survey applied in this assessment follows the scientific method noted by (Labrosse et al., 2002) and (R. A. Watson and T. JQuinn, 1997).

Having had this impacted area divided into two was to ensure that the team has cover all the affected area within the reef system and to allow for better analysis of the results.

Generally, the method applied here includes Interview and information gathering from resource owners, site visit to the actual site where the wreckage had occurred i.e. coastal area and data collection onsite through the application of proper scientific method.

1.6 Materials

The field assessment was completed with the aid of the equipment used. Some of the equipment's used during the field visit includes;

- | | |
|-------------------|-------------------------|
| • Diving mask | • Pen |
| • Snorkel | • Wet suit |
| • Diving shoes | • Measuring tape (100m) |
| • Diving flippers | • Nikon camera |
| • Diving slates | • Note book |

2.0 INSTITUTIONAL CONTEXT

2.1 Environment Act 1998 and Regulation 2008

The environment act 1998 is established to safe guard the environment and the natural resources of the Solomon Island for the maximum benefit of the citizen. Thus, relevant development as defined by the environment act 1998 as prescribe are required to have a development consent prior to any major development.

The Act makes provision for the protection and conservation of the environment. With regards to waste control and management, section 3 (c) of the Act specifies the following as part of its objectives:

(a) “to reduce risks to human health and prevent the degradation of the environment by all practical means, including the following 16

- i. regulating the discharge of pollutants to the air, water or land
- ii. Regulating the transport, collection, treatment, storage and disposal of wastes
- iii. Promoting recycling, re-use and recovery of materials in an economically viable manner

Also all development pursuant to the Environment Act are ‘prescribed development’. This means that for any such development activity to proceed, an environmental impact statement (EIS) or a public environment report (PER) is a required condition. A ‘development consent’ is required by the developer from the Environment and conservation Division in order for logging operations to begin, usually after vetting and approval of the EIS or PER. The EIS should identify all potential adverse environmental impacts and define appropriate mitigation measures to ameliorate the impacts in the project cycle.

The Act requires a set of criteria to be used in the EIA process in assessing the impacts of the development on the environment. It is the responsibility of the development proponent to prepare the EIS or PER, at its own expense. Concerns by local communities can be accommodated through the EIA process, which is necessary for environmentally sound management of the project.

2.2 Wildlife Protection & Management Act 1998 and Regulation 2008

The Solomon islands Wildlife Protection and Management Act 1998 is an Act which “makes provisions for the protection , conservation and management of wildlife in Solomon islands by regulating the export and import of certain animals and plants ; to comply with the obligations imposed upon Solomon islands comply with the obligations imposed upon Solomon islands under the convention on International Trade in Endangered species of Wild Flora and Fauna and for other Endangered species of Wildlife Flora and Fauna and for other matters connected therewith or incidental thereto “.

Under this Act it also guarantees that the country’s native wildlife flora and fauna are protected from invasion of introduced species. Additionally, the Act safeguards the international local/native plants and animals in the wildlife to be managed or regulated purposely for its sustainable use as an important resource which will benefit the local livelihood of Solomon Islands.

2.3: Forest and Timber Utilization Act 1990

It is an important requirement for industrial logging to comply with the relevant provisions of the forest and timber utilization Act 1990 (cap.40) and its regulations. In section 5 of the Act on licensee, which deals with the issues involving felling and removing of trees and sets out the approval or license conditions to cut, fell and extract trees or round logs for timbers from any land must be consistent with section 5.

Also the standard logging agreement in (Forest and Timber), (Prescribe form) and (Amendment) have the regulations that has provisions and procedures relevant to environment protection. Therefore, according to 1984 amendment stated that it is binding to the developer for example; to ensure soil erosion be prevented among other environmentally sound provisions. Also, the amendment further emphasized the need for environmental protection, when after an agreement is reached to carry out any logging activities in any customary land. And also for a developer to carry out such investigations to identify and describe any areas which should be excluded on from the application on grounds of environment or social values.

2.4 Lands and Titles (Amendment) Act 2016

An Act to amend the Land and Titles Act (cap. 133) to provide a right to resume certain fixed term estates.

This Act amends the Land and Titles Act by inserting a new section (142A), which makes provision with respect to resumption of fixed-term estates created under section 100 of the principal Act. The Land Board may resume all or part of the estate to use the relevant land for public purposes by: (a) giving the owner of the estate 6 months' written notice of the resumption; and (b) paying the owner reasonable compensation for the resumption. The section sets out the consideration for determining the amount of reasonable compensation.

