



# PROPOSED PROJECT

FOR

**Solomon Bauxite Limited**  
(SBL)

**ENVIRONMENTAL IMPACT ASSESSMENT**  
(EIA)

Final Report  
December, 2012

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## I. EXECUTIVE SUMMARY

### OVERVIEW

This is the overview of the environmental impact assessment report has been prepared for the proposed Vaghena Bauxite Project to be located at Vaghena Island, Choiseul Province, in the north western region of the Solomon Islands. See Figure I.1.

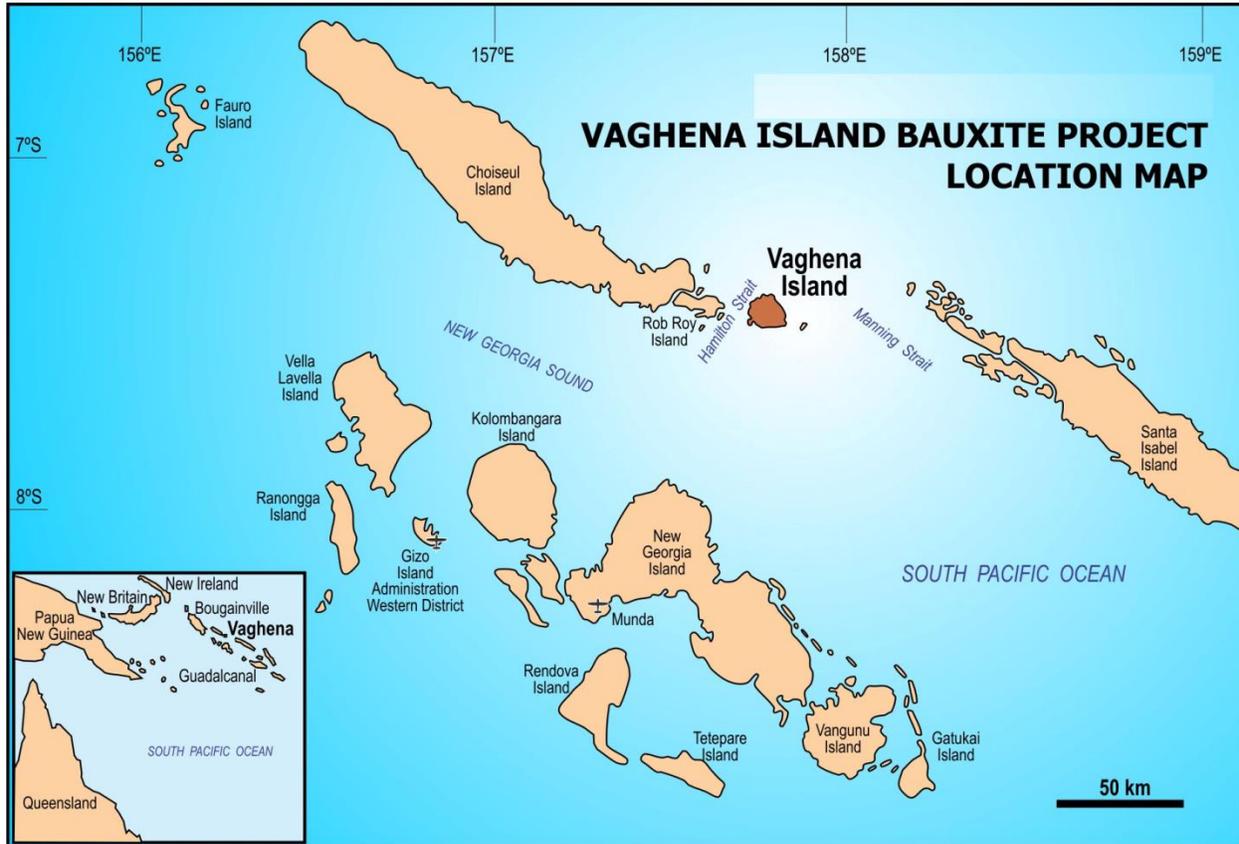


Figure I.1: Regional Map of Solomon Islands Showing the Location of Vaghena Island

The project proponent is a Solomon registered company, Solomon Bauxite Limited (SBL), which currently holds a prospecting license and plans to submit an application for a mining lease for the site. Vaghena is a medium grade bauxite deposit, the development of which will encompass mining, screening and possibly some drying prior to direct shipment to the international market. As a result of an assessment of the bauxite characteristics, the shallow nature of the deposit (1 to 15 metres) and the limited development currently existing on the Island, Vaghena has been chosen as a suitable site to initiate bauxite mining in the Solomon Islands by SBL. Direct shipping of the bauxite ore from the Solomon Islands avoids the need for secondary processing which is the principal cause of the environmental impacts from bauxite mining and processing in other parts of the developing world. In addition, all mining waste and processing rejects, which will be a relatively small volume, up to about 15 percent of the material mined, will be placed into the mined out areas, negating the need for the construction of an out-of-pit waste dumps or tailings dams. No toxic chemicals or reagents will be employed in processing the bauxite. The ore deposit at Vaghena has an area of approximately 16km<sup>2</sup> which by international standards is relatively small whilst the total land area of the Island is 78km<sup>2</sup>. In the Solomon context, the earthworks required to exploit Vaghena are much smaller in volume than

those being undertaken at the Gold Ridge open pit gold mine located on the island of Guadalcanal. The site is also topographically relatively benign being gently dome-shaped and undulating, seldom exceeding 50m above sea level.

### THE DEVELOPMENT

The project is expected to commence production at a rate of about 1.2 Mt (dry) per year and depending on market conditions expand to 2.0 Mt (dry) per year after several years, for an expected mine life of about 20 years. The development will include an open pit mine, bauxite screening and storage facility, a bulk carrier wharf and small boat wharf, and the establishment of other infrastructure to support the project. This infrastructure will include administration offices, a power station, fuel farm, vehicle parking and maintenance areas, warehouse, airstrip and accommodation for about 150 employees; and inclusive of their family the numbers may reach 1000 people. A mobile equipment workshop will be constructed in the vicinity of the mining area.

Prior to the commencement of bauxite mining SBL plans to construct drainage and sediment collection systems, then progressively clear trees and vegetation. Topsoil will be stockpiled and used for rehabilitation. Mining will involve development of mining roads, excavation and trucking of approximately 150 truckloads, each of 35 to 50 tonne pay load of bauxite per day. Mining operations will be undertaken over 16 hours per day, with bauxite mined and trucked from the mining area to the ore ROM pad at the processing facility via a designated 6 kilometre long private haul road to be specifically constructed for the project. Figure I.2 shows the layout of the activities proposed for the development.

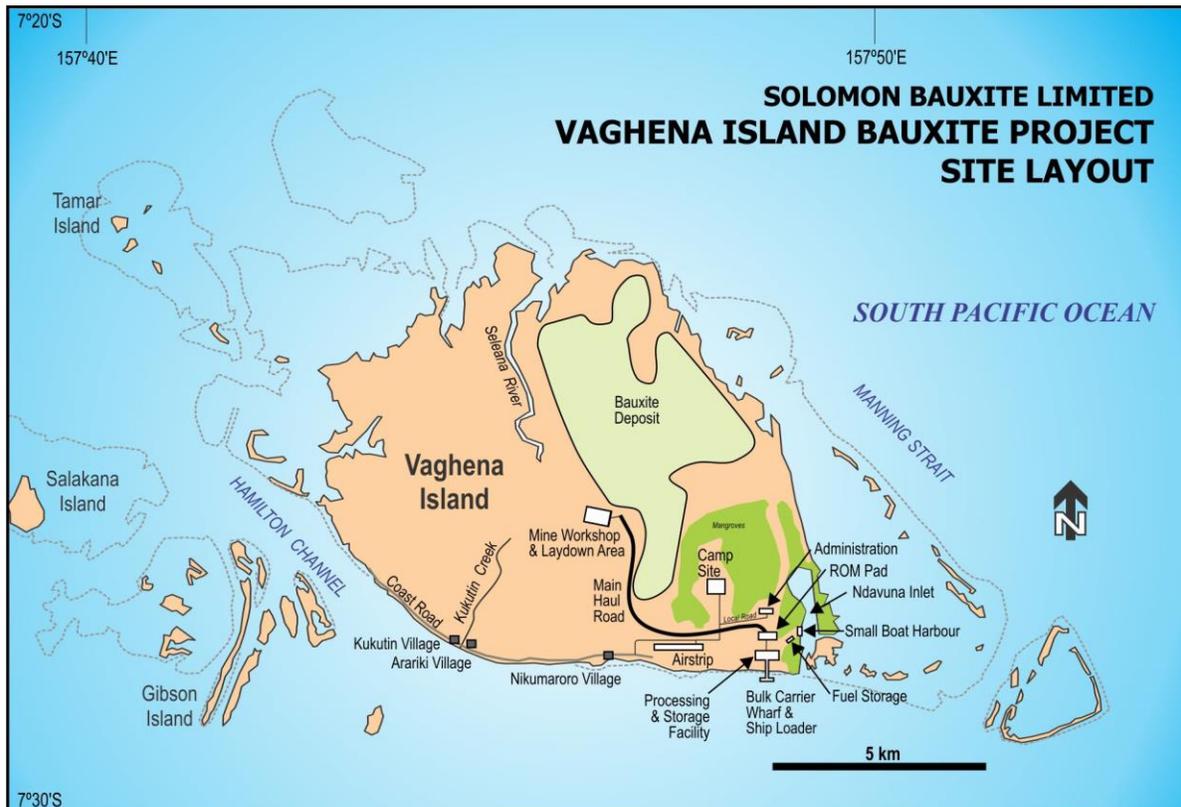


Figure I.2: Site Layout

The bauxite processing will include coarse screening to remove large rocks (typically >0.6m) and vegetation and then conveying to the storage sheds adjacent to the ship loading facility. It is anticipated that screen rejects will be insignificant at 1% to 3 % of the total material mined. In order to achieve the target moisture level, it may be necessary to mechanically roll or compress some of the bauxite containing higher than specification moisture, prior to it being delivered to the storage sheds. Sediment control will be incorporated into the design of the processing facility and storage sheds.

Bauxite product will be stored in two 60,000t capacity storage sheds, with stacking to alternate between the sheds so that one shed is being filled while the other is being emptied. There will be provision for expansion of the screening facility and storage sheds to support higher production levels than the initial annual rate of 1.2 Mtpa of dry product.

SBL will quarry limestone for the construction of roads and it will utilize a bulk carrier wharf to be constructed for the project for the loading of product bauxite for shipment, as well as the delivery of heavy stores.

Utilizing the deep waters on the south coast of Vaghena Island, at the bulk carrier wharf site, SBL will install a telescopic conveyor to enable bulk ships to load product for shipment overseas. Ship loading will occur around the clock whilst ships are berthed, typically taking five to six days per ship. A coastal processes study noted that for the project area at Vaghena there is a generally low energy environment with little movement of shoreline positions or mangrove extents on the southwest, but on the proposed wharf site southeast of Nikumaroro, the coast is quite open to medium and large swells. The study inferred that in order for the proposed wharf development not to have any significant effect on coastal processes it needs to sit on stilts causing free movement of coastal waters with littoral currents velocity of 1-2 knots at maximum<sup>1</sup>. It is intended that the proposed wharf will be constructed on stilts or piles to comply with this analysis.

The mining operation will be undertaken in series of open pits progressively planned and developed on a strip by strip basis, using conventional hydraulic excavator and truck techniques. Rehabilitation of each mined out area will be initiated immediately after the mining is completed for that area; utilizing stripped topsoil, screened oversize and any sub-economic material which will be mined to access the bauxite.

## **SERVICES**

The project will supply its own power through the use of diesel powered generators. Appropriate wastewater treatment will be installed to accommodate the maximum potential demand from the development sites. The development will require potable and ablution water for employees (700-1000 day employees and their families accommodated on site), sewerage systems, vehicle wash down bays, and water for dust suppression. SBL plans to draw water from borefields, local springs and rainwater collection. Water intended for potable uses will be treated to an appropriate standard. SBL will secure waste permits from Department of Environment (DOE) as required under the Environmental Act 2008. SBL will be required to hold permits for disposal of wastewater, solid waste and potentially air emissions over the life of the project. Most of these requirements will be covered under the conditions of the Mining License and apply for the duration of the mining and processing operation. Solid waste management will be a component of the Construction and Operational Environment Management Plans

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<sup>1</sup> CRA Alumina PTY, 1972, & GREENPAC, 2012

and will embody the principles of reduce, reuse, recycle. The plans will also prescribe effective waste disposal methods, safe use of hazardous substances if any, and an on-going employee training program.

### **EXISTING ENVIRONMENT**

The general location of the proposed development is an under developed rural area, with a landscape dominated by prime forest and average tree heights exceeding 10m. The annual rainfall is 3500 to 5000mm per year. The mine and infrastructure sites are currently uninhabited and will undergo significant civil works to suit the project needs. The mine area has relatively gentle and undulating slope and the maximum height rarely exceeds 50m above mean sea level, and a generally underlain by limestone with buried pinnacles. The south and east coasts rise sharply from the sea to heights of up to 25m in some areas, with a limestone low-lying coastal flat developed near sea level on the south coast<sup>2</sup>. The processing facility site is undeveloped and retains the existing vegetation of native forests and fern growth with extensive mangrove vegetation fringing the major marshland that runs from the entire south eastern coastal land to the north. Mangrove vegetation also covers the western coastal fringes of Tembaurua and to the north. At the north of the Island is Vaghena's largest river, the Selena River, which stretches almost 7.5km south into the centre of the Island and also has a dense cover of mangroves along its banks.

The removal of the vegetation on the project site could result in erosion and stormwater sediment transport into the Selena River system. The section of the Selena River which will receive the treated runoff from the mining areas will be kept free of siltation by the construction of settling ponds and strainer systems that will be erected to collect most of the fine sediment before it is discharged. Monitoring will be carried out to assess the degree of suspended sediment in the discharge water at very regular intervals, particularly after heavy rainfall.

The freshwater environment is insignificant compared to larger volcanic islands in the Solomon Islands, since Vaghena only has two freshwater creek systems, one of which is seasonal. As a consequence, the mine poses no significant threat to Kukutin Creek, near Kukutin and Arariki villages on the southwest coast of the Island.

The protected coastal area surrounding the entire southwest and southeast sides of Vaghena is used for coastal fisheries and harvesting of shellfish, crustaceans and as a seaweed plantation. The bulk carrier wharf footprint will result in minimal loss of tidal flat benthic habitat when stilts or piers are erected onto narrow fringing coral reefs. The mooring site is located adjacent to the deeper sandy-bottomed waters at a depth of up to 25m.

The marine survey around the Island found numerous areas or sites of particularly sensitive or vulnerable ecology in particular feeding and breeding sites of reptiles such as crocodiles, mammals such as dugongs, and live corals located around the river and lagoon fringes. Even though they are considered rare or endangered, significant numbers of marine species or communities of conservation significance were found during the assessment. Proper mitigation options to minimize impacts will be conducted with regular monitoring and appropriate solid and liquid waste management procedures will be implemented. Water quality testing in the foreshore area indicated normal conditions for a foreshore area. The low energy environment and hard substrate of the reef/rock platform and shoreline minimizes any potential adverse effects of the proposed bulk carrier wharf on coastal processes.

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<sup>2</sup> CRA Alumina PTY, Limited, 1971

An archaeological survey revealed that there appear to be no sites or records of archaeological significance in and around the project development sites. However, it will be necessary to have a response procedure in place during the construction and operation phase of the development, in the event of potential features of significance being uncovered. The local belief indicated that Vaghena was an island full of evil spirits, thus no one settled there until the I-Kiribati communities first settled the Island in the early 1960s.

The social study identified a sparse local population dominated by ethnic I-Kiribati settlers and their descendants who arrived in the Solomon Islands in 1962 and were resettled by the Government on Vaghena Island. The population derives its livelihood from subsistence farming and fishing. The only source of income for the Islanders is from seaweed harvests resulting in household income that is less than basic needs poverty line for the Solomon Islands. The recent census survey indicated a population of about 1500 living on the Island. Significant numbers of the population have migrated to Honiara and other centres such as Gizo, Rendell and Noro, where they have bought lands and resettled.

## CONSULTATION

The consultation process involved meetings with the following key stakeholders:

- Provincial Council, inhabitants of Vaghena, Lands Commission and Fishery Commission,
- Department of Fisheries and consultation with the Solomon Islands Marine Safety Administration;
- Meetings and interviews with the Department of Lands and;
- Meetings and interviews with neighbouring villages, settlements, households and school located at Arariki and areas of associated infrastructure (processing facility, haul road and service wharf);

While the local stakeholders are, in principle, supportive of the development, a range of concerns were expressed which should be able to be addressed through further consultation with the villagers of Arariki, Kukutin and Nikumaroro. These initial concerns included land tenure, however this has been resolved by the Commissioner of Lands stating legal ownership of the bauxite project site is specifically a perpetual estate with clear demarcation of the entitlements to plots of land by the residents.

Another issue which was raised is the impact of mining on the seaweed crop and fisheries resources. This issue was addressed during a village meeting with GREENPAC personnel in regard to the mitigation options related to siltation ponds, bunding of hazardous liquid and solid chemicals, management of solid and liquid wastes, coupled with recycling of wastewater.

Other issues include the social impact; these were left to the village committee and SBL to design security measures and control of human movements in and around villages. MOUs are to be signed by workers coming to the Island that will allow SBL management to terminate their employment and remove from the Island workers who cause social conflicts with the locals on the Island. No village or households are located near to the development sites; however, the concerns of the villagers were outlined in the minutes of meeting and addressed in the recommendations. In particular, SBL will develop and implement plans for the management of key social issues. These plans are to include:

- a Community Relations Plan (including consultation protocol),
- an HIV/AIDS prevention training program, and
- a Traffic Management Plan.

These plans will enable SBL to better address community concerns, particularly in relation to the conduct of non-local mine workers and the use of the local resources that are within the areas owned or controlled by the villagers.

SBL will employ suitably qualified local residents in preference to non-residents and will purchase local produce and supplies as appropriate for the project. SBL recognises the importance of providing support and assistance to the local community, particularly in the areas of health, education and community infrastructure. In order to ensure that benefits of the project are shared with the local communities and to ensure that funding is directed to areas of greatest need, SBL proposes to implement a regime of support and enhancement to the three village communities on Vaghena Island.

In terms of medical support SBL will assist with the provision of medicines for the local clinic and upgrading of the clinic facility on the Island. Residents will have access to the SBL medical facility and emergency services. To enhance the education of the local children, SBL will provide new classrooms for the high school, scholarships and school materials, whilst in terms of infrastructure, SBL will upgrade the coast road, provide access to the company supermarket and bank branch, wharf and airstrip, whilst also constructing a police post.

### **ASSESSMENT**

The environmental impact assessment process identified potential environmental effects arising from the project including:

- deteriorating water quality as a result of increased sediment in storm water;
- waste water effluents;
- solid waste disposal;
- sourcing off-site materials;
- risk of introduction of invasive species via boat ballast water and the import of site restoration materials;
- sustainability of water supply;
- cyclone and extreme weather issues; and
- the management of hazardous substances.

Potential social effects were also considered including:

- local poverty reduction;
- health and safety for mine workers and the local community;
- traffic and access issues;
- risk of spread of communicable diseases;
- resource use conflicts; and
- community relations including respect for local customs and protocols.

A coastal processes study noted that the proposed foreshore development is unlikely to have any significant effect on coastal processes. The bulk carrier wharf and product stockpile site are also likely to be at low risk of coastal hazards such as coastal erosion or inundation. Access between the wharf, stockpile and mine site will be via the private purpose-constructed project roads. The foreshore and inland tracks are the main rural arteries that already support local personnel movements. There are no public roads or vehicles on the Island. The coast road is currently only used as a walking track. There is a primary and secondary school at Arariki. The development will necessitate the introduction of traffic movements both on land and maritime; the level of activity will be considerable during the construction and operation phase, particularly at shift changes with the potential to cause adverse effects for the existing community. SBL will work with the local community, particularly the Vaghena Provincial Member (PRO), to develop a Traffic Management Plan that addresses the community concerns and introduces public safety measures along the public road and private project roads if villagers tend to

wander into these roads. SBL employees and contractors, apart from local residents, will be prohibited from entering the seaweed plantations for recreation or any other purpose.

If the Vaghena Bauxite Project proceeds as described, and in line with the recommendations outlined in this report, it will not result in any significant adverse environmental impact. While the mine and process plant sites will be fully rehabilitated at the conclusion of the project, the haul road, airstrip and wharves will become permanent features. Rather than being a negative residual impact they will be gifted to the Solomon Islands Government or community, as appropriate, for public use on completion of SBL's bauxite production activities on Vaghena; and, hence the residual impacts of the development will be on the whole positive.

## **RECOMMENDATIONS**

### **Land-based Construction**

It is recommended that:

1. All structural design conforms to the Solomon Islands National Building Code or another higher standard approved by the Department of Town and Country Planning;
2. There are no discharges of untreated runoff water from work sites directly to waterways or the foreshore;
3. Storm water runoff from all sites is managed to minimise sediment-laden water being discharged to the proposed sediment collection ponds which will be constructed on the low-lying coastal area adjacent to where the bauxite mining and processing operations are carried out. The final design specifications for the sediment ponds at the mine site and process facility are to be submitted to DOE, Lands Department and Mines Department for approval;
4. Solid waste is managed appropriately in accordance with the requirements of a solid waste permit from DOE;
5. Hazardous wastes are handled according to 'best practice' guidelines and only by trained personnel. All such substances to be stored more than 30 metres away from waterways and the foreshore area, behind bunds and shaded from direct sunlight;
6. The mine site is rapidly re-vegetated as mining areas are completed according to the rehabilitation plan so as to minimise exposed soil and erosion;
7. A protocol is introduced to stop work and get advice from the Solomon Islands Museum if archaeological sites or remains are discovered.

### **Construction of Foreshore Structures**

It is recommended that:

8. A coastal engineer confirms that the design for the bulk carrier wharf is structurally sound and that the planned use of local rock from the quarry for its construction is suitable;
9. The design and construction method for the bulk carrier wharf minimises disturbance into the mudflats;
10. Culverts are installed in the haul road to facilitate and control rainstorm flows;

11. Sediment control measures during the road construction and bulk carrier wharf follow best practice, including:
  - i) Minimising the exposure of unfinished surfaces to erosive runoffs and wave action by limiting working faces to 25m of exposed surface at any one time,
  - ii) Protecting working faces in the fastest possible time by the immediate placement of geotextile and armouring,
  - iii) Containing any generated suspended sediment with silt curtains/fences when necessary;
12. Construction equipment be kept in good order and its time in the foreshore area is kept at a minimum so as to minimise the leakage of fuel and oil;
13. No fuel, oil or grease to be stored, and no fuelling or servicing to be undertaken within 30 metres of the marine area and that spill kits be made readily available.

### **Mine Operation**

It is recommended that:

14. Measures are taken to prevent spills in the mining area, along the haul road and from the fuel farm at the mobile fleet service facility including staff training, bunding the fuel tanks, safe fuelling procedures and emergency procedures and equipment;
15. To reduce dust and spillage, water sprays are to be used on the haul road during dry periods, and dried bauxite product to be stored in covered facilities;
16. Boat traffic is limited to slow speeds to minimise erosive wakes in the vicinity off ringing reefs and low-lying coasts;
17. Navigational beacons be placed on reefs close to the bulk carrier wharf route and vessel anchorage; and
18. SBL will train its own operators and other barge and maritime vessel operators to comply with International Maritime Organization (IMO) guidelines for ballast water management.

### **Traffic**

It is recommended that:

19. Signs and appropriate safety features be erected to indicate the start and end of the haul route and any other road or traffic areas;
20. Haul roads are to be well maintained and kept clear of any spillage caused by the movement of mine or other vehicles;
21. The base operating hours for the mine and haul road cartage of bauxite are limited to 6.00 am to 10.00 pm Monday to Saturday. Work on Sundays will be undertaken for maintenance and from time to time to overcome production shortfalls caused by weather, machinery breakdown, etc. Mine and haul road night works (10.00pm to 6.00am) will be limited to rectification and maintenance. Screening, drying and ship loading of bauxite will take place up to 24 hours per day, seven days per week. Any

variations to these hours and scope of work will only be undertaken after consultation with the Vaghena community;

22. SBL is to ensure that the policy for the transport of materials to and from development and production sites contains strict criteria to control: noisy vehicles, possible loss of loads or spillage, operating outside approved hours, exhaust emissions not meeting Solomon Islands emission standards, and speeding or unsafe use of vehicles. SBL shall demonstrate to the satisfaction of DOE, that these provisions are in place prior to the commencement of bauxite production haulage;

23. A shipping Management Plan is prepared in consultation with the Maritime Authorities which demonstrates how maritime movements will be managed to minimise impacts of spillage, collision and shipwreck. The plan is to be submitted to DOE, for approval prior to commencement of ship loading;

24. SBL to provide road safety training to the workers, locals and students of the local school prior to the commencement of the construction phase and on an annual basis, or as required, thereafter.

### **Off-site Materials**

It is recommended that:

25. All materials imported to the development are approved and meet environmental and quarantine standards.

### **Services**

It is recommended that:

26. SBL secure waste permits from DOE, as required under the Solomon Islands Environment Act (Waste Disposal and Recycling) of 2008 and Regulations of 2010. The required permits will be for wastewater, solid waste and potentially for air emissions.

27. SBL to provide DOE and the Director of Mines with details of an assured and adequate water supply from the water sources and confirmation that use of the water will not affect the freshwater environment or water supply to others prior to receiving development approval.

### **Social Effects**

It is recommended that:

28. SBL's hiring, contracting and purchasing policy prioritizes employment and contracting of suitably-qualified employees and contractors from the Solomon Islands with preference given to local suitably qualified personnel.

29. SBL's hiring policy includes strict requirements in relation to the payment of legal award wages to employees, that no differential wages to be paid between men and women for work of equal value, and that there is no use of child labour for construction or operational activities;

30. SBL protects employees and public safety through: adequate signage and security at all project work sites, adequate health care facilities and training at all work sites, providing employees with personal protective equipment, and ensuring that there are safe and clean facilities including sanitation and drinking water easily accessible for all employees as required under OHS regulations;

31. SBL consults with the Gizo and Honiara Health Centre, Red Cross and UNAIDs to determine the best way to develop and deliver an STD and HIV/AIDS awareness training program to employees and local

communities in the Vaghena area. SBL to implement the training program as soon as possible and to include it as part of the induction of any new employees; and

32. SBL to develop and implement a Community Relations Plan which sets out requirements for employees' behaviour in the local area and a complaints procedure. The plan will also establish a communication protocol between the project and the local community and villages.

### **Environmental Management and Monitoring Programme**

It is recommended that:

33. SBL is required to prepare a Construction Environmental Management Plan (CEMP). The plan is to include all recommended content and all recommendations in relation to the construction phase of the development included in this EIS report. No project construction work should be undertaken until the CEMP is approved or provisionally approved by DOE.

34. SBL is to prepare an Operational Environmental Management Plan (OEMP) which does not duplicate the CEMP but includes all recommendations in relation to the mining and processing operation in this EIS report. The OEMP should be approved by DOE prior to the commencement of mining and processing;

35. In addition, the CEMP and OEMP will refer to plans that will developed for the management of key social issues, these plans are: Community Relations Plan (including consultation protocol), HIV/AIDS prevention training program, and Traffic Management Plan;

36. SBL will submit a regular monitoring report for the CEMP and OEMP to DOE.

37. Monitoring of progress with rehabilitation at the mine site and of maintenance status of the haul road and bulk carrier wharf is to be included in the OEMP reports.

## II INTRODUCTION

Solomon Bauxite Limited (SBL) a Solomon Islands registered company that currently holds Prospecting Licence PL-73/11 for the purposes of exploring and assessing bauxite deposits on Vaghena Island in the Western Region of the Solomon Islands in Choiseul Province. This document is the report of a study entitled: “Environmental Impact Assessment Report of Proposed Bauxite Mining Project, Vaghena Island, and Choiseul Province, Solomon Islands”. The purpose of the assessment is to characterise the existing environment and identify potential adverse environmental effects of the proposed project as well as opportunities to avoid, remedy or mitigate these adverse effects. The EIS is a summary document and is supported by the technical reports that are attached and ongoing studies. This EIS is solely for the evaluation of the exploitation of the Vaghena Island bauxite resource and the necessary ancillary infrastructure required for the ore to be mined, processed and shipped overseas. No other site or activities are included or assessed within this EIS.

### THE PROPONENT

The company was formed in 1997, under the registered name of Contractors South Pacific (SI) Limited and subsequently incorporated under the new name of Solomon Bauxite Limited (SBL) on 16<sup>th</sup> of July 2008.

SBL is currently owned in equal shares by its three Directors, namely:

- Keith Edward Garland Douglas
- Reginald Keith Garland Douglas
- Efstratis Kirmos

SBL has entered a Memorandum of Understanding with Southwest Pacific Bauxite Pty Limited with the objective that the two companies will jointly develop and exploit bauxite opportunities, including those on Vaghena Island. The parties have engaged Breakaway Mining Services Pty Limited to provide technical support for the assessment phase of the Vaghena Island Bauxite Project.

SBL is based in Honiara with contact details as follows:

Solomon Bauxite Limited  
Dalgro Compound  
Burns Creek  
Honiara, Solomon Islands  
677 39394/38341

### PROJECT SUMMARY

The bauxite ore deposit on Vaghena Island covers an area of approximately 16km<sup>2</sup>. The total land area of the Island is about 78km<sup>2</sup>. The deposit is flat lying and very shallow, typically 1 to 7 metres thick, with an average thickness of 3 metres. The overburden (soil) thickness is about 0.3 metre. There is approximately 28 million tonnes of bauxite ore available for extraction. The ore has a high moisture content of about 35% which results in a run of mine (ROM) ore tonnage of about 38 million tonnes. The project is expected to commence production at a rate of about 1.6 Mt (wet) per year and, depending on market conditions, expand to 2.7Mt (wet) per year after several years for an expected mine life of about 20years. Mining will be with conventional hydraulic excavator and truck techniques, hauling to a processing facility on the southeast side of the Island. Processing will involve screening and a limited amount of drying prior to shipping to offshore markets.

The project is quite unusual in as much as the mining overburden, internal waste and processing rejects, will be a relatively small volume, up to a maximum of 15 percent of the total material mined. This non-economic material will be placed into the mined-out areas as part of the rehabilitation process, negating the need for the construction of an out-of-pit waste dump or tailings dams. No toxic chemicals or reagents will be employed in processing the bauxite on the Island.

The project will be designed and operated to minimize the sediment discharge to the environment through the diversion of rainfall around active mining and processing areas, and settling or straining of sediment laden water prior to discharge.

### PROJECT LOCATION

Vaghena Island lies seven degrees south of the equator and lies between the large islands of Choiseul and Santa Isabel. See Figure II.1. Vaghena Island can be accessed by plane from Honiara to Kapau Airstrip, Choiseul Province (currently twice a week). From Kaghaus it takes about 45 - 60 minutes by boat to travel to Vaghena Island. SBL is proposing to construct an airstrip and develop port facilities on the Island which will provide significantly enhanced transport links to the Island.

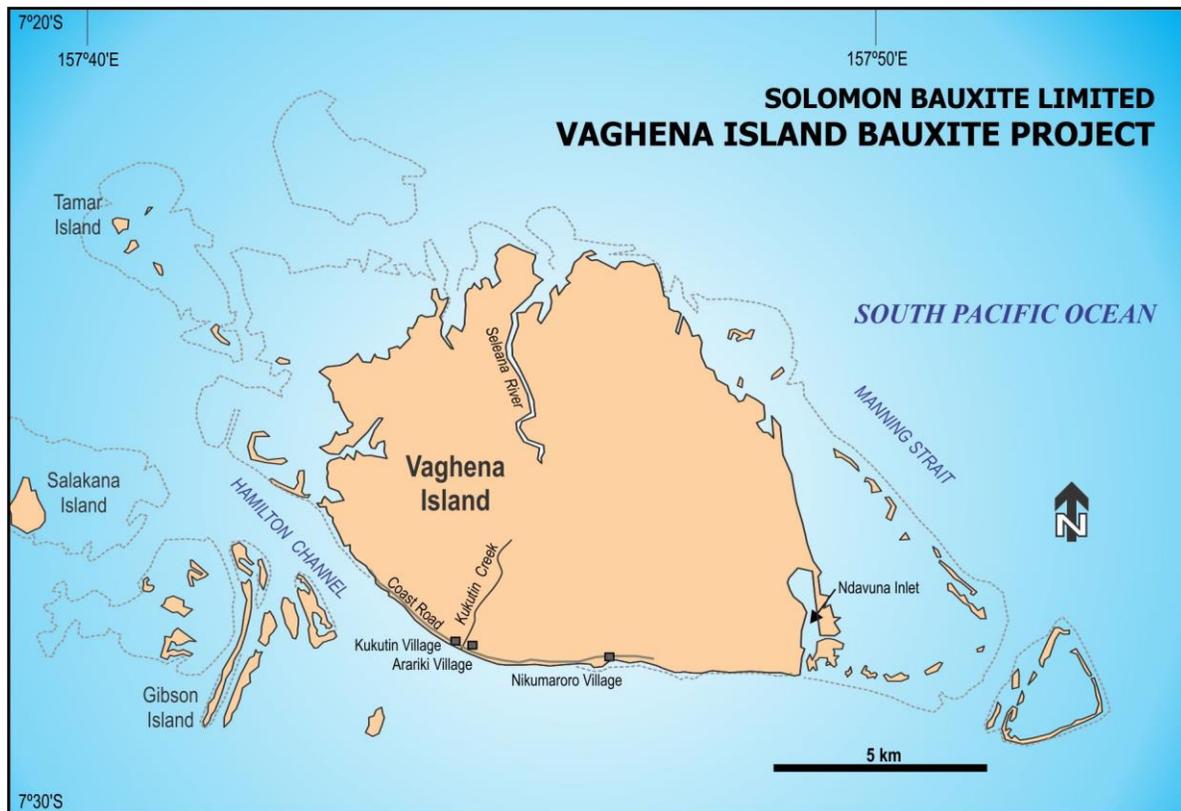


Figure II.1: Regional Map of Solomon Islands Showing the Location of Vaghena Island

The general location of the proposed project is an undeveloped and sparsely populated island, with a landscape dominated by largely unlogged forest with average tree heights exceeding 10m. The annual rainfall is 3500 to 5000mm. The mine and infrastructure sites are uninhabited. The project area has relatively gentle and undulating slopes with maximum heights rarely exceeding 50m above mean sea

level. The south and east coasts rise sharply from the sea to heights of up to 25m in some areas, with a limestone low-lying coastal flat developed near sea level on the south coast.

The 2009 population census indicates that the population of Vaghena Island may exceed 1500 people, (refer to Table 3.3 below) most of whom are distributed among the three villages of Kukutin (about 700), Arariki (about 500) and Nikumaroro (about 400). However, other studies have shown that there are more than two thousand residents on Vaghena. The inhabitants are ethnic Kiribati (Micronesians), who were relocated, to the Solomon Islands from the islands of Orona (Hull Island) and Nikumaroro (Gardener Island) in the early 1960s. The location of these villages and other geographical features is shown in Figure II.2.



**Figure II.2: Map of Vaghena Island showing location of Villages and Geographical Features**

The villagers live in traditional houses made from local materials. The village vegetable gardens are located on the south coast and for a short distance inland. Coconut plantations are located in the villages and on nearby islands. Fish, turtles and coconuts are the staple diet. The north coast areas are deserted, visited only by Choiseul and Santa Isabel people, mainly for fishing, logging and shell gathering.

It is recognized that there are concerns to be addressed with the residents of the villages who derive their livelihood from subsistence farming and fishing on and around the Island. These villages are Arariki, Kukutin and Nikumaroro, which is the closest village to the project site. Concerns relate to an influx of people and environmental harm.

Seaweed farming is the major revenue activity for the residents of Vaghena Island. They have expressed their concern about possible detrimental effects of bauxite mining, such as sediment run-off into the coastal waters, which would negatively impact on their income and well-being.

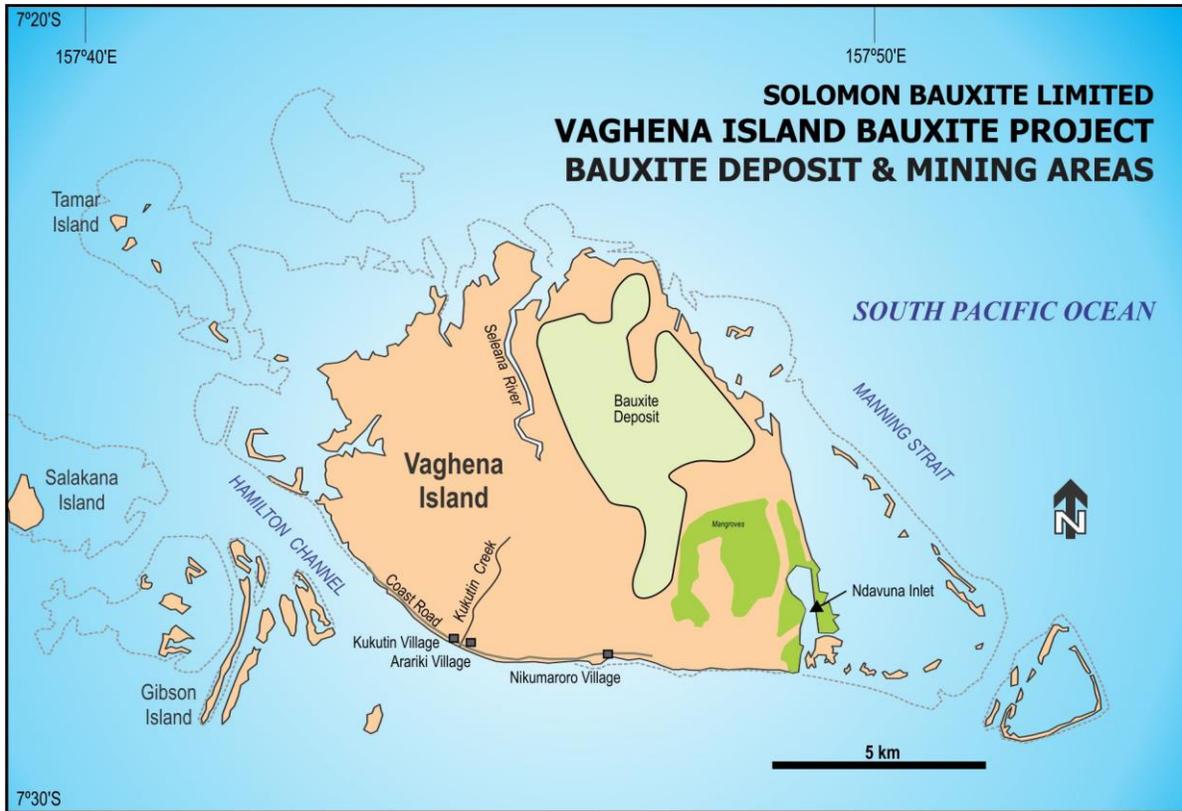
There are no villages or significant settlements located within 1km of the boundary of the proposed major mining activities or processing facilities. However, the proposed airstrip and small sections of the bauxite deposit are adjacent to Nikumaroro Village boundary. The main haul road will be located at least 500m from the nearest existing residence.

SBL will employ suitably qualified local residents in preference to non-residents and will purchase local produce and supplies as appropriate for the project. SBL recognises the importance of providing support and assistance to the local community, particularly in the areas of health, education and community infrastructure. In order to ensure that benefits of the project are shared with the local communities and to ensure that funding is directed to areas of greatest need, SBL proposes to implement a regime of support and enhancement to the three village communities on Vaghena Island.

SBL will develop and implement plans for the management of key local issues. These plans will include:

- A Community Relations Plan (including consultation protocol)
- An HIV/AIDS Prevention Training Program; and
- A Traffic Management Plan.

The bauxite deposit occupies the eastern side of the Island, particularly the northeast. The outline of the deposit is shown on Figure II.3. Most of the area within the deposit boundaries will be disturbed by mining activities and will subsequently be rehabilitated. On average, the rehabilitated areas will be 3m lower than the pre-mining surface, this being the average thickness of bauxite to be mined.



**Figure II.3: Location of Vaghena Bauxite Project Deposit**

The bauxite processing, product storage, ship loading facility, camp and associated infrastructure will be located on the south-eastern side of the Island. The proposed layout of these facilities is shown on Figure II.4. Project activities will be designed to minimize damage to or destruction of mangroves.

SBL will design, construct and operate the project to high workplace safety standards, ensuring that employee safety is the number one consideration in all design and operational considerations.