The issue of land is the most challenging in the modern development of Solomon Islands. This is due to the fact that landownership is related to customary practices and communal ownership of land and resources. Land ownership is attributed to tribes, clans, and families rather than an individual. Land include vast majority of land, including forests, lagoons, and reefs and that the clan or tribe, the chiefs or family heads decide over the deployment and use of the land for the benefit of the clan or community at large. No person other than a Solomon Islander may hold or enjoy any interest of whatever nature over, or affecting, customary land. A Solomon Islander is defined under the Land and Titles Act as a person born in the Solomon Islands who has two grandparents who were members of a group, tribe, or line indigenous to the Solomon Islands. An exception is made to this rule - s.241 (2), for a person, not being a Solomon Islander, who:

- is or has been married, whether according to current customary usage or otherwise, to a Solomon Islander and who according to current customary usage becomes entitled to acquire or enjoy the interest in question in right of his being or having been so married; or
- acquires or becomes entitled to enjoy such interest by inheritance according to current customary usage.

The Lands and Titles Act provided two alternative mechanisms by which land can be acquired. Under Part V of the Lands and Titles Act, voluntary acquisition under Division 1 or compulsory acquisition under Division 2.

2.5 Solomon Islands code of logging practice 2002

The code of logging practice complements and simplifies the complicated requirements in schedule c and form 4 of the forest and timber utilization act. It provides guidelines for planning and monitoring of logging operations to improve logging practices in Solomon Islands, thereby minimizing potential adverse environmental consequences associated with logging.

2.6 Fisheries Management Act 2015

This Act made provisions for the conservation, management, development and sustainable use of fisheries and marine resources of Solomon Islands, to monitor and control fishing vessels within and beyond the fisheries waters, to repeal the Fisheries Act 1998.

It shall ensure the long-term management, conservation, development and sustainable use of Solomon Islands fisheries and marine ecosystems for the benefit of the people of Solomon Islands. Unless otherwise specified under this Act, or by a Fisheries Management Plan adopted under this Act, this Act does not apply to or in relation to non-commercial fishing including customary fishing. All functions, duties and responsibilities under this Act shall be exercised in a manner consistent with specified principles including the precautionary approach which shall be applied to the management and development of the fisheries at a standard that is equal or superior to the standard set out in Article 6 and Annex II of the UN Fish Stocks Agreement.

3.0 RESULTS

The wreck had extremely damaged the East Rennell coastal area particular Nukuma'anu reef. The barge had travelled a distance of 3 kilometers from where it entered the reef to where it currently settled. The barge did not follow any linear trajectory since the incident took place during a bad weather; it has largely damaged the reef flat measured at 0.1 kilometers, thus, damaging an area of about 0.3 square kilometers. Within this area found hundreds of different marine organisms that depend on each other for their survival.

Table 1: Common corals found within the reefs of the East Rennell coast.

Site	Common name	Scientific name*	Damage Status		
			Major	Moderate	Minor
East Rennell (Nukuma'anu)	Branching	Acroporidae ¹	√		
East Rennell (Nukuma'anu)	Mushroom coral	Fungiidae ²	√		
East Rennell (Nukuma'anu)	Hard coral	Acroporidae ³	√		
East Rennell (Nukuma'anu)	Fire coral	Milleporidae ⁴	√		
East Rennell (Nukuma'anu)	Soft coral	Alcyoniidae ⁵		√	
East Rennell (Nukuma'anu)	Staghorn coral	Acroporidae ⁶	√		
East Rennell (Nukuma'anu)	Coralline algae	Coralinaceae ⁷	√		

*Scientific name used here is the family name, it was not classified down to the species level.

¹ Carden C. Wallace, 2011; https://doi.org/10.1007/978-90-481-2639-2_271

² Bert W Hoeksema, Sancia E.T. van der Meij and C. H. J. M. Fransen., 2014: *The mushroom coral as a habitat*: 10.1017/S0025315411001445

³ Carden C. Wallace., 2011; https://doi.org/10.1007/978-90-481-2639-2_271

⁴ University of Michigan data base; Animal Diversity Web

⁵ Tatsuki Koido, Yukimitsu Imahara, Hironobu Fukami., 2019; *High species diversity of the soft coral family Xenidae (Octocorallia, Alcyonacea) in the temperate region of Japan revealed by morphological and molecular analyses*

⁶ Carden C. Wallace, 2011; https://doi.org/10.1007/978-90-481-2639-2_271

⁷ ENEC 259 Coral Reef Ecology and Management at UNC

The barge was measured to be about 71 meters by 19 meters both length and width respectively. It has been completely broken up when it hits against rocks by waves during the storm. Possibly when the storm had finally over, it then come to where it finally settled

3.1 Map of Assessment Site



Figure 1: A map of the site where wreckage has occurred at Nukuma'anu coral reef.

3.2 Surface and Underwater Survey

Both surface and underwater within the 0.3 square kilometers area were being surveyed. The surface had some indications of damage along the cliff. Equally, the underwater survey indicates damages to the coral reefs and the path which the barge had been dragged along was clearly observed. There were attachments on the barge which has been broken off during the dragging process found laid underwater within the reef flat.

Table 2: Shows the total area being damaged by the barge along with the description of the distances within the reef flat.

Approximate Measurement	Description
3 kilometers	This was the distanced travelled by the barge during the stormy weather within the reef. This area is found within the reef flat. This was the length of the area being damaged.
0.1 kilometers	Distance measured from the shore to the reef crest. This was the distance being damaged within the reef flat, as well as the reef flat width relative to the shore and reef crest.
0.3 Square kilometers	Total area being damaged by the wreckage within the East Rennell reef system.

Table 3: Shows the impacts and the categorization of each impact with its time of recovery

Impacts	Short term	Long term	Recovery time
Coral damage		√	It will take more than a two century or more for corals to be fully recovered if there is no human intervention. Coral recruitment will depend entire on natural process but this also varies with the geomorphological features and oceanographic characteristics of the site. Overall, coral reef growth is slow, ranging from about 1 to 5 m per 1000 years. ⁸
Algal growth	√		Algae will eventually remove by natural process due to the geographical setting of the area and lack of embayment to impede such process. This can take a month or two for the algae to completely removed.
Reef fish depletion		√	Fish recruitment will take more than 10 years or so depending on the recovery rate of corals and natural habitat. Unless otherwise fish restocking happens.
Marine flora and fauna habitat loss		√	Recovery of marine flora and fauna loss can take probably more than ten years if natural process were to occur without human intervention. The recovery rate could potentially reduce if control measure or approach is made.
Ship wreck		√	Pollution from the wreck could take a century or even more to get rid of from the site depending on the eroding or decaying of metals.

⁸ Walter C. Jaap., (2000): *Coral reef restoration*, Ecological Engineering 15 (2000) 345–364;
https://www.researchgate.net/publication/222543381_Coral_reef_restoration



Figure 2: Shows the damages caused by the wreckage to the marine ecosystem. Pictures a-c displays the growth of algae in the reef system after a month when the barge had gone in-shore. Pictures d-f shows the general overview damages on the intertidal zone of the reef system. The barge had entered the reef at this point (indicated by the arrow in picture f) and was drag by wave action to where it finally settled, picture d.