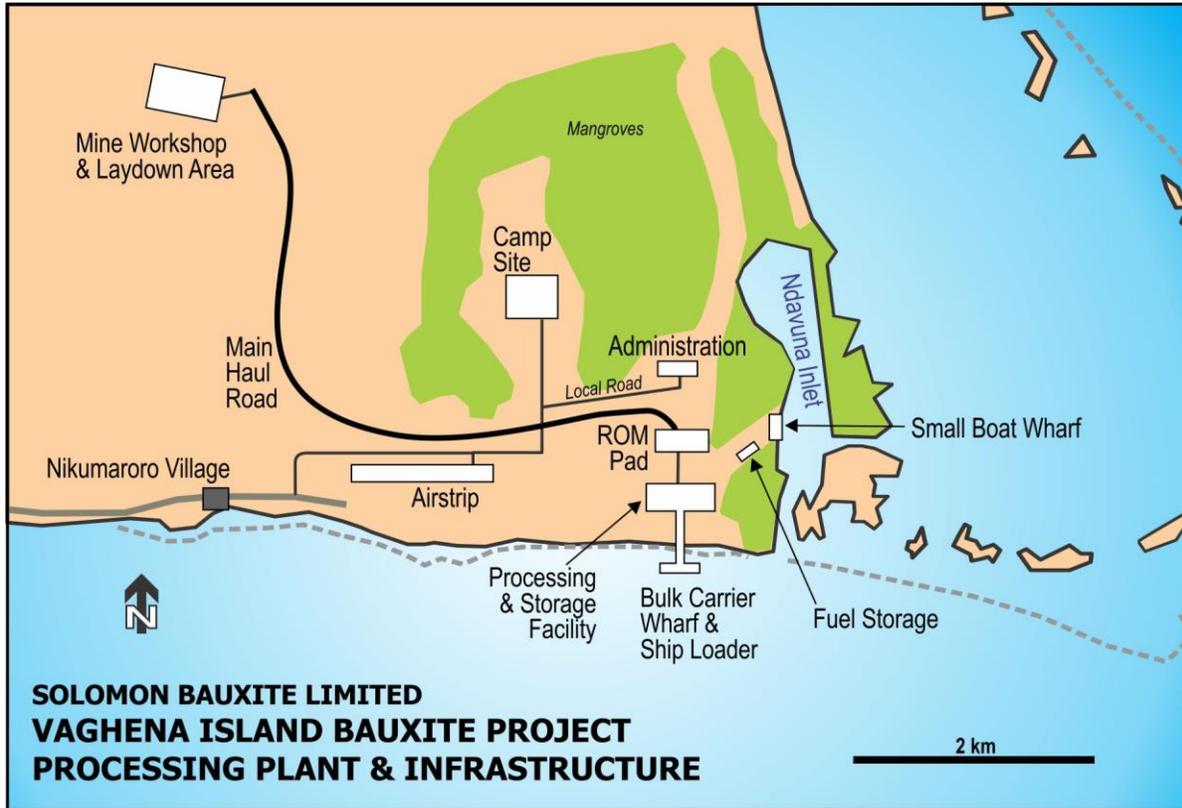
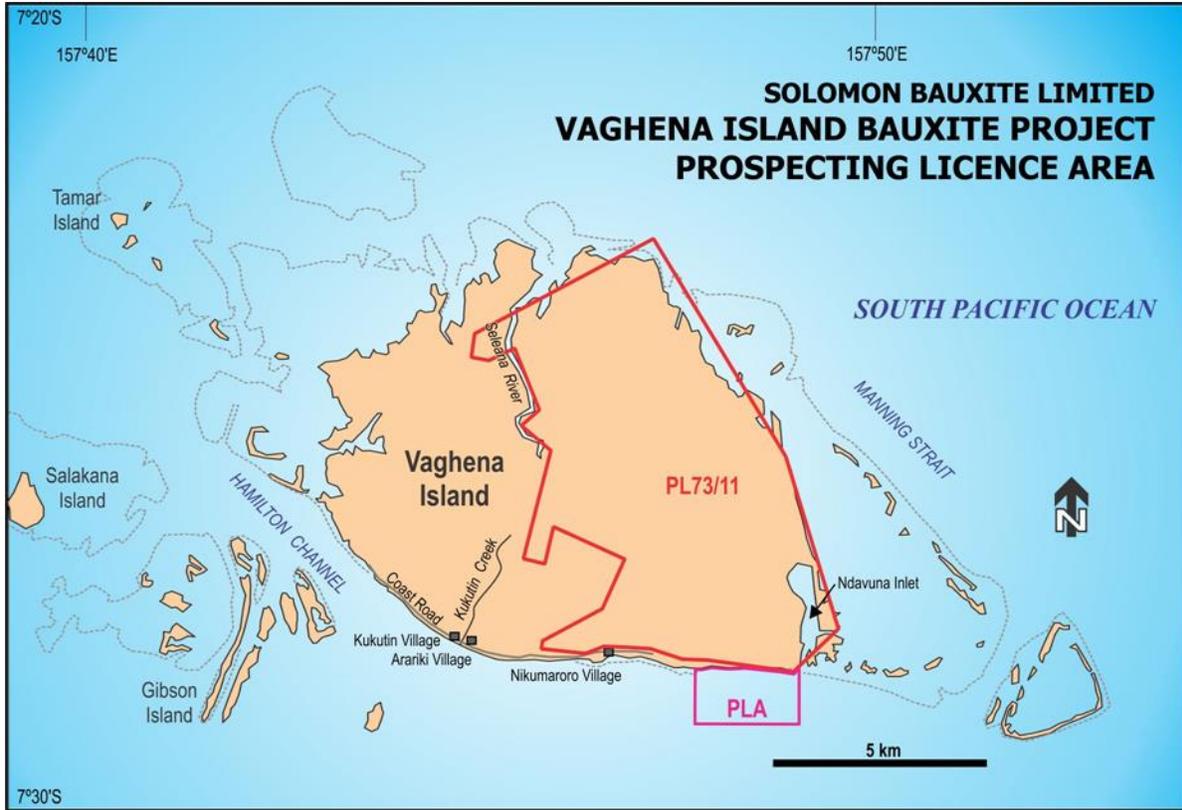


Figure II.4: Project Infrastructure on Southeast of the Island.

**TENURE**

The land tenure system for Vaghena Island is Crown land which means that the land is owned by the Central Government and administered by the Commissioner of Lands. Some Crown land is leased to the local residents as perpetual estates. On 9<sup>th</sup> March 2011 SBL was granted a Prospecting Licence, PL-73/11, for a three-year term over the main bauxite resource on Vaghena Island. The total area of the Prospecting Licence is about 48km<sup>2</sup>. An application for a further 3.4km<sup>2</sup> has been made to cover the coastline and offshore area for the bulk carrier wharf facility and mooring points. See Figure II.5.



**Figure II.5: Prospecting Licence and Prospecting Licence Application Boundaries on the Island.**

The parcels of land leased to the local residents, also called private land, are located along the south coast and further inland in the south-central part of the Island. Any private land, such as along the south coast of the Island, is excluded from the Prospecting Licence. Private land tenure boundaries are shown on Figure II.6

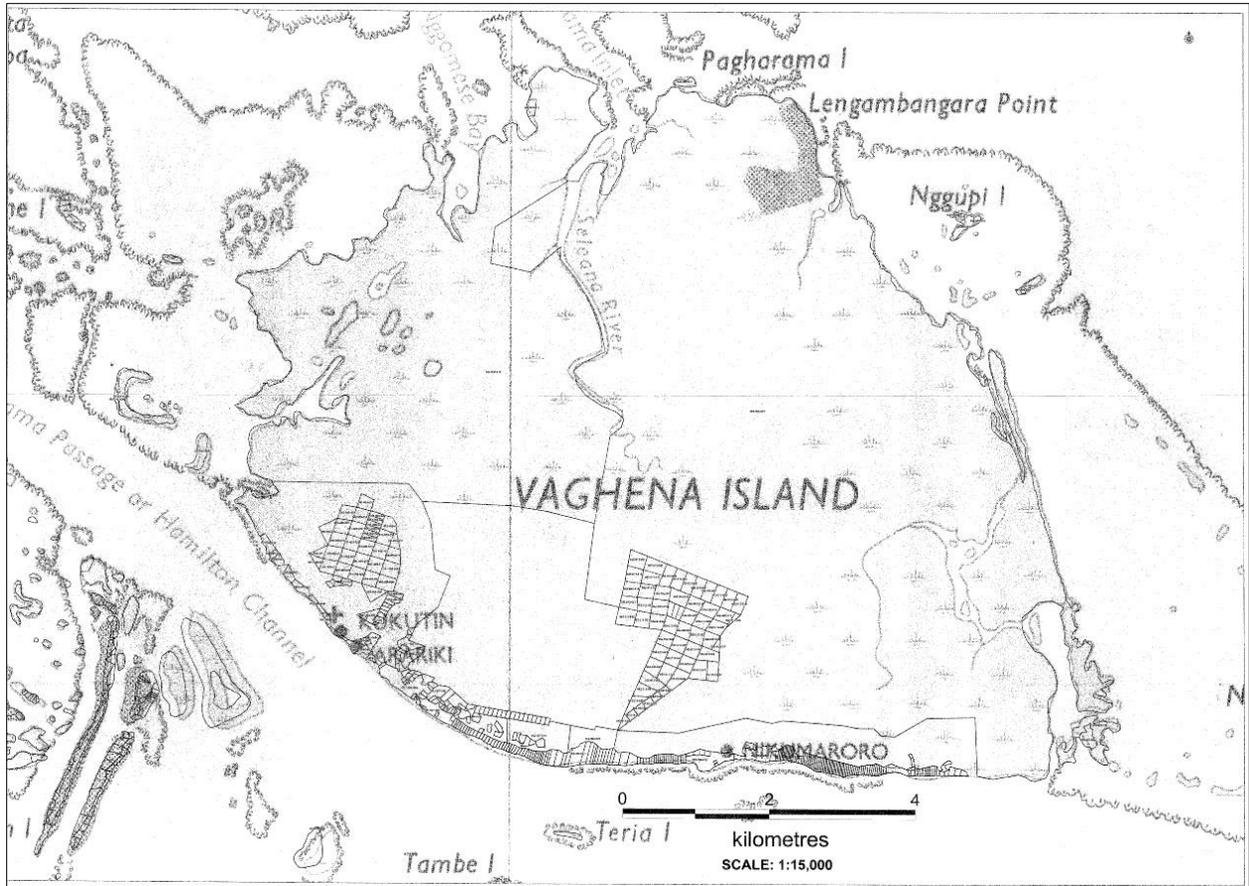


Figure II.6: Private Land Ownership Boundaries on Vaghena Island.

### III. PROJECT DESCRIPTION

#### (i) Project Overview

The project proponent is the Solomon registered company, Solomon Bauxite Limited (SBL), which plans to apply for a mining lease for the mining, processing and exporting of bauxite on Vaghena Island. The project is known as the Vaghena Bauxite Project.

SBL will begin developing mining, processing, storage, ship loading, accommodation facilities and associated infrastructure once the environmental documentation and procedures have been agreed in a Development Consent, mining and project engineering plans have been finalized, consultation has been undertaken and permits have been granted by the Choiseul Province, consultation and social issues have been addressed with local residents and a Mining Licence has been granted by the Solomon Islands Government. SBL plans to ship bauxite directly to International markets after reducing moisture content to a level which is appropriate for safe ocean transport and is confident of achieving a sustainable commercial outcome. The proposed Vaghena Island development layout is shown in Figure III.1

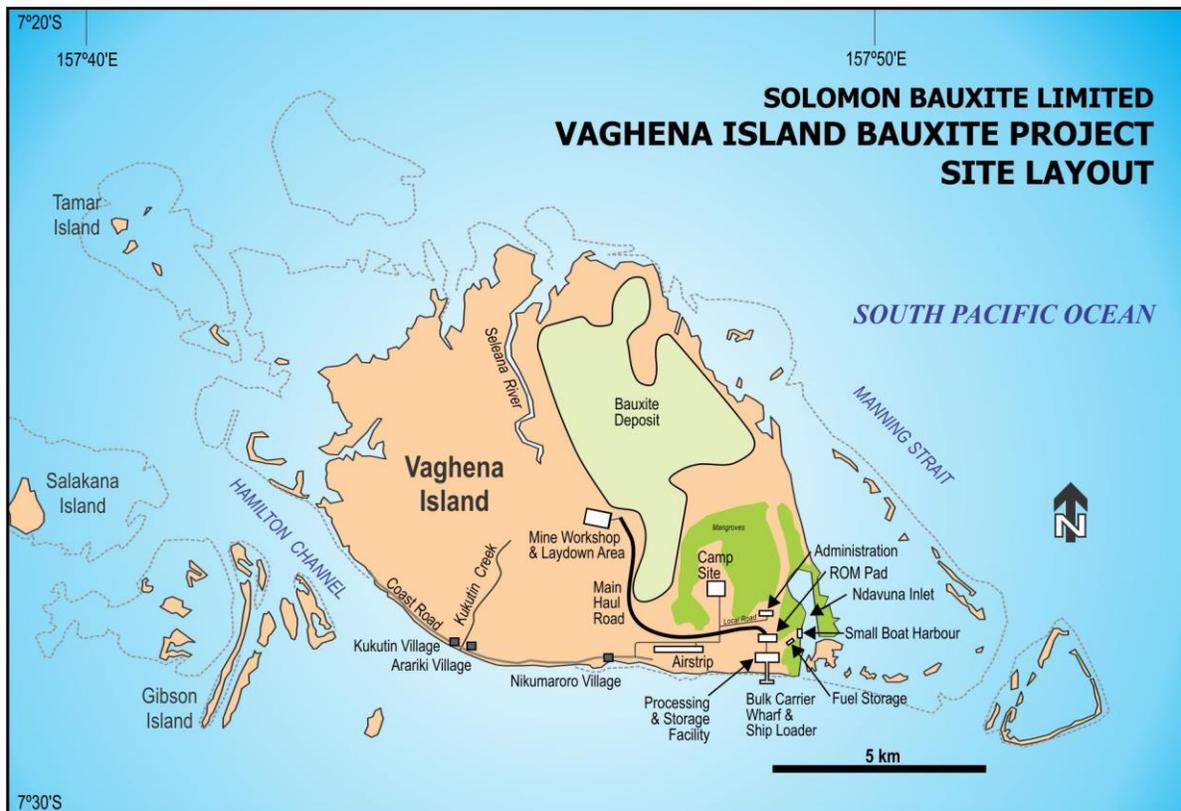


Figure III.1: Site Layout

The Vaghena Bauxite Project will initially be designed and constructed for a production rate of 1.2Mtpa (dry) of bauxite, a rate which it is anticipated will be achieved after mine and plant commissioning is complete. Depending on market factors and operational circumstances, it is planned to lift production to around 2.0Mtpa (dry) of bauxite within several years of reaching the 1.2Mtpa level. The anticipated project life is about 16 to 20 years, depending on market conditions and product demand.

The project can be divided into four key components or areas of activity, namely; mining and haulage; processing and storage; ship loading; and ancillary activities including camp and accommodation, power generation, water supply, airstrip, etc. Each of these activities is described below:

- **Mining and Haulage**

A conventional shallow open pit mine plan is proposed involving construction of main haul roads to access the mining areas, progressively develop secondary panel roads for bauxite extraction and then the actual mining of a series of open pits to the base of the economic bauxite, which generally coincides with a limestone basement. The flat-lying bauxite deposit has an average thickness of 3m and is overlain by a layer of overburden/topsoil, which is typically 0.3m thick. The limits of the currently defined bauxite deposit which is also the proposed mining area is shown in Figure III.2.

Prior to mining, in-pit drainage and sediment dams will be constructed, undergrowth and small trees will be cleared and large trees will be felled. The humus rich soil will be stripped using bulldozers and all soil and vegetable matter will be stockpiled or returned directly to mine out areas as part of a planned and sequential rehabilitation process.

Where possible, mining will be from high ground to low ground. This approach will assist with maintaining effective drainage and water control in the high rainfall environment that can result in wet and sticky operating conditions and minimising traffic on the bauxite which has poor bearing strength characteristics. The design of the mine haul roads is shown in Figure III.3.



Figure III.2: Bauxite Deposit and Mining Area

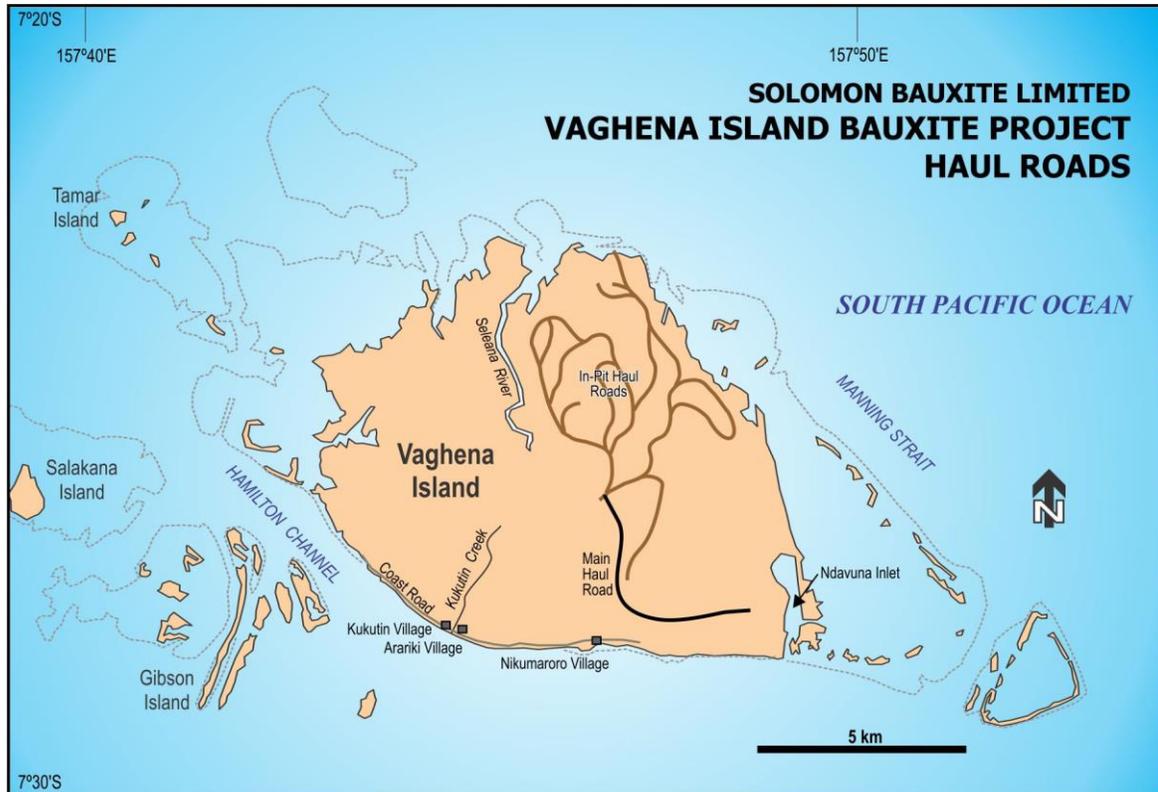


Figure III.3: Mine Haul Road Layout

The prime mining fleet will be hydraulic excavators and rear dump trucks. The hydraulic excavators will advance from the extremities of the deposit to the main haul roads along the top of the bauxite, loading directly into haul trucks which will travel across the levelled mined out pit floor. Where necessary, limestone pinnacles within the bauxite will be removed to simplify mining and to reduce the number of pinnacles which will remain proud of the rehabilitated landform. In areas where the bauxite is thicker than about 7.5 m, a second pass excavator will mine the deeper material, which may be located amongst limestone pinnacles, either loading directly into trucks or stockpiling material for later loading and haulage.

The proposed mining method is shown in Figure III.4. The rear dump trucks will transport the bauxite some six kilometres, via an out of pit haul road, to the run of mine (ROM) pad at the processing facility.

As sections or strips of bauxite are mined out, these areas will be utilised for the placement of uneconomic bauxite, screening rejects, overburden, and newly mined topsoil. They will then be contoured and re-vegetated. As the average bauxite thickness is about 3m, the final landform will be about 3m lower than the pre-mining landform.

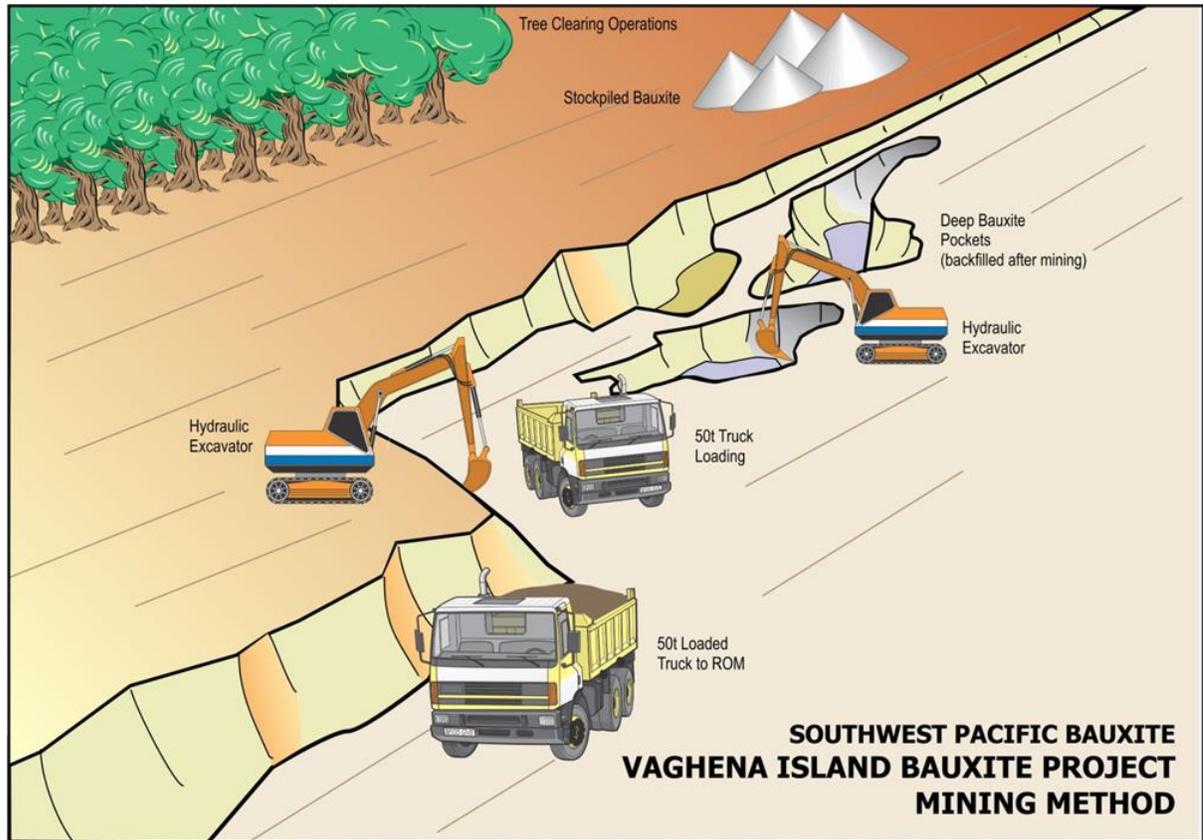


Figure III.4: Proposed Mining Method

Additional mining fleet will be required and additional mining areas will be opened up to meet the expanded 2.0Mtpa production scenario.

- Processing and Storage**

The bauxite processing will commence with reclaim of the newly mined bauxite by front end loader on the ROM pad, which will feed the bauxite into a bin from which it will undergo coarse screening to remove large rocks (typically >0.6m) and vegetation, followed possibly by finer screening and then conveying to the storage sheds adjacent to the ship loading facility. It is anticipated that screen rejects will be insignificant at 1% to 3% of the total material mined. In order to achieve the target moisture level, it may be necessary to mechanically roll or compress some of the bauxite containing higher than specification moisture, prior to it being delivered to the storage sheds. A covered hardstand area will be developed adjacent to the screening plant for drying. An assessment of the optimum moisture level for shipment is continuing. Screen rejects will be back hauled to the mined-out pit areas for placement in the rehabilitation program. The process plant conceptual layout is shown in Figure III.5.

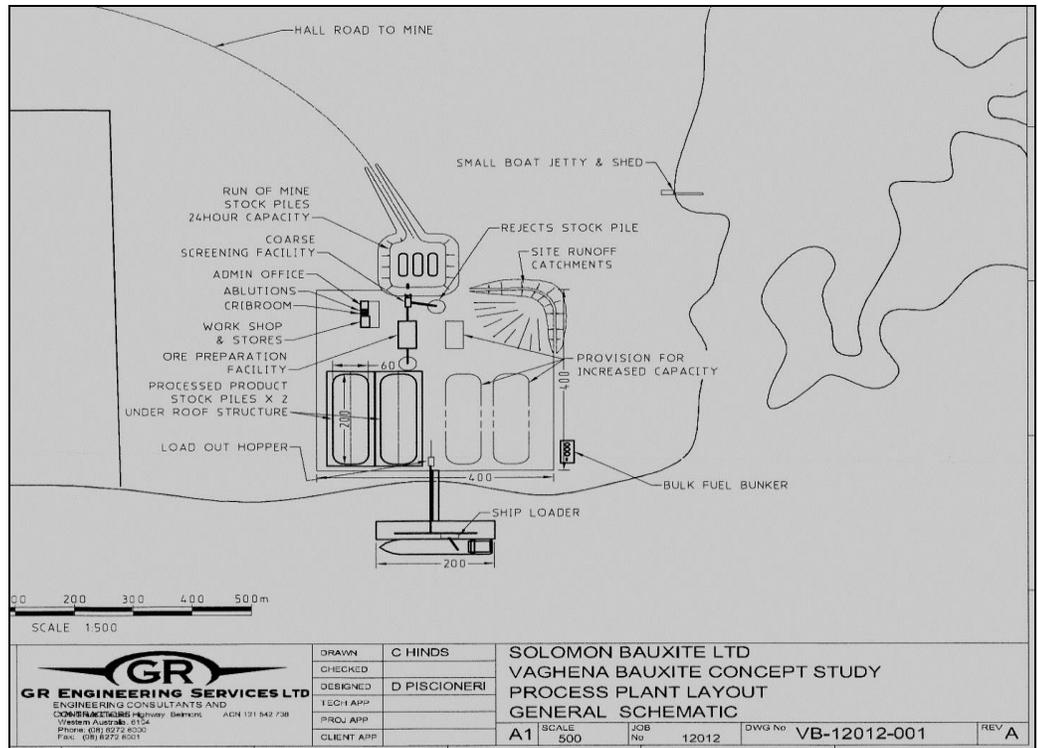


Figure III.5: Process Plant Conceptual Layout

Bauxite product will be stored in two 60,000 t capacity storage sheds, with stacking to alternate between the sheds so that one shed is being filled while the other is being emptied. There will be provision for expansion of the screening facility and storage sheds to support higher production levels than the initial annual rate of 1.2 Mtpa of dry product.

Detailed process design is yet to be completed; however, a processing engineering firm has been engaged to undertake the process plant design to feasibility study level.

- **Ship Loading**

Bulk carrier ships, planned to be around 60,000 tonne (Panamax size) capacity will dock at a purpose built wharf on the southeast coast of Vaghena Island, approximately every two weeks. Loading of ships will commence with reclaim from the bauxite product storage sheds by front end loader which will feed the bauxite directly into a hopper, from which the bauxite product will be drawn and conveyed onto the shiploader conveyor for delivery into the ship’s cargo hold. The shiploader will be designed to ensure that minimum spillage is created and so that dust generation is minimized. It is planned that each ship will take about five to six days to load. As the bauxite moisture level is currently planned to be around 27%, each 60,000 tonne ship will carry about 47,250 tonnes of bauxite. On this basis around 25 ship movements per year will be required at the 1.2Mtpa rate and about 42 movements at the 2.0Mtpa rate.

- **Ancillary Activities**

A camp and accommodation facility will be constructed on the south eastern end of the Island. The facility will be divided into two camps, namely a management and professionals’ facility and an operators and labourers facility. It is envisaged that the management and professionals’ facility will have around 15 self-contained rooms, as well as a wet and dry mess. The operators’

accommodation will be dormitory style for about 100 to 150 personnel with associated ablutions and washing facilities. It is anticipated that cooking and messing facilities will be provided by third parties, in accordance with hygiene principles approved by SBL. Employees who reside in the SBL facility will work on a roster basis, typically 14 days on, seven days off, whilst local employees will be required to work a five day week on a rotating roster basis to support continuous production operations. It is anticipated that employees and their families could total up to 1000 persons, including Vaghena Island residents who are employed by SBL and their families. The site layout is shown on Figure III.6

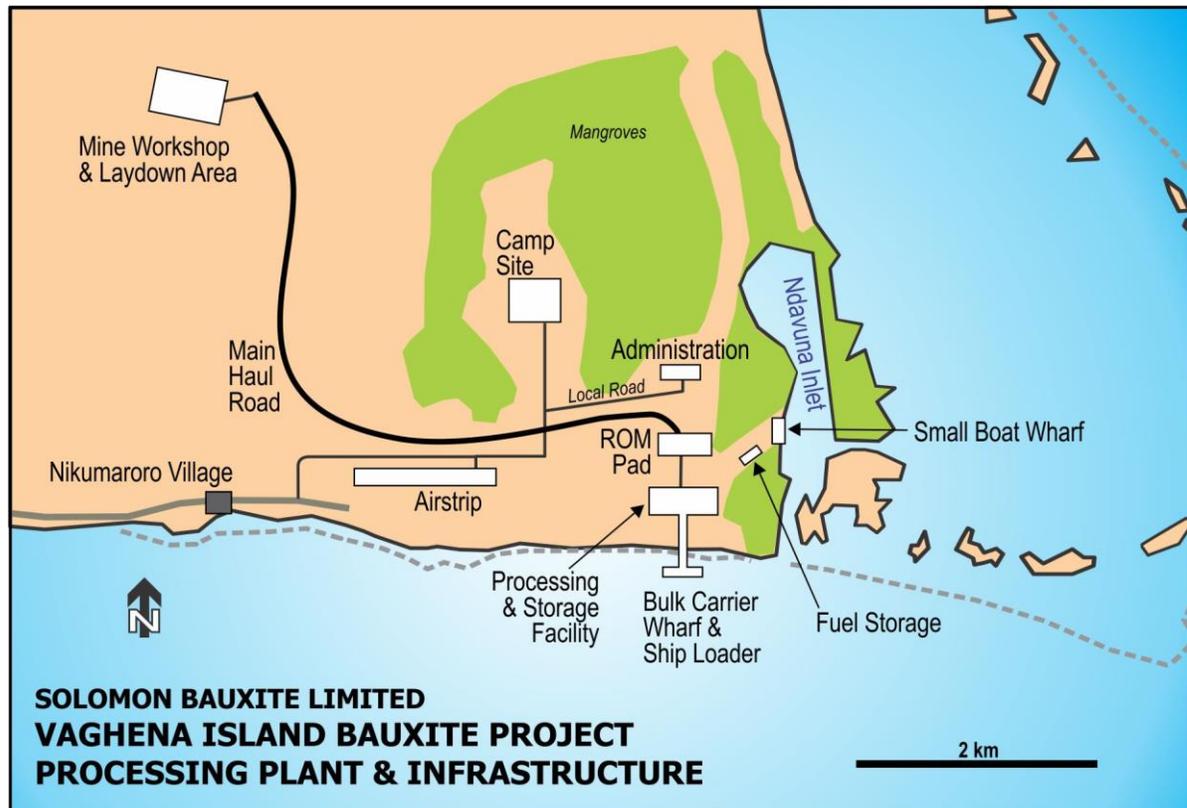


Figure III.6: Process Plant & Infrastructure Layout

The development will supply its own electric power through the use of diesel generators, with one system for the process plant and associated infrastructure, with remote generators elsewhere to meet local power requirements. The genset capacities and fuel consumption will be determined as parts of the feasibility study once the electrical drives and requirements have been finalised. The site power demand will be quite small as the bauxite will undergo limited treatment, with no requirement for crushing or grinding of the ore. Power for the bauxite processing facility, and other site infrastructure will be transmitted by overhead transmission lines or buried cables<sup>3</sup>.

The development will require potable and ablution water for employees (700-1000 day employees and their families accommodated at any time on site), process water, sewerage systems, vehicle wash down bays, and water cart. SBL plans to draw this water from a borefield and/or local springs. Water intended for potable uses will be treated to an appropriate standard. Water from surface water storage dams and

<sup>3</sup> Technical Report: SPB, 2012pg-24.

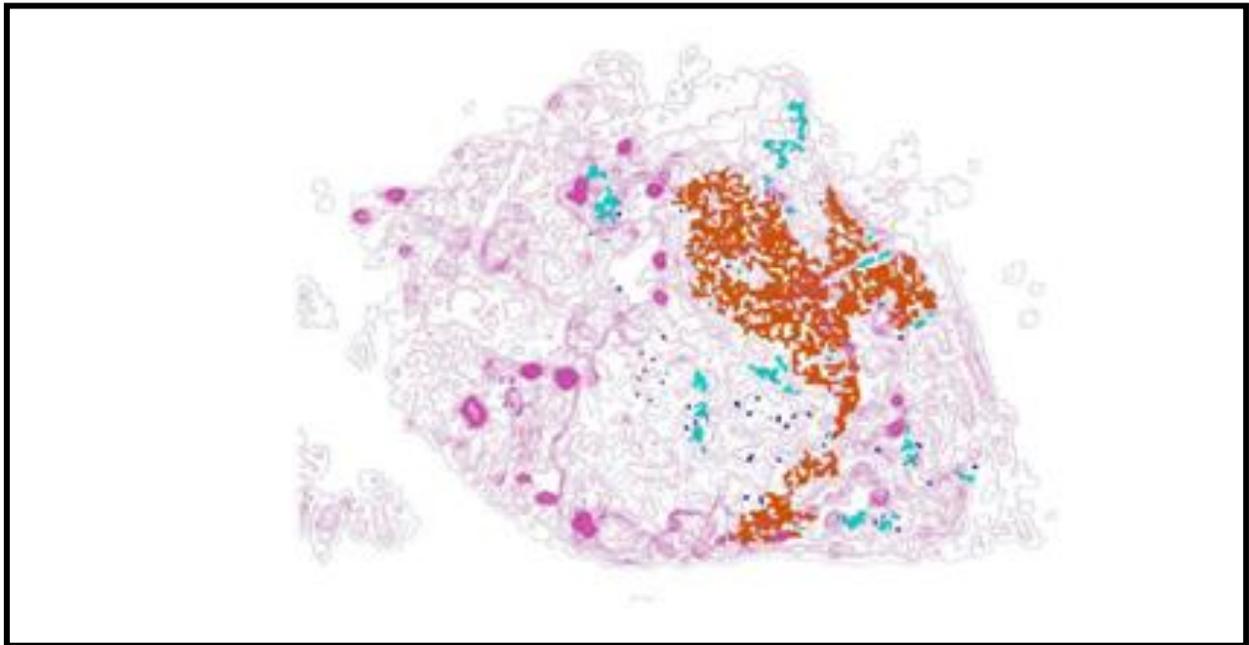
rainwater collection will also provide a source of good quality water, as annual rainfall is high at 3500 to 5000mm per year.

A 1000m long airstrip capable of handling Twin Otter aircraft will be constructed near the southern shore of the Island.

Vaghena Island will be the first site in the Solomon Islands where bauxite mining will be undertaken and direct shipping of the ore from the Solomon Islands will avoid the need for downstream processing which has been the principal cause of significant environmental impacts from bauxite mining and processing activities experienced in other developing countries. In addition, all mining waste and processing rejects, which will be a relatively small volume, about 15 percent of the material mined, will be placed into the mined out areas, negating the need for the construction of an out-of-pit waste dump or tailings dams. No dangerous or toxic chemicals or reagents will be employed in processing the bauxite. Vaghena is a medium grade bauxite deposit, the development of which will encompass mining, screening and possibly drying before shipment directly to the international market. The bauxite ore at Vaghena is a shallow (1 to 14 metres deep), flat-lying deposit, with typically 0.3m of overburden, and covers an area of approximately 16km<sup>2</sup> which is relatively small by bauxite deposit standards, but significant in the Vaghena Island context, as the Island has a total land area of around 78km<sup>2</sup>. In the Solomon Islands context, the earthworks required to exploit the Vaghena deposit will be much smaller than those undertaken at the Gold Ridge open cut mine located on the island of Guadalcanal. The site also has a relatively benign topography, being gently dome-shaped and undulating.

**(ii) Location Criteria (including constraints)**

Vaghena Island lies 7 degrees south of the equator, in the north-western region of the Solomon Islands and southeast of Choiseul Island. The major deposit of bauxite is located on the eastern side of Vaghena Island, a raised coral reef with a summit elevation rarely exceeding 50m above sea level (Figure III.7).



**Figure III.7: Topographic Map of Vaghena Island and the Bauxite Deposit on the Island**

### (iii) Land Tenure System

The land tenure system for Vaghena Island is Crown land which means that the land is owned by the Central Government and administered by the Commissioner of Lands. Some Crown land is leased to the local residents as perpetual estates. On 9<sup>th</sup> March 2011 SBL was granted a Prospecting Licence, PL-73/11, for a three-year term over the main bauxite resource on Vaghena Island, with the aim of undertaking further assessment and ultimately development of a viable bauxite mining and export operation on the Island. SBL also has a Surface Access Agreement with the Commissioner of Lands, granting access to undertake exploration activities in the area of the Prospecting Licence and for so long as the Prospecting Licence remains in force. The total area of the Prospecting Licence is about 48km<sup>2</sup>. An application for a further 3.4km<sup>2</sup> has been made to cover the coastline and offshore area for the bulk carrier wharf facility and mooring points. See Figure II.5.

The parcels of land leased to the local residents, also called private land, are located along the south coast and further inland in the south central part of the Island. Any private land, such as along the south coast of the Island is excluded from the Prospecting Licence.

In due course, SBL plans to submit an application for a Mining Licence with the same as, or similar boundaries to, the Prospecting Licence.

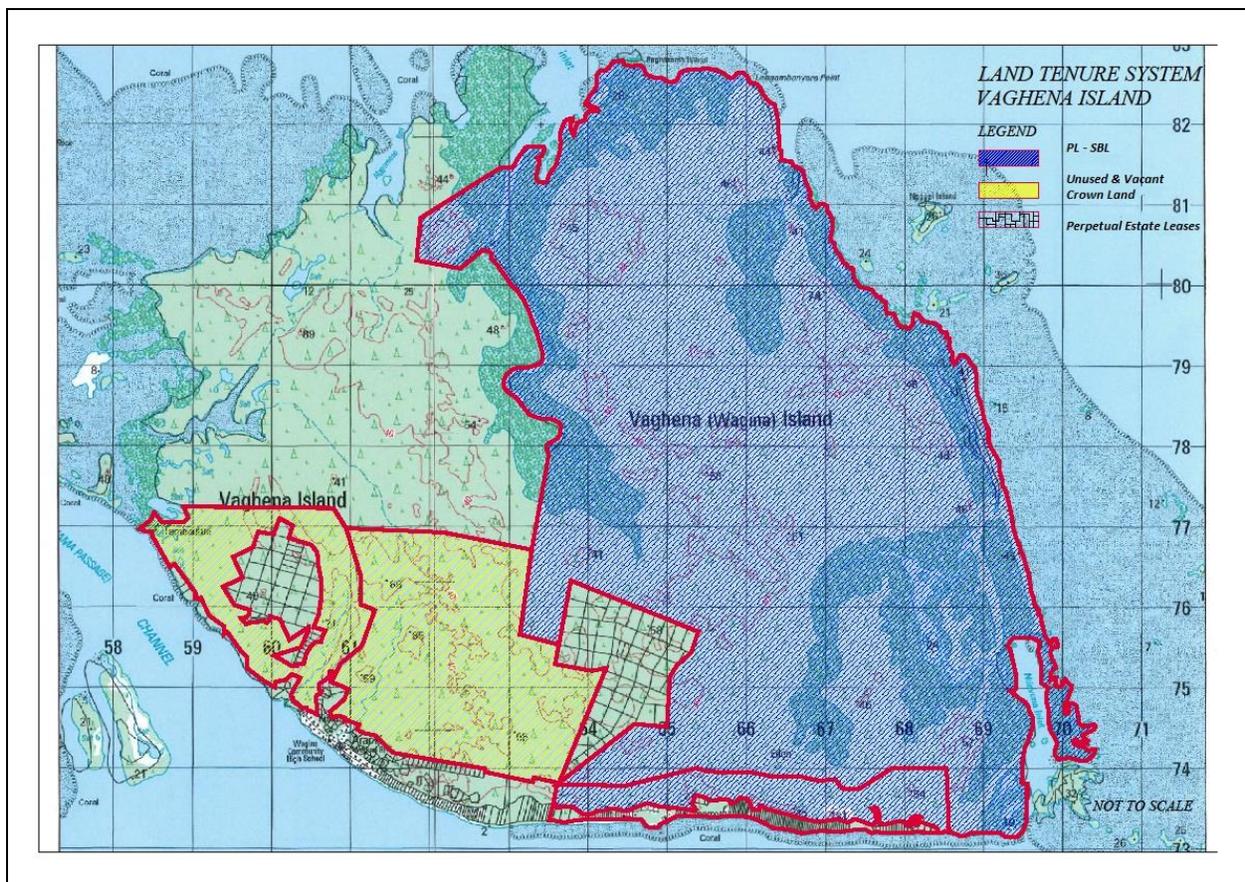


Figure III.8: Land Tenure System on Vaghena.

In Figure III.8 above, the area shaded in blue as PL-SBL represents the land area that is covered by SBL's prospecting license PL-73/11 for the purpose of prospecting for bauxite. SBL also holds a surface access

agreement that allows SBL to access the land. The land shaded yellow represents unused and vacant Crown lands. The remaining hatched shading represent islands belonging to local residents listed as perpetual estates.

**(iv) Area of Land for Development and Current Land Use**

The land area for the proposed development is covered in largely virgin forests, except for areas where the locals have logged timber for their housing, boats and household items such furniture and beds etc. The land where the bauxite is predominantly located covers an area of about 16km<sup>2</sup>. The total land area of Vaghena Island is about 78km<sup>2</sup> which means that the bauxite deposit represents about 20.5% of the Island's surface land area. The supporting mining and processing infrastructure will constitute a further 4km<sup>2</sup>. The population is scattered along the southern and south western coast of Vaghena Island. Nikumaroro Village is located at about the centre of the south coast, whilst Kukutin and Arariki Villages are located towards the south western corner of the island.

In Figure III.9 below, Vaghena Island represents the easternmost and largest island in the chain of hundreds of islands and islets that fringe the south eastern side of the large Choiseul Island and marks the western side of the deep Manning Strait that separates the Choiseul group from Anarvon and the larger Santa Isabel Island further south east (see Figure II.1). Vaghena Island is a fertile island that supports a population of about 1,500 to 2,000 residents, most of whom rely solely on a subsistence farming and fishing livelihood to sustain their daily life.

Based on recent observations, most of the Vaghena Islanders tend to concentrate much of their productive time at sea, farming and harvesting seaweed, which has become one of the Solomon Island's more economically lucrative seafood exports and is sold into the Asian markets.

A few Islanders tend limited agriculture plots cultivating cassava, yams and bananas on fertile flatland adjoining gentle rolling hills that are lined with coconut plantations.

The various habitats and relevant land /sea usage is illustrated photographically in Figure III.9 and described in Table (iii) below:

Item	Location/Settlement	Type of Land/Sea Usage	Habitat
A	West coast of Seleana River-Former residence of Vaghena Island I-Kiribati Settlers	Cultivated fruit trees, root crops and introduced trees and flowering plants	Low-lying coastal
B	Entrance to Seleana River	-	Mangrove forest
C	Upstream of Seleana River	-	Mangrove forest
D	Teraba west cove	Cultivated seaweed farms	Sandy tidal flat
E	Teraba forest	Pristine forest	Inner forest
F	Teraba forests	-	
G	Upper Nikumaroro	Subsistence farming and seaweed	High coastal hill
H	Nikumaroro Village	Subsistence and commercial farming	Low lying coastal
I	Kukutin land allotment	Subsistence and commercial farming	Plateau
J	Arariki Village	Subsistence and commercial farming	Low-lying coastal
K	Kukutin marina entrance	Subsistence and commercial farming	Kukutin River mouth
L	Tembaurua Village	Subsistence and commercial farming	Coastal flat

**Table (iii) Habitat and Type of Land/Sea Usage on Vaghena.**

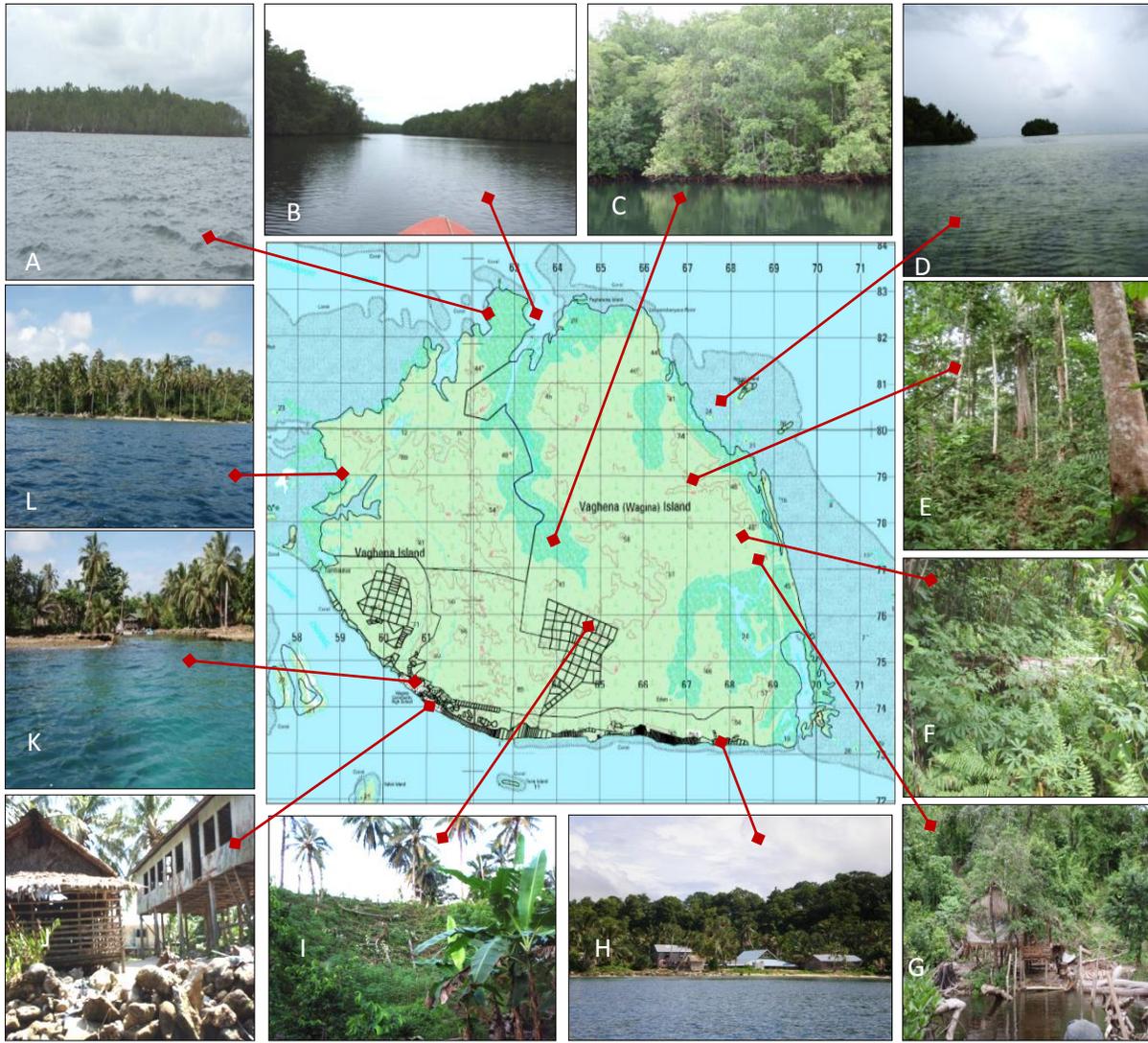


Figure III.9: Existing Environmental Surrounding and Land Use System on Vaghena.

**(v) Administration**

The Solomon Islands is a young democratic nation that has undergone rapid economic and political development over the last 20 years. Its main political and economic headquarters is based in the capital Honiara, located on the island of Guadalcanal. It is a constitutional monarchy with a democratically elected parliament. The government is led by a Prime Minister. The head of state is Queen Elizabeth II, with the Governor General as her local representative. The country is divided into ten administrative areas, nine provinces and the capital city Honiara. Vaghena Island is within the Province of Choiseul. All Central Government Departments e.g. Geological Survey, Marine, Labour, etc. are headquartered in Honiara.

**(vi) Regional Planning/Consultation**

To date, the Vaghena Bauxite Project consultation process has involved meetings with the following stakeholders:

- Choiseul Provincial Council, inhabitants of Vaghena Island, Lands and Fishery Commission,
- Department of Fisheries and consultation with the Solomon Islands Maritime Safety Administration;
- Meetings and interviews with neighbouring village elders and communities of Kukutin, Arariki and Nikumaroro.

While the local stakeholders are in principle supportive of the development, a range of concerns have been expressed which will be addressed through further consultation with the villagers of Arariki, Kukutin and Nikumaroro.

#### **(vii) Services**

Gizo Island in the Western Province is relatively close to Vaghena Island and contains key infrastructure such as a hospital, schools, telecommunications, airstrip, and a business centre, as well as markets. Nearer to Vaghena Island, a small airstrip at Kaghau Island provides transportation for people to and from the Choiseul Province, its associated smaller districts and also to Honiara. Local shipping services visit the island twice in a month, transporting people and delivering cargoes such as processed foods, fuel, medicines and building materials.

#### **(viii) Health care**

On Vaghena Island, a health station which is funded by the Government provides health services free of charge to the community. Most villages and settlements in the area have an allocated 'community health worker' who volunteers to receive training in basic health care so that he or she can in turn provide this service to the community. Emergencies are usually transferred to the main hospital in the provincial town of Gizo.

#### **(ix) Access and Transportation**

The location of the mine site will be approximately 6 km from the processing facility and the shipping wharf. Personnel access between the two sites will be by light vehicle, bus or mine truck along a private road which will be constructed and used by SBL trucks to haul bauxite to the processing facility and for SBL personnel to travel between the two operating areas (Figure III.1). Travel between the villages and the mine administration area adjacent to the process facility will be by vehicle or foot along the coast road, or possibly by boat.

Access to the site for the local villagers will be limited only to workers prior to the commencement of their shifts, with access to and from site to be closely monitored by security personnel. It is planned to upgrade the coast road linking Kukutin, Arariki and Nikumaroro settlements to improve workers ability to travel to and from work when the project is under construction and fully operational.

#### **(x) Communication**

Currently, there is limited mobile phone reception on the Island with mobile phone communications signals best in the vicinity of three main villages. As the project is developed, it is anticipated that telecommunications on the Island will be expanded and have a greater coverage at least over the project areas and population centres on the Island.

#### **(xi) Waste Management**

Solid waste management will be a component of the Construction and Operation Environment Management Plans and will embody the principles of reduce, reuse and recycle. The plans will also prescribe effective waste disposal methods, safe use of hazardous substances if any and an ongoing staff

training program. Appropriate waste water treatment will be installed to accommodate the maximum potential demand from the development sites.

**(xii) Area of Rehabilitation**

No areas outside the boundaries of the site will be subject to rehabilitation, as all project activities will be kept within the approved project area, except for any community projects such as road upgrades and school construction, which will be undertaken in consultation with the relevant community and clearly won't be the subject of rehabilitation. The bulk carrier wharf facility and the small boat wharf will remain available for service on the completion of the project for the benefit of the local community. These wharf projects will involve minimal earthworks and hence minimal ongoing impact on coastal areas and the seawater/land interface.

## 1.0 DESCRIPTION OF EXSISTING ENVIRONMENT

This section provides the baseline environmental (biophysical) and socio-economic context against which the potential impacts from the proposed bauxite mining project will be assessed. Where relevant, the baseline methodologies are detailed along with the findings of the study.

### 1.1 PHYSICAL ENVIRONMENT

#### 1.1.1 Geomorphology and Geology

Vaghena Island has a total area of approximately 78km<sup>2</sup> and together with its surrounding small islands and sand cays, is situated approximately 18km east of the Vealaviru or Rob Roy Island. These islands form a discontinuous chain south-east of the northwest-southeast trending, elongate island of Choiseul.

Voza Lavas form the oldest geological unit and are only exposed on the eastern part of Rob Roy Island. Here they differ from the Voza Lavas seen elsewhere on Choiseul and consist of ferruginous, mottled rock, dark brown and grey basalts; they are brecciated, veined with quartz and, in places, sheared<sup>4</sup> (see Plate 1.1.1).



**Plate 1.1.1: South Side of Rob Roy Island Shows Intact Forests that Extend Uninterrupted onto the Shore.**

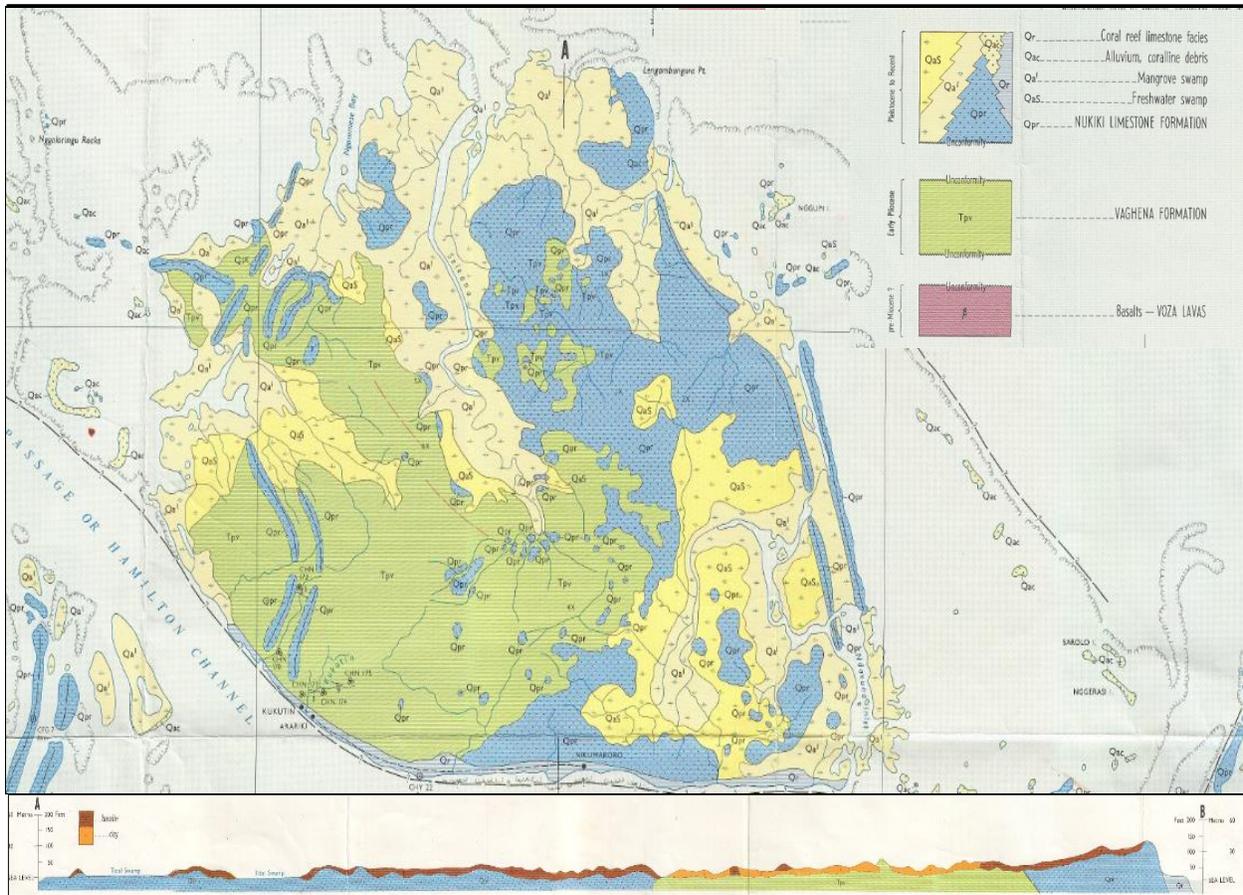
The land and marine environment progressing from the southwest side of Rob Roy Island to Vaghena Island, contains a largely pristine flora and fauna distribution pattern on these lagoonal islands. The terrestrial flora amalgamates with coastal vegetation to form an array of special and high quality habitat for marine and terrestrial fauna. The quality of the environment can be confirmed by the observation of seabirds mingling with terrestrial birds, deep sea fish, including bonitos, observed travelling through

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<sup>4</sup>West. K.N., CRA 1972.pg 8

heavily vegetated aquatic environments (see Plate 1.1.1). This distribution pattern stretches as far as Vaghena Island, where it is only interrupted when it reaches Manning Strait.

Vaghena Island is typically of low topographic relief with a maximum height of approximately 50m above mean sea level (MSL), apart from a few isolated higher points. The south and east coasts rise sharply to a height of about 24m above the MSL whilst the north and west coasts form a limestone terrace or platform that rises less than 12m above the MSL. The north and west coasts are fringed with mangrove vegetation at the base of a limestone ridge (refer to Figure 1.1.1 below).



**Figure 1.1.1: Geological Map of Vaghena Island with Cross Section from North to South (source: Geological Survey, 1979).**

The north and west coasts are only about 0.2m above MSL in the areas where mangrove vegetation fringes most of the coastal areas. In referring to the cross section of the Island in Figure 1.1.1, the tidal swamp on the north coast is at the same level as the mean high water mark (MHW). The coastline on the south rises initially slightly over 0.1m above MHW and becomes steeper than the western and northern coastlines with the clear formation of a raised coastline or escarpment which gets steeper to the west in the vicinity of Nikumaroro Village. The largest tidal river system is the Seleana River and it is the only major drainage system on the Island. It is fed by numerous small streams. The only other fresh water creek is near Kukutin Village. It has a small catchment and is not able to sustain the larger populations of Arariki and Nikumaroro.

### 1.1.2 Landforms

The predominant rock types which are exposed on Vaghena Island are tertiary sedimentary rocks. These outcrop over much of western Vaghena, and also on Rob Roy Island where they have a faulted contact with the older Voza Lavas (refer to Figure 1.1.1 above). There are two land forms or zones that are recognized within the Vaghena geology which are:

- Karst (limestone) areas; and
- Normal drainage (mudstone) areas

The karst terrain is developed where limestone occurs at the base forming the underlying rock strata and occurs mostly in the northeast of the Island in a narrow zone extending to the south coast. The area has an undulating surface which is thickly mantled with residual soil ridges, small rises and scree (outcrop) areas. The ridges of limestone tend to be narrow and elongate with steep sides and patches of soil and scree on the slopes (see Plate 1.1.2 below). The slope is steep and represents the topography of the east coastlines.



**Plate 1.1.2: Patches of Soil and Scree on the Eastern Ridge of Vaghena Island (insert is a small farming camp)**

Over extensive areas of the central and western part of the Island, the underlying rock comprises mudstone. Topography is markedly undulating with relatively steep small rounded hills, mostly mantled with residual soil and narrow valleys with drainage channels in the mudstone. Apart from the principal

headwater streams of the Selena River, drainage is sluggish. Near sea level these areas are low lying and swampy<sup>5</sup> (refer to Figure 1.1.2).

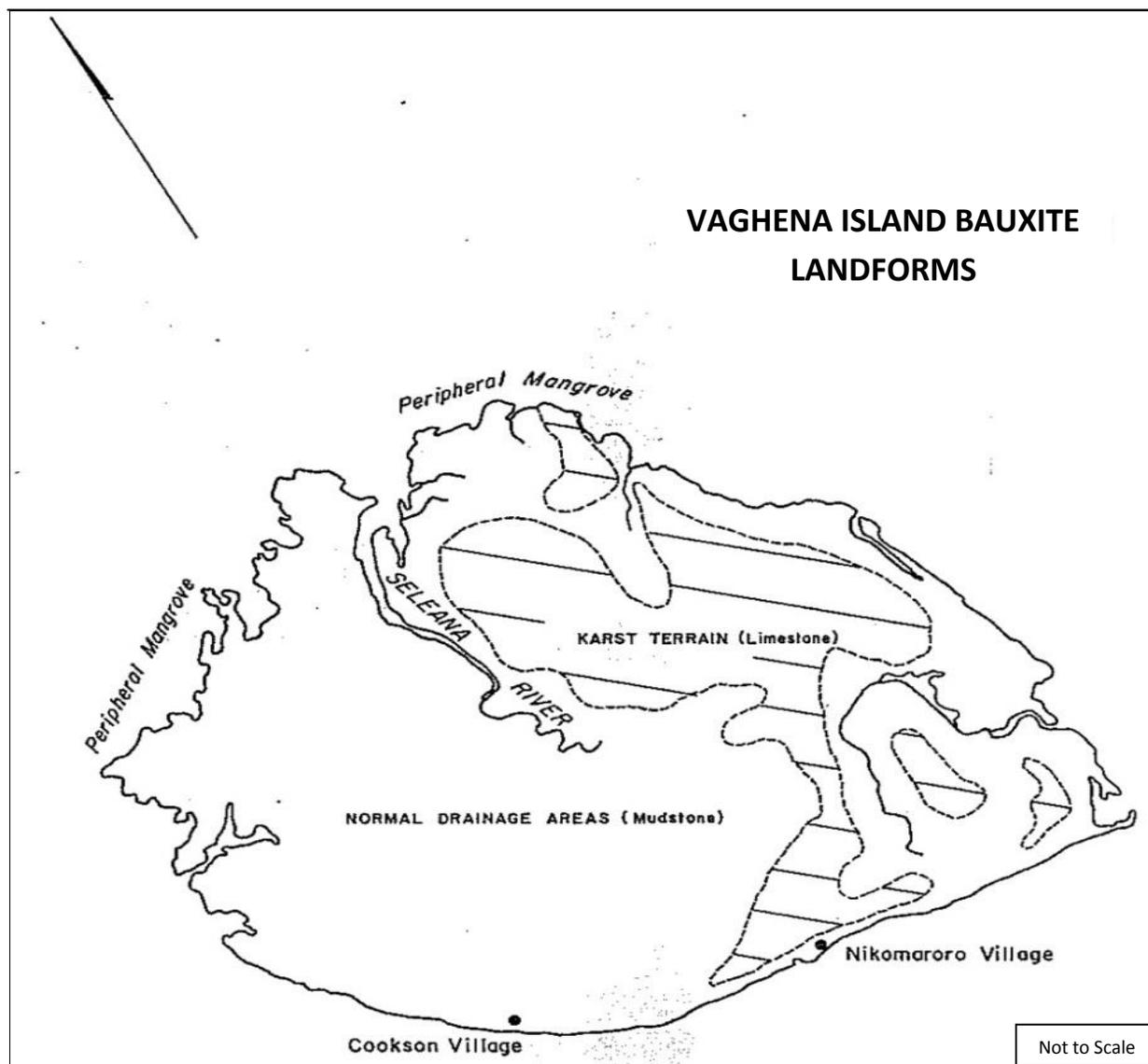


Figure 1.1.2a: Land Zones formed of Limestone and Mudstone. Bauxite Occurs mainly on the Limestone.

Vaghena Island is composed of a succession of marine calcareous sediments and raised reef limestone ridges and plateaus. Calcareous sediments form the oldest exposed rocks and occupy much of the western part of the Island<sup>6</sup>. They comprise siltstones and mudstones. Lateritic soil overlies much of the mudstone and limestone. Raised Pleistocene limestone overlies the calcareous sediments with angular unconformity.

<sup>5</sup>West. K.N., CRA 1972, pg 10

<sup>6</sup>G. W. Hughes classified these as the 'Vaghena Formation'

- **Bauxite Deposits in Mangrove Swamps**

Mangrove swamps are observed mostly along the north coast, but inland there are numerous freshwater swamps. Recent coral growth, reef sands and detrital deposits occur along the southern coastline. Mangrove swamp also occupies much of the inland water tracts, especially those which boarder the Seleana River, Ndavuna inlet and the Kukutin Creek inlet of Western Vaghena. These mangrove swamps merge into freshwater swamps inland, especially in areas adjacent to the limestone. Limestone-associated perched water tables may account for the distribution of freshwater swamp at such localities.

Most of the soil material in swamps is classed as low grade bauxite or waste. Only a small amount is considered to be economic bauxite. Overburden consists of silt or organic matter and is usually 30 cm to 1.2 m deep in internal swamps, but increases to 4.6 m in fresh water and mangrove swamp areas. Roots and humic material may persist below the overburden in some places in the profile. The colour and appearance varies between swamps according to the clay content.

In internal swamps, the bauxite zone immediately underlies silt deposits. Below the bauxite, is a zone of bauxitic clay which in turn is underlain by mudstone. Where it occurs on the mudstone, the bauxite material has similar characteristics to bauxite in the inland swamps.

- **Geology**

The rock formations on Vaghena Island range in age from Upper Miocene to Pleistocene. In the western and north western areas, the Miocene age Vaghena Formation dominates and comprises a sequence of calcareous marine sediments that closely resemble the Miocene-Pliocene sequence on Santa Isabel. Typically it consists of cream to buff coloured, well-bedded calcareous siltstones and mudstones. The calcareous siltstones have been greatly disturbed by bioturbation, most of which can be associated with worm casts on the bedding surface. The mudstone beds are mostly massive, but some display lamina and convolute bedding. *Arenaceous* beds are uncommon, less than 2cm thick, and are typified by abundance of trace fossils-especially *lithified holothurians* trails. Some of the *arenaceous* beds consists of white crystals, probably derived from the *Komoro andesitic volcanic*, some 24km to the north-west<sup>7</sup>.

Overlying the Miocene-Pliocene sediments of the Vaghena Formation is the Pleistocene *coraline* reef limestone, which occurs predominantly in the southeast, east and northeast regions of the Island. Its thickness is unknown, but small windows of the underlying Miocene mudstone were intersected in auger holes drilled in bauxite in an area east of the Seleana River. The limestone is a white, extremely pure, very porous crystalline rock composed almost entirely of calcite. Iron-rich concentrations up to 2cm in diameter are commonly restricted to certain horizons; macro fossils are rare and are represented only by occasional thin-shelled lamellibranchs. Pleistocene reef limestone, occurring as elevated ridges and plateau-like areas on Vaghena, also form some of the smaller scattered islands and are correlated with the Nukiki limestone formation of mainland Choiseul.

During Pliocene-Recent time volcanic material was deposited on the Island and was subjected to tropical weathering conditions which resulted in extreme leaching of silicate minerals. The resulting *laterite* now forms a mantle covering some 80% of the Island. The *laterite* varies from 0.33 m to greater than 12 m in depth. The bauxite generally constitutes the upper part of the laterite profile but in a number of places, particularly over limestone, the total laterite profile is bauxite.

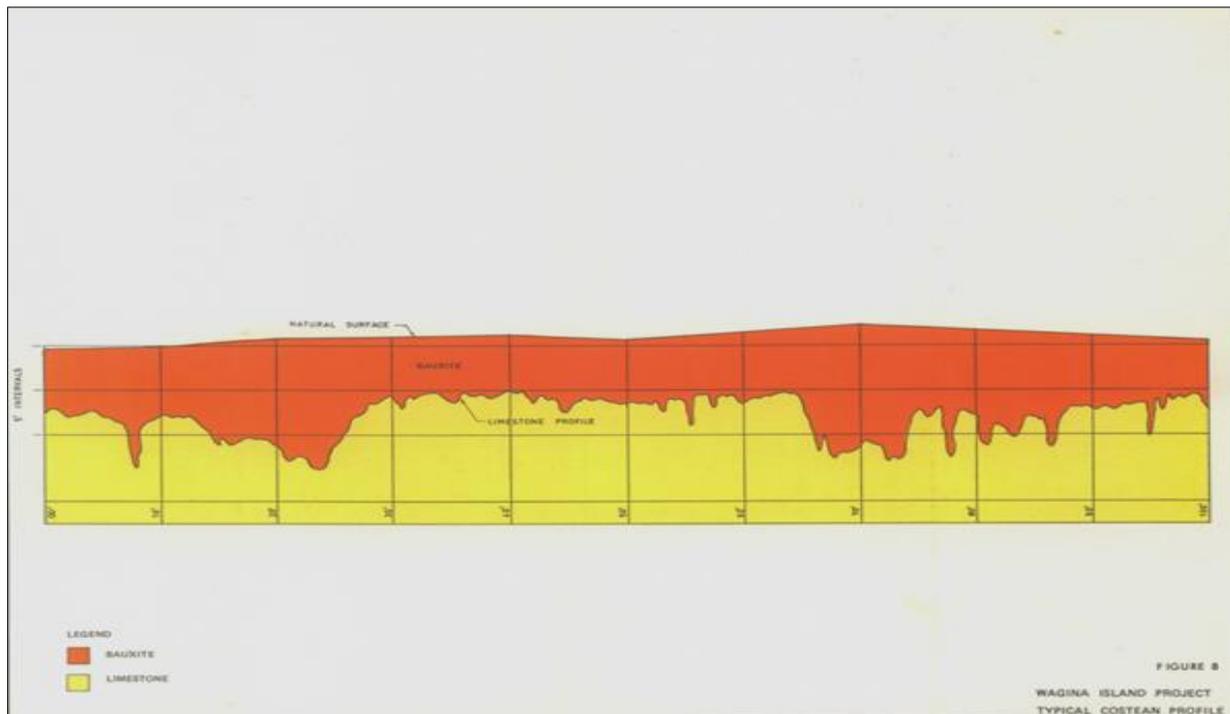
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<sup>7</sup> Technical Report, SPB, 2012 pg 4

- **Commercial Viability**

Bauxite clays, of economic proportions, have formed on Vaghena Island, especially in the areas underlain by limestone. Commercial investigations have estimated a total of about 28 million dry tonnes of bauxite, with a grade of 40.5% available  $Al_2O_3$ , extending over a surface of area of approximately  $16km^2$  and an average thickness of 3 metres. The bauxite clays were probably produced by extreme leaching of the silicate minerals present in a pre-existing mantle of andesitic ash which was deposited over the Island during the Pleistocene. These inferences were interpreted by both CRA and SPB.

It is further suggested that the deposits follow the karstified surfaces, such as potholes and sink cavities, on the lower surface where it is in contact with the limestone. On the upper surface, the bauxite corresponds with the ground surface, which is undulating and irregular. See Figure 1.1.2b. Limestone at the interface is weathered; the bauxite at the interface is loosely compacted and is always moist due to water flowing through the cavernous areas. Limestone float material up to 15 cm is found within the bauxite profile, but its distribution is sparse. The water table is generally below the limestone bedrock surface except in the proximity of swamps.



**Figure 1.1.2b: Bauxite Profile and Bauxite Limestone Interface – CRA Report 1972.**

The overburden is a layer of humus rich soil, which is rarely more than 30 cm thick, but may be up to 1.2 m deep in internal swamps and can increase to 4.6 m in fresh water and mangrove swamp areas. Roots and humic material may persist below the overburden in some places in the profile. The base of the bauxite is an irregular surface, but the boundary with the bedrock is sharply defined. As described above. The lower horizon of the bauxite frequently contains fragments of limestone.

In July 2012, Breakaway Mining Services (BMS), which provides technical support to SBL, reviewed the extensive historical exploration and feasibility data generated by CRA. Based on this data BMS estimated

a total Mineral Resource of 38.8 Mt (million wet metric tonnes) at 46.9% Total Al<sub>2</sub>O<sub>3</sub> (or 40.6% available Al<sub>2</sub>O<sub>3</sub>) of which 38.0Mt was categorised as being of 'High and Medium Confidence'.

Classification	Tonnes Mt	Total Al %	Si %	Al <sub>2</sub> O <sub>3</sub> %	SiO <sub>2</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
High Confidence	32.6	40.5	3.2	46.9	3.0	16.7
Med Confidence	5.4	41.6	2.0	47.4	2.7	16.8
Low Confidence	0.8	39.5	9.3	46.4	4.3	16.8
<b>Total</b>	<b>38.8</b>	<b>40.6</b>	<b>3.2</b>	<b>46.9</b>	<b>3.0</b>	<b>16.7</b>

**Table 1.1.2: BMS Resource Estimate**

The total BMS Resource correlates well with the earlier CRA estimate of 27.9 million dry long tons at 47.1% Al<sub>2</sub>O<sub>3</sub> (or 28.4 million dry metric tonnes or 38.3 million wet metric tonnes at 35% moisture), which excluded any bauxite in mangrove or peripheral freshwater swamps and mineralization less than 1 metre thick.

The CRA estimate applied conservative parameters for the silica cut-off grade, specific gravity and moisture content of the deposit. Additionally, drilling was generally limited to a maximum depth of around 9 metres and some of the auger holes finished in ore grade mineralization, adding to the conservatism of the estimate.

The BMS estimate did not comply with recommendations in the Australasian Code for Reporting of Mineral Resources and Ore Reserves (2004) by the Joint Ore Reserves Committee (JORC), as some original data was not able to be fully accessed, reviewed and evaluated. Nevertheless, in general BMS stated that the density and quality of data is likely to support conversion of 'High Confidence' category resources to JORC Measured Resource status when further data validation is completed. Similarly, the "Medium Confidence' category broadly equates to Indicated Resource and the 'Low Confidence' category to Inferred Resource.

BMS furthermore concluded that a base case scenario evaluated in a September 2012 study will mine and process 40.8 million wet tonnes of ROM ore (35% moisture), including mining dilution of 10%, producing 29.6 Mt (at 15% moisture) of saleable bauxite. This result in the mining of 95.6% of the BMS resource estimate or 96.8% of the CRA resource estimate<sup>8</sup>. Evaluations to ship bauxite at moisture levels higher than 15% are in progress.

### 1.1.3 Coastal Geomorphology and Processes

#### 1.1.3.1 Coastal Setting

Vaghena Island has a low relief, with the north and western coastlines being less than 0.2-0.5m above MSL. The north coast experiences relative calm water, except when the wind changes to a northerly direction, but the fringing reefs dissipate most of the wave energy and strength. These coastal locations are heavily forested with mangrove vegetation mingled with coastal vegetation, except for those cleared areas that have been logged for timber by the local residents. The north east coastline of the Island is elevated, and in some areas where the weathered limestone is exposed, waves have carved natural hollows into the limestone, whilst vegetation has grown onto of these exposed rocks. It appears that the

<sup>8</sup> SPB, 2012, pg III

former limestone plateaus which had previously been the eastern coastline have undergone uplifting or weathering such that the remnants have now formed clusters of small rock islets.

### 1.1.3.2 Coastal Processes

The south western side of the Island is a generally low energy environment with little recent movement of the shoreline position or mangrove extent, the water is also calm since it is protected from the southeasterly's by a series of island chains and submerged shallow coral reefs, whilst the south coast is open to the southeasterly winds. On the southeast coastline, the waters are exposed to the open sea and tend to generate greater swells during normal weather conditions. From observation even at 2-3 knots of wind speed; the swells tend to grow to a height of 0.5m to 0.7m.

- **Bathymetry**

A detailed bathymetry assessment will be systematically carried out prior to the construction of the bulk carrier wharf; it is important that this exercise will be undertaken by SBL to guarantee safe manoeuvrability of large bulk carriers that have the capacity to load around 60,000 tonnes of bulk cargo during the project's operational phase. Figure 1.1.3.2a shows the current bathymetry chart used by mariners to navigate coastal waters of Choiseul, Rob Roy and Vaghena Islands.



**Figure 1.1.3.2a: The Bathymetry Map of Vaghena Island and its Surrounding Islands.**

The coastal waters to the south are much deeper than those of the west and east coastlines. The depth averages between 30-45m, whilst on the west and east coastlines the depth averages around 16-27m. The north coastline depth averages around 16-23m.

- **Current, Wave and Wind movements**

The ocean current movements comprise two major phases of movements which occur during a six week cycle which is governed by astronomical changes. There is a southeast movement and a northwest movement over a six week cycle, except during a quarter moon, where the tidal movements change to a four day cyclical period. This period lasts for 3-4 days before it resumes its 6 week cycle.

Random tests of current movement were undertaken around the Island to determine current flow directions. Figure 1.1.3.2b shows the movements of tides around the Island, this is a one day observation and may not represent long run historical data. However, current movements will be gauged on a daily basis to accurately determine water movements and changes during astronomical tidal cycles once project construction and the operational phase are underway.

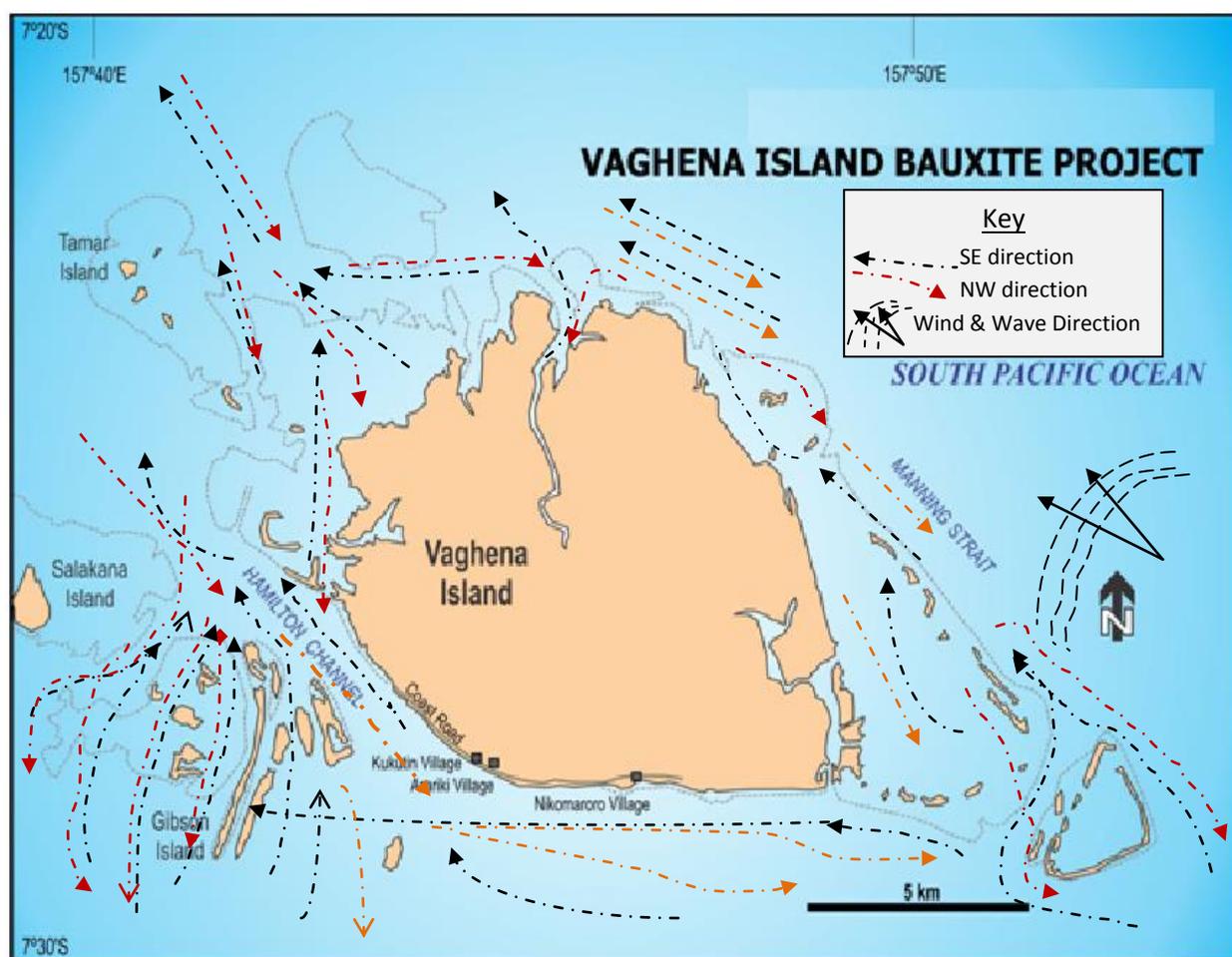


Figure 1.1.3.2b: Tidal, Wave and Wind and Water Currents around Vaghena Island.

The two major water currents are more pronounced as they enter shallow water especially between barrier and fringing reefs, such as the narrow openings around chains of islands including Gibson, Salakana and Tamar Islands. The current flow rate data recorded during a one day field trip averaged between 0.45m/s– 0.56m/s on the south coastline on its westward direction. As it reached the west, the current movements changed to a northwest direction recording a speed of 0.2m/s – 0.3m/s. The rate of

movement tends to slow down indicating that a significant drag coefficient might have been created by the numerous fringing and barrier reef systems along with the numerous sandy bar islets that exist along the west coast of Vaghena Island. Toward the southeast coastal waters, the movement recorded averaged between 0.33 to 0.38m/s. The south coastlines experience greater movements than the north and western coastal waters. This movement is accentuated during incoming and outgoing tides.

The prevailing wind is the east-southeast trade wind that blows all year round. A northerly wind is also experienced during full and/or low tide, whilst the trade wind is experienced during incoming and outgoing tidal changes. The waves are wind driven, as observed during the four day field trip, with the west and north shorelines protected most of the time, but exposed when the northerly wind is blowing.

As recorded during observations, when the wind builds up the height of the swells also builds up. On the sea surface, wind generated waves can reach a height of 0.5-0.7m at 3-5 knots of wind speed. This effect was clearly observed at the southeastern side of the Island just offshore from Nikumaroro Village toward the Ndavuna Inlet. The wind and wave swells must be considered in the design, construction and operation of a wharf or a jetty on this section of the coastline, because this coast is open to the easterly and southeasterly trade winds which can generate large swells from the deep sea of the Manning Strait. However, it also provides the safest maritime route to the Island since it is the deepest channel, is located well away from coastal settlements and the major seaweed farms at the west end of the Island.

Overall, the local residents' deep knowledge of the ocean current movements enables them to navigate around the Island<sup>9</sup>. Paddling canoes with support of the current is a valuable piece of information passed on from generation to generation. When the I-Kiribati settlers came to Vaghena Island, they quickly learned these current movements by observation, which they then rapidly applied for fishing excursions and sea transportation from Vaghena Island to Choiseul and return.

#### **1.1.4 Site Geotechnical Conditions Relevant to the Mining Operations**

The proposed haul roads and project infrastructure are planned to be developed only within the proposed Mining Lease (currently broadly equivalent to the Prospecting Licence) in order to effectively mine the deposit and to ensure that there is no possibility of any potential problems that could develop if any of the project activities impinge on the land which belongs to the I-Kiribati settlers on Vaghena. The land owned by the villagers is mainly concentrated on the southwest side of the Island as seen in Figure (iii), Project Description. An initial coastal process study noted that the proposed foreshore development is unlikely to have any significant effect on coastal processes as the wharf will be constructed on stilts or piles allowing free movement of coastal waters with littoral currents of about 1 knot maximum velocity<sup>10</sup>. The wharf, processing facility and product storage sheds are also likely to be exposed to only a low risk of coastal hazards such as coastal erosion or inundation. The deep bathymetric waters on the south coast, will allow SBL to construct a wharf with a fixed telescopic conveyor system to enable bulk carriers to load at Vaghena Island prior to the shipment of the bauxite ore overseas. Roads linking the mine to the processing facility and the wharf will be constructed to allow SBL personnel and machinery access to and from the inland mining areas and the foreshore facilities. The Holocene rock that forms the base of the coastal site is solid and able to support piles, piers and roadworks that will be constructed to haul, process and ship bauxite on and from the Island. Figure 1.1.4 shows the main haul roads that will link mining sites to the processing facility and then the conveying system onto the wharf and thence on to the bulk carrier.

<sup>9</sup>Pers Communication

<sup>10</sup> Hughes, W. G, 1979

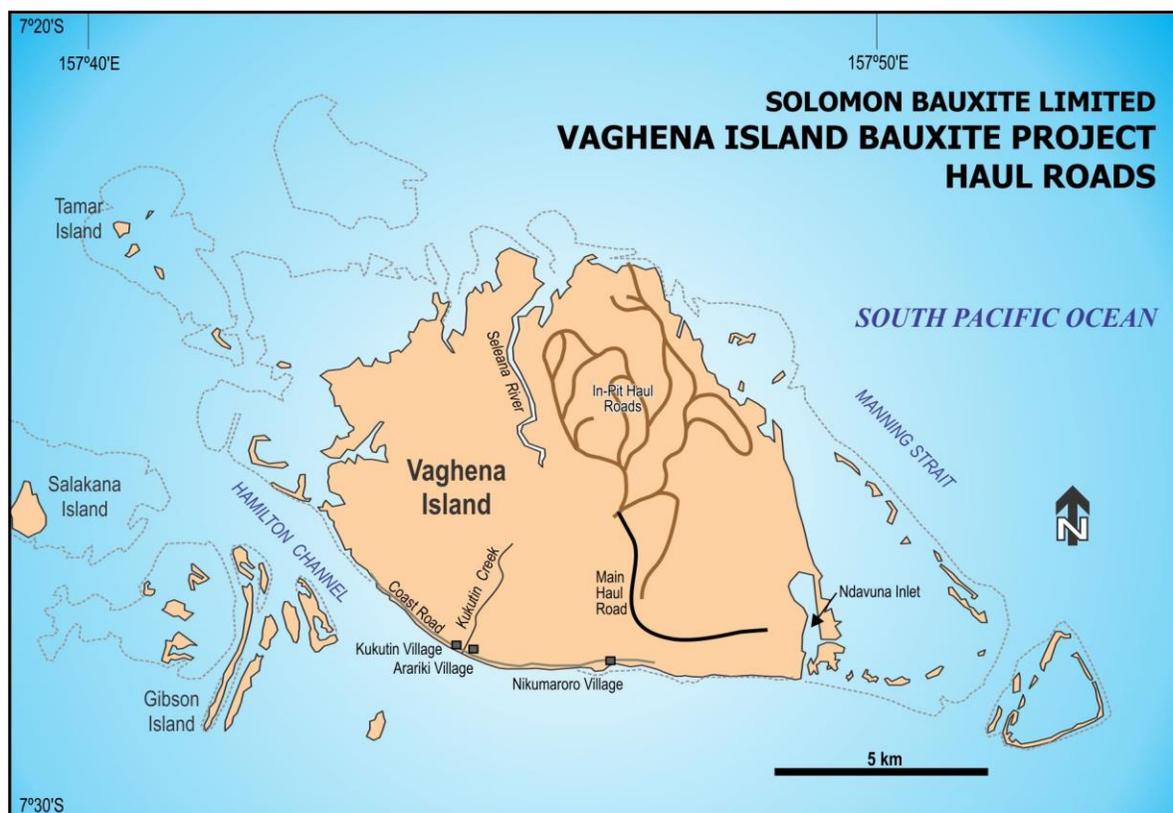


Figure 1.1.4: Shows the Proposed Main Haul Road and In-Pit Haul Roads.

## 1.2 PROJECT SITE

### 1.2.1 Vaghena Mine Site

The mining site is undeveloped and retains existing vegetation of native forest and fern growth with extensive mangrove vegetation fringing the major marshland that runs from the mouth of the Ndavuna Inlet along the east coast to the north. SBL initially plans to mine and haul approximately 1.2 Mtpa (dry) of bauxite ore from the mining area, to transport the ore to a processing facility via a designated 6 km long haul route which will be constructed specifically for the sole use of the project. SBL will quarry limestone and other local materials for use as road making materials. Care will be taken to ensure that the limestone does not contaminate the bauxite reserves. The processing facility area will also include a diesel fuel powered electric power station and associated fuel farm. Fuel will be transported to Vaghena Island by sea. Figure 1.2.1 shows the proposed mining infrastructure that includes an airstrip, a wharf, and a small boat harbour located within.

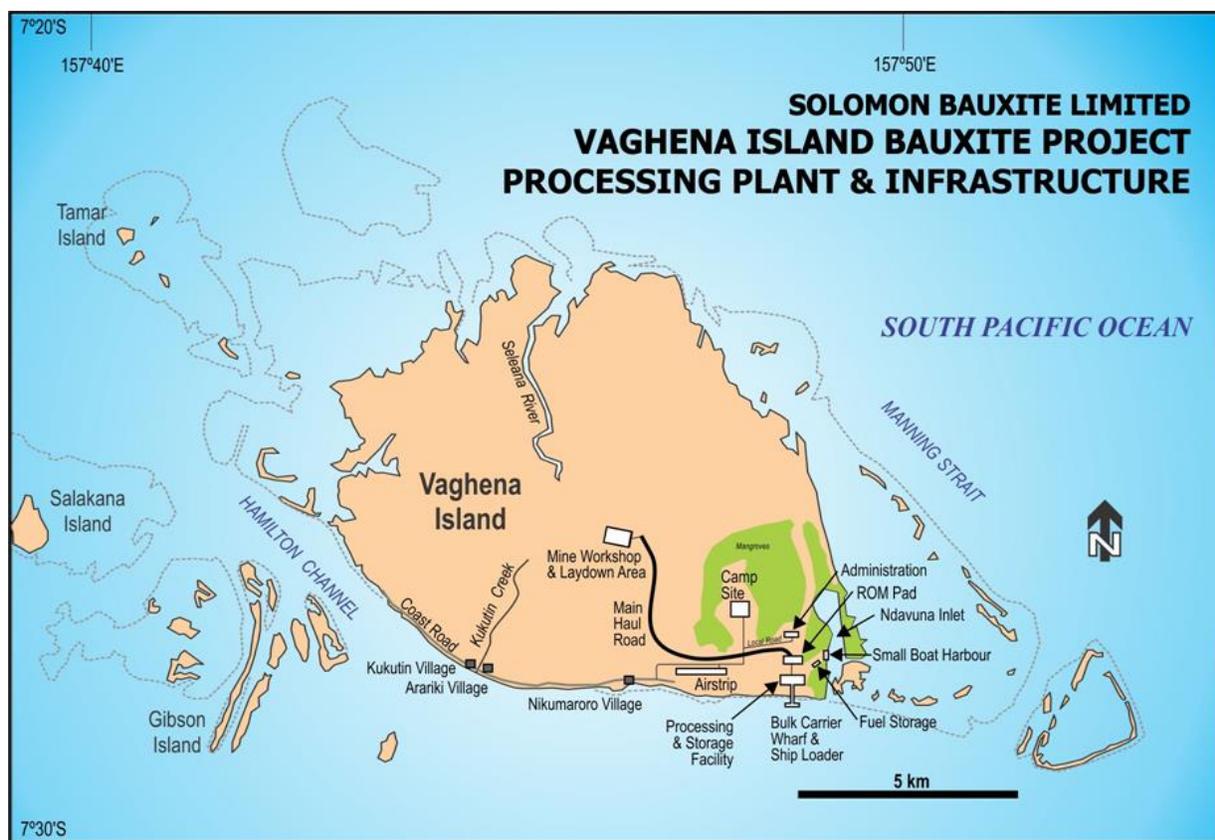


Figure 1.2.1: Shows the Proposed Plant and Infrastructure on the Island.