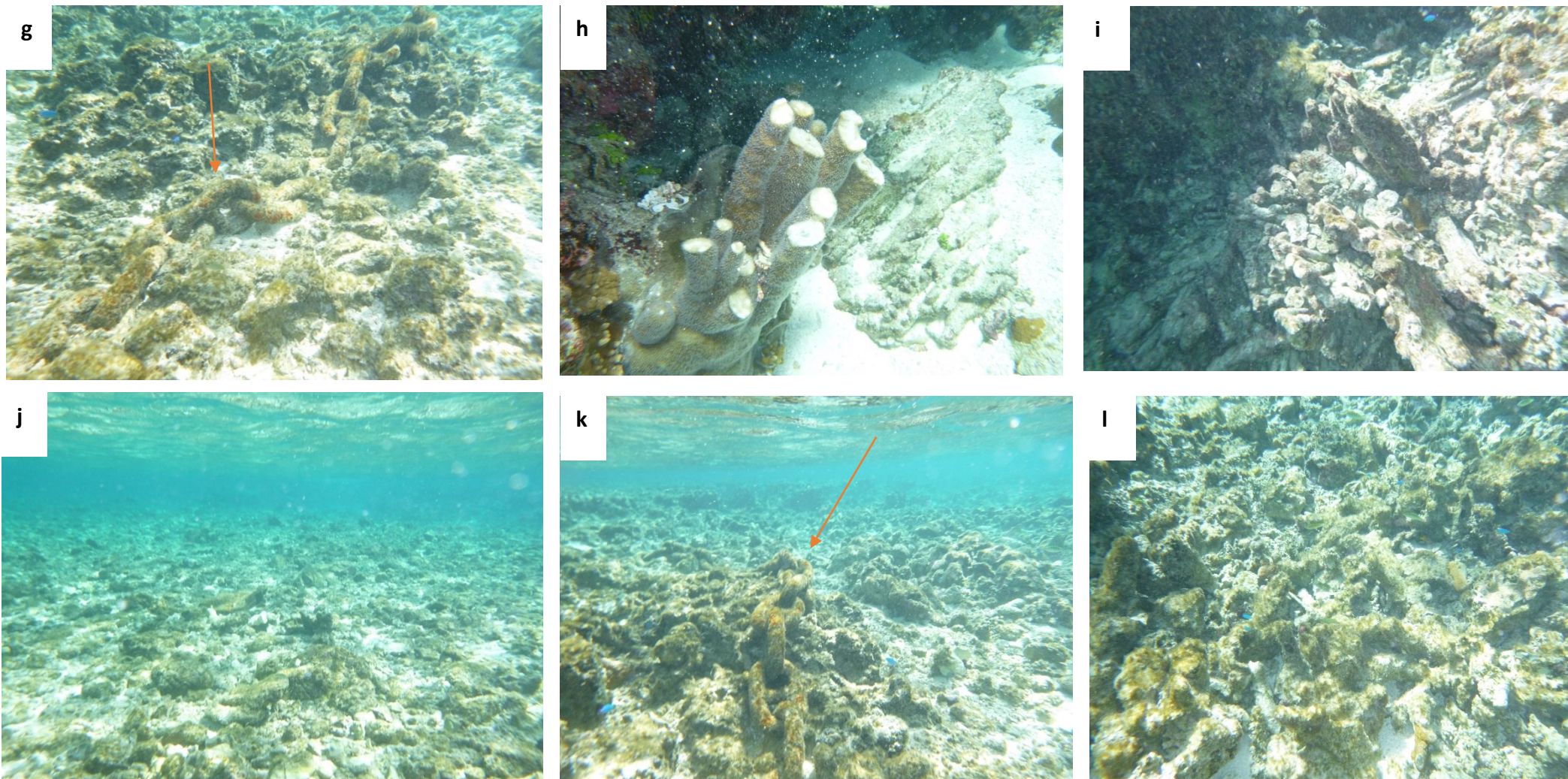


Figure 3: Shows the under-water images of the reef which was damaged by the barge. The entire corals in the reef had been extremely damaged by the barge indicated by the images i, j and l. the image g and k show some attachments from the barge (indicated by the arrows) that was broken off and remain within the reef.

4.0 Discussion

Data shows that the barge had damaged an area of about **30 hectares** within the Nukuma'anu coral reef system during the grounding event (table 2). This has caused substantial negative impacts to coral reef, marine habitats, breeding sites and the ecosystem at large. The natural dynamic and functionality of the coral reef system had been decimated by this undesirable event. Most of the corals found within the reef system had been equally damaged as most of the coral cover within the reef system are mostly Acropora (table 1 & figure 2). Hard corals and other coral species found in the reef system which can withstand high energy wave actions were found relatively close to the reef crest, acting as a barrier for brittle coral species such as Acropora and the coast.

Furthermore, sessile marine organisms such as clams, corals and other sea shells were largely affected. Since such organism function in the marine ecosystem as filters, the growth of algae in the reef had hugely affect their survival. Algal growth in such reef or costal area is quite rare to occur owing to its geographical setting, and besides, the coastal area is quite expose to wind and current movement allowing for the rapid movement of seawater in and out of the reef, letting minimal chance for any suspended matter which could potentially triggers the growth of algae within the reef to remain for an extended period of time. In figure 1.a-c, it shows algal growth within the reef system which had been triggered by the wreckage. The subsequent week after the barge had run aground, the growth of algae had covered almost three quarters of the entire reef causing sessile marine organisms to die as a result. Similarly, fish and other organisms which are mobile had to migrated owing to the lethal condition produced by the growth of algae.