A mining equipment maintenance workshop will be established near the mining area, whilst a processing facility, product storage facility, and a township that will include the accommodation for workers and professional employees will be constructed on the southeast part of the Island. The final positions of these infrastructure items may vary slightly according to detailed design, foundation test work, drainage considerations and other reasonable requirements of SBL.

### 1.2.2 Baseline Surface Water Quality

There is very little or no historical data available covering the baseline water quality for the site. A baseline water quality assessment was undertaken around the Island. This was for dry season conditions, whilst wet season conditions data are not available. A total of eight (8) environmental raw water samples submitted for bacterial analysis were assessed. In addition, thirteen (13) physical and chemical samples were tested.

Unfortunately, the National Public Health Laboratory (NPHL) located at Honiara, could only carry out five parameters of the physical and chemical tests, this included the *ph*, *turbidity*, *dissolved oxygen*, *conductivity* and *salinity*. For the biological bacteria tests, *total coliform* and *faecal coliform* were analysed. For the objectives of the study, this is sufficient information to gauge the current water quality baseline data of the Island. Water testing will continue and other parameters will be included once samples are sent overseas for assessment. Currently, the NPHL does not have the capacity to carry out other important chemical and physical parameter tests.

### 1.2.3 Heavy Metals

Heavy metals which may be contained in mine generated sediments carried by water flowing off the proposed mine site are to be settled in siltation ponds specifically constructed for the project. It is envisaged that when the sediments are settled out, only a few metals will possibly be found in detectable concentrations, namely; cobalt, iron, manganese, arsenic and zinc. If there are heavy metals found such as arsenic and zinc which exceed the trigger values, then the ANZECC 2000 guidelines for the protection of mangrove wetland ecosystems at the 99% level of protection (% species) will be implemented.

### 1.2.4 Marine Water Quality

Of the eight samples collected, five were taken from four marine sites, mostly along the south coast beginning from Nikumaroro and ending at Tembaurua at the west side of the Island. Three of these were taken from the only running creek on the Island called Kukutin Creek. The other chemical samples were taken from marine sites around the Island (refer to Figure 1.2.4). Appendix 11-3 lists all test results.

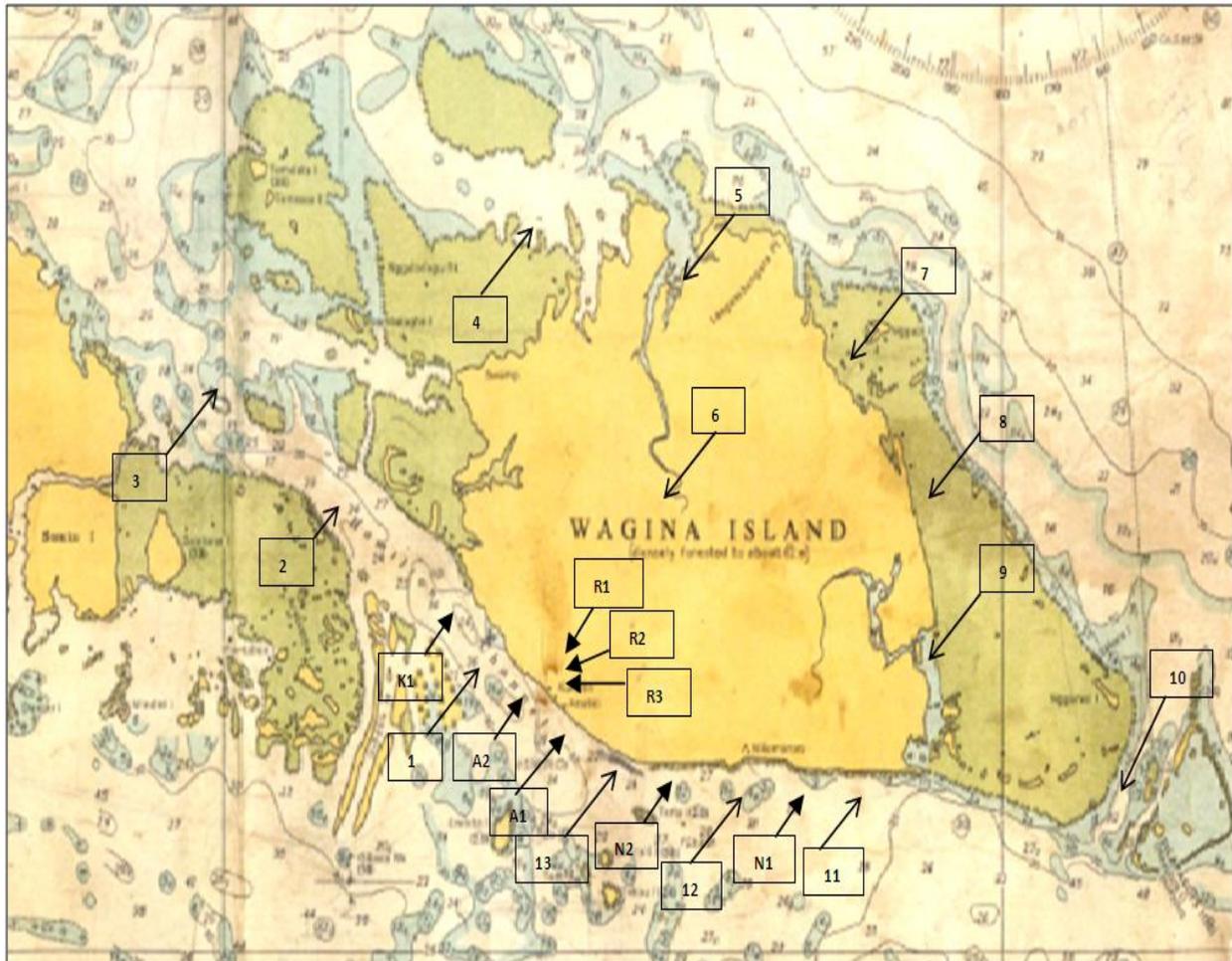


Figure 1.2.4: Shows the Sites Where the Water Samples Were Taken.

Sample sites	Item Tested	Total Coliform MPN/g	Faecal Coliform MPN/g	pH units	Turb NTU	DO (mg/l)	Cond (mS/cm)	Salinity (ppt)
A1	Seawater	1100	≤0					
A2	Seawater	≤0	≤0					
K1	Seawater	≤0	≤0					
N1	Seawater	23	≤0					
N2	Seawater	23	≤0					
R1	Freshwater	43	23					
R2	Freshwater	93	43					
R3	Freshwater	1100	93					
1	Seawater			8.14	<0.01	8.23	45	25.98
2	Seawater			8.45	<0.01	8.39	44.9	30.04
3	Seawater			8.48	0.23	8.30	44.5	30.76
4	Seawater			8.54	<0.01	8.34	44.5	31.79
5	Seawater			8.56	0.23	8.18	44.4	31.17
6	Seawater			8.56	0.07	8.46	44.4	30.36
7	Seawater			8.60	0.28	8.22	44.3	31.21
8	Seawater			8.64	0.44	9.50	44.7	30.16
9	Seawater			8.10	0.31	5.67	38.0	25.61
10	Seawater			7.71	0.17	5.17	34.8	23.37
11	Seawater			8.49	0.05	9.69	42.7	28.64
12	Seawater			8.46	0.03	7.63	40.6	26.53
13	Seawater			8.69	0.52	8.75	43.0	29.31

**Table 1.2.4: Shows the Water Quality Results from the Site.**

The total coliform reading was perhaps the most profound and surprising result for any of the sites. There are indications that raw effluent from pit toilets, pigs and other animal wastes seeps directly into the natural water systems. One result which is very interesting is the total coliform in seawater; this is from in front of the Arariki Village, which might indicate raw effluent seepage into immediate seafront area as shown in sample site A1 in Figure 1.2.4 above. This far exceeds World Health Organization (WHO) standards which range between zero (0) and 20 mg/L.

The results of the fresh water quality tests show the presence of faecal coliform for the three of the sites tested. The presence of faecal coliform makes the water unsafe for human consumption as the WHO standard sets a safe drinking level of zero (0) coliform. The main threat from sewerage contamination relates to increased risks of bacterial and viral infections in human beings, particularly through the consumption of shellfish harvested from contaminated sewerage water. Filter feeders such as oysters, clams and mussels tend to accumulate toxic chemicals and pathogenic organisms such as *Vibrio cholera*, *Salmonella* and hepatitis virus in their tissues, thus exposing humans to a greater risk of infection. While the local community may have some immunity to a range of endemic diseases transmissible in this way, the outsider or tourist must be wary of this health hazard.

For the rest of the site samples, the pH remains within the recommended standards, the turbidity shows pristine and clear water of between  $<0.1 - 0.52$ . This far lower than WHO standard of 5NTU.

- **Dissolved Oxygen**

The dissolved oxygen (DO) represents a very good indication of pristine waters as it exceeds more than 5mg/L. Biologically speaking, the level of oxygen is a much more important measure of water quality than faecal coliform. Dissolved oxygen is absolutely essential for the survival of all aquatic organisms (not only fish, but also invertebrates such as crabs, clams, and zooplankton, etc). Moreover, oxygen affects a vast number of other water indicators, not only biochemical but aesthetic ones like the odour, clarity and taste. Consequently, oxygen is perhaps the most well-established indicator of water quality<sup>11</sup>. This is one reason why the lagoons waters of the Western Province of the Solomon Islands are one of the best breeding grounds of many pelagic fish and organisms including other important marine animals and reptiles in the tropics such as crocodiles, dugong, leatherback turtles, sharks, and tuna etc.

- **Conductivity**

The conductivity ranges from 38.0 to 44.9 mS/cm, and averages 42.8mS/cm which indicates a higher than expected conductivity at the site, which maybe an indication of the dissolved ions (includes  $Fe^{+2}$ ,  $Fe^{+3}$ ,  $Mn^{+2}$ ) in soil water that seeps into the marine environment during high tide. High conductivities indicate that ions present in the surrounding soil are seeping into the nearby coastal waters.

- **Salinity**

Values of salinity at the surface ranged from 23.37 to 30.76 ppt (mg/L).The average salinity measured for the thirteen sites was 28.8 mg/L and these readings are lower than the marine standard range of 34-36.53 mg/L. This can be indicative of large amounts of freshwater from the freshwater springs and rainfall mixing with saltwater, as the coastal areas is lowlying and almost equivalent in elevation to the high water mark (HWM).

### 1.3 CLIMATE

The climate in Vaghena is tropical with two seasons as elsewhere in the Solomon Islands. The prevailing winds are northwest to northerly (associated with monsoons and squalls) from November to March and southeast trade winds are observed from April to October. Rainfall varies across the country. The northwest season is the accepted “wet” season and is characterized by frequent, localized squalls with strong winds over short periods. No local records of wind velocities are available. Monsoonal squalls occasionally develop into cyclones, during December months. The southeast season has marginally lower rainfall than the northwest season. Annual rainfall recorded between December 1970 and November 1973 was 4026mm and the maximum daily rainfall was 60.6mm recorded in 1971. Incomplete rainfall records from the north coast area conclude that rainfall is not substantially different to the south coast. Recordings by CRA taken in daylight hours in December 1971, show temperature variations between mid-70’s and mid-80’s (Fahrenheit) and relatively humidity between 65 and 95 percent.

#### 1.3.1 Temperature

Recent information regarding the average daily temperature of the Solomon Islands ranges from 23<sup>0</sup> C to 30<sup>0</sup>C. Temperature readings from Munda and Taro Island weather stations generally show that the temperature of the Western Province is relatively consistent. Table 1.3.1 shows the temperature

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<sup>11</sup><http://www.lenntech.com>

readings for Munda from 1982 to 2010 ranging from 23.5°C to 31.5°C, while the Taro weather station ranged from 23.9°C to 31.1°C.

Month	Temperature (°C)					
	Munda Weather Station			Taro Island Weather Station		
	Minimum	Average	Maximum	Minimum	Average	Maximum
January	24.1	27.7	31.3	24.9	28.0	31.1
February	24.0	27.4	30.8	24.8	27.9	31.0
March	23.9	27.5	31.0	24.8	27.9	31.0
April	23.9	27.4	30.9	24.8	27.8	30.9
May	24.0	27.3	30.6	24.5	27.6	30.7
June	23.7	26.9	30.1	24.1	27.1	30.1
July	23.6	26.5	29.5	23.9	26.8	29.7
August	23.5	26.6	29.7	24.0	26.9	29.9
September	23.7	26.9	30.3	23.9	27.0	30.0
October	23.8	27.2	30.7	24.1	27.8	30.1
November	23.9	27.5	31.2	24.5	27.9	31.0
December	24.1	27.8	31.5	24.9	28.0	31.1

**Table 1.3.1: Monthly Average and Maximum Relative Humidity for Munda and Taro Station Weather Stations from 1982 to 2010 (source: SSM, EIS, 2012).**

### 1.3.2 Rainfall

The Northwest Monsoon, although locally termed the “wet” season (due to the incidence of rapidly forming rain squalls) experiences in fact less rainfall than its counterparts. Rainfall records were kept for 3 years (Dec. 1970-Nov. 1973) and the following statistics<sup>12</sup> have been extracted:

- Average annual rainfall 4,026 mm
- Average for the wettest month (Jul.) 673 mm
- Average for the driest month (Nov.) 189 mm
- Wettest month recorded (Jul.) 981 mm
- Driest month recorded (Nov.) 124 mm
- Number of days that rain falls in every 10 days 7 days
- Average number of days that rain falls each month 20 days
- Longest sequence without rain 14 days
- Longest sequence with rain 26 days
- Average rainfall intensity 9 mm/hr
- Maximum intensity recorded over a period of 10 mins 110 mm/hr
- Average length of rain period 40 hrs/mnth-5% of the time
- Average length of showers 27 mins
- Average number of long wet days per annum 32 days per year over 4 hours rain per day. 91 days per year with over two hours rain per day.

<sup>12</sup> CRA, 1979

In general the Solomon Islands annual rainfall is typically 3000mm to 5000 mm, with monthly rainfall exceeding 200mm. The wettest areas occur in the northwest with the heaviest rainfall associated with the monsoon season (December to April). Recorded data available at Munda and Taro Island indicate that there is significant variation in the monthly rainfall. One of the reasons maybe the differences in the prevailing wind and topography in the areas where weather stations are located (see Table 1.3.2). It can be inferred that the Vaghena Island rainfall recordings from the 1970's fall within the annual rainfall range.

Weather Station	Annual Rainfall in mm (year)		
	Minimum	Average	Maximum
Munda	2,112 (1997)	3,513	4,230 (2006)
Taro Island	1,773 (2000)	3,164	5,132 (1993)

**Table 1.3.2: Shows the Minimum, Average and Maximum Annual Rainfall for Munda and Taro Island Weather stations (1980 to 2010).**

The minimum and maximum month rainfall values at Munda and Taro weather stations were recorded in April 2009 at 134.5mm and in July 2009 at 746.5mm respectively. No definable wet and dry seasonal pattern could be established from the rainfall data<sup>13</sup>.

### 1.3.3 Wind

The wind direction is from the northwest in November to March and from the southeast in April to October. Mean monthly and maximum daily velocities are 6 to 8 knots from May to November and 3 to 4 knots from December to April. Gusts rarely exceed 20 knots except during cyclones. The rainfall tabulation indicates observed conditions over a period of 332 days:

Calm	-	46
Slight	-	214
Moderate	-	60
High	-	10
Cyclonic	-	2

Local squalls approach and recede rapidly and are usually short in duration. Some frontal weather is associated with the southeast seasons (April to October) and these patterns may last for several days. Wind is normally only experienced along the coast line. No wind is felt at ground level in the uncleared forest area.

### 1.3.4 Humidity

Relative humidity in general in the Solomon Islands has a low seasonal variation but does show a diurnal variation. The Munda and Taro Weather stations recorded in 2009, between 64.5% and 87.9% showing a relative humidity in the Western Province as seen in Table 1.4.3 below.

<sup>13</sup> SMM, EIS, 2012

Month	Relative Humidity (%)					
	Munda Weather Station			Taro Island Weather Station		
	Minimum	Average	Maximum	Minimum	Average	Maximum
January	71.90	78.30	82.60	70.34	78.79	83.04
February	72.20	79.10	85.20	69.38	79.52	86.46
March	75.90	80.20	86.30	75.33	80.34	89.67
April	77.00	82.60	87.80	76.43	82.18	87.51
May	79.30	82.60	86.00	77.95	83.11	87.13
June	74.00	81.80	85.60	74.23	82.39	87.57
July	76.70	80.90	85.60	76.94	82.24	85.21
August	74.30	80.30	84.70	76.21	81.20	84.95
September	76.90	81.60	85.00	77.86	82.18	84.89
October	75.10	81.40	84.30	74.63	81.56	84.70
November	75.10	81.30	86.80	73.97	80.69	85.42
December	75.60	80.30	86.00	75.45	80.12	85.10

**Table 1.3.4: Shows the Relative Humidity For the Munda and Taro Island Weather Stations.**

The overall trend for humidity, even though higher in Munda than Taro Island, tends to exhibit a uniform trend throughout the year<sup>14</sup>.

<sup>14</sup> SMM, EIS, 2012

## 2.0 BIOLOGICAL ENVIRONMENT

### 2.1 Overview of Terrestrial Flora and Fauna

The *flora* of the Solomon Islands comprises mainly rainforests with the average tree height exceeding 25 metres. On Vaghena Island, where vegetation occurs on limestone and mudstone areas it is generally similar except fern growth is prolific on mudstone and sparse on the limestone. There are also mangroves and swamps to be found, particularly near the coast. The coasts may also be lined with coconut palms. In addition, there are a considerable number of flowering plants such as orchids and bougainvillea. As a direct result of these flowering plants, there are plenty of butterflies also to be found on the Solomon Islands.

*Fauna* on the Solomon Islands comprises a large number of bat and rat species; many of which are unique to the Solomon Islands. Some of the species observed are the *Bougainville monkey-faced flying fox*, *Cusp-toothed fruit bat*, *Montane monkey-faced bat*, *Emperor rat*, *Poncelet's giant rat*, *black-bellied fruit bat*, *Florida naked-tailed rat*, *flower-faced bat*, *Isabel naked-tailed rat*, *king rat*, *large-eared sheath-tailed bat*, *flying fox*, *Malaita tube-nosed bat*, *old world leaf-nosed bat*, *Ontong Java flying fox*, *orange fruit bat*, *Santa Cruz flying fox*, *Temotu flying fox* and *Vanikoro flying fox*. The other mammals in the sea around the Solomon Islands are *dugongs* and *humpback whales*.

Vaghena Island is home to most of the above fauna and other marine mammals such as dugongs and humpback whales that reach the Islandwaters from the Manning Strait. Reptiles such as saltwater crocodiles have found sanctuaries in the Seleana River and these can be seen at night. Daylight sightings of crocodiles are rare as they mostly try to avoid human contact.

Insects are plentiful; however a detailed study has not been undertaken. Historically very little study has been carried out on Vaghena Island to assess the inventory of insects and birds species that inhabit the forested areas. The detailing of these species will be undertaken as a monitoring and evaluation exercise during the development and operations phase.



Plate 2.1: Some of the Unidentified Butterfly, Dragonfly and Mantis Species of the Vaghena Forests.

#### 2.1.1 Solomon Islands Wetlands

There has been very little scientific work carried out on the wetlands of the Solomon Islands. The last national map coverage of vegetation types was by Hansell and Wall (1976), and this is now very much out of date due to land clearing for subsistence agriculture and for commercial logging operations. A National Forest Resources Inventory has been completed, and information on vegetation types

(including wetlands) will be updated. The information provided below is derived from the Hansell and Wall (1976) study.

TYPE	CATEGORY	DETAILS
i	SALINE SWAMP FOREST	Low mangrove forest 80 km <sup>2</sup>
		Tall mangrove forest 562 km <sup>2</sup>
ii	FRESHWATER SWAMP FOREST	<i>Casuarina</i> swamp forest 16 km <sup>2</sup>
		Reed swamp ( <i>Phragmites</i> ) 47 km <sup>2</sup>
		Herbaceous swamp 4 km <sup>2</sup>
		<i>Campnosperma</i> swamp forest 51 km <sup>2</sup>
		Mixed species swamp forest 631 km <sup>2</sup>
		<i>Pandanus</i> swamp 83 km <sup>2</sup>
		Sago palm swamp 19 km <sup>2</sup>
		<i>Terminalia</i> swamp forest 288 km <sup>2</sup>

**Table 2.1.1 below lists the major wetland vegetation communities mapped by Hansell and Wall (1976).**

Mangroves are the most extensive wetland type in the Solomon Islands. Hansell and Wall (1976) found mangroves on most islands and covering large coastal areas on Isabel, New Georgia and Malaita. On Makira and Guadalcanal, mangroves are more or less confined to the eastern extremities at Star Harbour and Marau Sound respectively. The mangrove communities are characteristically species-poor by South East Asian standards, but rich by Australian standards. Woodroffe (1987) lists 19 species for the Solomon Islands. The most widespread genera are *Rhizophora* (four species) and *Bruguiera* (three species), while *Avicennia* (three species) occurs locally but not in large stands. Other mangrove species include two species of *Sonneratia* and single species of *Ceriops*, *Aegiceras*, *Xylocarpus*, *Lumnitzera*, *Osbornia*, *Scyphiphora* and *Nypa*. There are ten wetland vegetation types in the Solomon Islands. Three examples of these given below:

1. Low Mangrove forest: Low (2-5 m) and sometimes stunted mangrove forests occur along the seaward margins of coastal swamps or locally in back swamp areas.
2. Reed Swamp: Small areas commonly dominated by *Phragmites* occur on most islands, often close to large rivers where they fill abandoned meanders. The ground cover largely consists of scattered small trees with a low cover of grasses, sedges or reeds.
3. Sago Palm swamp: This forest type is dominated by the sago palm *Metroxylon* sp. On Guadalcanal, some of the larger swamps contain almost pure stands of *Metroxylon sagu*. In other areas, scattered individual emergents of *Eugenia tierneyana*, *Inocarpus fagiferus*, *Erythrina orientalis* and *Pandanus* sp. are commonly associated with sago. Because of its importance in the economic life of village communities, sago has been distributed and planted around the islands so that many stands can be considered to be cultivated.

There are a number of small lakes or brackish lagoons throughout the Solomon Islands, but the two most notable are Lake Te-Nggano on Rennell and Lauvi Lagoon on Guadalcanal. Due to its isolation, the island of Rennell has a high proportion of endemic species. Lake Te-Nggano is most notable for an endemic species of sea krait (*Laticaudacrockeri*) which is found nowhere else (McCoy, 1980). Lauvi Lagoon supports the largest single population of Estuarine Crocodiles (*Crocodylus porosus*) in the Solomon Islands. A national survey in 1989 (Messell & King, 1989) found that the crocodile population was severely depleted. Messell and King estimated that the total population was only about 1,000

individuals, and concluded that the species was now threatened with extinction throughout the Solomon Islands. Only a few scattered localities appeared to support viable populations.

For Vaghena, the category is synonymous with saline swamp forest where tall and low mangrove vegetation exists. Most of the 19 species of mangrove are found from Choiseul, Rob Roy and Vaghena. In Vaghena the tall mangroves exist along the Seleana River system, whilst the low mangrove exists on the east side of the Island (Plate. 2.1.1a).



**Plate 2.1.1a: Left to Right: Rob Roy Mangrove, Low Mangrove of Vaghena East and Tall Mangrove Stands on the Banks of the Seleana River**

The terrestrial flora of Vaghena Island largely resembles most of the flora of the Choiseul, except for the habitat difference due to its low altitude island topography. The entire Island especially on the northern part on both the west and east side is prime forest with the average distribution of large timber being described as sparse but with the average tree height exceeding more than 24m. Most of the wooden framework for all of the housing in the three settlements is derived from the forests of Vaghena, as well as for housing, local timber is used for most of the furniture and canoes etc. Most of the trees, shrubs and grasses observed are native to the Island.

A detailed study of the flora was not carried out due to the inaccessibility of the interior of the Island. Since no-one resides in these areas, a new track is required to be constructed to access these sites, however related studies taken from the neighbouring islands of Choiseul and Santa Isabel provide a relative distribution of the types of flora on Vaghena which may replicate most of the same species. In Choiseul a dataset generated from the SSM EIS on Choiseul provided information on most dominant flora species on Choiseul and Isabel Islands and also determined the composition and richness of the Solomon Islands terrestrial faunal assemblages and the conservation status of fauna in that project area. The baseline vegetation was completed by sampling randomly selected 20m x 20m quadrants. A total of six sites were selected and twelve quadrants were sampled on both Choiseul and Isabel islands. A total of 95 and 104 flora species were identified along the Choiseul and Isabel Island transects respectively, by a Solomon Islands botanists. Vaghena, on other hand, would lack inhabitant diversity, but maybe high in endemism which would require detailed study to assess. The only inland area that the survey team could reach was the eastern side, which was accessed by the geologists engaged by SBL to sample and reassess the bauxite deposit in 2012 (Plate 2.1.1b)



**Plate 2.1.1b: The flora of the East Forest of Vaghena shows a typical flora resembling that of Choiseul**

### **2.1.2 Wildlife**

The Solomon Islands has a large variety of wildlife. However very little work has been carried out in detail at Vaghena, this EIS document is proposing a detailed study is to be undertaken during the production phase, so that detailed inventories of the flora and fauna of the unexplored sites in the mining area are to be developed. The information gathered to date is only from spot observations which do not meet the detail required for a wildlife inventory of this unique island ecosystem.

### **2.1.3 Herpetofauna**

The *herpetofauna* of Vaghena Island consist mainly of crocodiles, lizards, turtles, frogs and snakes. They can be located at different locations and these include vegetated areas, freshwater wetlands, mangroves and marine sites, especially in the deeper and pristine forest that surrounds the upper northwest and northeast side of the Island. For example crocodiles are mainly found in mangrove swamps, on the Seleana River banks, but may also be located in and around coastal fringes foraging at night. The same can be said about turtles, but they are becoming quite a rare sight due to their meat being a delicacy for the local villagers. For a similar reason, dugongs are also becoming quite rare. Snakes inhabit both land and the water. Frogs and lizards are mainly located on the land, but their habitat is under threat wherever development results in its removal. The skink (*Sphenomorphus transverses*) is endemic to Vaghena.

### **2.1.4 Birds**

There are a total of 289 bird species in the Solomon Islands. Out of these 71 are listed as endemic (*E*), 3 introduced (*I*) and 39 rare (*R*). Refer to Table 2.1.4A & B below. Sadly the habitats of many birds found in the Solomon Islands are being diminished by industrial logging or where the forest and grasslands are

being converted to agricultural development, or destroyed by expanding human settlements. Some are unique to the Solomon Islands while two have are endemic only to St Cruz and Nendo. They are the Cardinal Honeyeater and the Red Jungle Fowl which are protected by Government Wildlife Act. The Red Jungle Fowl is an introduced species. A study was completed by Tarburton, K M, in 2005, who carried out a bird assessment on Ondalau Island, South of Vaghena Island (refer to Table 2.1.4A). This is in very close proximity to the Vaghena Island and is likely to closely reflect many of the observed species on Vaghena as seen during the site trip in 2012.

#	Common Name	Scientific Name	Ecological Status	Abundance	References
1	Lesser Frigatebird	<i>Fregata Ariel</i>	Res	1 seen 21.12.05	1
2	Melanesian Scrubfowl	<i>Megapodiuseremita</i>	Res bre	1 heard 21.12.2005	1
3	Crested Tern	<i>ThalasseusBergicristanus</i>	Res bre	1 seen 1km offshore	1
4	Little Tern	<i>Sternulaalbifrons</i>	Res	1 feeding 21.12.05	1
5	Island Imperial Pigeon	<i>Dueulapistrinaria</i>	Res	6 feeding 21.12.05	1
6	Cardinal Lory	<i>Chalcopsitta cardinals</i>	Res bre	3 seen 18.12.05, 2 flew towards Isabel then returned	1
7	Collared Kingfisher	<i>Todirhamphuschloris</i>	Res bre	1 heard 21.12.05	1
8	Yellow-bellied Sunbird	<i>Nectariniajugularis</i>	Res bre	5 seen + 1heard & fledging. 21.12.2005	1

**Key:** Ecological Status End –Endemic to island unless otherwise stated. Res Bre=Resident Breeder, Res=resident i.e breeding not proving or not likely. Reference: Tarburton, M.K. 2005, Personal Field Notes

In 2005 prior to the Ondolau Bird Assessment, a detailed study was undertaken on Vaghena by Tarburton, K.M. Table 2.1.4b shows the result of this assessment.

#	Common Name	Scientific Name	Ecological Status	Abundance	References
1	Lesser Frigatebird	<i>Fregata Ariel</i>	Res	1 seen 21.12.05	1
2	Little Tern	<i>Sternulaalbifrons</i>	Res	3 feeding 1km offshore 13 perched in tree 16.12.05	1
3	Black-naped Tern	<i>Sterna s.sumatrana</i>	Res	1 feeding 1km offshore 29 perched in tree 16.12.05	1
4	Brown Noddy	<i>Anousstoliduspileatus</i>	Res	16 feeding 1km offshore 16.12.05	
5	Black Noddy	<i>Dueulapistrinaria</i>	Res	19 feeding 16.12.05	1
6	White-billed Crow	<i>Chalcopsitta cardinals</i>	Res bre	Coll AMNH	2

**Key:** Ecological Status End –Endemic to island unless otherwise stated. Res Bre=Resident Breeder, Res=resident i.e. breeding not proving or not likely. Reference:1. Tarburton, M.K. 2005, Personal Field Notes 2.Mayr. E. & J. Diamond. 2001. Birds of Northern Melanesia. Oxford University Press.Oxford.

Overall the bird distribution on Vaghena has been affected by human intervention since the first residents arrived on Vaghena in the early 1960's, particularly the logging of forests on the periphery of the village settlements and of other accessible sites around the Island including the Seleana River banks where, tropical forest continues and is blended with coastal vegetation.

### 2.1.5 Mammals

There are 57 mammal species in the Solomon Islands of which four are critically endangered, one endangered and 15 vulnerable. Some of these endangered and vulnerable species are rodents and bats, *Sirenia* etc. *Rodents (Rodentia)* which make up the largest order of mammals with over 40 mammalian species available. These include mice, rats and gerbils etc., which are members of the *Muridae* family. The Poncelets Naked-Tailed Rat (*Solomysponceleti*)-(EN)<sup>15</sup> and the Florida-Naked Tailed Rat (*Solomysalamoms*)-(VU) are two members of this family. The Solomon Islands has nine bat species. The most distinguishing feature of bats is that their forelimbs are developed as wings making them the only mammals in the world that fly. They account for 20% of all mammal species in the Solomon Islands. The Solomon Islands bat species include the Naked Fruit Bat (*Dobsoniainermis*)-(LR/lc), the Common Tube-Nosed Bat (*Nyctimenealbiventer*)-(LR/lc), Island Tube-Nosed Bat (*Nyctimene major*)-(LR/lc) and the Guadalcanal-Monkey Faced Bat (*Pterlopeanceps*)-(CR). Fully aquatic herbivorous mammals that inhabit rivers, coastal marine waters, swamps, and wetlands include *dolphins*, *porpoises*, *dugongs* and *whales*. Most of the above bat species are found on Vaghena Island. During the recent site observation expedition, breeding and residential habitats of bats were observed along the Seleana River (Plate 2.1.5).



Plate 2.1.5: Shows the Residence of Bats Along the Seleana River Banks toward the Interior of Vaghena.

### 2.1.6 Conservation Significance of the Fauna and Flora

The fauna of the Solomon Islands is of considerable international importance. With the exception of Papua New Guinea, the Solomon Islands have a greater diversity of animal species and a higher level of endemism than any other Pacific island nation (Leary, 1991). Little is known of the ecology and habitat preferences of most of the animal species. However, at least some appear to be wetland dependent. For example, there is an endemic subspecies of the Mangrove Monitor *Varanusindicus spinulosus* which appears to occur only in the San Jorge and Thousand Ship Bay area, on both sides of the Ortega Channel.

<sup>15</sup> NB. EN-endemic, VU-vulnerable, LR/lc- least common, CR-common resident

This area supports a distinctive vegetation community (*Casuarina* swamp forest), found nowhere else in the Solomon Islands. Further taxonomic examination may reveal that *spinulosus* is in fact a distinct species. The preferred habitat of an endemic giant rat (*Uromysponceleti*) is believed, by local residents, to be *Terminaliabrossii* swamp forest. This giant rat is found only on Choiseul.

There are approximately 50 species of waterfowl and seabirds in the Solomon Islands (Mayr, 1945). Of these only Becks' Petrel (*Pterodromabecki*) and Solomon's Sea Eagle (*Haliaeetusanfordi*) are listed as globally threatened species (Collar and Andrews, 1989). However, Diamond (1987) also states that the Grey Teal (*Anasgibberifrons*) has not been recorded in the Solomon Islands since 1928, and this may now be extinct in the archipelago.



**Figure 2.1.4: Some Species of Birds in the Solomon Islands. Also Pictured the Threatened Solomon Sea Eagle**

Freshwater wetlands and mangroves are of economic importance to the largely subsistence economy of Solomon Islanders. The leaf of the sago palm, in particular, is an important building material, and is also extensively used in traditional weaving. Mangroves and other types of swamp forest also supply important building materials and food resources ranging from the fruits of mangroves to a large variety of shells, crustaceans and fish. There is little information on the fish of the mangroves of the Solomon Islands, but Blaber and Milton (1990) sampled 13 estuaries and found 136 species, although no individual estuary contained more than 50 species.

The relatively sparsely populated nature of the Solomon Islands has resulted in few threats to freshwater wetlands and mangrove areas. To date, mangroves have not been exploited on an industrial scale, and are protected under the Forest Resources and Timber Utilization Act. However, there is some exploitation of mangroves by customary landowners for fuel wood for fish smoking, especially in the vicinity of the Noro fish cannery. Some degradation of mangrove resources is occurring through clearing for new settlements and expansion of old settlements, cutting for firewood (especially for drying copra and bech-de-mer), siltation from onshore soil erosion resulting from agriculture and forestry activities,

and landfill for coastal "reclamation", especially by using mangroves as dump sites. The latter is restricted to the vicinity of provincial capitals and is not widespread.

## 2.2 BIOLOGICAL SETTING – FRESHWATER

The Vaghena Island freshwater environment is insignificant compared to larger volcanic islands in the Solomon Islands since it has only two freshwater creek systems with one being seasonal. In consequence, the mine poses no significant threat to Kukutin Creek, the creek which divides the Kukutin and Arariki villages on the southwest side of the Island.

### 2.2.1 Freshwater Fish

During a terrestrial biodiversity survey<sup>16</sup> of Choiseul Island, freshwater fish surveys were conducted in seven sites between July 2005 and August 2006. The study found 32 fish species from 15 families (38% of known Solomon Islands freshwater fish). Most species were uncommon with the exception of *Kuhliamargianta* (6/7sites), *K. rupestris* (5/7 sites) and *Glossogobius* (5/7 sites). No introduced species were found in any of the sites. Species richness ranged from 2 to 14 species per site and was highest in Lumutu River and Kolombangara River. This difference between the sites is partially attributed to substrate type (highest richness in sites with gravel substrates than mud) and distance from the coast (higher richness near the coast than inland). The result of the survey, in conjunction with a previous survey, brings the total number of freshwater fish species on Choiseul Island to 41. This diversity is threatened by habitat degradation through sedimentation and the overharvesting of some species.

Freshwater ecosystems are the most productive and diverse ecosystems and are estimated to support over 10,000 species of fish. Of the 1,000+ islands in the Solomon Islands, Choiseul is recognized as one of the most biodiverse for a number of terrestrial taxa including birds (McClatchey et al.2005), plants (McClatchey et al.2005), reptiles (McCoy 2006) and frogs (Morrison et al. in press). This has been primarily attributed to its relatively large land size. Table 2.2.1 below summarizes the description and location of the seven freshwater fish survey sites on Choiseul Island.

Site/Physical characters	Sene Creek	Lumutu Creek	Vurulata Creek	Kolombangara River	Bisilata Creek	Sui River	Manapagu River
Date Surveyed	16/08/05	17/08/05	18/08/05	23-24/08/05	25/08/05	03/09/05	08/01/06
Width (m)	2-3	8-14	8-12	7-15	2-5	1.5-4	6-9
Depth (m)	0.1-1	0.1-3	0.1-2.4	0.1-3.2	0.1-1	0.1-2.2	0.1-1.2
Speed (m)	0.1	0.5-1	0.2-0.7	0.5-0.8	0.1-0.3	0.5-1.5	0.5-0.8
Distance from ocean (km)	2.0	3.25	3.75	5.25	6.0	1.5	11.25
Stream type and major habitat	Riparian plants along the creek edge. Flows through lowland tropical rainforest.	Riparian plants river edge. Flows through a lowland rainforest.	Paragrass and ferns are the dominant Riparian plants on the river edge.	Paragrass and ferns are the dominant Riparian plants on the river edge.	Paragrass and ferns are the dominant Riparian plants on the river edge.	Sui River above Parasi waterfall. Flows through garden and low land secondary forest	Riparian plants along the river edge. Flows through primary tropical rainforest.
Major substrate	Soft muddy bottom	Boulders in the river	Muddy on the river	Muddy edge with gravel	Soft muddy bottom	Limestone rock with	Rocky river edge, boulders

<sup>16</sup>Boseto.D et.al, SPCNS-Journal, 2007 3. 16-21

type		with sand and gravel bottom	edge with gravel and sand on river bottom	bottom		gravel bottom	in the river with gravel bottom
Lat/Long	07°18'04.6'' S 157°05'57.3' E	07°14'49.9'' S 157°07'12.6' E	07°11'26.3'S 156°59'16.2' E	06°59'05.6'' S 156°45'57.8' E	06°59'23.6'' S 156°46'34.8' E	06°041'46.0'' S 156°26,28.3'' E	07°04'19.3'' S 157°01'45.2'' E

Table 2.2.1: Summary of Description and location of freshwater fish<sup>17</sup>

### 2.3 BIOLOGICAL SETTING - MANGROVES

Mangroves are found on most islands in the Solomon Islands. On Choiseul, many are found at the south eastern end of the island, including Vaghena and Rob Roy Islands. Leary (1996b) reported the dominant mangrove species to be *R.stylosa* and *R.apiculata* with local concentrations of *S.caseolaris* and *N.fruticatus*. Other species are *Bruguieraspp*, *L.littorea* and *X.granatum*.

Mangroves and coconut groves shelter the coastal strips, while the interiors of the high islands are swallowed by dense rainforest. The forest climbs through 24 belts, from towering lowland hardwoods to the mosses atop Guadalcanal's 2,300metre peaks. Where the forests have been destroyed by slash-and-burn agriculture or logging, grasslands have taken hold. Crocodiles lurk in brackish mangrove swamps in the river deltas, while sago palms grow in freshwater swamps. More than 230 varieties of orchids and other tropical flowers brighten the landscape. Of the 4,500 species of plants recorded so far, 143 are known to have been utilized in traditional herbal medicine. The endemic land mammals (bats, rats, and mice) are mostly nocturnal, so they are rarely seen. The grey cuscus is the only marsupial found in the Solomon Islands. Birdlife, on the other hand, is rich and varied, with about 223 species including 16 species of white-eyes, fantails, rails, thrushes, and honeyeaters that occur only in the Solomon Islands. The most unusual is the megapode or incubator, a bird that lays large eggs in the warm volcanic sands of the thermal areas. After about 40 days, the newly hatched megapodes dig themselves out and are able to fly short distances as soon as their wings dry. There are many species of colourful parrots and 130 species of butterflies, including several species of birdwings. The 70 species of reptiles include crocodiles, frogs, lizards, skinks, snakes, toads, and marine turtles. The five species of sea turtles nest from November to February. Several of the 20 species of snake are poisonous, but fortunately they're not common and therefore are not a major threat. Centipedes and scorpions are two other potentially dangerous but seldomencountered jungle creatures. The isolated Santa Cruz Group has fewer indigenous species than the main island chain. Each year thousands of rare birds, reptiles, amphibians, aquarium fish, and butterflies are exported from the Solomon Islands and are sold in Asia, North America and Europe.

The mangrove swamps harbor many species which are of economic value and constitute an important food source. This includes oysters, clams, gastropods and crustaceans such as mangrove lobster (*Thalassinaanomala*), commercially imported prawns which have become invasive (e.g.*Penaeusspp*), the coconut crabs (*Birguslatro*), hermit crabs (*Ucaspp*), etc.

Many of the fish species are equally important food fishes for e.g. snapper, mullet, rabbit fishes etc. 136 species of fish from 13 families have been recorded in the Solomon Islands (Blabber & Milton in Leary, 1993)

<sup>17</sup>Boseto.D et.al, SPCNS-Journal, 2007, 3. 16-21



**Figure 2.3: I-Kiribati Settlers on Vaghena Using a Canoe as a Source of Transportation through a Mangrove Swamp.**

In summary, Vaghena Island mangrove is dominated by *Rhizophora* and *Bruguiera* while *Lumnitzera* is commonly found. As observed, many living organisms rely on the mangrove ecosystem. Mangrove habitats provide an array of uses to humans directly and indirectly. On the subsistence level, humans rely heavily on the mangroves and the mammals associated with them for a variety of products including food, firewood, building materials and medicine.

#### **2.4 BIOLOGICAL SETTING - MARINE**

A healthy environment is paramount to the wellbeing and security of Solomon Islanders and with approximately 85 per cent of the population relying on a subsistence lifestyle, sustainable use and conservation of biodiversity is critical. Loss of biodiversity and a healthy environment can lead to hunger, poverty, disease and conflict, and is a threat to the internal security of the Solomon Islands. It also leaves coastal communities vulnerable to the impacts of climate change due to loss of protection for coastal habitats.

The environment and natural resources of the Solomon Islands are under threat. The threats include invasive species; loss of major land and marine habitats; over exploitation of natural resources; destructive harvesting techniques; and climate change resulting in sea level rise and more frequent destructive climatic events. The root causes stem from human activity - increasing population, increasing consumption, changing economic circumstances and the need for cash, the drive for a more technological world, and even globalisation.

The population of the Solomon Islands is increasing at approximately 4.4% annually. This is putting pressure on natural resources and land for food and food production, building materials, and other life

support systems. Land is cleared for timber, forestry, oil palm plantations, farming, urban and rural developments and infrastructure. Marine habitats are damaged by destructive fishing practices such as blasting and poisons, pollution and harvesting of rock and coral. Solomon Islanders are moving to a cash economy for school fees, petrol and kerosene, and for processed foods. This is resulting in a loss of traditional methods of natural resource management and use.

Compounding the impacts of human pressure is the threat of climate change and sea level rise. Unfortunately for small island states like the Solomon Islands, the developed countries are the main producers of greenhouse gases and other climate changing factors. However, the effects will severely impact coastal communities, islands and atolls, unless there is a serious attempt at national level mitigation and adaptive measures to ensure the Solomon Islands is prepared to deal with the changes and impacts.

#### **2.4.1 Detailed Habitat Descriptions**

The study divided the marine area into two main environments, these were: the shallow flats/near shore slopes and the deeper and off-shore reefs. A summary of these two different marine environments follows. Considering the shallow flats and near-shore slopes; salinity, pH, and temperature in this area was normal for Solomon Islands seawater, and bacterial levels were low to moderate, affected by runoff from the nearby Kukutin Creek. Water turbidity and sedimentation were extremely high, leading to most surfaces being covered by a thick layer of soft, deep silt. Water was shallow (less than 4m at low tide) up to about 400m from shore. Refer to Section 1.3.3.

The dry reef flats are composed largely of dead coral fragments and layers of dark, soft mud. A small live coral community exists at the seaward edge of the flats, but it was heavily sediment laden and in poor health. There is also a small algae community at the reef edge, but none of notable biological significance.

A sand flat exists to the west and southeast of the site, where the major economic crop of the islanders, especially seaweed, does have an indication of the sea grass (*Halodule wrightii*), it is expected that this is just one of the many surface organisms of any biological significance found in the area. However this needs to be verified (refer to Plate 2.4.1).

The second main environment, the deeper sea bed, in which it is expected that the sea floor will be 100% covered with deep, soft, dark silt. This sedimentation is dark and muddy, and probably originates from deforested land via rivers and creeks in the area. There is no live coral or algae.

Tidal currents are negligible, although there is a change of direction with tidal changes from northwest to southeast during incoming tides and vice versa during outgoing tides. The deep silt in deeper areas and the sand flat that exists in pockets along the main coastline of the inhabited south coast of the Island are probably a result of these low current conditions. In all areas, many subsurface invertebrates are to be found, and larger invertebrates are collected by locals in the mangrove areas. This is important to both local subsistence fisheries, and the food chain for larger fin-fishes. Although no fish assessment was undertaken, local fishers report good catches in the area, probably of fish which feed in the mangrove roots at high tide. This possible source of raw data has to be verified on site.



**Plate 2.4.1: Shows the Sea Grass (*Haloduleoavalis*) Growing Naturally on the East Coast**

Recent studies<sup>18</sup> have shown that mangrove environments of this coastline are of enormous importance to the local fisheries and reef environment and that as little disturbance as possible should be made to them. The main potential impacts of construction or dredging in the area are changes to sand and mud flats, if strong currents are caused by solid obstructions to tidal flow, and increased sedimentation of surrounding areas due to disturbance of the soft sediments which form the sea floor at all points sampled within the southeast coast where the bulk carrier wharf is proposed to be constructed.

#### **2.4.2 Deeper and Off-Shore Reefs**

The offshore reefs are quite deep, they cannot be seen during low tide, and slope upwards to silt flats which are between 7 and 14 meters deep, but further out propagate to more than 20-30m deep. Some reefs on shallow areas have mangroves growing on the flats, others do not.

In most cases, reefs appear to be less heavily sedimented at greater depths and less in shallows waters where wave action has a little energy. Water turbidity and sedimentation were heaviest within 1 kilometre of the shore, heavy up to 3.5 kilometres from shore, and slightly lower 7 to 8 kilometres from shore. All deeper flats, if examined will definitely consist of deep, soft brown silt, probably originating from deforested land brought into the sea via rivers and creeks on the south side of the Island due to human settlement at Arariki. However it is also expected that very little sediments will have been derived from the interior because the only possible source is the existing seasonal Kukutin Creek.

On the shallower reef areas, where sediments do not settle so thickly due to wave action and littoral drift, the coral cover is widespread and diverse, although many corals tend to suffer from bleaching, which is expected to be due to sedimentation and increase water temperature. Very few large edible invertebrates are to be found, possibly due to overfishing, but also possibly as a direct result of

<sup>18</sup> Jenkins et al 2004

sedimentation. Large star fishes were found on reefs with higher coral cover. Fish numbers and variety observed were low on all sites, but fishing catches appear to be good, as fishing is carried out in deeper water on the outer edges of the Island, especially in the uninhabited locations to the northwest of the Island. Fish of particular conservation value are to be assessed.

### **2.4.3 Overview of Marine Study Findings**

The immediate marine area adjacent to the proposed development on the southeast side of the island reflects a shallow sea floor with reef flats and a silt-bottomed bay at Ndavuna Inlet. Further from shore there are patches of fringing reefs, which are less sedimented with terrigenous silts, except the calcareous silt flats at 7 to 14 metres depth. The site is also a sensitive site with vulnerable reef ecology, particularly the endangered dugong and sea turtle. The mangrove fringing forests are extensive and of great importance to the area's coastal protection and fisheries, which would be made vulnerable if any significant mangrove removal was proposed. It is imperative therefore that a proper environmental management plan is to be put into place to safeguard future sustainability of these resources.

### 3.0 SOCIO-CULTURAL ENVIRONMENT

Any major development will have some impacts on the social and cultural values of all stakeholders within the vicinity of the project site. This section briefly describes the existing socio-cultural environment around the Vaghena Island site and how the project will affect stakeholders and the socio-cultural environment.

#### 3.1 Existing infrastructures/utilities -access and transportation

Due to the remote location of the project area, it is uninhabited and undeveloped. There is no form of utilities or infrastructure available, apart from mobile phones. There is no wharf, airstrip or jetty to service inter island cargo ships, and only walking tracks exist around the settlements on the southern coast. The only way to get around the Island is either by foot or by open runabout boats, locally called canoes, which are made from wood or fiberglass materials.

#### 3.2 Settlement and land use within 1km boundary of project

There are no villages or significant settlements located within 1km of the boundary of the proposed major mining activities or processing facilities planned within the project area. However, the proposed airstrip and small sections of the bauxite deposit are adjacent to Nikumaroro Village boundary. Apart from emergencies, all airstrip movements will be constrained to daylight hours. Any construction or mining which occurs within 1km of residences will only take place during daylight hours on Monday to Saturday and after consultation with potentially affected residents. The main haul road will be located at least 500m from the nearest existing residence.

It is recognized that there are concerns to be addressed with the residents of the villages who derive their livelihood from subsistence farming and fishing on and around the Island. These villages are Arariki, Kukutin and Nikumaroro, which is the closest village to the project site.

In particular, SBL will develop and implement plans for the management of key local issues. These plans will include:

- A Community Relations Plan (including consultation protocol)
- An HIV/AIDS Prevention Training Program; and
- A Traffic Management Plan.

The adoption and communication of these plans will enable SBL to better address community concerns and provide information, particularly in the relation to the conduct of non-local mine workers and the use of the local resources, particularly any resources that are within the village boundaries, although it is currently believed that apart from potential mine workers and some local food supplies, all resources will be drawn from outside the village boundaries.

#### 3.3 Demographic profiles and population numbers

The 2009 population census indicates that the population of Vaghena Island may exceed 1500 people, (refer to Table 3.3 below) most of whom are distributed among the three villages of Kukutin (about 700), Arariki (about 500) and Nikumaroro (about 400). However, other studies have shown that there are more than two thousand residents on Vaghena. The inhabitants are ethnic Kiribati (Micronesians), who were relocated, to the Solomon Islands from the islands of Orona (Hull Island) and Nikumaroro (Gardener Island) in the early 1960s. While Tengangea-Kukutin often referred to as Kukutin is Catholic, the people of Arariki and Nikumaroro belong to the United Church. The two communities of Tengangea-Kukutin and Arariki are adjacent to each other, while Nikumaroro is located further to the east on the south coast of the Island.

The villagers live in traditional houses made from local materials as shown in Figure 3.4. The village vegetable gardens are located on the south coast and for a short distance inland. Coconut plantations are located in the villages and on nearby islands. Copra production is very limited and is controlled by co-operative societies. Fish, turtles and coconuts are the staple diet. The north coast areas are deserted, visited only by Choiseul and Santa Isabel people, mainly for fishing and shell gathering.

The easiest way to reach Vaghena is by plane to Kaghau Airstrip, Choiseul Province, from Honiara (currently twice a week). From Kapaau it takes only 45-60 minutes by boat to Vaghena.

Prov	B/Sex	M	F	H/hold	Ins	B/Sex	M	F	H/hold	Ins	B/Sex	M	F	H/hold	Ins
Sol Island	515,87	264,46	251,42	91,25	990	101,80	53,480	48,320	15,335	261	414,07	210,98	203,095	75,916	729
Choiseul	26,372	13,532	12,840	4,712	28	810	428	382	145	4	25,562	13,104	12,458	4,567	24
<b>Vaghena</b>	<b>1,636</b>	<b>852</b>	<b>784</b>	<b>250</b>	-	-	-	-	-	-	<b>1,636</b>	<b>852</b>	<b>784</b>	<b>250</b>	-
Katupika	1,988	1,018	970	399	4	-	-	-	-	-	1,988	1,018	970	399	4
Vasipuki	1,574	806	768	312	1	-	-	-	-	-	1,574	806	768	312	1
Viviru	1,499	771	728	289	-	-	-	-	-	-	1,499	771	728	289	-
Babatana	1,746	863	883	325	2	-	-	-	-	-	1,746	863	883	325	2
Tepazaka	1,680	893	787	322	2	-	-	-	-	-	1,680	893	787	322	2
Batava	4,931	2,578	2,353	802	15	810	428	382	145	4	4,121	2,150	1,971	657	11
Tavula	2,487	1,240	1,247	418	-	-	-	-	-	-	2,487	1,240	1,247	418	-
Polo	1,719	872	847	305	-	-	-	-	-	-	1,719	872	847	305	-
Bangera	1,158	576	582	189	-	-	-	-	-	-	1,158	576	582	189	-
Susuka	1,726	896	830	301	-	-	-	-	-	-	1,726	896	830	301	-
Senga	1,848	945	903	344	-	-	-	-	-	-	1,848	945	903	344	-
K/panga	1,140	553	587	204	2	-	-	-	-	-	1,140	556	587	204	2
Kirugela	1,240	669	571	252	2	-	-	-	-	-	1,240	669	571	252	2

**Table 3.3: Total Population by Sex and Number of Private Households by Urban-Rural Distribution and Ward, Solomon Islands, 2009.**

### 3.4 Socio-Economic-Seaweed Farming

The live seaweed stocks for farming were introduced and distributed to interested farmers in early 2004. Registered farmers reached a production record of 232 tonnes when the price of seaweed was \$2.00 per kilogram. In June 2004 dried seaweed production from Vaghena reached more than 9 metric tonnes and became the number one site, taking over from Rarumana. In 2005, the Rarumana site was seriously affected by disease, which destroyed about 90% of the farms, leaving Vaghena as the only major site and supplier in operation.

When the European Union approved and provided funding for a Seaweed Project in July 2005, there were ample stocks of seaweed planting material available in Vaghena to enable other sites such as North Malaita, Ontong Java and Reef Islands to be established. Since its introduction, Vaghena farmers have maintained dry seaweed production for export, albeit at fluctuating levels. Currently there is a significant resurgence in the farming effort, due to the banning of *beach-de-mer* harvesting and more important an upward movement in the farm gate price. Figure 3.4 shows a family with their harvest. A record of more than \$500,000 revenue was generated from cultivating seaweed by Vaghena farmers in 2005.



**Figure 3.4: A Typical House in Vaghena and Harvested Seaweed.**

Based on socio-economic survey results, using fully-structured, closed questionnaires, and including 58 households, the average household size is large, ranging from six to eight people, and today, most households in the three communities are engaged in seaweed farming (69%). Refer to Table 3.4 below.

	Arariki	Tengangea/Kukutin	Nikumaroro	Wagana
<i>Data (estimated) from 2009 census</i>				
Total number of households	70	79	60	209
<i>Data from FAO seaweed socio-economic survey November 2009</i>				
Number of households surveyed	19	22	17	58
Number of seaweed farming households (surveyed)	14	14	12	40
Number of non-seaweed farming households (surveyed)	5	8	5	18
Average household size (surveyed)	6	8	7	7
Total population estimated	399	593	390	1382
Total population surveyed	108	164	110	382
Population and household survey sample (%)	27	28	28	28

**Table 3.4 Shows the Number of Households Engaged in Seaweed Farming.**

### 3.5 Education and Religion

The availability of a primary and secondary school (Vaghena Community High school) on Vaghena Island ensures that the young are able to be educated. The schools are attended by local residents living in or close to Kukutin or Arariki village. Tertiary education is then pursued abroad, mainly at the University of the South Pacific located in Fiji. Catholicism is the main religion; however, other religious denominations exist.

### 3.6 Culture and Music

Traditional forms of art on the Island comprise mainly of the use of natural materials. The main artifacts are made from different types of wood - especially ebony, shells and leaves. Inlay works are a specialty

of the Solomon Islands. Among them, the most famous are the wood inlays and pearl shell inlay. Weaving and plaiting of baskets are also of considerable artistic and utilitarian significance. Making traditional war accessories like shields and canoes are also considered a form of art. The making of battle canoes having "Nuzunuzu" prows is an important skill. The I-Kiribati descendants on Vaghena still hold on meticulously to their I-Kiribati traditions of mat weaving and traditional "Batere" dances<sup>19</sup>.

The Solomon Islanders are very traditional people and still adhere to a great extent to their ethnic way of life. They also have a strong national and clan consciousness. However, they live a simple life, full of the culture and tradition that is sadly missing from modern life in most countries.



Figure 3.6: Culture and Music of the Solomon Islands of Melanesian Origins.

### 3.7 Status of Sexually Transmitted Diseases

Sexually transmitted diseases, including HIV, are a major emerging public health problem in the Solomon Islands. As the main transmission mode of HIV has been found to be heterosexual sex, this has led to fast growing epidemics, and as a result, this disease poses a risk to the whole population (WHO 2006). Other risk factors in the Solomon Islands for a fast growing HIV epidemic include: the high incidence of sexually transmitted infections; a considerable level of homosexual and male bisexual activity; high incidence of unprotected sex among teenagers; a high incidence of drug and substance abuse; a mobile population; many people working abroad; a large tourism industry; and cultural behavior that includes a considerable degree of extramarital sex and sexual violence (WHO, 2006). Of the known HIV infections in the Solomon Islands, over half are male, and 82% are in the indigenous Solomon Islands population (UNICEF, 2007). The Solomon Islands Ministry of Health advises that this is likely to be a gross underestimate of actual incidence due to the low level of surveillance.

### 3.8 Water Supply and Evidence of Sufficiency for Development Proposal

<sup>19</sup> [www.solomoncultures](http://www.solomoncultures)

The project development will require potable and ablution water for employees (700-1000 day employees and their families accommodated on site), sewerage systems, bauxite processing vehicle wash down bays, and dust suppression. SBL plans to draw this water from a bore field and/or local springs. Water intended for potable uses will be treated to an appropriate standard. Water from a surface water storage dam will provide an alternative source of water supply if necessary, as annual rainfall is 3500 to 5000mm per year. As the focus of the bauxite processing will be to remove water from the ore, the project will use only a small amount of water for processing. As the primary source of potable water and make-up supplies for process water at the mine site will be obtained from ground water and rainwater, there is sufficient water supply for the development.

### **3.9 Noise Impacts Including Traffic**

The use of machinery and equipment may create adverse noise impacts at residences mostly during the construction stages of the processing facility and from ongoing mining and processing operations. However, as most of these activities will take place at distances in excess of 1.5km from existing residences, noise impacts at residences are expected to be minimal. Construction peak hours will be from 7.00am to 6.00pm, whilst mining will take place from 6.00am to 10.00pm, up to seven days per week. Bauxite processing and ship loading will be undertaken up to 24 hours per day, seven days per week.

### **3.10 Traffic Management Plans for the Project**

Either on a permanent basis or during working hours, as appropriate, the following traffic management plans will be implemented:

- For safety reasons, local residents will not be able to access the project area, and in particular, active mining and other operational areas without permission and supervision.
- Signs and appropriate safety features be erected to indicate the location of the project area, haul road and any road works;
- Haul roads are to be well maintained and kept clear of any spillage caused by the movement of mine or other vehicles; the base operating hours for the mine and haul road cartage of bauxite are limited to 6.00 am to 10.00 pm Monday to Saturday. Work on Sundays will be undertaken for maintenance and from time to time to overcome production shortfalls caused by weather, machinery breakdown, etc. Mine and haul road night works (10.00pm to 6.00am) will be limited to rectification and maintenance. Screening, drying and ship loading of bauxite will take place up to 24 hours per day, seven days per week. Any variations to these hours and scope of work will only be undertaken after consultation with representatives of the Vaghena community;
- SBL is to ensure that the policy for the transport of materials to and from development and production sites contains strict criteria to manage and control: noisy vehicles, possible loss of loads or spillage, operating outside approved hours, exhaust emissions not meeting Solomon Islands emission standards, and speeding or unsafe use of vehicles. SBL shall demonstrate to the satisfaction of DOE that these provisions are in place prior to the commencement bauxite production haulage.

### **3.11 Accessibility to Site (issues)**

The easiest way to reach Vaghena is by plane to Kagau Airstrip, Choiseul Province, from Honiara (currently twice a week). From Kagau it takes only 45 - 60 minutes by boat to Vaghena. SBL is proposing to construct an airstrip and a small boat harbour to support transportation requirements. The small boat wharf will be within the ML at the southeastern end of the Island in Ndavuna Inlet. The local community will be able to utilise this wharf for their supply ships at times to be mutually agreed with SBL project management.

The mining areas will be accessible by 4WD vehicles, trucks and mobile mining equipment. The construction of the new private 6km long haul road for hauling bauxite from the mine to the processing facility is a key piece of infrastructure for the project, as it will provide a safe, direct and reliable source of transportation for SBL employees and equipment. After mine closure the road will remain for the use of local residents.

### **3.12 Waterways**

On the north side of the Island, Vaghena's largest river, the Seleana River stretches almost 7.5 km south into the centre of the Island. Its banks are densely covered in mangroves. Unless adequate safeguards are incorporated into planning and operating the mine, the removal of vegetation from the mining areas could result in erosion and storm water sediment being transported into the River. The Vaghena freshwater environment is insignificant compared to larger volcanic islands in the Solomon Islands, since it has only two freshwater creek systems with one, Kukutin Creek, which divides the Kukutin and Arariki Villages on the southwest of the Island, being seasonal. Due to its location, in a different catchment and well away from the project area, the project poses no threat to Kukutin Creek.

### **3.13 Sites of Archaeological or Historical importance**

An archaeological survey did not locate any sites or record of archaeological significance in relation to the project development areas. However, it will be necessary to have a response procedure in place during the construction and operations phase of the project if the situation arises where potential sites or features of significance are discovered.

#### 4.0 VULNERABILITY OF THE PROJECT TO NATURAL DISASTERS

The vulnerability of the project site and Vaghena Island to natural disasters, possible events or outcomes, in the order of decreasing probability is:

- Topsoil loss
- Land use or topography change
- Slope failure on the south coastline
- Cyclones and monsoonal rainfalls
- Earthquake
- Tsunamis; and
- Volcanism.

As a result of clearing of vegetation, exposure and removal of topsoil, prior to bauxite mining, there will be some permanent top soil loss, however, SBL will strive to minimize losses by ensuring that topsoil is selectively stockpiled and reused in rehabilitation activities as soon as possible. Any topsoil loss will potentially impact the ultimate land use or topographic land forms in the areas where bauxite mining has taken place. Mining will proceed on a strip basis with topsoil and other non-economic material which is moved ahead of mining placed in mined out areas behind the mining production face. Areas with little and/or no economic bauxite deposits will be left intact with vegetation undisturbed, apart from those areas which are contoured into mined out areas or required for roads, infrastructure and services.

The monsoonal rains and cyclones that can occur in December to April on an annual basis will potentially cause siltation issues unless mitigation facilities such as drainage systems to direct water flows from active areas to sediment traps are constructed. Where possible, clean rainwater will be diverted around active areas to minimise sediment laden water requiring settling before discharging to the environment. It is planned to incorporate these controls in and around the mining areas and the processing facility during the construction and operations phases of the project.

Earthquakes, especially events of high seismic intensity, can prove to be fatal if not detected early and if early warnings are not given, since these events may generate tsunamis which could pose major problems for unprepared villagers in the three coastal settlements on the south of the Island. SBL will monitor regional tsunami warnings, notify employees and residents of possible danger, and cease coastal activities during periods of high risk. Volcanoes are rated last, but must still be treated with caution due to the existence of the Savo volcano located approximately 350km to the southwest of Vaghena Island and other dormant and semi-dormant volcanoes in the region.

##### 4.1 Vulnerability of Project to Cyclones and Storm Surges

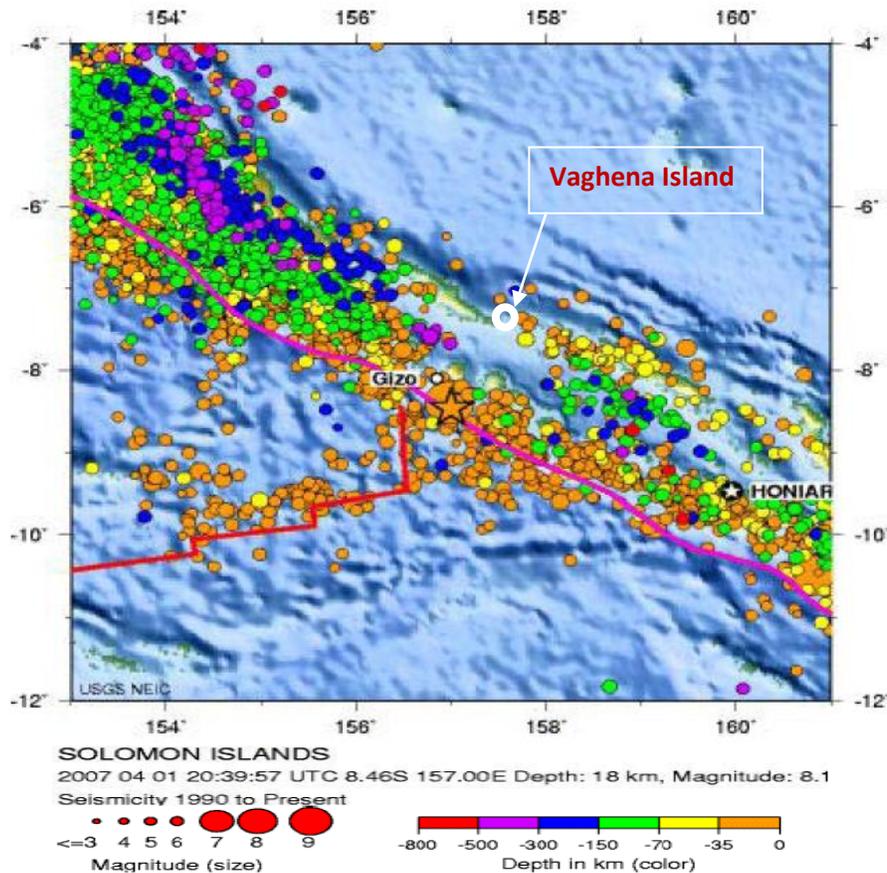
Vaghena Island is located in a tropical cyclone area. Due to the limited time that the Island has been settled, little information is available on the intensity and damage caused by previous cyclones. However, during November 1967, "Cyclone Annie" passed through Vaghena and it is reported that considerable damage was done to Arariki village. In June 1972, "Cyclone Ida" struck Vaghena with wind gusts up to 100km/h (60 mph), but little damage was reported.

Munda weather station on New Georgia Island recorded winds up to 30 knots and 7 inches of rain over a 48 hour period during "Cyclone Annie". The maximum wind recorded at Munda since this weather station was installed in 1962 is about 40 knots. The maximum wind gust recorded at Honiara was 67 knots on 28<sup>th</sup> March, 1967. Building regulations for Papua New Guinea have adopted a wind velocity for

design purposes of 80 m.p.h. (69 knots) for the easterly tip of Papua (east of longitude 150° E) which is in the same cyclone region as the Solomon Islands.

**4.1.1 Seismicity and Liquefaction**

On 2 April 2007, the Solomon Islands was struck by a major earthquake followed by a large tsunami. Initial reports indicated that the tsunami, which mainly affected the small island of Gizo, was several meters high (perhaps as high as 10 meters (33 ft) according to some reports, 5 meters (16 1/3 ft) according to the Foreign Office). The tsunami was triggered by an 8.1 magnitude earthquake, with a hypocenter 349 kilometers (217 miles) northwest of the Solomon Island's capital, Honiara, at Lat -8.453 Long 156.957 and at a depth of 10 kilometers (6.2 miles). The death toll from the resulting tsunami was at least 52 people, and the tsunami destroyed more than 900 homes and left thousands of people homeless. Land thrust up during the earthquake has extended out from the shoreline of one island, Ranongga, by up to 70 meters (230 ft) according to local residents. This has left many once pristine coral reefs exposed on the newly formed beaches. Figure 4.1.1 shows the Solomon Islands historic earthquake occurrences and moments tensors from 1999 to 2007.



**Figure 4.1.1 Historic Earthquake Occurrences and Magnitudes (NEIC, 2010)**

A tsunami wave hit the Solomon Islands on 4 January 2010. The tsunami washed away many homes and villages. While no injuries were reported at the time the tsunami struck, it was confirmed that over

1,000 people were left homeless after more than 200 homes on the island of Rendova were destroyed by the waves.<sup>20</sup>

The tsunami resulted from a series of earthquakes that occurred in the region. The largest tremor, a magnitude 7.2 underwater earthquake, occurred around 9:30 am and caused the tidal wave that reached up to 3.1m high in some places. At least nine more strong earthquakes have occurred in the area since then. However, Vaghena Island lies the north of the main east-west belt of seismic activity which passes through Bougainville, Shortland and Treasury Islands, Lavella, Kolombangara and New Georgia. Based on previous records Vaghena can be considered seismically inactive as only micro-seismic tremors have been reported. However, a recent active area to the immediate south of Santa Isabel Island indicates the need for design safeguards since the dormancy may change as it did at Santa Isabel.<sup>21</sup>

A statistical analysis was made for Vaghena based on known events. In a 20 year period the ground acceleration may only exceed 0.06g on one occasion, although accelerations up to 0.10g could foreseeably occur. In a 100 year period large earthquakes up to magnitude 8 could occur which may result in accelerations in the vicinity of 0.1 to 0.15g. On the basis of a statistical occurrence of one seismic event in 20 years being an acceptable risk, the following seismic co-efficients have been tentatively adopted:

Soft rock areas	0.07g
Reef areas and bauxite	0.09g

The predominant frequency of seismic pulses is estimated between 0.4 and 0.8 seconds as shown in Figure 4.1.1 above. This area is in the centre of an active seismic zone with the possibility that a major tremor will occur. As the soils are mostly saturated and lack cohesion (clay and marshy top soil) a major earthquake could cause the soil to become a viscous fluid creating problems with all structures – bridges, buildings, buried pipes, tanks, power poles, roads etc - that are founded only on the soil. This is the liquefaction phenomenon which develops from repeated seismic shaking and disturbances of saturated low cohesion soil to cause excessive displacements of the ground. Buildings sink, because as a result of liquefaction, the soil density becomes less than the building density; equally, empty fuel tanks buried underground can rise to the surface<sup>1</sup>. Liquefaction as a result of an earthquake will be a real risk and measures will have to be considered to ensure that the foundations for significant structures are on firm strata beneath the soil layer.

#### 4.1.2 Vulnerability of Project to Floods

The mine site, haul road, processing facility, wharves and the camp site have a low risk of coastal hazards, such as erosion or inundation. All of these facilities, with the exception of the wharves will be located at 10m to 40m above the MSL.

#### 4.1.3 Vulnerability of Project to Droughts

Droughts due to ENSO events are possible and in the past have caused significant damage in the drier areas of the Solomon Islands, however, as the annual rainfall at Vaghena has been recorded as 3500mm – 5000mm, this is not regarded as a risk.

<sup>20</sup> [www.goggle.com/search-solomontsunamis](http://www.goggle.com/search-solomontsunamis)

<sup>21</sup> [www.goggle.com/search-solomontsunamis](http://www.goggle.com/search-solomontsunamis)

**4.1.4 Summary**

Table 4.1.4 summarizes the risk ratings for the natural hazards that can have major impacts on the project site.

Cyclone	Storm Surge	Tsunami	Earthquake & Liquefaction	River Flood	Drought
<i>High</i>	<i>Low</i>	<i>Low</i>	<i>Extreme</i>	<i>Extreme</i>	<i>Low</i>

**Table 4.1.4: Summary Risk Rating of Natural Hazards**

**5.0 POTENTIAL SIGNIFICANT ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES**

The community consultation, EIS guidelines by the Department of Environment and the environmental impact process have identified matters that need to be considered in terms of potential environmental impacts arising from the project and the opportunities to avoid, remedy or mitigate potential adverse impacts. This section addresses issues of the physical and biological environment.

The potential impacts of the development can be both positive and negative. The impacts need to be considered in the light of their potential magnitude combined with the likelihood of them occurring. The nature of potential impacts has been considered in relation to the state of the existing environment. This section considers the impacts of the construction and operation phases of the project in regard to the following:

- Construction on the land – camp site, processing and product storage facilities, and infrastructure;
- Quarrying operations – production of material for wharf and road construction;
- Road building and maintenance;
- Marine construction – wharves;
- Mining extraction and transport of the bauxite ore;
- Reclaiming and loading the ore into bulk carrier vessels
- Water extraction and treatment;
- Waste water treatment;
- Solid waste management;
- Extreme weather;
- Hazardous substances;
- Rehabilitation of the development site prior to decommissioning; and
- A bond.

The formulation of environment policies or plans for the construction and operation phases is discussed in Section 7 (Refer to Appendix 10-9).

**5.1 CONSTRUCTION IMPACTS/DESIGN AND ENGINEERING**

**5.1.1 Land-based Construction Impacts**

Construction of the camp site, airstrip, the processing facility, the product storage buildings and associated infrastructure have the potential to cause adverse impacts. Table 5.1.1 identifies the potential adverse impacts and how these may be mitigated. Site clearing may also expose areas of archaeological or cultural significance. A protocol for responding to the discovery of potentially significant sites or artifacts during construction will be included in the Construction Environmental Management Plan (CEMP).

<b>Activity</b>	<b>Potential Adverse Impacts</b>	<b>Mitigation Impacts</b>
<b>Site clearing at camp, airstrip, processing facility, product storage and infrastructure sites</b>	Loss of vegetation  Discovery of archaeological sites or remains	There are no character trees or vegetation of special interest; nonetheless the principal should physically mark any trees which are to be retained. Include a protocol in the CEMP to stop work and get advice from the Solomon Islands Museum if such sites are discovered.
<b>Cement batching at all sites</b>	Discharge of sediment and alkaline water into the marine environment	Cement to be stored in a sealed container. Cut-off drains to be installed to minimize the amount of storm water generated on the batching site.

		All storm water generated from the area to be directed into a sediment pond. If the sediment needs to be emptied of water, the pH will be tested by the Construction Site Manager and adjusted if required. Clean water will be then decanted off the top and sprayed on to the ground for disposal. The sediment from the pond will be excavated out as required or at end of the pond’s life and buried on site.
<b>Use and storage of hazardous substances</b>	Contamination of water and marine water.	Ensure that hazardous substances are used by trained personnel and store all such substances away from the foreshore and waterways and undercover from direct sunlight. Ensure spill kits are readily available on site.
<b>Waste Disposal</b>	Littering of site	Waste materials will be collected on a regular basis and managed in accordance with the protocol in the CEMP.
<b>Sewerage Disposal</b>	Discharge of contaminants to water and freshwater environment.	Toilets and washing facilities will be installed for the construction workers that will ensure that the wastewater is treated prior to discharge to ground, waterways or the foreshore.

**Table 5.1.1. Summary of Potential Impacts and Mitigation Measures for Land-Based Construction Activities**

**5.1.1.1 Compatibility with Existing Structural Plans, Site Suitability**

The major potential significant environmental impacts of the proposed development could include:

- Storm water containment, management and drainages during heavy rainfall events
- Inundation of flat land area near to a major river system
- Sinking building foundations in any backfilled areas

The structural designs of all proposed buildings will need to conform to the existing topography and all engineering and building plans will have to certified and approved by the Department of Town & Country Planning in accordance with the OHS regulations Department and the subsequently approved by the relevant authorities. All buildings are to be constructed on select engineered fill.

**5.1.2 Quarry Operations at Process Facility Site**

**5.1.2.1 Geotechnical Considerations**

Construction of foundations and roads will require materials of appropriate design specification. SBL will notify the Commissioner of Lands and DOE an estimate of the quantity and specifications of materials to be quarried for foundations and road construction in the Quarry Management Plan (refer section 7.2).

**5.1.2.2 Discharges to Air**

It is currently anticipated that the use of explosives may be required to break rock at any quarrying sites, for road construction or other civil works. Discharges to air from blasting, crushing and vehicles on site have the potential to cause adverse impacts. Table 5.1.2.2 identifies the potential adverse impacts and how these may be mitigated.

<b>Activity</b>	<b>Potential Adverse Impact</b>	<b>Mitigation Measure</b>
<b>Noise</b>	Excessive noise from blasting, crushing and vehicles	Ensure all vehicles are in good working order. Machinery that is causing excessive noise will be shut down and repaired.
<b>Blasting</b>	Creation of fly rock material	A careful blasting plan together with inspections of all blasts will reduce the potential of fly rock. The production of fly rock

		is usually the result of poor blasting practice using too much explosives and with shallow drill holes.
<b>Crushing</b>	Dust from the crusher	Where practical water sprays will be used to avoid dust problems.
<b>Traffic on site</b>	Dust generated by traffic	A speed limit will be placed on vehicles in the quarry/crusher area, the lower the speed, the less dust generated. Water carts could be used to dampen the area if the need arises.
<b>Burning</b>	Smoke from burning	No burning will be allowed on site without the approval of the Environment Officer.

**Table 5.1.2.2 Summary of Potential Impacts and Mitigation Measures for Discharges to Air**

### 5.1.2.3 Sediment Discharges

There is potential for sediment to be generated from the construction of the processing facility, quarrying and crushing activities, with the potential for this sediment to be discharged into the adjacent marine environment. Table 5.1.2.3 identifies the potential adverse impacts and how these may be mitigated.

<b>Activity</b>	<b>Potential Adverse Effect</b>	<b>Mitigation Measures</b>
<b>Quarrying</b>	Discharge of sediment to the foreshore with adverse impacts on marine water quality and the marine environment.	Minimise areas of disturbances. Divert clean water way from disturbed areas. Discharge stormwater to a silt retention pond or grit trap prior to discharge to surface waters. Regularly clean stormwater control drains, silt retention ponds and grit traps.

**Table 5.1.2.3 Summary of Potential Impacts and Mitigation Measures for Sediment Discharges to the Marine Environment**

### 5.1.2.4 Quarry & Crusher Operational Activities

There is potential for adverse impacts to be generated from quarrying and crushing operations. Table 5.1.2.4 identifies the potential adverse impacts of these operational activities and how these may be mitigated.

<b>Activity</b>	<b>Potential Adverse Impacts</b>	<b>Mitigation Measures</b>
<b>Storage of explosives</b> (if needed to be used)	Unplanned explosions on sites or theft of explosives	Safe storage of explosives in accordance with Quarry Act.
<b>Use of explosives</b>	Explosives used by unqualified staff	Only staff with current qualifications and training will be allowed to handle or set-off explosives.
<b>Blasting</b>	Vibration from blasting causes damage to buildings and structures at the nearby Nikumaroro Settlement.	The blasting patterns will be designed to ensure that the blasting will only have a localized effect in the quarry area.
<b>Fuelling</b>	Leaks from fuel storage tanks getting into the groundwater or adjacent marine environment.	The bulk fuel store on site will be bunded. All fuelling will take place in the same area and this area will be designed and equipped to contain spillages should they occur.
<b>Chemical storage</b>	Leaks or spills of chemicals used on site getting into ground water or adjacent marine water.	There will be no bulk storages of chemicals on site. All chemicals will be stored in a storage room and the required amount of chemical will be measured out in the storeroom and then taken to where it is needed.

<b>Waste management</b>	Litter on site	The approach to waste management will be to minimize the production of waste by reusing and recycling. Any waste produced on site will be collected and managed in accordance with the CEMP.
<b>Public safety</b>	Public being endangered	There will be no unauthorized public or villager access to the site during quarry operations due to health and safety requirements. A fence, gate and warning signs will be erected to keep visitors out.
<b>Sewerage</b>	Contamination of groundwater	A conventional septic tank will be constructed.

**Table 5.1.2.4: Summary of Potential Effects and Mitigation Measures for Quarry Operation Activities**

### 5.1.3 Road Building and Maintenance

Constructing the haul road from the mine site to the processing facility site has the potential to cause adverse impacts, in particular the contamination of surface waters with sediment laden storm water. Table 5.1.3 identifies the potential adverse impacts of these operational activities and how they may be mitigated.

The proposed construction methodology, outlined below, is a key element in minimising the sediment transported into the surrounding marine environment when rock placement is going to take place, especially during storm events.

Haul road construction material including gravels and sand will be sourced from the process facility site quarry or other suitable areas away from the Island shore. Construction of the haul road will be scheduled in line with the expected productivity and supply rates for materials from the quarry so that, in particular, the placement of geotextile (if applied initially to wet and water soaked areas) and road aggregates can be undertaken immediately after clearing vegetation and topsoil where the roads are being constructed. Materials will be placed directly onto existing substrate, generally after vegetation and topsoil has been removed. Initial indications suggest that the work can be progressed at a rate of approximately 1-2km per day. This will allow each daily advance to be covered in road dressing aggregates the following day and then compacting the rough edges the day after. In this way no more than 1.5km of roads should be exposed unfinished material at any one time. Should production and aggregate supply rates vary during construction, the allowable daily advance may also be varied. At no stage will construction of the road be allowed to continue if sufficient rock aggregates are not available on site to complete the protection of that segment of road.

<b>Activity</b>	<b>Potential Adverse Effect</b>	<b>Mitigation Measure</b>
<b>Road building</b>	Discharge of suspended sediment into rivers and creeks	Ensure that all storm water from road works passes through sediment traps or ponds prior to discharging to waterways. Complete construction in sections finished with a well compacted surface-thereby minimizing amount of earthworks exposed to rainfall

**Table 5.1.3: Summary of Potential Impacts and Mitigation Measures for Road Building and Maintenance Activities**

### 5.1.4 Wharf Construction - Marine-based Construction Impacts

The construction of the bulk carrier wharf and small boat wharf has the potential to cause adverse impacts. Listed below are the potential adverse impacts and how these may be mitigated. The potential impacts from these construction activities are:

- The discharge of sediment and pollutants to the marine environment;
- Loss of marine habitat and communities; and,
- Damage to the wharf in storms rendering it inoperable.

The potential for the generation of sediment comes from two activities; the first is from the displacement of soil/rock on the wharf approach and jetty footprint. The second is the construction of the wharf itself with concrete piers and bollards.

The construction of the wharves will result in some permanent loss of marine habitat to the extent of its footprint; however, wharves also provide some protected habitat for fish and small marine animals. The loss is a permanent residual loss of a habitat representative of the immediate shallow and deeper marine habitat in the immediate vicinity of the wharf construction. Placement of wharf jetty with rock placed directly onto the substrate is currently planned which will minimize marine earthworks and sediment disturbance.

The wharf armouring on the jetty leading to the main bulk carrier wharf will be designed to be stable, meaning that the profile of the armour rocks will remain consistent over time, however, storm damage may occur from time to time which may require maintenance post storm events. A philosophy of minimum maintenance will be incorporated in the design as the bulk carrier and small boat wharves are to be gifted to the Government after completion of the bauxite project. The objective of the mitigation measures for the wharf construction is to limit the suspension and deposition of sediment in the surrounding sea to levels that will not induce deterioration of coral and other marine life.

It is not possible to stop completely the generation of suspended sediment while undertaking excavation and filling works as the marine muds contain fine sediments which, when disturbed, quickly become suspended and are slow to settle creating plumes. Material placed as part of the construction of the bund will also be susceptible to erosion from natural coastal processes until completely protected by rock armour and filtering layers. The focus therefore needs to be on:

- minimising the amount of sediment generated through best practice construction techniques,
- minimising the exposure to erosion by limiting working faces,
- protecting working faces in the fastest possible time, and
- containing any generated suspended sediment.

In the event that there are disruptions to the construction system and/or where sediment transportation is evident above acceptable levels, sediment containment devices such as silt curtains and silt fences will be used. Sufficient sediment containment devices shall be kept in reserve on site in the event of uncontrolled sediment loss. SBL is planning to build appropriate silt ponds to capture most of the seepage and run offs from cleared sites earmarked for development.

<b>Activity</b>	<b>Potential Adverse Effect</b>	<b>Mitigation Measure</b>
<b>Site preparation</b>	Discharge of suspended sediment into the marine environment	SBL to ensure minimal loss of mangroves as currently planned
<b>Construction of wharf</b>	Discharge of suspended	Minimise the amount of sediment generated through

	sediment into the marine environment	best practice construction techniques. Minimise the exposure to erosion by limiting working faces-limit to ~25m of exposed working face at the wharf at any one time. Protect working faces in the fastest possible time. Contain any generated suspended sediment, with silt curtains and faces.
<b>Construction of airstrip</b>	Discharge of suspended sediment into the marine environment	Minimise exposure to erosion during storm events; ensure silt screens are installed during clearing and leveling for the airstrip.
<b>Operation of excavation equipment</b>	Contamination of marine water from machinery operating in marine area	Ensuring construction machinery is kept in order with no oil leakages. No parking of construction equipment in marine area when not in use. No storage of fuel, oil or grease in marine area. Ensure spill kits are readily available.
<b>Maintenance</b>	Armouring designs to minimise maintenance	Design of the wharves and in particular any rock armour needs to be of a high standard, as SBL plans to vest the wharves to the Government at the conclusion of the bauxite project.

**Table 5.1.4: Summary of Potential Impacts and Mitigation Measures for Marine-based Construction Activities**

**5.1.5 Off-Site Sourcing of Materials**

SBL will need to import a range of materials to the site for construction including consumables, fuels & oils, cement & aggregate, organic fertilizer, food, domestic requirements and seeds/propagates for the rehabilitation work and potentially other items. These and any other materials that are brought to the site will need to come from a DOE approved source. All off-site material requirements (description of material, volume and source) will be communicated to DOE for approval as and when these requirements are confirmed.

In seeking approval, SBL will assess the risk of introduction of invasive species to the local area via these materials, particularly any organic material, and provide DOE with confirmation of how these risks will be managed. Where possible, materials will be sourced from Vaghena, however, some items such as cement and concrete aggregate will only be available from external sources.

**5.2 Impacts on Coastal Processes**

According to the coastal processes assessment, the bulk carrier wharf site experiences small to medium ocean swells during normal conditions, thus it is of great importance that the structure is poised well above the mean sea level high water mark to mitigate against possible damage from cyclonic and monsoonal weather conditions. The hard substrate of the reef/rock platform and cyclonic proof design of the structures will minimise any potential adverse impacts of the proposed wharf development on the high energy coastal environment.

Local tidal water levels and currents may be impacted by the wharf alignment to the coast. To reduce the impacts of the wharf alignment on tidal movements within the southeast coastal, it is recommended that the wharf is to be largely erected on high stilt piles to allow water to move freely underneath.