Moreover, pollution from metal corrosion and antifouling paints has been a major impact on the coral reef. The barge itself and other parts which had been broken off from it (figure 2 & 3) were gradually eroding and spreads out into the coral reef and potentially into the ocean. This is one of the concerning issues in particular, since, once these pollutants enter the base of the food chain it can bioaccumulate and could possibly biomagnified and when it reaches the top predators which humans feed on, it could potentially pause major health risk. For such reason, communities were being advise not to fish or use the fishing ground until it is verified safe to be reuse. Threats paused by the continuous eroding of the grounding vessel and other parts which had been broken off during the grounding events will continue putting human life at stake. As long as the vessel remains within the reef these threats will continue but will be more catastrophic than it is at present time. Therefore, it is important and environmentally safe for the grounding vessel to be remove from its current site to a safer place till it will be finally disposed of.

Consequently, the acute damages on this once pristine natural environment had broader negative impacts to both the biotic and the abiotic aspects of the ecosystem which were largely categorized into short term and long term (table 3). Equally, the natural environment and the livelihood of the communities at large is at stake. At present, the communities of the World Heritage site are finding hard to cope with or accept what had happened to their fishing ground knowing very well the nature of damage and the negative impacts they will suffer now and in years to come.

Nukuma'anu fishing ground plays a crucial part to the livelihood of the communities at Lake Tegano. The coastal area has been reserved for major activities in those communities and also when they want to make an income, this is due largely to the high catch of fish in the reef. In addition, it was also a way of sustainable use of resources and to avoid overharvesting, reserving such fishing ground could sustain not only the present generations but the future ones, a practice which has been passed on among many generations throughout time.

The unwelcomed event of the wreckage has obliterated the intrinsic quality of the environment which supports and sustain many, and has equally upset the natural harmony of the people with their pristine environment. Besides that, the reef ecosystem which forms part of the Outstanding Universal Value of the Natural World Heritage Site or property was negatively impacted since the physical damage to the corals were significant and covers a large portion of the reef area.

The natural dynamic and the functionality of the coral reef system in this locality or the ecosystem functions at large could not replenish naturally quickly (table 3) to support and sustain the livelihood of the communities of Lake Tegano. Corals for example, has a growth rate of 1- 5 mm per 1000 year (Jaap. W, 2000), thus recovery is very slow. Besides, depending on the coral recruitment process (settlement of juvenile organisms) and the conditions of the environment whether it is conducive for coral polyps to survive. Also, there are other factors which is at play in this particular geographical setting which might potentially have further impeded the natural recruitment process prolonging even further the recovery rate. The same is true for other impacts like reef fish depletion and marine flora and fauna loss. The recovery rate of the environmental damages could potentially reduce or improve by applying other means such as restocking of the wild and or coral gardening. Thus, it is imperative that facilities for such method have to be set up onsite and requires continues monitoring and assessment of the progress of recovery or restoration.

5.0: ENVIRONMENTAL VALUATION

Marine reef ecosystem and biodiversity hosts a lot of living things. Nukuma'anu coastal reef ecosystem likewise provides service for both human and living things in a countless manner. Its natural setting and disturbance is of consideration under this assessment for economic valuation.

It is evident that the significant impacts identified during the assessment where the wreckage is, corals that provide habitat were loss, continuous coastline pollution and contamination with rust deposits and loss of living things in the sea.

In principle, the environmental economical values on each area of concern were calculated and valued according to:

- a) The extent and nature of the problems created in people's lives and number of people affected.*
- b) The replacement costs in economic terms of replacing the lost goods and services provided by forests.*
- c) Changes in social stability, with women and children often suffering the most.*
- d) The environmental impact and damages area.*
- e) Effects on all living things or organisms, their ecosystem and co-existence in the affected areas.*

Estimation of costs (or values) associated with the environment damage is based mainly on impacts and effects on the marine ecosystems and ecological services due to the environment alteration reported above. This ranges from reef and marine system permanent change and general decimation of original ecosystem of the studied damaged site.

Considering environment effects and impacts highlighted above, these were generally regarded as the baseline for establishing remediation options to restore the destroyed ecosystem. Rehabilitation is necessary for this valuation exercise to establish the Total Economic Value (TEV). Rehabilitation option is important to ensure damage can be reduced or remedied by taking appropriate measures to restore the quality of the damaged site. In this case, the costs of the rehabilitation measures are taken as the yardstick for the environmental damage costing. This is also regarded as a recommended revealed preference method since environment valuation remains far from uncontroversial issues, market failure and externality.

Apart from that, stated preference method was used to provide related costs on non-market goods and services. This involved use of contingent valuation method (CVM) administered for Willingness To Accept (WTA) the above intervention, considering economic theory of traded goods & choice modelling.