The proposed development is also likely to be exposed to low risk of coastal hazards such as coastal erosion or inundation, provided any land based development is above 4.0m above the high water mark. Table 5.2 summarizes these impacts and mitigation measures.

Activity	Potential Adverse Effect	Mitigation Measure
<b>Wharf alignment</b>	Tidal water level and currents maybe restricted thereby disturbing invertebrate life and food chains, and possibly also increasing sedimentation elsewhere, but this will be minimal.	Bulk carrier wharf design to incorporate appropriate building design to mitigate impact on conditions of the coastal site. Final design of foreshore structures to be undertaken by suitably qualified coastal engineer to minimize impacts.
<b>Extreme weather</b>	Coastal erosion or flooding	All land based structures at the wharf and process facility site are to beat 4.0m above high water mark.

**Table 5.2: Summary of Potential Impacts and Mitigation Measures for Coastal Process Impacts**

### 5.3 Operational Impacts

#### 5.3.1 Ore Mining and Transport to the Processing Facility

The Vaghena bauxite mine area is approximately 20km<sup>2</sup>. The processing facility, product storage and other infrastructure will occupy a further 2.5km<sup>2</sup> approximately. This is quite a small bauxite mining operation by world standards, but a moderate development for the Solomon Islands. The earthworks involved are modest in comparison to some of the Solomon's larger developments such as the Gold Ridge Mine on Guadalcanal.

The operational phase of the project will involve land clearing, topsoil stripping, bauxite extraction, haulage, screening, drying, storage, loading and marine transportation of a significant volume of bauxite ore. Preventing sediment laden runoff water reaching the freshwater and marine environment will be an important operational undertaking and require significant planning and control structures (refer to Appendix 10-9). Table 5.3.1 identifies the potential adverse impacts and how these may be mitigated. Refer to Appendix 10-4 for detail information on mining operations.

The freshwater environment is relatively insignificant compared to larger volcanic islands in the Solomon Islands since it has only two freshwater creek systems with one being seasonal. The mine poses no threat to Kukutin Creek on the southwest side of the Island, as there will be no project activities within its catchment.

The impact of the operational phase on road infrastructure and road-side communities is considered in Section 6.3.

Activity	Potential Adverse Effect	Mitigation Measure
Ore extraction and transport to the processing facility	Discharge of suspended sediment into freshwater environments	Ensure that all storm water runoff from the mine, processing and product storage facility sites passes through appropriately sized sediment retention ponds prior to discharge to natural waterways. The detailed design of the sediment retention ponds to be submitted to Commission of Resources and Development and DOE for approval. Minimise storm water drainage from the mine haul road into natural waterways (if any) by placement of cut-offs and installation of sediment retention measures prior to

	<p>Ore spillage on to haul roads</p> <p>Discovery of archaeological site or remains</p> <p>Sedimentation of wetland</p>	<p>the water entering waterways. Mining is planned to be done progressively in defined pits of about 100m in width with rehabilitation commencing immediately after the active site has been completed so that exposed surfaces are minimized.</p> <p>Ensure trucks are not overloaded and measures are taken to minimize dust.</p> <p>Include a protocol in the CEMP to stop work and get advice from Solomon Islands Museum if such sites are discovered.</p> <p>Install sediment retention ponds in the mine drainage system, maintain ponds regularly.</p>
Stockpiling ore awaiting processing and transport to the wharf	Discharge of suspended sediment to the foreshore and the marine environment	<p>ROM ore pad drainage to be controlled and discharged via sediment retention ponds. Dry ore to be stockpiled in storage sheds.</p> <p>Ensure all sediment laden storm water and run-off from the processing facility sites passes through sediment retention ponds-as per mine plan dimensions. Dimension to be determined when mine plans and process facility designs undergo detailed design.</p>
Use and storage of hazardous substances	Contamination of surface water	<p>Ensure that hazardous substances (including any agrochemicals associated with rehabilitation) are used by trained personnel and store all such substances away from direct sunlight.</p> <p>Ensure spill kits are readily available on site.</p>

**Table 5.3.1: Summary of Potential Impacts and Mitigation Measures for Operation Activities likely to Impact on the Terrestrial and Freshwater Environment**

**5.3.2 Marine-Based Operational Impacts**

Marine based operational activities on site have the potential to cause adverse impacts. Table 5.3.2 identifies the potential adverse impacts and how these may be mitigated (refers to Appendix 10-9).

<b>Activity</b>	<b>Potential Adverse Impacts</b>	<b>Mitigation Measure</b>
<b>Barge and bulk carrier vessel traffic</b>	<p>Discharge of fuels, other pollutants and litter into marine environment.</p> <p>Damage to reefs</p> <p>Shipwrecks</p>	<p>If refueling is carried out at the wharf, only trained personnel are allowed to carry-out refueling and fuel spill kits will be readily available.</p> <p>The OEMP to identify acceptable servicing activities that can be undertaken at the wharf.</p> <p>Navigational aids are to be installed, as required. All reefs are to be clearly marked.</p> <p>Contingency plan for the breakdown, running aground or shipwreck of a barge or the bulk carrier.</p>
<b>Spillage of ore on the wharf and while loading barges</b>	Discharge of suspended sediment into the marine environment	<p>Ensure ship loading equipment is not overloaded and conveyors are covered and/or protected with spillage collection facilities.</p> <p>Ensure wharf head drains to a sump where sediment can be removed or pumped back into sediment ponds on</p>

		land. Maintain wharf and clean-up ore spillage.
<b>Spillage of ore while transferring to bulk shipping vessel</b>	Discharge of rock and suspended sediment into the marine environment	Ensure that the bulk shipping vessel is tightly moored to the wharf. Ensure loader operators are trained. Ensure design of ship loader does not allow spillage into the marine environment.
<b>Operation of a fuel farm at the processing facility site</b>	Discharge of fuel into marine or freshwater environment	Fuel tanks will be banded. Only trained employees will be able to carry out filling and refueling. Fuel spill kits will be readily available.
<b>Discharge of ballast water from bulk carriers and presence of vessels in Vaghena</b>	International introduction of invasive species via the vessel hulls and discharged water ballast	SBL to require bulk carrier operator and barge operators to comply with International Maritime Organization (IMO) guidelines for ballast water management 1997. Requirements include but are not limited to: <ul style="list-style-type: none"> <li>• Performing open ocean exchange of ballast water if safety permits,</li> <li>• Keeping records of ballasting operations,</li> <li>• Regular removal and safe disposal of organisms from hull, piping and tanks,</li> <li>• Anchors and chains to be rinsed during retrievals,</li> <li>• Avoiding ballast take up at night.</li> </ul>

**Table 5.3.2: Summary of Potential Effects and Mitigation Measures for Operation Activities Likely to Impact on the Marine Environment**

**5.4 Water Supply**

SBL intends to locate a suitable water supply which they will then extract and treat for their potable water needs. The most likely option is to install water bores utilizing the underground aquifers, combined with utilizing natural springs and rainwater collection. Vaghena Island has an annual rainfall of 3500mm to 5000mm with 40% finding its way into the groundwater system. As bauxite processing will be minimal with an emphasis on minimizing water addition to the product; SBL’s requirement per day constitutes a small percentage of the available water flow. Although it is a very small proportion given the large amount of rainfall the Island receives daily, it is still possible that SBL’s requirement may constitute a significant proportion of water flows during a drought. There are very few above ground freshwater systems on Vaghena, thus during a drought the quality and volume of this water is likely to have reduced to very low levels. SBL will install a series of freshwater bore holes inland to draw from aquifers as a reliable source of water. Bauxite dewatering surface drains may also become a source of process water. Should drought conditions emerge these bores and drains will become the main source of water for the operation. Once the abstraction source(s) is identified, SBL will submit a report on the proposed water supply abstraction treatment to DOE for approval.

**5.5 Wastewater**

SBL intends to install septic tanks compliant with DOE and appropriate requirements at the camp, the mobile fleet workshop, and at the processing facility. Table 5.5 identifies the potential adverse impacts that can arise from waste water treatment and how these may be mitigated.

<b>Activity</b>	<b>Potential Adverse Effect</b>	<b>Mitigation Measure</b>
<b>Black water (Sewerage) Disposal</b>	Poor sewerage and waste water treatment leading to elevated bacterial levels affecting water quality, and elevated nutrient levels affecting the	Septic tanks must be of the correct size to handle the expected load. The soakage pit must be able to handle the loading and pass the percolation test.

	freshwater or marine ecosystems.	Septic tanks to be de-sludged periodically.
<b>Grey Water</b>	Poor treatment can lead to elevated levels of chemicals and nutrients discharged to the freshwater or marine ecosystems.	Grey water to be treated by the septic tanks and not discharged to the ground or waterways. Introduce appropriate use of detergents, soaps and other chemicals to minimize nutrient discharge. SBL to secure a waster permit from DOE. Under the regulations of the Solomon Islands Management Act for treatment plants prior to the commencement of any works.

**Table 5.5: Summary of Potential Impacts and Mitigation Measures for Wastewater Treatment**

**5.6 Solid Waste Management Impacts**

The collection of solid waste from all components of the project will be undertaken as a responsibility of the mine management. This responsibility should also include the collection of litter. On the basis that the waste management measures recommended are implemented, no adverse impacts should result from waste management operations on site. Solid waste that cannot be satisfactorily recycled or disposed of on the Island will be transported to Honiara for disposal in an approved facility.

**5.7 Extreme Weather Impacts**

The camp and processing facility are to be located well above the flood plain with well-designed drainage systems, so flooding issues are expected to relate solely to flood events crossing of the mine haul road. Culverts and drains will be designed for reasonably anticipatable events. Cyclones and storm surges are extreme weather hazards which can be expected at the site. Mitigating the hazard is a process of good design and introducing contingency plans. Foreshore erosion can be a consequence of cyclones and storm surge but is not considered an issue at the bulk carrier wharf or the processing facility site. Table 5.7 identifies potential impacts and mitigation measures in respect of site drainage and storm surges.

<b>Hazard</b>	<b>Potential Adverse Effect</b>	<b>Mitigation Measure</b>
<b>Storm Measures</b>	Damage to bulk carrier wharf and the processing facility	Construct the wharf in accordance with the approved design and ensure that all land based strategic infrastructures have foundation levels above 4.0m RL.
	Worker safety	Develop a cyclone contingency plan for the mine, workshop, processing facility and storage sites and provide training to all employees.
	Foreshore erosion	Not regarded as an issue at the site
<b>Cyclones</b>	Potential damage to structures and buildings from cyclones	Ensure the structural plans are to the appropriate cyclone standard. Develop cyclone contingencies plan for the camp, mine, and processing facility sites and provide training to all employees.

**Table 5.7: Summary of Potential Impacts and Mitigation Measures for Cyclones and Storm Surges**

**5.8 Rehabilitation Impacts and Rehabilitation Plan**

Appropriate rehabilitation of the mine site and processing facility site when it is decommissioned is an important requirement for SBL. The fertile soil and vibrant vegetation cover on or around the site are considerations which SBL will need to assess in undertaking the rehabilitation. SBL will prepare a rehabilitation plan which documents the objectives of rehabilitation and the approach that SBL will

undertake to ensure effective and timely rehabilitation. This plan will include a trial to identify successful rehabilitation methods. There will be constant evaluation and regular reporting to DOE and the Commissioner of Lands as the trials progress and as a preferred method is identified.

The overall philosophy of the rehabilitation plan will be to leave the land which had previously been used for the bauxite project, both for mining and infrastructure as a physically stable, environmentally sustainable, safe and productive landform for subsequent uses, which are yet to be fully defined.

Important components of the rehabilitation plan will be:

- The stockpiling of any topsoil encountered on the site (though there is little of this);
- The collection and composting of debris after the forest harvesting;
- Early start of a trial to identify appropriate rehabilitation methods; and
- Immediate commencement of rehabilitation of mined areas after mining has been completed.

The mining area will constitute the major area of disturbance by the project. Due to the shallow nature of the mine and the clear lower boundary of the bauxite against the limestone basement, rehabilitation to final landform will be able to progress closely behind active mining areas. Initially, out of pit stockpiles of topsoil and low grade bauxite will be established. Once mining is established and moves to “steady-state” newly cleared topsoil and sub-grade bauxite will be placed in the mined out areas as this material becomes available. Screened oversize limestone, which will be typically larger than 0.6m in maximum dimension, will be placed in the areas to be rehabilitated ahead of the topsoil. Where practical standing limestone pinnacles will be felled to assist in forming a safe and stable landform. Areas of non-mined sub-grade bauxite adjacent to the mined areas will be contoured into the mined out areas to form a consistent and undulating final landform. Wherever it is possible and safe to do so, large trees and vegetation in the mining area, but not sitting above economic bauxite will be left in-situ. As surface areas are contoured into a landform which will be typically 3 metres lower than the pre-mining landform, being the thickness of the bauxite mined, but ranging from a similar elevation to 10 metres lower, and appropriate drainage systems will be established, then revegetation will commence. Plantings will commence as soon as possible after contouring and drainage is complete. Revegetation will be with selected tree species, shrubs and grasses, and subject to agreement with the Crown.

Likewise the processing facility, product storage areas, camp site and associated infrastructure will be removed; the areas contoured and replanted with trees, shrubs and grasses, and also subject to agreement with the Crown.

It is proposed that the bulk carrier wharf, small boat harbor wharf and airstrip will be ceded to the Government for the use of the local community, at the completion of the bauxite project, assuming that the Crown as landowner agrees. The processing facility, buildings and services when removed from Vaghena Island and disposed of appropriately. Concrete floors, foundations and other infrastructure items may be left in-situ and/or buried on the Island, subject to mutual agreement with the Crown at the time of project closure.

## **5.9 BOND**

The Terms of Reference set by DOE require consideration of the need for and quantum of a bond. A bond would be required if, for whatever reason, SBL had to abandon the operation suddenly and irrevocably if there was little or no useful resource left on the mine site, Government would then need to stabilize and restore the operational sites and remove any unwanted infrastructure.

Table 5.9 lists restoration and stabilization activities which may be required in the event of sudden abandonment. A **bond of SB\$2.0 million** in the form of a bank guarantee would appear appropriate. The bond would be progressively lodged to match the potential liability.

Activity	Estimated Cost (\$SB)
1. Rehabilitation of mine site requiring contouring, ripping, and replacement of topsoil	1,000,000
2. Dismantling and removal of mine camp and processing facility	Sale of items to fund cost
3. Preparation of processing facility and building sites for sediment stabilization, removal of sediment ponds	500,000
4. Stabilizing quarry face and other working areas	250,000
5. Ensure wharves and airstrip in satisfactory condition for ongoing usage	250,000
<b>Total</b>	<b>\$2,000,000</b>

**Table 5.9: Estimated Costs for Government in the Event of Sudden Abandonment of the Mine.**

## 5.10 Ecological Impacts

### 5.10.1 Loss or Alteration of Terrestrial Habitats

The impact of alteration and degradation of habitats that will occur during the clearing and mining stages will lead to the following ecological impacts:

- loss and degradation of potential habitats
- possible death of less adaptive species through exposure and physical changes
- migration of existing species to other areas
- erosion of slopes and loss of burrows
- loss of minerals from soil

Re-vegetation work will assist in re-establishing the site, recreating habitats and restoring biodiversity.

### 5.10.2 Effects of project on water quality

One of the major environmental concerns that the project will have on the water quality is the seepage of effluents and sewerage from potential sources into the freshwater systems. Increasing the amount of untreated sewerage reaching the river and coastal waters increases faecal coliform, which is a health hazard. An increase in nutrient loading will also lead to a decline in water quality. Effluent and sewerage emanating from the project and its on-site workforce will be treated to appropriate standards prior to discharge into the local systems.

## 6.0 SOCIAL IMPACTS AND MITIGATION MEASURES

Community consultation on Vaghena Island has been an integral part of communicating the EIS process to ethnic I-Kiribati local residents who live on the Island and who, with their forebears, have made Vaghena their home for about the last 50 years. During this time, Provincial representatives, Central Government agencies and SBL's management have identified matters that need to be considered in terms of potential social impacts arising from the project and the opportunities available to prevent or mitigate identified potential adverse impacts. This section considers impacts which can be both positive and negative and, where needed, recommends how they should be managed by SBL (refer to Appendix 10-9)

### 6.1 Contribution to Poverty Reduction and Community Assistance

For four generations the I-Kiribati community resident on Vaghena Island has considered that the land belongs to them. The population is increasing over time and the need for increasing areas of land for housing, gardening, agriculture and economic development is evident. The local residents' perception of land ownership has been a huge concern and they have felt a strong need to clarify and understand the true legal ownership of the whole Island and in particular, the bauxite project area. Since the Government has shown interest in inviting investors to engage in bauxite mining on Vaghena Island, it has also provided documentation that the proposed bauxite mining project area belongs to the Perpetual Estate (Crown). The Crown, through the Commissioner of Lands, has also provided SBL with a Surface Access Agreement, the boundaries of which incorporate SBL's Prospecting Licence and other areas likely to be required by SBL for the purpose of mining the bauxite deposits on the eastern side of Vaghena Island.

This project has wide economic and employment benefits. These include the following:

- Increased employment – employment opportunities will be significant with the employment of around 150 to 200 skilled, semi-skilled and unskilled workers who will mostly be recruited from the local area, subject to an assessment of the appropriateness of their skills or their ability to be trained to work in the construction and/or operation of the project. Employment will be a significant contribution to the local community, particularly considering the high levels of unemployment amongst young men on Vaghena and other nearby islands;
- Additional jobs will be provided by contracting companies and by suppliers of construction machinery and materials to the project, with preference given to contractors from Vaghena and Choiseul;
- Opportunities for local commerce in fisheries, farm produce and commercial goods due to the demand that will be generated by the mine workers, the accommodation camp and by the increased local buying power generated by local employment;
- Provision of health, education and infrastructure assistance by SBL to the local community;
- Royalty payments to Government;
- An increase in Solomon Islands foreign exchange earnings;
- Increased VAT collections;
- Contributions to employment levies;
- Payment of company tax;
- The Government will not have to bear any significant costs associated with this project.

SBL recognises the importance of providing support and assistance to the local community, particularly in the areas of health, education and community infrastructure. In order to ensure that benefits of the project are shared with the local communities and to ensure that funding is directed to areas of greatest

need, SBL proposes to implement the following regime of support and enhancement to the three village communities on Vaghena Island.

### Health

- Provision of medicines and equipment to the existing clinic to the value of SB\$1,000/month, from the commencement of project construction.
- Repairs and/or modifications to the existing clinic to the value of SB\$10,000 prior to the first commercial shipment of bauxite.
- Access to the SBL clinic for emergencies/services not available at the village clinic once it is operational.
- Provision of information sessions on HIV/AIDS/STD prevention plans at a timetable to be agreed with the community leaders.
- Training and information sessions on personal and village hygiene at a timetable to be agreed with the community leaders.
- Use of SBL ambulance and SBL driver for transport to airstrip/wharf for emergencies.

### Education

- Expand the number of classrooms by three (3) at the community school, in order to facilitate students up to Form 6 (six years of secondary school), up to a value of SB\$60,000, prior to first commercial shipment of bauxite.
- Provision of school materials (books, pencils, paper, etc) to the value of SB\$10,000/school year from the commencement of project construction.
- Provision of 30 secondary school scholarships, nominally five (5) students per form, to the value of SB\$1,000/scholarship/year to academically gifted students to support fees for attendance at secondary school at Vaghena, within 12 months of the commencement of commercial production.
- Provision of three (3) secondary scholarships to the value of SB\$6,000/scholarship/year to gifted students to attend a secondary school in Choiseul or New Georgia to be awarded within 12 months of the first commercial shipment of bauxite.

### Infrastructure

- Upgrade of the coastal road between the villages to good unsealed standard by the commencement of commercial production.
- Upgrade the existing playing field once 1Mt of bauxite has been shipped.
- Establish a police post on the mine access road at a site to be agreed.
- Consultation with community leaders over possible use of SBL small boat wharf and airfield facilities, when not in use by SBL but at all times under the management control of SBL.
- Establishment of a supermarket and bank to be located within the mine facilities area which can be used by local communities at daily times, to be agreed with the community, six (6) days per week.

These proposals will be discussed with the village representatives so that they can be tailored and administered in the best interests of all parties.

During the consultation process, the residents sought reassurance that in the negotiations and consultations prior to the issue of the Mining Lease for the project, SBL would participate in a fair, well-informed and transparent process. Under the Perpetual Estate, the Commissioner for Lands is the landlord. The current Surface Access Agreement was processed by the Lands Commission in accordance

with established procedures. Similarly the Commissioner of Lands will only issue a foreshore lease for the bulk carrier wharf facility when he is satisfied that adequate consultation has been undertaken with relevant stakeholders.

Table 6.1 summarizes recommended measures to ensure that the economic benefits of the project are channelled to the local area to the maximum possible extent.

Activity	Potential Effect	Mitigation Measure
SBL Hiring, Contracting, and Purchasing Policy	Economic benefits	SBL to prioritize employment of suitably-qualified mine workers and contractors from the Vaghena area in the first instance and from Solomon Islands as the second priority. Only if has been confirmed that such skills or services are not available locally should the mine look further afield.
	Inadvertent discrimination against the poor and women	Use of locally sourced materials and services for construction and operation phases to the maximum extent possible. Ensure payment of appropriate award wages and benefits to workers.
	Inadvertent discrimination against children	No differential wages to be paid between men and women for work of equal value. No use of child labour for construction or operational activities.

**Table 6.1: Summary of Measures to Ensure Maximum Economic Benefit to the Local Area**

**6.2 Health and Safety**

The project’s construction and operation phases could cause a range of health and safety impacts for construction and mine workers as well as the neighbouring communities, if appropriate design and mitigation measures are not put in place. This section considers the risk of accidents or ill-health at work sites. Other impacts on the health and safety of the mine workers and local community are considered in separate sections, these are:

- Contamination of local water supplies (refer section 5.3.1).
- Traffic safety issues (refer section 6.3).
- The risk of spread of communicable diseases (Section 6.4).

Observing general health and safety requirements, including training, provision of safety and personal protective clothing and equipment to workers, will reduce the risk of accidents and injury at the work sites. A medical clinic will be established on site both for employees and local residents. The mine site and other work sites, including the processing facility, the product storage facility, camp, bulk carrier wharf, airstrip, fuel farm, workshops and small boat wharf will be equipped with first-aid equipment and basic medical supplies, as appropriate. To reduce the risk of incidents anywhere on the project site, access to work sites by other than those authorized to do so will be prohibited.

**6.3 Traffic and Access Issues**

Access between the process facility and the mine site will be via the private haul road that will be constructed specially for project purposes. There is a local track running along the south coast of the Island between Nikumaroro and Arariki villages near to existing residential areas and a primary school. The development will necessitate an increase in traffic, including the introduction of motor vehicles to this track; this will be very significant during the operation phase as local workers make their way by

vehicle and foot to and from work, with the potential to cause adverse impacts for the existing community and road-users. Measures and upgrades will also need to be undertaken on this road to ensure the safety of workers and other road users.

A particular concern is the effect of increased local traffic associated with the project, especially noise and dust causing a distraction to the students during school hours. However, it is likely that shift change hours, when the bulk of the traffic will occur, will be outside school hours. If not adequately controlled and managed, the dust and exhaust fumes from the vehicles may affect the respiratory health of the children and also create pedestrian safety issues in and around the existing villages. The proposed development will see a significant increase in vehicle movements on the road over the life of the project, especially when roads are improved between the three settlements on the south coast. However, the mine site is at a sufficient distance from the villages, so as to ensure that there will be no problems from noise impacting on local communities. During the operations phase, the traffic generated could equate to approximately one additional bus or light vehicle movement approximately every 15 minutes during the one to two hours it takes for shift changes, twice a day. The private mine haul road will be more than 1km from any population centres, although it may come to within 500m of a few outlying houses of Nikumaroro Village. Mine truck movements on the mine haul road, between the mining operation and the processing facility will vary according to the production rate and the payload of the trucks utilised. Assuming 2.0mtpa of wet ore (2.6 mtpa wet) is transported in 50 tonne capacity trucks, between 6:00am and 10:00pm, six days per week, then it could be anticipated that a truck movement will occur every 4 or 5 minutes in each direction.

Issue	Potential Adverse Effect	Mitigation Measure
Inadequate Signage and Security at Work Sites	Avoidable harm to unauthorized people who have entered the site	Adequate signage and security provided at all project gates and work sites and prevention of unauthorized people entering the sites.
Inadequate Provision for Health and Safety Training and Facilities and Measures for Mine Employees and Contractors	Avoidable harm to mine or contractor employees	SBL and any contractors will provide adequate health care facilities including a clinic and first aid facilities within the project work sites. SBL to also provide construction and mine workers with training in all basic sanitation, hygiene and healthcare issues, health and safety matters, and on the specific hazards of their work. Provide workers with personal protective equipment, such as safety boots, reflector vests, hard hats, gloves, and protective clothing and goggles if required. Safe and clean facilities, including sanitation and drinking water easily accessible for all workers.
Dust	Respiratory problems and safety concerns	Ensure that wherever on the project site elevated dust levels occur, the area is dampened with the use of a water cart or sprays, enclosed cabins and dust masks are provided, if required.
Noise	Hearing problems and safety concerns	Ensure that all machinery is in a good state of repair and hearing protection is provided; Ensure that Solomon Islands legislative provisions for noise in the workplace are abided by.

**Table 6.3a: Summary of Potential Impacts and Mitigation Measures of Health and Safety Measures at the Project Work Sites**

SBL will address the concerns mentioned above. A Traffic Management Plan will be developed and implemented by SBL and all its contractors and subcontractors. Table 6.3b identifies measures to mitigate potential adverse impacts from use of the local road which will be included in the Traffic Management Plan.

Activity	Potential Adverse Effect	Mitigation Measure
Works to upgrade road drains and erect safety warning signs	Road Safety	Warning signs along the local road to warn approaching traffic and pedestrians of the works ahead. Provision of safe access around the work site to pedestrians
Construction and operation phase traffic through the residential areas and school	Road Safety	Signs and appropriate safety features to be erected to indicate hazards and the entrance to the project site. Ensure that road is kept clear of any waste or damage caused by the movement of mine or contractor vehicles. Prior to the commencement of the construction phase, SBL to provide road safety training to nearby residents. SBL to provide training for road wardens to manage traffic during sensitive pedestrian times. SBL to require that any loads that have potential to discharge dust or other falling objects be covered or otherwise controlled with penalties for non-compliance.

**Table 6.3b: Summary of Potential Impacts and Mitigation Measures for Local Road Use by the Project**

#### 6.4 Risk of Spread of Communicable Diseases

The transmission of communicable diseases such as sexually transmitted infections (STIs) and the Human Immuno-Deficiency Virus (HIV) is a potential impact of the construction and operations phase posed by workers engaging in either commercial sex or casual sexual relationships with local people. SBL aims to maximize employee recruitment from the local area, but there will inevitably be some expatriate employees and employees from outside of the local area. Up to 150 employees as well as family members for some Solomon Islands employees will be accommodated in the camp area at the mine site.

The risk of spread of STIs and HIV associated with the project is a function of a number of factors including:

- (i) Existing knowledge about the risk;
- (ii) The length of time large and relatively mobile populations will be located in the project area; and
- (iii) Engagement in high-risk behaviours (such as increased alcohol consumption and multiple partners).

The Health Ministry along with a range of non-governmental organisations such as the Red Cross and UNAIDs have active sexual health awareness-raising programs underway in the Solomon Islands. However, the Health Centre is the first point of contact for health matters in the study area. The Health Centre regularly arranges local training and awareness-raising programs and has good contact with the local population as well as a network of registered community health workers that reside in the villages and settlements and receive training and support from the Health Centre. The project's awareness and prevention measures should link in with existing initiatives wherever possible.

Another important consideration in the context of mitigating the spread of communicable diseases is the minimization of mosquito populations in the development area. Mosquitoes act as a vector for a range of diseases present in Solomon Islands including dengue fever and filariasis. The Health Office for

Vaghena must ensure that no bodies of still water are allowed to stand for more than 10 days without being completely emptied or treated for mosquitoes.

Activity	Potential Adverse Effect	Mitigation Measure
Workers engaging in either commercial sex or sexual relationships with local people	Spread of STIs and HIV/AIDS between workers and local people	SBL to consult with local Health Centres, Red Cross and UNAIDs to determine the best way to develop and deliver a STI and HIV/AIDS awareness training program to the mine employees and local communities in the Vaghena area. SBL will require all mine and construction workers to attend STIs and HIV/AIDS awareness induction training. Awareness training to be provided to all villages, settlements and high schools in a 15km radius of the area that the mine workers will be living and operating within.
Drainage and sediment control measures on development sites	Disease vectors establish populations	Ensure that there is adequate drainage through the worksite (including any camp) to ensure that unnecessary still or stagnant water bodies and puddles do not form. All operational still bodies of water such as sediment dams to be free of mosquitoes through measures including drainage, introduction of fish or appropriate mosquito larvae insecticides.

**Table 6.4: Summary of Potential Impacts and Mitigation Measures for the Spread of STIs, HIV/AIDS and Mosquito Borne Diseases**

### 6.5 Perceived Resource Use Issues

The landowners do not currently use either the mine or the processing facility sites for any productive purpose. Some members of the local community (who are not landowners) advised that they graze cattle on the site and use it as a thoroughfare. This will not be possible when the area is an operating mine, as wandering cattle can pose a danger to operators and machinery.

Residents and fishers use the sea, mangroves, etc for fishing and the harvesting of crustaceans and shellfish for subsistence foods. It is also used as a thoroughfare, especially by the Islanders who regularly travel on canoes and outboard motor boats around the coast of the Island.

Access to the marine areas by the local communities will not be significantly affected; in fact it will be facilitated as a new small boat wharf will be constructed for SBL's use in Ndavuna Inlet, and will also be available for public use, but only at agreed times for the local supply ship. The bulk carrier wharf area will be a restricted area as vessels are berthing, loading and departing, however, only the wharf itself will be a restricted area when there are no vessels in the vicinity. The bulk carrier wharf and the small boat wharf will be passed to the Government for community use once the bauxite deposit has been depleted, rehabilitation completed and the project made safe. The marine assessment concluded that the development will not have a significant impact on the livelihood of the nearby residents.

The bulk carrier wharf will remove a very small area of the coral reefs that support inshore marine organisms and that are an important link in the food chain, but these areas are a minimal part of the local environment. The mooring and movement of the bulk carrier vessels may require slight changes to the routes and fishing sites used by local communities but this will be temporary whilst ship movements are taking place. Hence overall, the use of the area by current users for transport and harvesting will not be significantly affected by the development, and they will ultimately be the beneficiaries of the wharf.

The mine and processing facility sites will have extensive runoff, stormwater and sediment controls in place, such that there should be no significant change to the water quality or flow in the waterways and groundwater downstream of the development sites, once the controls are in place. Section 5.3.1 details how the freshwater impacts of the development will be managed.

The Nature Conservancy (NC) has advised that the mine and its related development lies within a much larger regional area that has been earmarked through conservation planning as an important area for the protection of Solomon Islands unique marine biodiversity. World Conservation Society (WCS) has recommended that the Solomon Islands Government has the region listed as a World Heritage Site with the United Nations Educational, Scientific and Cultural Organization (UNESCO), and is concerned that a poorly managed mine may compromise a potential World Heritage listing. If SBL follows its development plan and the recommendations for the management of marine impacts in Section 5.3.2, the development is very unlikely to have any detrimental effect on the region's eligibility for World Heritage site listing. Section 5.3.2 details how the marine impacts of the development will be managed.

SBL have resolved that while the small boat wharf will be within the designated project site on Ndavuna Inlet, with restricted entry at all times, but it will allow conditional non-damaging public use when it is not in use by SBL. When SBL have completed bauxite mining in Vaghena, the bulk carrier wharf will be left, in good condition, for public purposes. Also, at the conclusion of operations related infrastructure such as the airstrip and main haul road will remain for community use, although items of machinery and equipment will be removed and/or sold.

## **6.6 Community Relations**

The non-local workforce (including the bulk carrier vessel crew) could introduce negative social impacts such as: drug trafficking, prostitution and customs that are incompatible with Solomon Islands traditions and values.

At all times workers will be required to respect property boundaries and be cognisant of cultural rules and codes of conduct (especially when addressing women and elders).

SBL will develop a Community Relations Plan which sets out the above requirements and establishes a communication protocol between the project management and the local community and villages. One member of the SBL staff will be appointed as the liaison person between SBL and the community and village leaders, as well as between SBL and any contractors.

SBL will be responsible for the conduct of its employees at all times and will create the same obligation for its contractors in any construction contracts. In the event that there are complaints about the behaviour or conduct of SBL employees or contractors, the complaints will be dealt with promptly and taken seriously by SBL, and the method of addressing the grievances will be relayed to the complainant. If the complainant is not satisfied that the complaint has been satisfactorily resolved, the complainant may contact the Provincial Office in respect of the complaint. The lodgement and resolution of complaints will be monitored by SBL and reported as part of their CEMP and OMP procedures.

It is known from other projects that children like to visit camps to sell small goods and to generally spend time 'somewhere new'. The mine and work sites will need to be carefully monitored and only allow admittance to authorized personnel. Village children and teenagers will be expressly forbidden entry to the accommodation camp, unless under their own parental supervision. Prior to commencing the construction and operation phases, SBL will liaise with residents of the nearby villages and school(s)

to inform them about the impending project work and how the local community might be affected by the employment of SBL’s workers from the three villages.

SBL will also inform the local villagers of the content of the SBL Traffic Management and Community Relations Plans and the behavioural obligations that SBL employees and contractors will be obliged to comply with. SBL will also make arrangements to deliver the STI and HIV/AIDS awareness programs to the communities. Furthermore, SBL will advise the communities on how to make an enquiry or complaint to SBL. Equally, the communities will agree who should be the local resident contacts when SBL wishes to communicate or raise an issue with the Vaghena Island communities. In this way SBL will establish lines of communication with the communities and minimise the risk of misinformation or negative relations developing.

Activity	Potential Adverse Effect	Mitigation Measure
<b>Interaction between non-local mine workers, contractors and local communities</b>	Introduction of negative social impacts such as: drug trafficking, prostitution and customs that are incompatible with traditional Solomon Islands values	Mine workers and contractors to respect property boundaries and to be cognizant of cultural rules and codes of conduct at all times. Complaints about the behaviour or conduct of SBL employees or contractors to be dealt with promptly and taken seriously by SBL. Children and teenagers to be expressly forbidden entry to the construction camp. Community Relations Plan to be developed and be implemented by SBL which sets out the above requirements and establish a communication protocol between the project management and the local community and the villages. All complaints to be registered and reported periodically to DOE/Commissioner of Lands.
	Inadequate communication to communities	Prior to the project commencement SBL will visit nearby residents and schools to inform them about the impending project work and the associated management plans and how the local community can communicate complaints and requests. The communities will be asked to nominate representatives with whom SBL can discuss issues and raise matters of mutual interest.
<b>Interaction between bulk carrier vessel crew and local communities</b>	Introduction of negative social impacts	The vessel will not have any contact with land other than receiving the bauxite from the ship loader at the wharf, no crew will be allowed to disembark, except to liaise with SBL management within the project area. SBL personnel and Government representatives will be allowed to board and disembark from the carrier.
<b>Local religious practice-no work on Sundays; or outside normal working hours</b>	Possible offence to the local Christian community	Discussions with local communities will be held to stress the importance of seven day a week operations in modern mining and processing businesses. Mining and other noisy activities which could impact on the villages to be minimised on Sundays.

**Table 6.6: Summary of Potential Impacts and Mitigation Measures for the Management of Community Relations**

## 7.0 ENVIRONMENTAL MANAGEMENT PLAN

DOE requires that Environmental Management Plans (EMP) be developed to cover the three different phases of the project construction, operations and decommissioning (including rehabilitation). EMPs will need to cover each of the project site locations including the mine site, whilst a Quarry Management Plan will be required for the limestone quarry site, if and when it is developed.

SBL is committed to implementing a Construction Environmental Management Plan and Operational Environmental Management Plan for the proposed development (CEMP and OEMP respectively). These plans are to be approved by the DOE. The CEMP will be submitted to the DOE prior to the commencement of construction. Once the plans are approved, SBL will be responsible for ensuring that its activities conform to the plans (Refer to Appendix 10-9 for detail CEMP).

### 7.1 Construction Environmental Management Plan

The Construction Environmental Management Plan (CEMP) will detail the operational and management mechanisms by which adverse impacts identified in this EIA are avoided, remedied or mitigated during the critical construction period. The scope of a standard CEMP is outlined in Table 7.1.

The CEMP will address the planned construction work described in this report, and will include considerations in relation to:

- Camp site;
- Power station and fuel storage farm
- Airstrip construction
- Mine site preparation
- Mobile equipment workshop
- Marine works, particularly the bulk carrier wharf and the small boat wharf;
- Processing facility (screening, drying and product storage facility construction); and
- Road works (upgrading of public roads and construction of the mine haul road).

Section	Important Conclusions
Introduction	Purpose and objective of the CEMP
Site description	Identification of sensitive habitats
Project description	Activity based, identification of activities likely to have an environmental impact
Site organization and management	Assessment of environmental management roles and responsibilities
Management of construction activities	Design and operational requirements, including measures to minimize sediment discharge
Contractors responsibilities and obligations	Specifications for inclusion in contracts
Monitoring	Rationale, location, parameters, methodology, equipment and calibration
Audit	Schedule
Forms and reporting	Details of reporting methodology to be employed
Contingencies	Prescribed responses to incidents
Forms and Contractor Acknowledgement	Templates for forms and contractor agreements

**Table 7.1: Outline Scope of the Construction Environmental Management Plan**

## 7.2 Quarry Management Plan

A Quarry Management Plan (QMP) defines the responsibilities of the quarry operator to ensure:

- Quarry staff is suitably qualified and trained;
- That procedures are in place for the safe operation of the quarry; and
- That records are maintained.

It is now the normal practice for the QMPs to incorporate the requirements of DOE in respect of CEMPs and OEMPs. The outline scope of a QMP incorporating these requirements is given in Table 7.2.

Section	Important Inclusions
Introduction	Purpose and objectives of the OEMP; stakeholders and legislative requirements
Management	Staff structure; record keeping and reporting; training; complaints
Site Features	Identification of important features; sensitive habitats
Site Preparations	Setting out; vegetation removal; storm water control; buildings and other amenities
Operation	Drilling and blasting; rock storage; crushing; storm water control maintenance; fuelling; traffic management; waste management
Quarry Closure	Process
Monitoring	Environmental monitoring-locations, parameters

**Table 7.2: Outline Scope of the Quarry Management Plan Incorporating Environmental Management**

## 7.3 Operations Environmental Management Plan

An environmental plan for operations is generally required by DOE for all large developments as a condition of Development Approval. The Vaghena Bauxite Project will have a detailed mine plan which will contain environmental provisions. These provisions will be reviewed by the Director of Mines and recommended by the Director of Environment and approved by the Minister for Environment. A comprehensive OEMP would duplicate much that is already in the mine plan.

SBL intend to provide an OEMP which will detail the normal requirements not included in the mine plan, in particular, the design and siting of the sediment retention ponds. Separate subsidiary plans for specific social issues, namely: Community Relations Plan, Traffic Management Plan, and HIV/AIDS Prevention Training Program will be submitted separately, but will be referred in the OEMP.

## 7.4 Monitoring

### 7.4.1 Monitoring Committee

The implementation of the CEMP and OEMP will be monitored through regular meetings of a Monitoring Committee as established by DOE and comprising people involved in the implementation and supervision of the plans as well as Government and Provincial officials. A monitoring report for the CEMP and subsequently the OEMP will be submitted to the DOE and DTCP every three months. Monitoring activities will need to focus on determining whether the project is having any significant impact on the environment – including whether new and potentially invasive species have been introduced via the transport vessels (marine environment) or materials and equipment imported to the site (terrestrial environment).

#### 7.4.2 Baseline Water Quality Monitoring

SBL have initiated a freshwater and marine surface water quality monitoring program to establish a benchmark prior to the commencement of project development and to establish initial monitoring stations.

The CEMP and OEMP will detail the proposed ongoing monitoring program derived from the baseline work. SBL are proposing both chemical and physical testing as summarized in Table 7.4.2. The results will be submitted regularly to DOE in the CEMP and OEMP monitoring reports.

Physical Parameters	Microbiological & Nutrients
Turbidity	Total Coliform
Total Suspended Solids	Faecal Coliform
Temperature	Total Nitrogen
pH	Nitrate
Salinity	Phosphate
Dissolved Oxygen	

**Table 7.4.2: SBL Water Quality Monitoring Parameters**

#### 7.4.3 Wastewater Treatment

Currently SBL are planning to install a modular sewerage treatment plant for the camp and processing facility. An effluent monitoring regime will be included in the application for a liquid waste permit under the Solomon Islands Environmental Management Act. Septic tank systems will be installed at other sites, such as the mine workshop. Monitoring of these facilities will be included in the effluent monitoring regime.

#### 7.4.4 Rehabilitation

Reporting on the progress of rehabilitation trials and site rehabilitation will be an important component of the monitoring reports to DOE.

#### 7.4.5 Wharf

In view of the large ships which will use the bulk carrier wharf, regular maintenance will be an important requirement, especially after storms or any damage causing during ship docking activities. Monitoring for maintenance requirements will be included as a component of the regular OEMP reporting.

## 8.0 CONCLUSION

SBL under the Solomon Island environmental act (2008) has undertaken an EIA of its proposed bauxite mining in accordance with its regulations under the 2010 Solomon Environmental Guideline. This report culminates the responsibility and underlines the baseline requirements under the two legislative tools mentioned above.

The Bauxite mine even though will provide anticipated potential economic benefits to the local people in terms of employment, increase input of outside income into the local cash flow, improve infrastructure developments on the roading system of the island, on the regional context it will also open up opportunities to locals outside the I-Kiribati Settlers on Vaghena and main Melanesian communities of Choiseul Southeast communities to the greater Solomon people who have skills that are useful for the construction and operational phases of the site.

On the other hand, the impact of mining on an island ecosystem if it is not well managed will result in some negative environmental impact to the fragile island ecosystem. In this study, we have identified some potential negative environmental outcomes from the proposed development and have suggested proper management and mitigation measures to minimize these impacts.

Monitoring Assessments will be carried out once the initial works are put into perspective according to the laws of the country for development of mineral resources on the island of Vaghena.

Overall, the EIS study supports the mining proposal and recommends the Department of the Environment to support this local initiative by the Solomon Bauxite Limited in conjunction with the support of the Solomon Governmental stakeholders such as the Lands Department and Commissioner of Lands Office.

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**10.0 APPENDICES**

**APPENDIX 10-1 : 2010 SOLOMON ISLANDS EIS GUIDELINES**

**APPENDIX 10-2 : ML PROPOSED TENEMENT BOUNDARY-PROSPECTING LICENSE BOUNDARY**

**APPENDIX 10-3 : WATER QUALITY ASSESSMENT**

**APPENDIX 10-4: CIVIL ENGINEERING, PROCESSING & STOCKPILE FACILITIES, WHARF AND AIRPORT**

**APPENDIX 10-5 : MINUTES OF THE MEETING-PUBLIC AWARENESS**

**APPENDIX 10-6 : TYPES OF MACHINERY TO BE UTILIZED FOR MINING**

**APPENDIX 10-7 : BULK SHIP AND WHARF DIAGRAMS**

**APPENDIX 10-8 : SBL PREFEASIBILITY STUDY-TECHNICAL REPORT 2012.**

**APPENDIX 10-9 : CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN**



# *Solomon Islands*

## Environmental Impact Assessment Guidelines

*April 2010*

Ministry of Environment, Conservation and Meteorology

Produced by the Environment and Conservation division, Ministry of Environment,  
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# Acronyms

<b>ACT</b>	Environment Act 1998
<b>CA</b>	Consent Authority (ECD)
<b>EAC</b>	Environment Advisory Committee
<b>ECD</b>	Environment and Conservation division
<b>EIA</b>	Environmental Impact Assessment
<b>EIS</b>	Environment Impact Statement
<b>EMP</b>	Environmental Management Plan
<b>MECM</b>	Ministry of Environment, Conservation and Meteorology
<b>PER</b>	Public Environment Report
<b>REG</b>	Environment Regulations 2008

# Glossary

## Terms Explanation

<b>Developer</b>	Any person who undertakes or proposes to undertake development.
<b>Development Consent</b>	Consent or Approval to carry out any prescribed development issued by the CA.
<b>Director</b>	Refers to the Director of Environment and Conservation, representing CA.
<b>Environment</b>	All natural and social systems and their constituent parts, and the interactions of their constituent parts, including people, communities and economic, aesthetic, culture and social factors.
<b>Environment Advisory Committee</b>	A group comprising of a chairman, vice chairman and not more than 10 members established for the purpose of the ACT.
<b>Environmental Impact Assessment (EIA)</b>	Environmental Impacts Assessment (EIA) is a tool used to identify, predict, assess and mitigate environmental, social and other relevant effects of proposed developments prior to major decision makings and commitments.
<b>Environmental Impact Statement (EIS)</b>	A detailed report presenting the results of an environmental impact assessment.
<b>Public Environmental Report (PER)</b>	A brief report presenting the results of a preliminary environmental assessment of an existing or proposed development.
<b>Scoping</b>	The process undertaken to identify the main issues to be addressed by an EIA, the information to be collected, the baseline

studies that should be carried out and the methodology that should be used to evaluate their significance.

### **Screening**

The initial stage in the process, when a decision is made on whether or not EIA is required for a particular proposed development.

### **Prescribed Development**

Development prescribed under Part III of the Act (See Appendix A). Prescribed development is intended to refer to developments which are considered to have potential for significant environmental impacts.

# Introduction

Most of the development activities that generate foreign earnings for the economy of Solomon Islands are heavily dependent upon the exploitation and utilization of natural resources. For many years, economic development activities in Solomon Islands have not integrated environmental considerations. As a result of its accelerated pace of development and level of exploitation of its natural resources, the country witnesses significant natural resources depletion resulting in environmental pollution, degradation and damage. Thus, it is crucial that there is proper legal mechanism in place that governs the proper and responsible management of the natural resources and the environment in general by means of controlling and regulating development activities.

The Environment Act 1998 which is administered by Environment and Conservation Division introduces an integrated system of development control, environmental Impact assessment and pollution control. The thrust of the ACT is on the procedures of environmental impact assessments (EIA). It is a requirement of the ACT that all prescribed developments are mandatory to undergo EIA for which development consent is required. EIA is a management and planning tool used for examination, analysis and assessment of proposed developments with a view to ensure environmentally sound and sustainable development. It is envisaged that enforcement of EIA in controlling and regulating developments will improve the management of natural resources, prevent and protect the environment from pollution, degradation and damage.

The aim of EIA can be divided into two categories. The immediate aim of EIA is to inform the process of decision-making by identifying the potentially significant environmental effects and risks of development proposals. The long term aim of EIA is to promote sustainable development by ensuring that development proposals do not undermine critical resource and ecological functions or the well being, lifestyle and livelihood of the communities and peoples who depend on them.

This guideline has been prepared by the Environment and Conservation Division with the aim of simplifying the procedures of EIA outlined in the ACT and accompanying Environment Regulations 2008 to provide basic advice and guidance to government officers, planners, developers, resource owners and those involved in processing development proposals, on the environmental impact assessment process.

# Purpose of EIA

Promote environmentally sound and sustainable development through the identification of appropriate mitigation measures.

Protect the quality and productivity of the natural environment.

Predict and avoid, minimize or offset the adverse significant environmental, social and other relevant effects of development proposals.

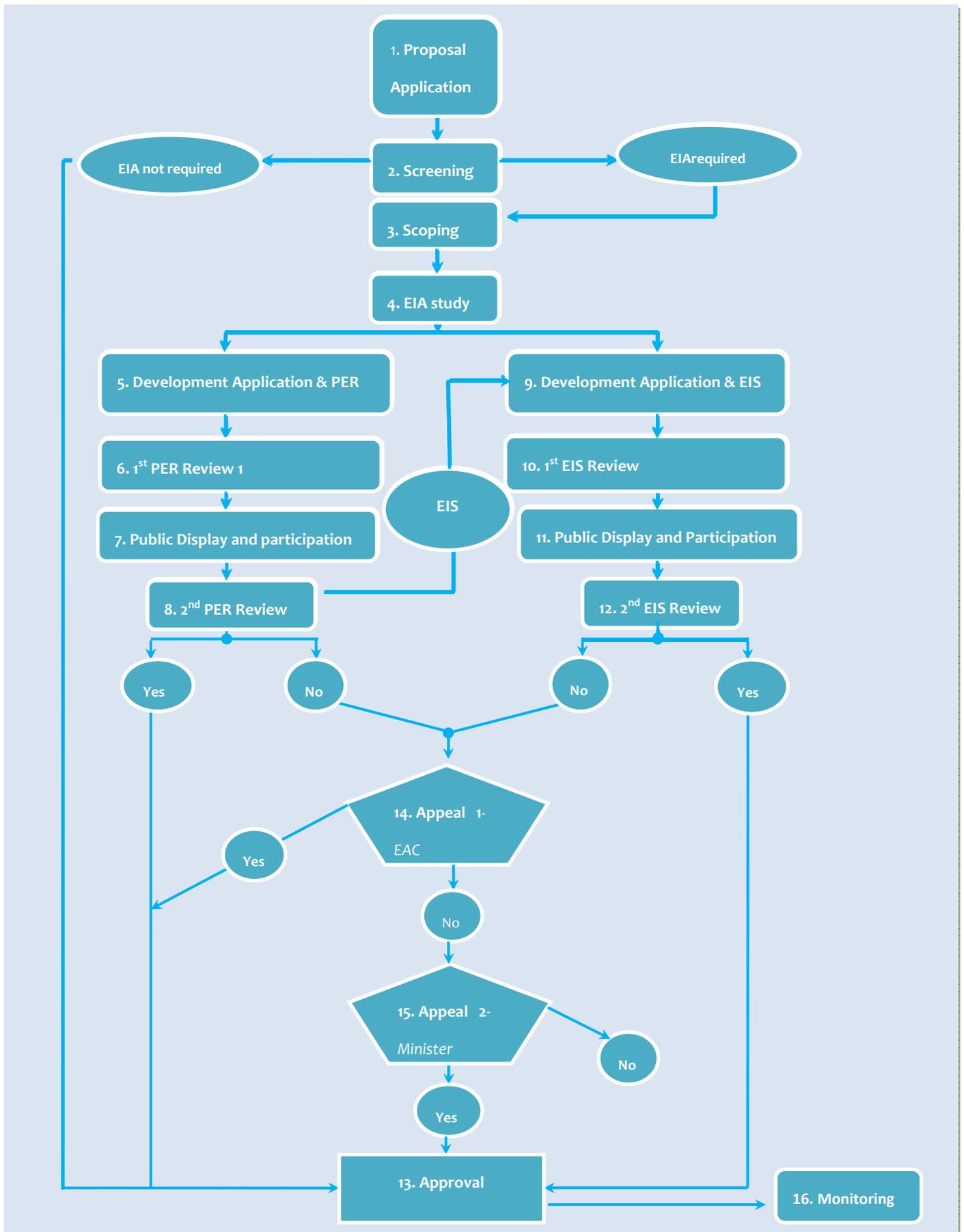
Provide information for decision-making on the environmental consequences of any proposed developments

# EIA Procedures

The Environment Act stipulates the general procedures for EIA in Solomon Islands. This section elaborates on those procedural guidelines making it easier to understand.

The procedural steps as required under the ACT and regulations are illustrated in Figure 1 below. The subsequent table (table 1) depicts the brief explanations of each step including those key players and the time frame for each action.

Figure 1: EIA procedural steps



Step	Title	Details of Actions	Time frame (days)	Stakeholders involved in each action
1.	<b>Proposal Application</b>	The developer lodges a proposal application to the ECD with an application fee of \$200. The proposal application should be a formal letter outlining detail description of the proposed development.  <i>Act 17(1) &amp; Reg 6</i>	na	Developer
2.	<b>Screening</b>	ECD decides whether or not EIA is required by screening the proposal applications. In the case where EIA is not required, go to <b>step 13</b> . Conversely once an EIA is required, then go <b>step 3</b>	15	ECD & Developer
3.	<b>Scoping</b>	ECD after considering the application within 15 days requires the developer to carry out an EIA study. Scoping is where major impacts of the proposed development are identified and highlighted. ECD will then advise the developer of the type of information required and will decide whether PER or EIS is required of the developer.  <i>Act 17(2) and Reg 7</i>		ECD & Developer
4.	<b>EIA study</b>	The developer carries out studies to collect and prepare the environmental information (report) required by ECD. If the developer is preparing a PER go to step 5 or EIS go to step 9.	na	Developer
5	<b>Submission of PER and Development application</b>	The developer prepares and submits PER and the development application (Form 2 in Environment Regulations 2008) with a development application fee .  <i>Act 17(2a),30</i>	na	Developer
6	<b>1 st Review of PER</b>	ECD reviews the application to determine the nature of the proposal and whether the PER complies with the ACT. If the PER does not fulfill the requirements of the Act, ECD may advise the developer to submit further information or details. If the PER meets the Act requirements, go to <b>Step 7</b> .  <i>Act 21,29 and Reg 8 (a)(b)(c)</i>	10-review 5- decision	ECD

7.	<b>PER : Public Display/participation</b>	<p>ECD will publish the PER document such that it is made available to the public and convene a meeting that ensures public participation. The notice of the meeting (form4 in Environment Regulation 2008) will be published in the newspaper and posted in public places in the communities, which will be likely affected. Any cost associated with the publication of the Notice or PER will be borne by the developer.</p> <p><i>Act 22(1,2),30 and Reg 11&amp; 12</i></p>	30	ECD, relevant organization, provincial government, developer, resource owners/users, public.
8.	<b>2<sup>nd</sup> PER Review</b>	<p>The PER will be reviewed again by ECD taking into consideration any objections and information received during the Public display meeting or after the meeting. ECD may after the review:</p> <ol style="list-style-type: none"> <li>1. Approve (<b>step 13</b>)</li> <li>2. Reject- developer may appeal to advisory committee(<b>step 14</b>)</li> <li>3. Deferred for approval- ECD may require an EIS from developer (<b>step 9</b>)</li> </ol> <p><i>Act 22(3),Reg 8(e),13</i></p>	15	ECD
9	<b>Submission of EIS and Development Application</b>	<p>Developer prepares and lodges the EIS and development application with development application fee. If the EIS meets the requirements of the Act, go to <b>Step10</b>.</p> <p><i>Act 17(2b)and 30</i></p>	na	Developer
10	<b>1<sup>st</sup> EIS Review</b>	<p>ECD reviews the application to determine the nature of the proposal and whether the EIS complies with the ACT. If the EIS does not fulfill the requirements of the Act, ECD may advice the developer to submit further information. If the EIS meets the Act requirements, go to <b>Step 11</b>.</p> <p><i>Reg 8 (a)(c)</i></p>	10-review 5- decision	ECD
11	<b>EIS Public Display and Participation</b>	<p>The ECD will publish the EIS document such that it is made available to the public and convene a meeting that ensures public participation. The notice of the meeting shall be published in the newspaper and posted in public places in the communities, which will be likely affected. Any cost associated with the publication of the Notice or EIS will be borne by the developer.</p> <p><i>Act 24(1)(2),30 and Reg 11 &amp; 12</i></p>	30	ECD, Any person, relevant organization, provincial government, developer

12	2 <sup>nd</sup> EIS Review	<p>The EIS will be reviewed again by ECD taking into consideration any objections and information received during the Public display meeting or after the meeting.</p> <p>ECD may after the review:</p> <ol style="list-style-type: none"> <li>1. Approve (<b>step 13</b>)</li> <li>2. Reject- developer may appeal to advisory committee(<b>step 14</b>)</li> </ol> <p><i>Act 24(3),Reg 8e</i></p>	15	ECD
13	Approval	<p>The development consent is issued to the developer with conditions (form 5 of Environment Regulation 2008).The fees for development consent vary depending on the type of prescribed development.</p> <p>The decision of ECD shall be published in the newspaper having wide circulation in the Solomon Islands or in any other forms of public notices as approved by ECD.</p> <p><i>Act 24(3a)and Reg 14,16</i></p>	5	ECD
14	Appeal 1.	<p>The developer or any person(s) who disagrees with any decision of the Director may within 30 days of publication of the decision appeal to the Environment Advisory committee (EAC) in writing, stating clearly the grounds of appeal. The appellant shall pay an appeal fee.</p> <p><i>Act 32(1)(2)(3)(4)(5) and Reg 18</i></p>	30	Developer/Any person
15	Appeal 2.	<p>If again any person disagrees with the EAC's decision, he or she may within 30 days from such decision appeal to the Minister who will make the final decision.</p> <p><i>Act 32(7)</i></p>	30	Developer/Any person
16	Monitoring	<p>ECD or any relevant public authority may at any time, whether before or after a development activity has been completed, monitor or cause to be monitored, all or any of the environmental aspects of the implemented development activity.</p> <p><i>Ref: Act 31</i></p>	na	ECD /Other relevant public authority

## Summary of the Timeframe for EIA

Below is a summary of the time frame in the 4<sup>th</sup> column of the table 1 above.

15 days <sup>1</sup>	Processing of proposal application and CA making decision. (Screening & Scoping)
15 days <sup>1</sup>	Processing of development application and CA making decision. (Review 1)
5 days <sup>1</sup>	Publish the EIA report and notice for meeting
30 days <sup>1</sup>	Public display of EIA reports and consultations (incl. public meeting)
15 days <sup>1</sup>	Determining the application (Review 2)
5 days <sup>1</sup>	Approval or Rejection
30 days <sup>1</sup>	Lodging of Appeals

1- Refers to the normal working days

# EIA Procedural Descriptions

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## Proposal Application

Prior to submission of the proposal application by the developer to the Consent Authority, it is advisable that the developer should first seek written advice from the Consent Authority. It will take about 10 working days for the CA to respond to the developer. The Proposal application should be in the form approved by the Minister of Environment.

At present, the Environment Regulations 2008 has no prescribed forms available for proposal application. Therefore, the CA accepts formal letters/documents outlining the details of the proposed development. A good written proposal application should include the:

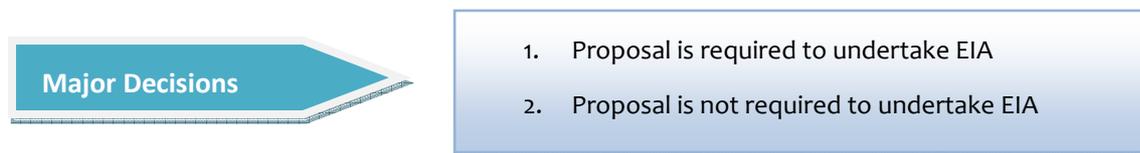
1. Name and description of the proposed development
  - Describe the type, size or nature of the development.
  - It may include the plan or design of the development. (E.g. a building plan)
2. Proposed location(s)
  - It should provide map/site plan is essential.
  - It should indicate the geographic location of the site, elevation and slope, any nearby area of environmental significance such as proposed or declared reserves, protected areas, world heritage sites, watercourses, wetlands (etc.) and adjacent land uses, including the nearest villages/communities.
3. Objectives of the proposed development

### Box 1: Checklist for Application package

- ✓ Official letter of application ( must include current address/phone contacts)
- ✓ Relevant documents (maps, plans etc.)
- ✓ Receipt of Application fee

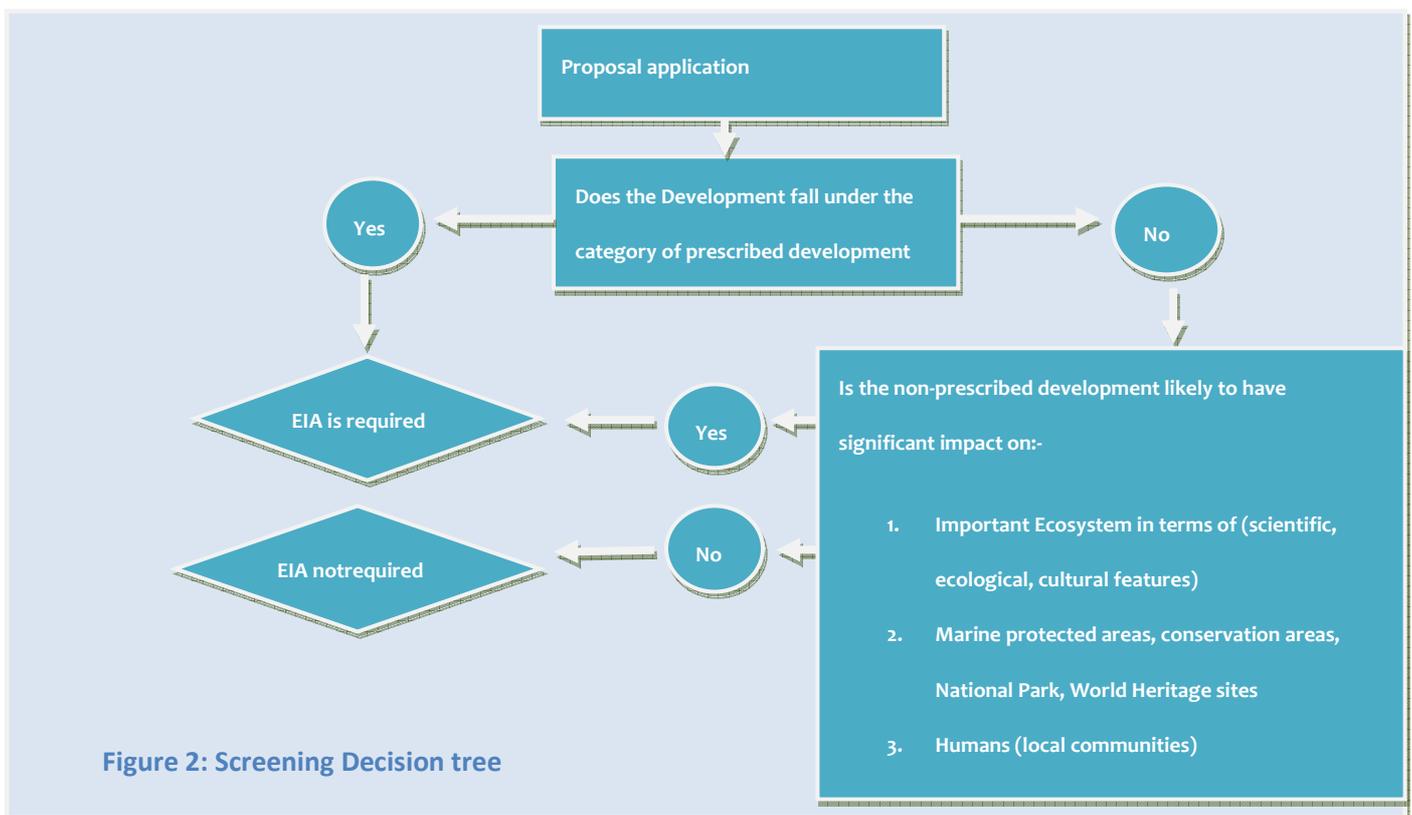
## Screening

Screening is the first step in the EIA process in which the CA makes a decision on whether or not EIA is required for a development proposal. The main purpose of screening is to verify if the proposed development type has potential environmental impact or not. Screening is undertaken using the information provided in the proposal application. At this scoping stage, the following decisions will be made by the CA:-



Screening of all ‘prescribed developments’ must lead to a “yes” decision that EIA is required. The CA is responsible for screening of development proposal application. To carryout screening, figure 2, outlines the procedure which shall lead to the following decisions:-

1. Environment Impact Assessment is required where the proposed development is likely to have significant adverse environmental impacts.
2. Environmental Impact Assessment is not required where the proposed development is unlikely to cause significant environmental impacts.



## Scoping

Scoping is the procedure carried out by the CA after the screening procedure. In some instances, in the case of large projects, the developer may execute the scoping process and then submits its scoping report to the CA for consideration. In terms of local resource owners who do not have technical expertise, the CA may assist them in undertaking scoping.

Scoping applies to the development proposal which is identified in the previous stage to undergo EIA. It is principally to identify the main issues to be addressed by an EIA, the information to be collected, the baseline studies that should be carried out and the methodology that should be used to evaluate their significance. It is the stage whereby the CA identifies and highlights the major impacts of the proposed development.

Assessment of the development site by the CA may be carried out in this stage as to:-

- ☞ allow an on the ground check and verify the proposed development site
- ☞ be familiarized with the site and its environment
- ☞ be able to identify the issues that require detailed study
- ☞ identify the likely impacts of the development.

At this scoping stage, one of the following decisions will be made by the CA:-

### Major Decisions

1. Advise the developer to submit development application and PER
2. Advise the developer to submit development application and EIS
3. Dispense the requirements of (1) or (2)...Act17(2)

The CA may dispense a development from further requirements of EIA if:

- The short and long term impact of the prescribed development will be trivial or negligible.
- There is already in existence an EIS produced in respect of the same prescribed development.
- If the anticipated impact of the prescribed development will not affect forested

areas and services.

- If the anticipated impact of the prescribed development will not adversely coastal zones or the marine environment.
- The prescribed development does not fall into the category of construction, infrastructure, agriculture or mining.

*(Source: Section 9 (1) of the Environment Regulation 2008)*

The decision on the type of Environmental Report (PER or EIS) required by the CA in submission with the development consent depends on:-

- The type and magnitude of the proposed development.
- The significant impacts of the proposed development.
- The type of environments within or surrounding the proposed development site.

#### **BOX 2. PER or EIS**

Most prescribed developments will need a Public Environmental Report (PER). However, many major developments like mining, extensive logging, large scale tourism resorts, re-settlements, agriculture schemes, and large scale infrastructure developments will need a thorough technical assessment of impacts that will result in the need for Environmental Impact Statement (EIS).

EIS may be required of prescribed developments that may induce significant adverse impacts that may be sensitive, irreversible, and diverse, with attributes such as direct pollutant discharges large enough to cause degradation of air, water or soil. This includes developments that may involve large-scale physical disturbance of the site/surroundings, extraction, consumption, or conversion of substantial amounts of forest and other natural resources and involuntary displacement of people and other significant social disturbances.

## EIA study

The EIA study subsequently follows the scoping where a study is conducted to assess the significant environmental issues and develop adequate mitigation measures and alternatives. The developer is responsible to carry out the EIA study following the requirements made by the CA in the scoping process. This study should address the issues highlighted by the CA. The outcome of the study is the production of an environmental report (EIS or PER). The developer should engage qualified and experience

Person(s) to carry out the study especially for the technical parameters. It is important to note that to be able to prepare a PER or EIS, it is required in section 4 of the Environment regulations 2008 that initial approval has to be obtained from the CA. Approval may be obtained by written application to the CA. The CA may issue approval for any person to undertake or prepare PER or EIS base on the following criteria:-

1. If he/she has the necessary qualification and experience to undertake, prepare and produce any PER or EIS
2. If he/she has written accreditation or approval in another country to undertake, prepare and produce any PER or EIS<sup>(source REG 4)</sup>

A list of approved person(s) and their contacts that are liable to undertake EIA study can be obtained from CA.

In the EIA study the developer or its consultant carries out studies to collect and prepare the environmental report required by CA. The study should focus and provide information on:-

1. The Background of the Prescribed development,
2. The Description of the Prescribed development,
3. The Environment likely to be affected by the proposed prescribed development,
4. The Relevant Impacts of the proposed prescribed development,
5. The proposed safeguards and Mitigation measures,
6. Any other approvals and Conditions, and
7. The Sources whereby the information is obtained.

The prescribed Forms 1 and 3 in the Environment Regulations should be used in preparing the Environmental Reports.

## Submission of Development Application and EIA Reports

When the EIA study is completed, the developer must submit the development application (Form 2 of the Environment Regulations) together with an EIA report as determined in the scoping stage. There are two forms of EIA reports that are required in the EIA procedure: Public Environment Report (PER) and Environmental Impact Statement. The developer is required to send only one type of EIA report with the development application as advised by CA. Development application and processing fees will be paid at this stage and receipts attached to the development application and submitted to the consent authority.

### First Review of PER or EIS

Upon the receipt of the PER or EIS with its corresponding development application form, the CA will then conduct an internal review on the contents of the Report. The CA will use a set of guidelines in reviewing the content of the PER or EIS. The main purpose of reviewing the reports is to ensure that it:-

1. Is presented in a manner that is easier to understand and conforms to the required prescribed format.
2. Contains all the required information as required by the prescribed forms (1 & 3)
3. Conforms to the requirements of the ACT and Environment Regulations.
4. Address all the significant environmental issues.
5. Is prepared by an approved or authorized person(s).

### EIS or PER Public Display and Participation

Subsequent to the first review and acceptance of the PER or EIS, it is a requirement under section 22 and 24 of the Environment Act 1998 that the report will be subject to public display. The CA will publish a notice to allow the public to be aware of the proposed development application. The notice will be in Form 4 of the Environment Regulations and it will be published in a newspaper that is published regularly in the Solomon Islands. The notice should also be posted in public places in the communities that will be likely affected.

The notice includes the date and venue for a meeting that will be organized by the CA. This meeting shall purposely to:-

1. Explain contents, recommendations and findings of PER or EIS,
2. Receive/record any written or oral representations from any person.
3. Receive and consider any objections (*Regulations 12*)

### [Who should attend the Meeting?](#)

1. The communities within or close to the area of the proposed development.
2. The provincial government of the province in which the proposed development will undertaken.
3. Any relevant organization that would provide useful contribution to proposed prescribed development.
4. Any persons who may be affected by the proposed development.

The venue of the meeting will depend on the location of the proposed development. If the proposed development is in a rural area, the meeting should be held in a community within the area. Conversely, if it's in an urban center, the venue shall be determined by the director.

### [Consideration of Objections and Submissions](#)

There are certain criterion whereby the CA will consider any objections following the publication of the PER/EIS. The criteria as in Regulation 13 are as follows:-

1. The objection is in writing
2. It states the interest that the person making the objection claims to have in relation to the proposed prescribed development; such interest are not being limited to economic or property interest
3. It clearly states the nature of objection that is being made to the development
4. It provides sufficient details of the grounds upon which the objection is based.

### [Public Display of PER or EIS](#)

The CA will also be responsible for making copies of PER/ EIS documents to be made publicly available. Copies of the PER/EIS should be displayed in communities, villages, residents, settlements, provincial headquarters/station for persons whose interests are likely to be affected by the proposed development prior to meeting. The purpose of such activity is to allow any concerned person(s) to view the report and get first hand information on the proposed development and its effects, and be able to effectively participate in the meeting.

### [Who will meet the cost for publication?](#)

The developer will be responsible for any costs associated with the publication of the Notice, Public Environmental Report or Environmental impact assessment. *(Regulation 11 (1))*

## Second PER or EIS Review

Following the Display and Publication of the PER or EIS, a second review will be executed internally within the Consent Authority. This review will consider the public submissions, comments and objections taken during the event of the public display and participation (meeting). The review of either PER or EIS will provide adequate information and allows the CA to make a rational decision on whether to approve or reject the proposed development application.

## Approval

The whole EIA process is aimed to improve decision-making, from screening stage to approval.

Granting of development consent by the CA will use the following criteria:-

- a. The finding or recommendation of the PER or EIS supports the proposed development
- b. That the proposed prescribed development will be carried out in a manner which is consistent with all relevant environmental policies and regulations
- c. Has reasonable steps in place to minimize any risk of environmental harm, as a result of the prescribed development
- d. The proposed prescribed development will not contravene any relevant environmental obligation under any international treaty, convention or instrument to which Solomon Islands is a party.
- e. The applicant will abide by the conditions of the development consent.
- f. No approval will be given to an applicant if all the criteria specified in above are not met.

*(Regulation 14 (1) (2))*

The issuance of consent shall be in Form 5 of the Environment Regulations and the decision of the CA shall be published in newspaper having wide circulation in Solomon Islands. *(Regulation 14 and 15)*

It is important to note that in granting of the Development consent the CA will impose conditions. These conditions are necessary to ensure that developer safeguards the life supporting capacity of the environment and steps are taken to mitigate any adverse environmental impacts. Additionally, it is important to note that a development consent is non transferable. *(ACT 33(1))*

## Appeal System

The appeal system is in place to make sure that the decision made is unbiased and conforms to the Environment Act 1998 and Regulation 2008.

There are two forms of appeal that may be carried out during the EIA process, specifically, Appeal 1 and 2.

### Appeal 1: an appeal made to the Environment Advisory Committee (EAC)

The developer or any person(s) who disagrees with any decision of the CA may appeal to the Environment Advisory Committee (EAC) in writing stating clearly the grounds of appeal within thirty days (30) of the publication of the decision. *(Act 32)*

As defined in Regulation 18, an appeal may be made against the CA's decision on the following grounds:-

- a. Inconsistent with any provisions of the Environment Act 1998
- b. Inconsistent with the finding or recommendation of PER or EIS
- c. Inconsistent with any international treaty, conventions or regional arrangements to which Solomon Islands is a party.
- d. The prescribed development is to be undertaken on customary land, the said development is not supported by majority of the legitimate customary landowners, as determined by chiefs in accordance with local Court.

The person who lodges an appeal shall pay to the CA, an appeal fee as set out in Part 5 of this guideline. *(Act 32(3))*

The EAC in hearing the appeal shall give the appellant, CA (director) and any relevant authority a reasonable opportunity of being heard. The EAC may by a majority decision either confirms the CA decisions or substitute its own decision for that of the CA. *(Act 32(5))*

### Appeal 2: An appeal made to the Minister of Environment

If again the developer or any person(s) aggrieved by the EAC's decision, an appeal may be made to the Minister of Environment who will make such order as he considers just.

*(Act 31(7))*

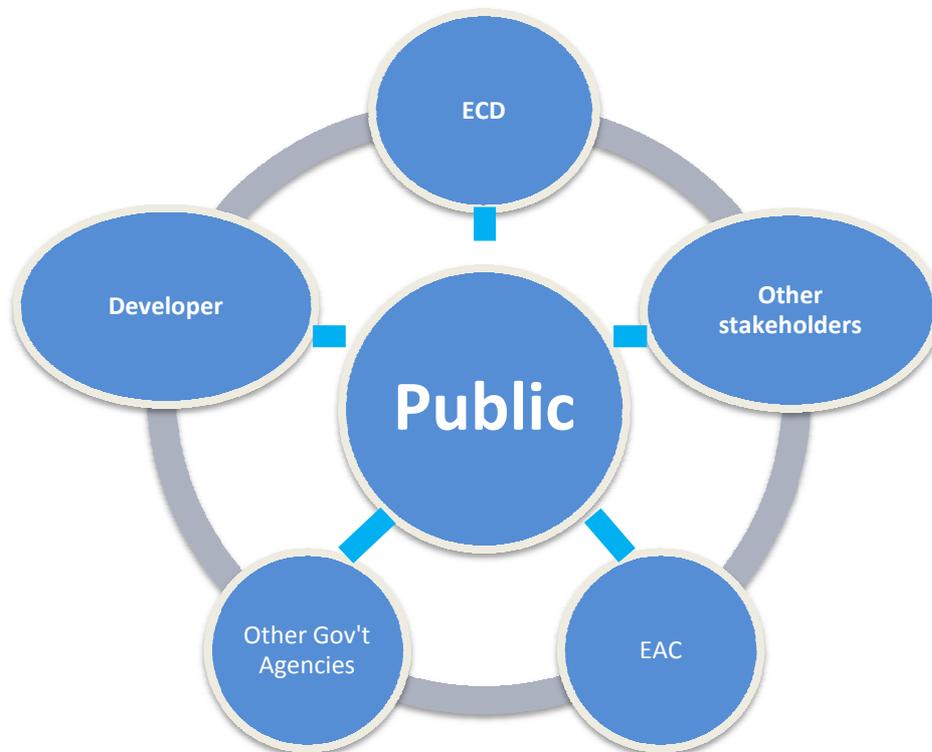
## Monitoring

The final step in the procedure is to conduct monitoring on the various prescribed developments that have been granted development. Monitoring will be carried out by the CA according to its monitoring programme and will concentrate on the developer's Environmental Management Plan (EMP). This monitoring should focus on the environmental impacts, effectiveness of the mitigation measures, safeguards and standards adopted by the developer for the protection of the environment. The developer may also execute its internal monitoring based on its monitoring plan.

### Power of Inspectors

It is important to note that the CA or any relevant public authority may at any time, whether before or after a development activity has been completed, monitor or cause to be monitored, all or any of the environmental aspects of the implemented development activity.<sup>(Act 31(1))</sup>. In addition, under the Environment Act in section 11, an inspector (Environment officer) may enter any land, building or house however with prior notice given to the owner(s).<sup>(Act 11)</sup>

# Stakeholders in the EIA process



## Environment and Conservation Division (ECD)

The core responsibilities of ECD include:

- Receives development proposal applications
- Screening of applications
- Scoping
- Review of PER or EIS
- Issuance of Development consent
- Conduct Monitoring of EMP and enforce any conditions
- Assist the developer in the EIA process

## Developer

The developer's responsibilities are to:-

- Lodge the application for proposed development
- Meet application and processing fees/cost
- Produce/meet PER or EIS consideration fee/public displays
- Mitigating costs for any adverse environmental impacts

## Public/Other Stakeholders

Their responsibilities are mainly to submit views, comments and objections regarding the proposed development. They may involve in the scoping process, the meeting (Publication/Display of reports) and in the Appeal stages.

## Other Government agencies

The government ministries or provincial governments, relevant environmental related agencies with jurisdiction over the aspects of the proposed development. Their responsibilities depend very much by their relevant statute.

## Environment Advisory Committee

Its function is to advise the ECD or Minister on any matters connected with Environment and Conservation and to conduct or perform any task assigned to it under the provisions of the ACT. The EAC shall receive any written appeals submitted by any appellant(s) who disagrees with the decision of ECD and shall make a majority decision.

# Fees and Cost

As stipulated in the Environment Regulations 2008 schedule 1, the following prescribed fees are applicable.

No.	Subject –matter	Amount (SBD)
1	Proposal application	200.00
2	Development application	200.00
3	Application for license (section 39)	200.00
4	Notice of appeal	200.00
5	Processing of PER	200.00
6	Processing of EIS	200.00
7	Search fee (section 28)	200.00
8	Amendment of License (section 41(2))	150.00
9	Development consent for food industries	8,000.00
10	Development consent for iron and meal industries	10,000.00
11	Development consent for logging operations	10,000.00
12	Development consent for mining	10,000.00
13	Development consent for Agriculture	10,000.00
14	Development consent for estate development	5,000.00
15	Development consent for residential	2,000.00
16	Development consent for fishing and marine products	10,000.00
17	Development consent for leather, paper, textile	10,000.00
18	Development consent for chemical industry	10,000.00
19	Development consent for tourism industry	10,000.00
20	Development consent for public works	10,000.00
21	Development consent for industrial estate	8,000.00
22	Development consent for petroleum products storage/works	8,000.00
23	Development consent for ports/harbours	10,000.00
24	Development consent for infrastructure	5,000.00
25	Development consent for airport/aerodrome development	8,000.00
26	Development consent for waste disposal	8,000.00

## Payment of Fees

Payment of the fees will be made to the government at Treasury, Ministry of Finance; however, a receipt(s) will be presented to ECD as evidence of payment. Prior to this, the developer should consult the ECD to obtain details of the payment procedure.

## Costs

Though the exact cost of an EIA are difficult to determine, it is important to note that it is the responsibility of the developer to meet all expenses incurred in the preparation and publication of PER or EIS. More so, the developer is responsible for costs involved in mitigating any environmental impact.<sup>(Reg 17)</sup>.

In terms of monitoring that is done by the CA (environment inspector), the developer shall pay the inspector at a rate of \$100 an hour, or where the CA (director) determines that the monitoring is to be done by an independent person or body, at actual cost charged by that person or body.<sup>(Reg 27 (6))</sup>.

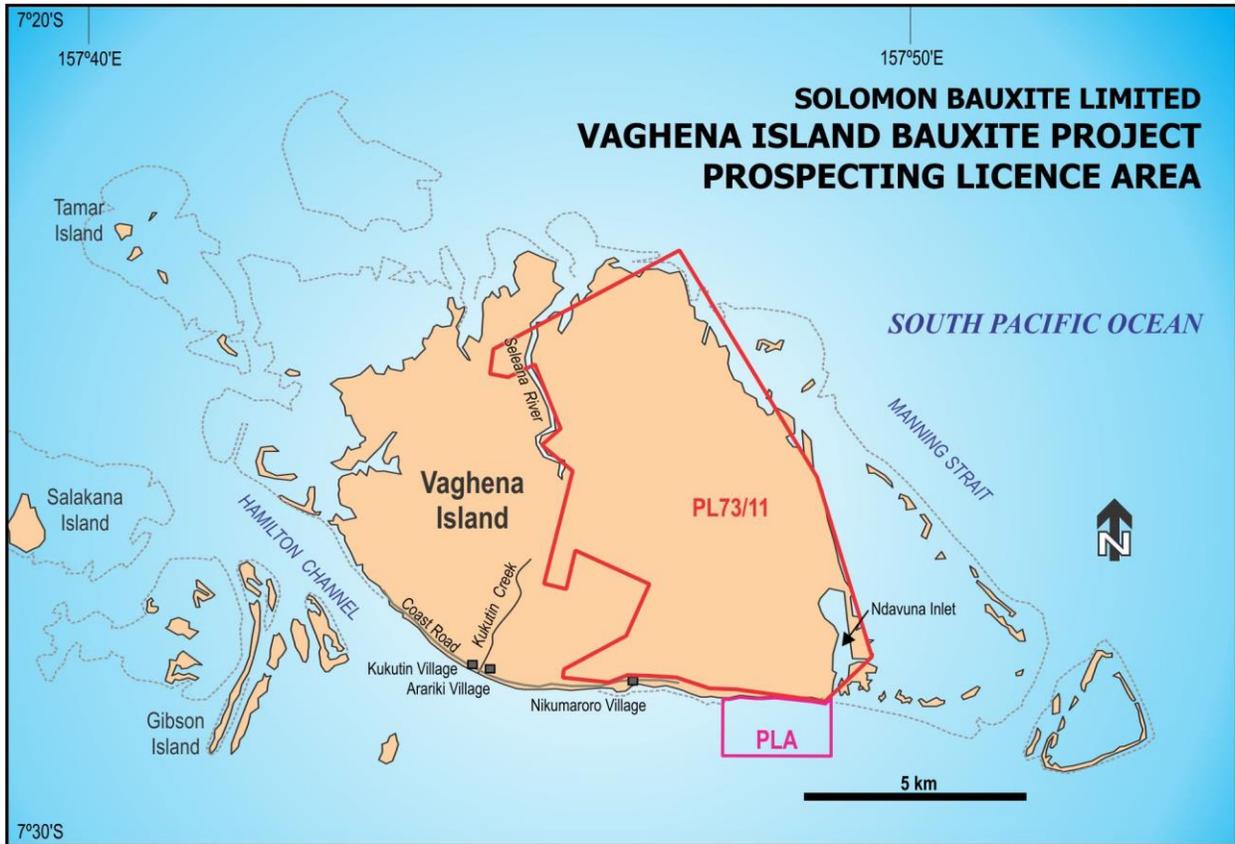
# References

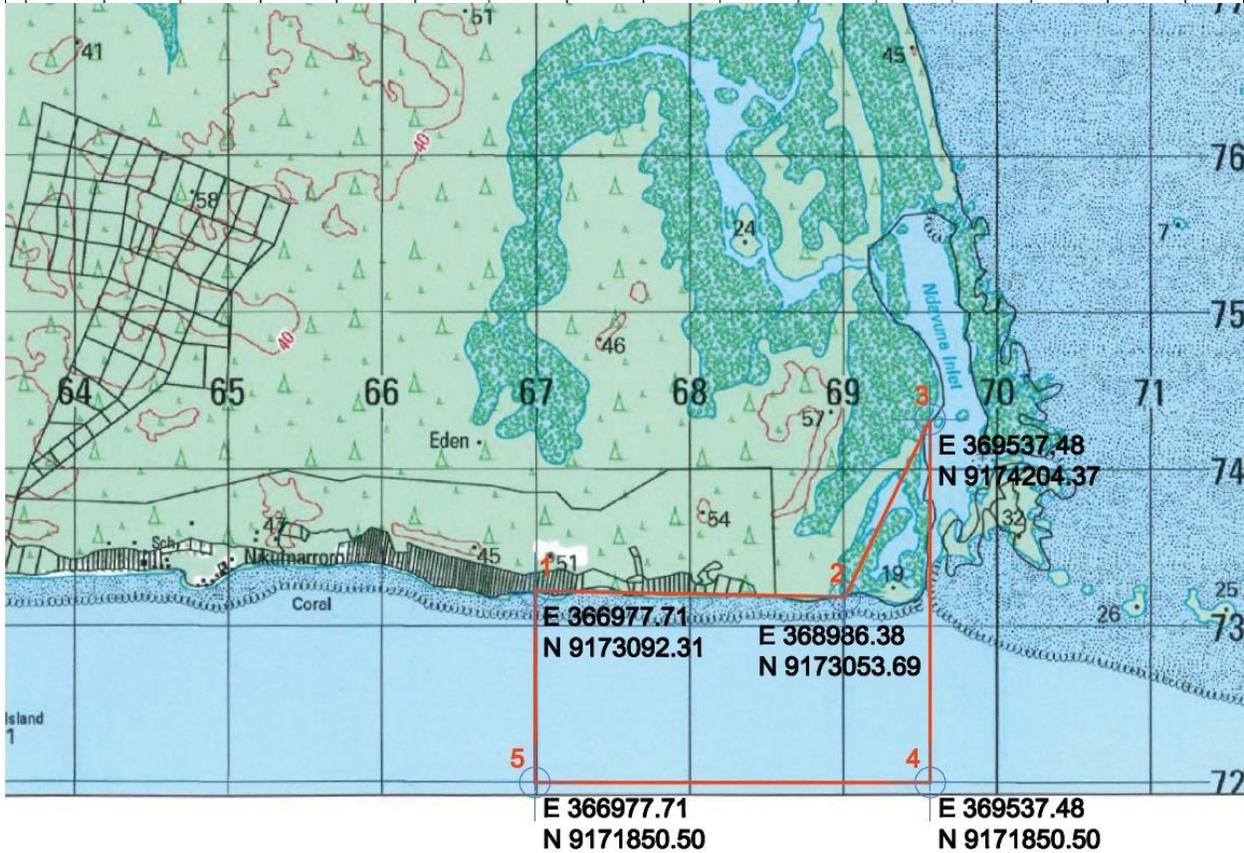
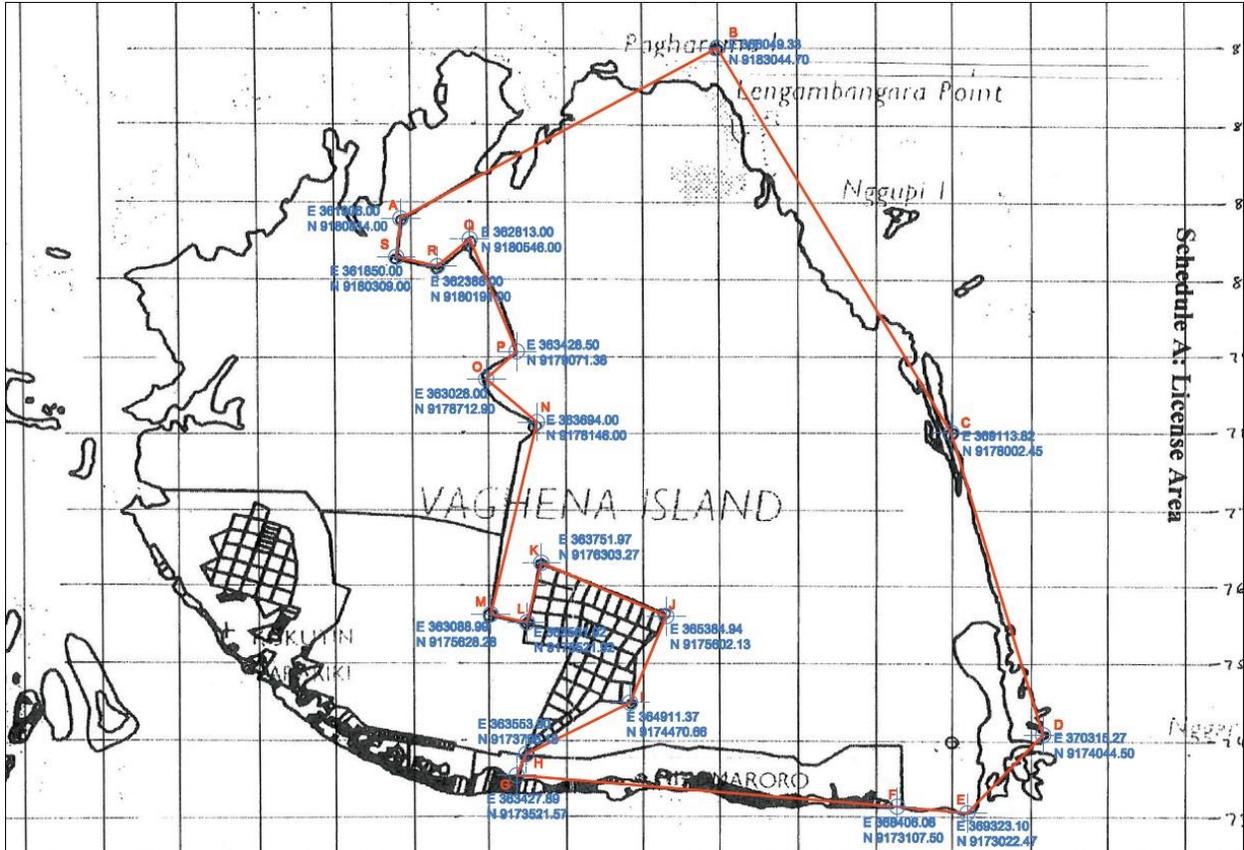
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# APPENDIX 10-2 : ML TENEMENT BOUNDARY-PROSPECTING LICENSE