The activities outlined under replacement is considered necessary to ensure full recovery of the damaged site. The costing is based on the environmental standard costing for commercial sea species or key species with a revealed method available at the local level.

5.1: Marine Damage Rate Cost (MRDC)

Damage Coral Reef Area: The immediate impacts and effects of the grounding include damages to the marine reef ecosystem. The total extended damaged area was estimated to be 30,000 m² as reported by the assessment. Negative effects and impacts on fish and marine habitats, invertebrate and organisms were inevitable and likely to affect direct & indirect benefits and non-use values. It is estimated a total of five years to monitor the full recovery of the site.

$$\text{Value/Amount (\$) for Damage} = \text{Total area damaged (hectare/km/m sq.)} \times \text{Amount (\$/area (hectare/km/m sq.)} \times \text{Time(for recovery)} \dots \dots \dots \text{Equation 1}$$

Therefore 30,000 m² x \$50.00/m² x 3 years, the total amount (dollar value) estimated from this marine damage is calculated to be **SBD 4, 500, 000.00**

NB:

Rate of \$50.00/meter sq. (note: The rate is based on a TEV from a scientific study conducted in 2012-14).

5.2: Rehabilitation and Restoration Cost (RRC)

Since pre-assessment was not in place & detail quantification exercise would be very expensive or impractical to count (tally), rehabilitation cost is considered appropriate. Therefore, replacement as rehabilitation measure would provide estimate costs associate with the environment damage. This is primarily to restore the damaged site to recover to its original status. This would also involve re-establishing the productivity and some, but not necessarily all, sea species originally present. For ecological or economic reasons, the recovery of the damaged site may include marine species not originally present. In time, the original marine reef protective function and ecological services may be re-established.

It was proposed that natural rehabilitation would be the cheapest means for the damage site. However, this would involve monitoring cost to ensure full recovery. It was reported that it would even take 50-100 years for recovery therefore rehabilitation and monitoring could also take long term plans. This is expected to be very expensive with a designed rehabilitation programme to restore direct, indirect and non-use values. The monitoring programme was proposed for a total of five years, way lower than the duration required for the recovery of the coral.

Note that monitoring is only required at this stage to consider alternative options and to observe above suggestion. The costing of these monitoring activities is an important indicator and revealed method to value cost of damages in the context of this incident and its economic implication.

Table 3. Rehabilitation cost using revealed prices of materials & equipment working against an estimated marine area expose to damage and disturbance.

Rehabilitation Programmes	Details	Costings
1. Collection of source material	<ul style="list-style-type: none"> This includes costs associated with corals of opportunity, fragments from donor colonies, mature colonies/colony-segments about to spawn, and spawning slicks. Number of person-hours are required to collect x corals of opportunity, x fragments from donor colonies, x mature colonies/colony-segments about to spawn, an amount of spawning slick necessary to generate x competent embryos etc. Costs of equipment needed for collecting and holding the coral source material? [This cost needs to be expressed per amount of material so that costs can be scaled.] Boat transport costs for above activities etc. 	\$ 550,000.00
2. Setting up coral culture/nursery/hatchery facilities (in situ or ex situ nurseries, tanks, etc.)	<ul style="list-style-type: none"> Costs associated with rehabilitation and direct transplantation of fragments is proposed, or corals are being translocated from a site threatened by development (e.g. construction or dredging) to a safer site, then material may just be held temporarily in the field, but there may be some 	\$ 580,000.00

	<p>equipment/consumable/ person-hour costs associated with this.</p> <ul style="list-style-type: none"> Associated costs of equipment/consumables/staff time (person-hours) to set up nurseries/tanks? [These costs need to be expressed per amount of material which facilities can handle (e.g. per 1000 or 10,000 fragments/nubbins or per 10,000 or 100,000 newly settled coral spat) so that costs can be scaled to size of operation planned.] <p><i>(These also considers how long are these facilities likely to last and what annual inputs (on average) are likely to be required to keep facilities functional and in a good state of repair.</i></p>	
3. Establishing collected coral material in culture/nurseries.	<ul style="list-style-type: none"> Estimated costs associated with time and consumable costs involved in setting up x amount of coral material (e.g. 1000 fragments or 100,000 settled coral spat) in culture? <p><i>[For asexual fragments, this might include plastic pins/wall-plugs/hose-pipe/other rearing substrates, glue, cutters, etc. and person-hours to set up x amount of coral in an in situ nursery.]</i></p>	\$ 500,000.00
4. Maintenance of corals in Culture.	<ul style="list-style-type: none"> Maintenance activities are required to ensure good survival of corals No: of person-hours are required per month/year/ culture cycle to maintain material. Consumable/equipment/boat/SCUBA costs involved. <p><i>(Is some basic level of maintenance mandatory to avoid high mortality; are some activities discretionary (i.e. their cost-effectiveness is marginal)</i></p>	\$550,000.00
5. Transfer of corals from culture/nursery/farm or source reef and attachment at the rehabilitation site.	<ul style="list-style-type: none"> Number of person-hours are required per x amount of material to transfer cultured/farmed/collected corals from 	\$600,000.00

	<p>nursery site or source reef to the rehabilitation site?</p> <ul style="list-style-type: none"> • Consumable/equipment/boat/SCUBA costs per x amount of material? <p><i>(These are some of factors primarily determine these costs? (E.g. distance to restoration site)</i></p>	
6. Maintenance and monitoring of transplants at the rehabilitation site.	<ul style="list-style-type: none"> • Costs associated with maintenance activities and at what frequency are recommended to enhance survival of transplants? • Number of person-hours are needed for these activities per unit area restored? • Costs associated consumable/boat/SCUBA costs? <p><i>(Monitoring is needed both to evaluate the success/failure of your project (and to allow adaptive management if things do not go according to plan (More elaborate forms of monitoring are largely scientific exercises which should be separated from maintenance in costing).</i></p>	\$550,000.00
TOTAL COST		\$3,330,000.00

5.3 Removal & Monitoring Cost for Ecological & Ecosystem Service Restoration.

The removal cost covers an option for totally removing the wreckage from the marine site (Nukuma'anu) due to potential hazard & pollution posed to the marine site. This measure would ensure a full recovery of the site overtime and in a long term while mitigating any future harm and pollution. This has provided the indirect value for the environment damage.

This measure is regarded appropriate where there is no internalisation of externalities to account for effects on non-value market goods and services, especially in Solomon Islands. And where reliable parties are not currently required under a tax regime to pass on responsibility for salvage work to be done by responsible authorities.

Generally, this approach values damages to ecosystem services using the cost for removing all the waste machineries(wreckage) from the site to restore and replaces damages to Nukuma'anua Island marine reef ecosystem. In a short term, it is necessary to consider oil removal as a priority cost since it can pose potential danger to the marine environment.

Table 4, below entail costs associated removal of these heavy machineries from the above marine site, especially in the absence of compromised amount for damages and pollution reported (from the assessment). Note, this is a local cost associated with needed equipment required to do most heavy work at the wreckage site for the purpose of this valuation.

Table 4. Removal and Restoration value from a breakdown cost needed to remove the wreckage for full restoration of the Nukuma'anua damaged reef ecosystem.

No:	Equipment	Company & Firm	Rate	Total	Comments
1	Crane	Hatanga Company	SBD 2,200/hr (4 weeks)	1,478,400.00	
2	Tug Boat	Private Shipping Company	40,000/day 1 week(7days)	280,000.00	
3	Pull Barge	Private Company	30,000/day 1 week(7days)	210,00.00	
4	Labour Cost(site)	Labour Division(Ministry of Commerce)	SBD 100/day 8 weeks(40 days) x 20 people	80,000.00	
5.	Landing craft	LC Ocean Grace	40,000/day 1 week(7days)	280,000.00	
6.	Alternate disposal site cost	Customary land(negotiation & Agreements)		200,000.00	
7	Marine reef restoration programme	Ministry(Fisheries & Environment), NGOs, CBOs		\$200,000.00	Restoration programme for the site (Coral planting etc.)
TOTAL(RRC Value)				\$3,128,400.00	SBD

(Note: this does not include vast array of specialised equipment and floating sheerlegs etc. Hiring of specialised equipment could be done from oversea and is very expensive).

Table 5. Monitoring costs including procurement of basic needs to undertake monitoring and possible protection of the damage site.

No:	Equipment	Company & Firm	Rate Cost	Total	Comments
1	OBM	Y-Sato	OBM & Boat	\$120,000.00	OBM for monitoring
2	Fuel	South Pacific Oil	1drumfuel/2month (30months programme) x \$1,500.00	\$45,000.00	
3	Specialised Diving & Monitoring Equipment	Island Enterprise Limited	Standard rate & prices	\$150,000.00	Estimated budget for specialised equipment for monitoring.
5	Labour Cost(site monitoring)	Community Representatives	SBD \$250/fortnight for 60 months x 5 people	\$75,000.00	Five years was estimated time for actual removal of the wreckage.
6	Specialised Training	Local Consultant	\$150,000.00	\$150,000.00	Breakdown for training programme is not included.
TOTAL(RMC)				\$540,000.00	SBD

5.3: Contingent Valuation Cost (CVC)

Contingent Value Method (CVM) was engaged mainly to capture non-market goods and services. This value is usually elicited using various methods including CVM which administered designed questionnaire or choice modelling which both involved focus group on Willingness To Pay (WTP) or Willingness To Accept (WTA).

In economics, Willingness To Accept (WTA) is the minimum amount of money that a person is willing to accept to abandon a good or to put up with something negative, such as pollution and environment damage. It is equivalent to the minimum monetary amount required for sale of a good or acquisition of something undesirable to be accepted by an individual.

In the above situation, this involved WTA for the intervention or damage done to custodian of the above site. Listed below are ecosystem goods and services that were identified within the damage site as non-market goods and services but remain significantly important in the ecosystem and ecological processes.

Table 5. Environment & ecological damage along Nukuma'anua coastal & marine reef area.

ENVIRONMENT & ECOLOGICAL DAMAGE, NUKUMA'ANU MARINE REEF SITE		
Type of Ecosystem Service	Checklist	Reference to Valuation Method
Provisioning Service		
• Food	✓	CVM & RVM ⁹
• Raw materials	✓	CVM & RVM
• Genetic resources	✓	CVM & RVM
Regulating Service		
• Carbon sequestration and storage	✓	CVM & RVM
• Biological control	✓	CVM & RVM
Habitat & Supporting Service		
• Maintenance of genetic diversity	✓	CVM & RVM
• Gene pool protection (conservation)	✓	CVM & RVM
• Habitat for species	✓	CVM & RVM
Cultural Service		
• Aesthetic information	✓	CVM & RVM
• Recreation and tourism	✓	CVM & RVM
• Inspiration for culture, art and design	✓	CVM & RVM
• Spiritual experience & sense of place	✓	CVM & RVM

The representative amount elicited for WTA approach is \$2,000,000.00. This includes illegal entry or trespass claim for unauthorized entry into a customary owned reef, destruction of sites, destruction of Nukuma'anua reef & aquatic environment.

This value is mostly considered for regulating services, habitat & supporting services, cultural services and potential provisioning services that are decimated. These ecosystem goods and services remain invaluable due to lack of market prices but underlies the most significant processes in any existing natural ecosystem.

⁹ RVM is the Restoration Valuation Method. This is one of the methods recommended in report by Network for Business Sustainability.

5.4: Total Environment Damage Value

Below is the total monetary value based on three main components for consideration:

No	DIRECT & INDIRECT ENVIRONMENT COSTINGS	ECONOMIC VALUE
1	Marine Damage Rate Cost (CDC)	4, 500, 000.00
2	Rehabilitation and Restoration Cost (RRC)	\$3,330,000.00
3	Removal & Monitoring Cost	\$3,668,400.00
4	Contingent Valuation Cost (CVC)	\$2.000,000.00
	Total Environment Damage Value	\$13,498,400.00

6.0 CONCLUSION

In conclusion, based on the field observation and assessment of the studied site this is to verify there are marine environment damage has been caused the wreckage of barge (SAPOR 2302) (logging Company). It is evident that there are significant impacts caused. This is since the wreckage which remains a health risk for people within the vicinity who depend much on sea area for food and cash income like sea cucumbers and other sea resources. Therefore, the economic valuation of these environmental damages were valued at \$13,498,400.00 (SBD) for both market and non-market values. This represent a significant loss in which the responsible company and licensee must bear to redress the damage caused by the barge.

7.0 RECOMMENDATION

It is highly recommended that Gulf Tree and Associates (Solomon Resource Limited) should take measures and means to ensure compensation for environment damages caused by the wreckage of SAPOR 2302 as claimed by rightful landowners of the above marine site.

Here are necessary recommendations for serious consideration:

- i. For company to undertaking relevant methods of rehabilitation in consultation with the land owners of Nukuma'anu by fully meeting rehabilitation costs((above) including other environment damages cost to fully account for damages done as witnessed and reported in this report.
- ii. By all means ensure monetary compensation are agreed between land owners and company and rightfully paid to the landowners based on the above aggregated damage value (monetary figure) of \$13,498,400.00 (SBD).

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