# Appendix 10-3 : WATER QUALITY ASSESSMENT

 <p><b>NATIONAL PUBLIC HEALTH LABORATORY -MHMS</b>                  P.O. Box 349                  Honiara. Solomon Islands                  Phone: 677 38871</p>				
<b>TEST REPORT</b>				
<b>Customer:</b>	Envi-Green Pacific	<b>Date Received:</b>	12/10/2012	
<b>Owner:</b>	Dalgro	<b>Date Analysed:</b>	12/10/2012	
<b>Sampler :</b>	Dr Paulo & Galo	<b>Date Released:</b>	16/10/2012	
<b>Date collected:</b>	11/10/12	<b>Product Id :</b>	ERW- Shortland.	
		<b>Batch Id :</b>	ERW-01 SL	
<b>MICROBIOLOGY RESULTS</b>				
Sample ref	Item Tested	TTC : MPN/ g	Faecal MPN / g	Test Method
A1	Sea water	1100	≤ 0	Most probable number
A2	Sea water	≤ 0	≤ 0	Most probable number
K1	Sea water	≤ 0	≤ 0	Most probable number
N1	Sea water	23	≤ 0	Most probable number
N2	Sea water	23	≤ 0	Most probable number
R1	Fresh water	43	23	Most probable number
R2	Fresh water	93	43	Most probable number
R3	Fresh water	1100	93	Most probable number
<b>Comment</b>				
<p>A total of 8 environmental raw water samples submitted for bacterial analysis using the standard method "three tube most probable number" with findings displayed above. Sample with ref A2 and K1 indicate negative for microorganism tested for, sample with ref A1, N1 and N2 indicates the presence of coliform microorganisms and sample with ref R1, R2 and R3 reveals the presences of faecal coliforms at the time testing was performed.</p>				
Analyst: <i>D. Akse</i> ..... Microbiology analyst		Approved: <i>[Signature]</i> Head; National Public Health Laboratory		
				
<p><i>This results shall not be reproduced except in full, or used in any way without the written approval of the head of the National Public Health Laboratory.</i></p>				



**National Public Health Laboratory (NPHL)**

P.O. Box 349, Honiara, Solomon Islands.  
 Telephone: (677) 38871  
 Fax: (677) 38871

Test Report No. **CTR 13 / 12**

Date of Issue: 17 / 10 / 12  
 Page: 1

**TEST REPORT**

Client: <b>ENVIGREEN PACIFIC CONSULTANCY ltd</b> Honiara Solomon Islands		<b>National Public Health Laboratory</b> Environmental health division, Ministry of health and medical services, PO box 349, Honiara, Solomon Islands			
Description of goods : Water Samples (Water Quality ) Customer Product Code : ENG-PC					
Destination : Environnent (Choi) Receiving date : 12 / 10 / 12		Sample number : 1 - 13 Analysis date : 15 / 10 / 12			
<b>Part A Physical and Chemical tests</b>					
Sample No.	Physical				
	pH	Turb NTU	DO (mg / L)	Cond (µsc/cm)	Salinity (ppt)
1	8.14	<0.01	8.23	45	25.98
2	8.45	<0.01	8.39	44.9	30.04
3	8.48	0.23	8.30	44.5	30.76
4	8.54	<0.01	8.34	44.5	31.79
5	8.56	0.23	8.18	44.4	31.17
6	8.56	0.07	8.46	44.4	30.36
7	8.60	0.28	8.22	44.3	31.21
8	8.64	0.44	9.50	44.7	30.16
9	8.10	0.31	5.67	38.0	25.61
10	7.71	0.17	5.17	34.8	23.37
11	8.49	0.05	9.69	42.7	28.64
12	8.46	0.03	7.63	40.6	26.53
13	8.69	0.52	8.75	43.0	
Verified by: <i>David Hobbs</i> ( <i>David Hobbs</i> ) Head of Chemistry Section		Approved: <i>Dickson M...</i> ( <i>Dickson M...</i> ) Head of NPHL (Admin)			
This report shall not be reproduced except in full, with out written approval of the laboratory.					

## APPENDIX 10-4 : CIVIL ENGINEERING, WHARF, AIRPORT AND STOCKPILE FACILITIES

Civil engineering designs for the processing facility, bauxite storage buildings, bulk carrier wharf and airstrip will be undertaken by qualified engineering organisations and where appropriate designs will be checked by third party reviewers/auditors.

The processing facility will be relatively modest compared to many other mineral projects, however, the product storage sheds will be quite large and required to support significant floor loadings and wind loads. The bulk carrier wharf and associated moorings will be a significant structure capable of handling Panamax sized bulk carriers in most weather conditions.

G R Engineering Services Limited (GRE) has been selected to undertake the design of the process plant and associated infrastructure, including all materials handling aspects from the ROM pad to discharge of the bauxite product into the bulk carrier cargo hold, to a feasibility study level. GRE will also provide a design for the product storage buildings and drying facilities, if it is determined that such facilities are required.

The bulk carrier wharf facility will be designed and constructed by Dalgro (SI) Ltd., a company with wide experience in the design and construction of wharves and bridges in Solomon Islands.

The design groups will undertake structural analysis of the designs to ensure they meet the relevant codes and capable of meeting any climate or seismic activity that could be reasonably anticipated during their service lives.

Construction activities will be supervised by qualified technicians with regular review and inspection by experienced engineers.

## **MINUTES OF MEETING –VAGHENA BAUXITE MINING PROJECT**

**Date:** 11<sup>th</sup> of October, 2012

**Time:** 10:30am

**Venue:** Kukutin Village, Vaghena Island, Province of Choiseul, Solomon

**Present:** Vaghena Island Chairman-Mr.Tebukewa Mereki, Solomon Bauxite Limited (SBL) rep –Mr. Leban Galo, GREENPAC consultant: Dr. Paulo Vanualilai, Elders of Nikumaroro, Elders of Kukutin and Elders of Arariki, and more than 20members of three villages, including chairman of Arnavon Island Nature Conservation Committee Mr. Gideon Kaipeau.

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### **Point of Discussion:**

- Welcome speech by Chairman of Vaghena Island Committee to SBL REP and GREENPAC Consultant and opened the meeting with a prayer.
- Votes of thanks by Dr. Paulo Vanualilai to reciprocate welcome speech
- Introduction of the aim of the visit to the island by Dr. Vanualilai and the following issues were mentioned:
  - 1- Main aim of the trip to the island is to carry out an environmental impact assessment (EIA) and clarify the legal guidelines that constitutes the EIA which include the Solomon 2008 Solomon Mining Act and the 2010 Solomon Environmental Impact Statement (EIS) Guidelines
  - 2- Dr. Vanualilai also emphasizes the type of land tenure systems on Vaghena stating that the land tenure system constitutes three types of ownership that comes under the umbrella of Perpetual Estates (PE).
  - 3- He further stated that the 2008 Mining Act is a powerful act that almost supersedes any other acts in the governmental constitution and legislation, meaning that the Solomon Government owns the resources whilst the entitlement to the land is classified as surface access that can be sought through the land owners. In this case the area demarcated by SBL is owned by the State and the Landowner is the Commissioner of Lands. The other two entitlements are owned by the Vaghena people with the largest land area owned by four trustees.
  - 4- He continued by stating that the Land which is earmarked for Bauxite mining is now under the prospecting license of SBL, with the surface access rights agreement approval. He distributed the Commissioner of Land's letter to SBL to clarify their authority over the Demarcated Bauxite Boundary which almost constituted 48% of Vaghena entire land area. A map of the entire island with demarcations of land types were given to the people to verify the Commissioner of Lands claim over the Bauxite Land now given to SBL.
  - 5- He further outlines that there are land entitlements which are still under the names of deceased relatives such as grandparents and parents and have not been claimed or allotted to immediate siblings and descendants. He stated that if these lands are not claimed by immediate relatives, the Government can take them back to use for its own purpose.
- The Chairman acknowledged the seriousness of the land now left unclaimed for the people to act quickly and to claim it if indeed the government of the day can claim them back if left under deceased relatives. The Chairman also emphasizes the importance of getting new trustees for the

remaining land area on Vaghena before most of the current trustees are passed away. Infact only three trustees are still alive but are old and aged.

- Dr. Vanualilai inform the villagers that this is a very important task that the people of Vaghena should priorities for their current and future generations, he advised that they need to mobilize their resources to update ownership entitlements of the areas that are left vacant by deceased members and forefathers. Distribution of land ownership should be carried out immediately to secured land ownership. Dr. Vanualilai extended the invitation of the Chairman under the request of SBL management to visit their office at Honiara and work with the Land's Department and SBL to begin formalization of entitlement claims over deceased members land. SBL has already identified entitlements each of the land owned by the Vaghena people and has compiled a record of these land titles.
- A prominent member of Solomon government now a retired former high ranking officer (Provincial Secretary) residing at Vaghena expresses his concern about the mining and stated that the land which is now under SBL's PL and Surface Access Rights (SAR) entitlements were actually part of the I-Kiribati Community when they first arrived on the island. He stated that the British Government (BG) informed them that the entire island belonged to them and that they the BG had actually bought the entire island from its previous owners for them. He suggested that this issue should be first discussed at the Provincial level and that they wanted the Provincial Premier to stop everything until this issue is settled.
- Dr. Vanualilai stated that even though the BG informed them that they owned the entire Island, the actual demarcation of tenureship rests within the Perpetual Estate Demarcation after independence under the prerogative of Commission of Lands as its rightful owner for the bauxite mining area. He stressed that even if they owned the island they only owned the surface right but the mineral resources is still owned by the state and under the mining act which supersede most of the existing governmental acts and legislations, it is going to be a difficult position to negotiate unless original documents pertaining to the claim is available.
- Gideon Kaipeau the Chairman for the Arnavon Island Conservation committee under Choiseul conservation scheme with Nature Conservation stated that this mining project if not controlled well will damage the pristine marine environment which most of the Vaghenian I-Kiribati settlers now rely solely on seaweeds as their economic cash crop. He stresses that the former island committee along with the Choiseul Provincial members did not carry out their duty to safeguard the island interests on land ownership protection. Now that SBL has been given the green light to carry out prospecting and mining soon, the people of Vaghena have to wake up and join their voices in unison to protect their land against the negative impact of bauxite mining. He stressed that he will rather gave his life to safeguard against mining than sit down and let mining ruin Vaghena. He challenged the entire Vaghena people to protect the island against mining.
- One of the Elders of Kukutin shouted and make known his intention that he will set fire to all of the Machinery of SBL once it is transported to the site.
- The Chairman replied to both the Elder and Gideon that they should take away the emotions

and face the reality of the situation. He advised against any kind of violence and animosity toward SBL would spell legal disadvantages. He stated that even giving up their life for the cause of safeguarding the land which is not theirs, is not worth the sacrifice and everything will be in vain. He warned against any insurgent that might cause political conflict with governmental authorities, in the end the government will use its authority and send or can use force to keep them clear from entering the mining site and can throw most of them in behind bars for trespassing into governmental leased land. They do not want anything to cause confrontations with Government for fear of harsh penalties and retaliations.

- The former PS also reiterated the same sentiments echoed by the Chairman and asked the two gentlemen to be more level headed by using their minds and wisdom rather than emotions.
- Dr. Vanualailai thank the Elders (Chairman and former PS) for sympathizing with the emotions from Gideon and one of the Elders and reiterated that emotions are to be assessed from a logical perspective using the mind to best mitigate the appropriate responses to the daunting of a new era of mining history on Vaghena. He emphasizes that the best way for the community is to find themselves taking advantage of the economic spin-off that mining would bring to them.
- Gideon thanked Dr. Vanualailai for opening up their eyes in the things they do not know or take for granted, he calls upon the Village committees and the entire assembly that it is time to wake up from their slumber and be more alert using logic and wisdom to maneuver them in this critical moments of their life. He reminded the people that they should no longer be idled but to take initiatives and be more proactive in major decision making that would concern the welfare of the people. He apologises for the surge of emotions, but stated that these are better disclosed through spoken language than be kept burning within his soul.
- One of the Elders from the community seeks clarification on how would mining be managed from an environmental perspective. He further wants clarification on the negative impact of mining on the environment.
- Dr. Vanualailai emphasizes that there is a clear guideline on how to run a bauxite mining project through proper environmental management plans that constituted two important guidelines such as 1).Construction Environmental Management Plan (CEMP) and 2) Operational Environmental Management Plan (OEMP). He stated that a baseline study was carried out around the island to test the water quality of both freshwater and seawater quality around the island. Another study will look at the study of the existing terrestrial fauna and flora of Vaghena Island. Once these are defined, it will provide baseline information to gauge future monitoring and assessment around the island. He further emphasizes proper solid and liquid waste management to be carried out by SBL.
- One of the Elders query the independent nature of monitoring and assessment (M&A), questionings as to whom or which organization the role of M&A should fall upon.
- Dr. Vanualailai suggested that the Department of Environment should be responsible for this, but for independent review, he encouraged that Arnavon Conservation Committee should be pro-active in the M&A undertakings with Vaghena village committee, he further commented that SBL will also be conducting its own M&A which can be disclosed to the village committee for transparency and accountability.

- Dr. Vanualailai emphasizes that the Vaghena community has to find their place in the advantages that the mining project would bring to the island such as: greater accessibility to air and sea transportation once the airport and wharf are constructed on the island. Requests can be made to SBL for upgrade of village housing and school facilities from timbers that will be felled from areas that are going to be mined. Scholarships can also be requested for career paths that can allow the young generation to have skills that would allow them to work with SBL in the mine. Vaghena village committee can also requests SBL for apprenticeship engagement of Vaghena youths in their workshop at Honiara to prepare them for skills in mechanical engineering and driving of large earthmoving vehicles and related knowledge about mining works etc. There are potentials for other economic incentives that the islands can take advantage of due to consistency in the air and sea transportation in the area.
- The Chairman thanked Dr. Vanualailai and Mr. Leban Galo for their presentation to the village committee and the locals I-Kiribati communities, he commented that this is the first time they have been clarified with the Land Act in Government and convey his appreciation for the clarity of information regarding the environmental management and conservation issues along with the social issues that will come with mining works. He further sends his invitation to Dr. Vanualailai for a planned meeting with the Vaghena I-Kiribati Communities on Honiara upon our return from Vaghena.
- Dr. Vanualailai extends his appreciation to the Vaghenian communities for their warm reception to the team for the past 2days, wishes them good luck in the near future. He bids them farewell and looks forward to another opportunity in the future when mining works are underway to be abled to return to Vaghena.
- The Chairman and Communities thanked both GREENPAC and SBL reps and emphasized the importance of things that has been disclosed and said during the meeting, he wishes good luck to the two gentlemen and bade them farewell. He closed the meeting with a prayer.
- The meeting was closed formally at 12.30pm.

---

**Signatures to confirm meeting proper:**

1. Mr. Leban Galo

3. Dr. Paulo Vanualailai

---

*Secretary and Public Relations Officer\_SBL*

---

*Environmental Consultant-GREENPAC*

2. Mr.Tebukewa Mereki

---

*Chairman\_Vaghena Island Village Committee*

*Date of signature: 15<sup>th</sup> of October, 2012*

## APPENDIX 10-6 : MACHINERIES TO BE UTILIZED



Figure 1: Bulldozer for Land Clearing & Levelling



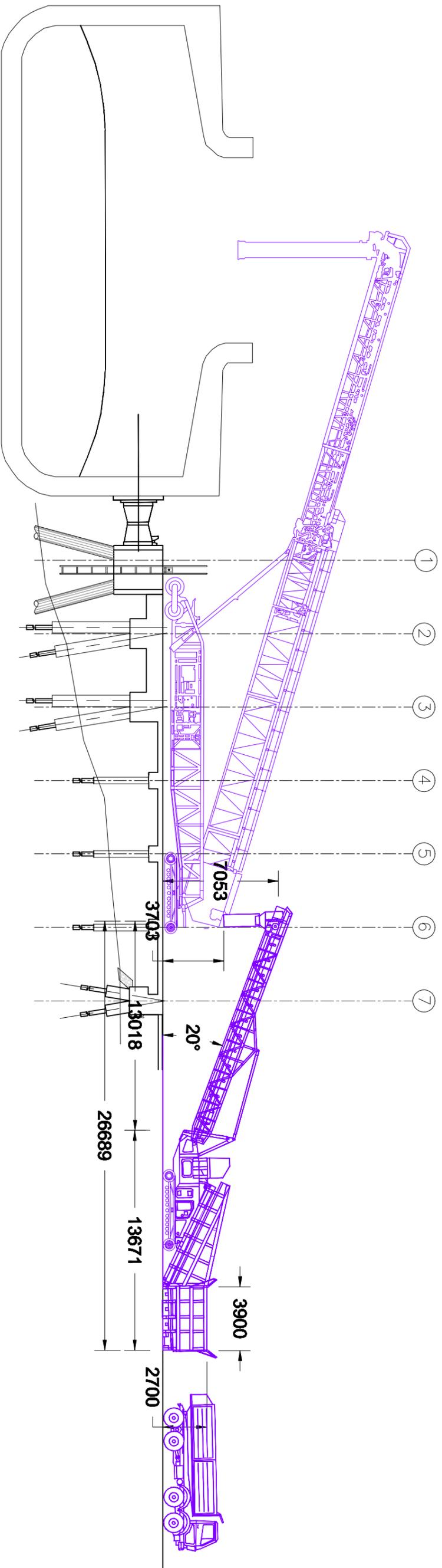
Figure 2: Haul Truck for Hauling Ore to the ROM Pad



Figure 3: Excavators for Mining Bauxite and Loading Trucks

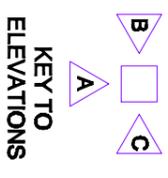
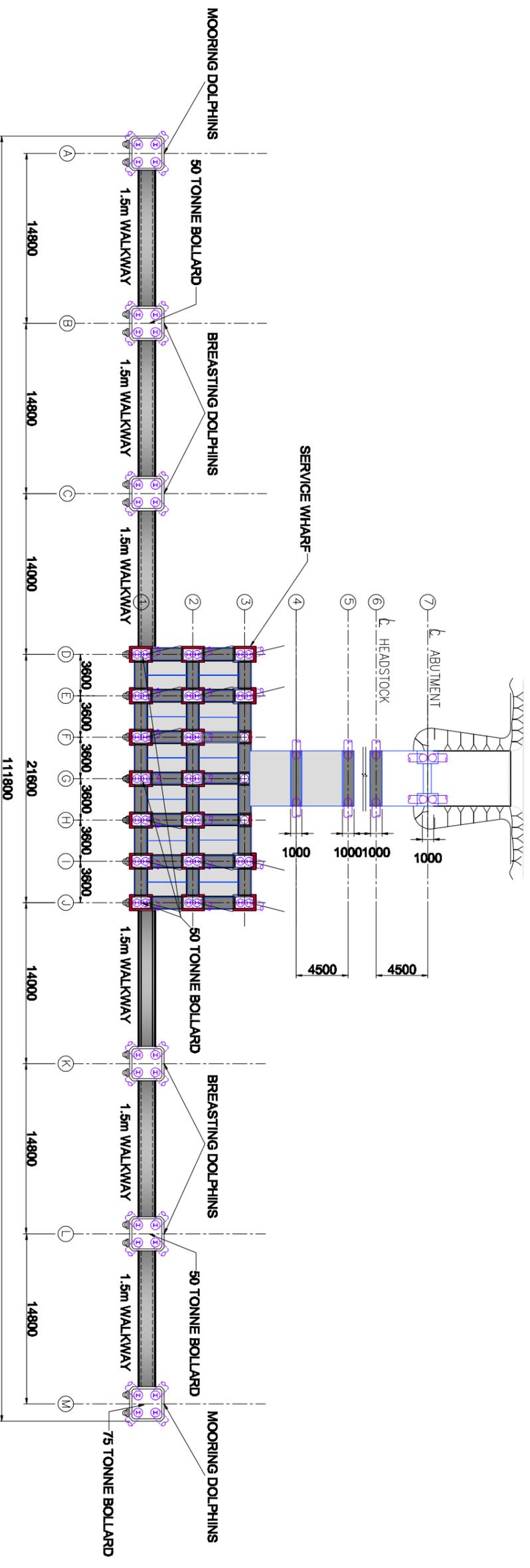


Figure 4: Front End Loader for Feeding Process Plant and Stacking Product



ELEVATION C & D  
SCALE 1:200

ARCHITECT/STRUCTURAL ENGINEER		PROJECT		OWNER		SHEET CONTENTS		REVISIONS		PROJECT NUMBER																											
ARCHITECT/STRUCTURAL ENGINEER 		PROJECT <b>WAGINA ISLAND PORT LAYOUT</b> LOCATION: <b>WAGINA ISLAND</b>		OWNER <b>SOLOMON ISLANDS MINING</b> ADDRESS: P.O. BOX 1731, HONIARA, SOLOMON ISLANDS		SHEET CONTENTS <b>ELEVATION C&amp;D</b>		REVISIONS <table border="1"> <thead> <tr> <th>NO.</th> <th>DESCRIPTION</th> <th>DATE</th> </tr> </thead> <tbody> <tr><td>1</td><td></td><td></td></tr> <tr><td>2</td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td></tr> </tbody> </table>		NO.	DESCRIPTION	DATE	1			2			3			4			5			6			7			CAD BY: _____ DATE: _____ CHECKED BY:  DATE: _____ DATE: _____		PROJECT NUMBER REF: _____ SHEET NO.: <b>D 03</b>	
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**GENERAL BEAMS & SLAB ARRANGEMENT**  
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SCALE:		LOCATION:	WAGINA ISLAND	ADDRESS:	P.O. BOX 1731, HONIARA, SOLOMON ISLANDS								





# **Vaghena Island Bauxite Project Technical Report**

## **Executive Summary**

**September 2012**

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# Vaghena Island Bauxite Project

## Technical Report

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and

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# Executive Summary

## Introduction

Breakaway Mining Services (BMS) has completed a 'base case' assessment of the key technical factors influencing the potential development of the Vaghena Island Bauxite Project, located on the small, sparsely populated Vaghena Island in the Choiseul Province, Solomon Islands.

The base case project will initially produce 1.2 Mtpa of saleable bauxite for sale into the export market and has a relatively low upfront development cost in the order of US\$25 million. It is proposed that saleable bauxite production will be increased to +2 Mtpa early in the project life, with key initial infrastructure sized accordingly. Project life will be approximately 16 years.

BMS concludes that the base case Vaghena Island Bauxite Project represents an attractive investment opportunity at this time, with a relatively long life and an indicative strong cash operating margin of around US\$10/t.

BMS and the project owners, Solomon Bauxite Ltd (SBL), have identified a range of opportunities to enhance the operating performance and financial returns from the project. These include assessment of centrifuging to dewater the bauxite (reducing drying costs), cost benefit analysis of transporting ROM ore to the plant via a slurry pipeline, optimising the production grade and schedule, and consideration of an earlier commitment to expanded production.

SBL will design, construct and operate the project to high workplace safety standards, ensuring that employee safety is the number one consideration in all design and operational considerations.



Figure 1: Vaghena Island Location

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## Project Background

CRA Exploration Pty Ltd (CRA) discovered bauxite on Vaghena Island in 1967. Vaghena Island is relatively small, having a surface area of about 78 km<sup>2</sup>, with the main bauxite deposits covering some 30 to 35% of the surface area of the Island, predominantly on crown land on the eastern half of the island. The Island is relatively flat, rising to a maximum height of around 50 m above sea level. Annual rainfall is relatively high at 3.5 to 4.0 m and much of the Island is covered by tropical forest.

CRA undertook detailed exploration on Vaghena Island from 1969 to 1971, which culminated in a feasibility study assessing the viability of the project. The study indicated that development of the project was technically feasible, but CRA did not proceed with development at that time due to competition from its involvement in the world class Weipa project.

## Permitting

On 9<sup>th</sup> March 2011 Solomon Bauxite Ltd (SBL) was granted a Prospecting Licence, PL73/11, for a three-year term over the main bauxite resource on Vaghena Island, with the aim of undertaking further assessment and ultimately development of a viable bauxite mining and export operation on the Island. SBL also has a Surface Access Agreement with the Commissioner of Lands, granting access to undertake exploration activities in the area of the Prospecting Licence and so long as the Prospecting Licence remains in force.

On 21<sup>st</sup> March 2012 SBL signed an MOU with Southwest Pacific Bauxite Pty Limited (SPB) in order to obtain technical and financial support for the Vaghena Island Bauxite Project, as well as broadening SBL's exposure to other bauxite opportunities.

SBL and its partners are currently preparing an Environmental Impact Assessment (EIA) and a Mining Lease application with the aim of gaining approval to commence production in late 2013.

## Resources

In July 2012, BMS reviewed the extensive historical exploration and feasibility data generated by CRA and based on this data estimated a Total Mineral Resource of 38.8 Mt (million wet metric tonnes) at 46.9% Al<sub>2</sub>O<sub>3</sub>, with 38.0 Mt occurring in a 'High and Medium Confidence' categories.

**Table 1: BMS Resource Estimate**

Classification	Tonnes Mt	Total Al %	Si %	Al <sub>2</sub> O <sub>3</sub> %	SiO <sub>2</sub> %	Fe <sub>2</sub> O <sub>3</sub> %
High Confidence	32.6	40.5	3.2	46.9	3.0	16.7
Med Confidence	5.4	41.6	2.0	47.4	2.7	16.8
Low Confidence	0.8	39.5	9.3	46.4	4.3	16.8
<b>Total</b>	<b>38.8</b>	<b>40.6</b>	<b>3.2</b>	<b>46.9</b>	<b>3.0</b>	<b>16.7</b>

The total BMS Resource correlates well with the earlier CRA estimate of 27.9 million dry long tons at 47.1% Al<sub>2</sub>O<sub>3</sub> (or 28.4 million dry metric tonnes or 38.3 million wet metric tonnes at 35% moisture), which excluded any bauxite in mangrove or peripheral freshwater swamps and mineralisation less than 3 feet thick.

The CRA calculation applied conservative estimates for the silica cut-off grade, specific gravity and moisture content of the deposit. Additionally, drilling was generally limited to a maximum depth of around 9 metres and some of the augur holes finished in ore grade mineralisation, adding to the conservatism of the estimate.

The BMS estimate does not currently comply with recommendations in the Australasian Code for Reporting of Mineral Resources and Ore Reserves (2004) by the Joint Ore Reserves Committee (JORC), as some original data is yet to be fully accessed, reviewed and evaluated. Nevertheless, in general the density and quality of data is likely to support conversion of 'High Confidence' category resources to JORC Measured Resource status when further data validation is completed. Similarly, the "Medium Confidence' category broadly equates to Indicated Resource and the 'Low Confidence' category to Inferred Resource.

The base case scenario evaluated in this study mines and processes 40.8 million wet tonnes of ROM ore (35% moisture), including mining dilution of 10%, and produces 29.6 Mt (15% moisture) of saleable bauxite. This represents mining 95.6% of the BMS resource estimate or 96.8% of the CRA resource estimate.

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## Mining

A conventional shallow open pit mine plan is proposed involving construction of main haul roads to access the mining areas, secondary panel roads for extraction and then the mining of pits to the base of the economic bauxite between the previously developed panel roads. Mining will commence on high ground with the removal of overburden expected to average around 0.9 m thick. Initial mining will focus, where possible, on areas of higher  $\text{Al}_2\text{O}_3$  grade although the current schedule applies a constant grade at the deposit average. As sections are mined out, they will be utilised for placing overburden and screening rejects, and then contoured and re-vegetated.

The prime mining fleet will be hydraulic excavators and rear dump trucks. The hydraulic excavators will retreat from the extremities of the deposit to the main haul roads along the top of the bauxite, loading directly into haul trucks which will travel across the levelled mined out pit floor. The average bauxite thickness is about 3 m. In areas where the bauxite is thicker than about 7.5 m, a second pass excavator will mine the deeper material, which may be located amongst limestone pinnacles, either loading directly into trucks or stockpiling material for later loading and haulage. The rear dump trucks will transport the bauxite some five kilometres, via an out of pit haul road, to a screening station for processing.

Prior to mining, undergrowth and small trees will be cleared and large trees will be felled. The humus rich soil will be stripped using bulldozers and all soil and vegetable matter will be stockpiled or returned directly to mined out areas as part of a planned and sequential rehabilitation process.

Where possible, mining will be from high ground to low ground. This approach will assist with maintaining effective drainage and water control in the high rainfall environment that can result in wet and sticky operating conditions and minimising traffic on the bauxite which has poor bearing strength characteristics.

## Processing

Bauxite processing will entail coarse screening of the run of mine feed to remove large rocks and vegetation, followed by fine screening to remove smaller pebbles and other foreign matter. The 'base case' proposes that the bauxite will be dried in rotary kiln dryers to the desired moisture of around 15%, prior to conveying to the storage sheds adjacent to the ship loading facility. The following table outlines the target product specification:

**Table 2: Target Product Specification**

Total Available Alumina	Reactive Silica	Total $\text{Al}_2\text{O}_3$	Total $\text{SiO}_2$	$\text{Fe}_2\text{O}_3$	$\text{P}_2\text{O}_5$	Moisture
40.0%	2.5%	46.4%	3.3%	17.2%	3.4%	15%

Dried bauxite product will be stored in two 60,000 t capacity storage sheds, with stacking to alternate between the sheds so that one shed is being filled while the other is being emptied. There will be provision for expansion of the storage sheds to support higher production levels than the initial annual rate of 1.2 Mtpa of dry product (1.4 Mtpa at 15% moisture). Reclaim from the sheds will be by front end loader directly into a hopper, which will direct the bauxite product onto a conveyor for feeding onto the ship loader, and into Panamax size vessels.

Testwork has commenced on assessing the potential to dewater the ROM bauxite ore via centrifuging, and early indications highlight the opportunity for significant operating cost savings compared to the current base case processing via rotary kiln dryers. Additional operating benefits may accrue from the associated opportunity to transport the ROM ore from the mine site to a processing facility adjacent to the storage sheds via a slurry pipeline.

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## **Infrastructure**

An accommodation township will be constructed on the south-eastern end of the Island. It is anticipated that employees and their families could total around 700 persons, including Vaghena Island employees and their families. Access to Vaghena Island will be by sea or air. A port site for landing of personnel and supplies, as well as the loading of bauxite product is planned to be located on the southern shore of the Island towards the south-eastern tip.

An airstrip will be constructed near the southern shore of the Island on or close to the site previously selected by CRA. Electric power will be generated at an approximately 200 kW diesel electric power station located in the services area. The power station capacity will be determined by the processing and drying method adopted.

Potable water will be drawn from natural freshwater springs, or bores, whilst the majority of process water is expected to be obtained from surface dams, which will collect rainfall, or dewatering operations and if necessary, a groundwater bore field.

## **Schedule**

A 15 month schedule is envisaged to complete all necessary project approvals, arrange off-take and financing, finalise the project design and undertake construction and commissioning. This will enable first shipment of bauxite in December 2013 as outlined in Table 3.

## **Financial Analysis**

The 'base case' assessed in this evaluation generates strong indicative financial outcomes over its 16 year life. In addition, BMS has identified a range of optimisation opportunities that could significantly enhance financial returns. These include:

- the potential for reduced operating costs via the use of centrifuges to dewater the bauxite,
- enhancement of cash flow by optimising the production grade and schedule, and
- an earlier commitment to expanded production.

A medium term shortage of supply identified in the seaborne bauxite market following the proposed ban by Indonesia of exporting unprocessed bauxite further supports the development opportunity.

## **Conclusions and Recommendations**

Financial modelling by BMS indicates that the Vaghena Island Bauxite Project represents a technically and financially robust development opportunity in the current bauxite market and under prevailing economic conditions. While some cost estimates have been completed to feasibility standard, others are at scoping study level and require refinement and/or further assessment.

A number of opportunities have been identified that could enhance the operation, improve the financial returns, reduce operating costs and/or reduce start-up capital requirements. BMS recommends that assessment of these opportunities be advanced in parallel with completing all the statutory environmental and mining approvals.

This will enable the parties to be in a position to make a timely decision to commence development, taking advantage of the current favourable market circumstances for developing a bauxite operation.

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## **1.0 ENVIRONMENTAL MANAGEMENT/MONITORING PLANS (EMP)**

### **1.1 Introduction**

An Environmental Management Plan (EMP) is a site specific plan developed to ensure that all employees, contractors and subcontractors comply with the environmental conditions of approval for the project and that the environmental risks are properly managed.

The purpose of the EMP is to:

- identify priorities;
- set objectives and targets;
- define performance indicators;
- document strategies and time frames to achieve targets
- allocate responsibilities and identify the resources to enable realization of the overall plan;
- establish mechanisms to monitor, evaluate and report progress

The Environmental Management Plan contains two major components, namely:

- **Construction Environmental Management Plan (CEMP)**
- **Operational Environmental Monitoring Plan (OEMP)**

#### **1.1.1 Purpose of CEMP**

The purpose of the CEMP is to identify and outline methodologies that will guide the proposed SBL project during the construction stages to control and minimise potential adverse environmental impacts and where necessary implement appropriate mitigation measures. The CEMP is designed to set out control plans and principles to be applied to the project during the construction activities phase, and to assess the adequacy of these plans and principles. The CEMP will also identify Environmental Control Procedures and incorporate the principles of Environmental Monitoring Plan (EMP) with which all project employees and contractors are required to comply as outlined in the attached 2010 Solomon EIS Guideline (Appendix 10-1).

#### **1.1.2 Purpose of OEMP**

The purpose of the OEMP is to identify and outline methodologies that will guide the proposed SBL project during the operation stages to control and minimise potential adverse environmental impacts, and where necessary implement appropriate mitigation measures. The OEMP is designed to set out control plans and principles to be applied to the project during the operational activities phase, and to assess the adequacy of these plans and principles. The CEMP will also identify Environmental Control Procedures and incorporate the principles of the Environmental Monitoring Plan (EMP) with which all project employees and contractors are required to comply as outlined in the attached 2010 Solomon EIS Guideline (Appendix 10-1).

#### **1.1.3 Priorities**

In line with the Solomon Islands environmental policy Acts and Assessment Guidelines, the following criteria will be used to determine the priorities for management and controls:

- Impacts on the physical and biological environments
- Contribution to innovations which lead to improvements in environmental performance and definition of best environmental practice

- Compliance with statutory requirements and other environmental commitments
- Availability of resources

The EMP also acknowledges the social and cultural dimensions of responsible environmental management along side the biophysical environment to provide a holistic approach.

#### 1.1.4 CEMP Approval and Implementation Schedule

TASK	TIMELINE
CEMP approval by DOE	CEMP lodged after initial EIS approval and subsequently approved
CEMP provided to contractors	At tender phase
Contractor's plan for CEMP compliance received by SBL for approval	Lodged with SBL as part of tender for works
CEMP compliance cost provided to SBL	
Successful tenderer's task-related CEMP lodged with DOE for approval	CEMP lodged with DOE prior to construction commencing. DOE approves within 1 month with conditions as required
CEMP implemented throughout construction phase	

**Table 1.1.4-1: Approval Schedule of the CEMP**

#### 1.1.5 Implementation Cost

The capital cost of this project is to be estimated for a facility with a lifespan of more than 20 years and assuming that construction commences in the year 2013.

#### 1.1.6 Project Overview

The project proponent is a Solomon registered company, Solomon Bauxite Limited (SBL) which has commenced the process of securing mine lease for the bauxite project on Vaghena Island. Vaghena Island has a surface area of about 78 km<sup>2</sup>. The bauxite deposit which is the subject of this proposal covers about 16 km<sup>2</sup> or about 20% of the Island's surface area.

The Vaghena bauxite deposit is medium grade deposit, with minimal impurities which means it can be shipped directly to the international market without significant processing. The bauxite deposit does however have a high moisture level of around 35% in-situ. The characteristics of the deposit and requirement for minimal processing make it an ideal candidate to initiate bauxite mining in the Solomon Islands.

The project development will include appropriate mitigation options to ensure that it meets its environmental obligations whilst bringing to Vaghena Island and the whole of the Solomon Islands a new industry, skills, employment, infrastructure and much needed foreign exchange that will benefit the Provincial and national economy.



Figure 1.1.6: Vaghena Island Located in the Western Province Choiseul in the Solomon Islands.

### 1.2 Roles and responsibilities

This section describes the organizational structures and responsibilities of individuals involved with the implementation of the CEMP.

PARTY/POSITION	RESPONSIBILITIES/TASKS
Vaghena Island, SBL	<ul style="list-style-type: none"> <li>▫ Implementation, monitoring and compliance with the CEMP including the activities of the contractors, sub-contractors, employees and site management</li> <li>▫ Reviewing the performance of the CEMP and adjustments to improve efficiency and application</li> <li>▫ Reporting to DOE</li> <li>▫ Compliance of constructional activities with the EIS guidelines and approval conditions</li> </ul>
<b>Employees &amp; Contractor (s)</b>	<ul style="list-style-type: none"> <li>▫ Implementation of all conditions/measures in the CEMP</li> <li>▫ Preparation and implementation of procedures by the CEMP</li> <li>▫ Inspections and implementation of environmental performance</li> <li>▫ Maintain all documents and environmental records In accordance with the CEMP and in reporting to SBL.</li> </ul>
<b>Site Management</b>	<ul style="list-style-type: none"> <li>▫ Working in accordance with the CEMP</li> </ul>

	<ul style="list-style-type: none"> <li>▫ Make recommendations to <b>SBL</b> for improvements for the environmental management of site activities</li> </ul>
<b>All Employees/Sub-contractors</b>	<ul style="list-style-type: none"> <li>▫ Work to be in accordance with the CEMP</li> <li>▫ Make recommendations to the contractors or <b>SBL</b> for improvements for the environmental management of site activities</li> </ul>

**Table 1.2: Responsibilities of Relevant Parties/Positions**

**1.2.1 Procedure for Task-Related CEMP**

Each SBL manager or contractor will be responsible for the development and implementation of the task-related CEMPs for his area of activity. Managers and contractors will have direct control over the machines, equipment, personnel and resources employed on this project and therefore are best placed to plan, program, implement and monitor mitigation practices.

The CEMP shall include (but not be limited to) the following:

- 1) Scope of Work
- 2) Introduction and Training in the CEMP
- 3) Work Practices and Procedures
- 4) Registers
- 5) Inspections and Monitoring of Performance
- 6) Emergency and Incident Response Procedures
- 7) Communications with Stakeholders
- 8) Progress Reporting

**1.2.2 Scope of CEMP**

The proposed site is located on the eastern side of Vaghena Island. As mentioned the proposed development is large as a proportion of the Island but quite small compared to many other bauxite mining operations. It also has a much smaller footprint than some other developments that have been carried out in the Solomon Islands; such as the Gold Ridge mine on Guadalcanal. The main objective of the CEMP is to ensure that the site development is undertaken in accordance with approved plans and in a manner which minimises environmental damage and degradation beyond the boundaries of the project area.

**1.2.2.1**

**Construction objectives**

The main construction objectives are as follows:

- Extraction of bauxite ore from the mine site (multiple pits).
- Quarry rock aggregates for the construction of roadworks. The quarrying activities will be designed and operated to minimise disturbance of the coastal mud flats.
- Construction of a processing facility to screen, dry and store bauxite product.
- Construction of an airstrip.
- Construction of a bulk carrier wharf by erecting concrete piles, decking and earthworks for the creation of a stable platform.
- Construction of a fixed telescopic conveyor for ship loading.
- Establishment of a camp site, administration offices, workshops, vehicle parking areas, maintenance etc.
- Installation of culverts to facilitate diversion of rainstorm water flows.

All structural designs will conform to the Solomon Islands National Building Code and other pertinent rules and regulations.

#### 1.2.2.2 Construction Detailed Planning

The construction planning, from an environmental perspective, is geared towards environmentally sustainable development practices including construction of bunding and sediment control structures to contain materials extracted during the construction process. Much of the Island foreshores contain significant areas of mangrove vegetation. There is to be minimal clearing of mangrove areas, as they act as natural silt traps. Procedures will be implemented to ensure that any clearing of mangroves is only authorized by site management and in line with agreed CEMP procedures.

#### 1.2.2.3 Landscaping

The Environment Officer will commence a rehabilitation program to replant exposed soil and rock areas once construction or mining activities are complete in those areas. Only endemic vegetation commonly found in the area will be planted as part of the rehabilitation program. The aim of the rehabilitation will be to provide a natural habitat and a nursery ground for endemic fauna, whilst being suitable for the task of sediment control and appropriate for a longer term sustainable environment. SBL will set up a plant nursery to ensure that timely and appropriate rehabilitation is undertaken.

#### 1.2.2.4 Proper solid waste management

Whilst development of the site is carried out, the shrubs and vegetation which have been removed will be recycled as fuelwood or building materials. Logs from trees which have been cleared to allow the development to proceed will be utilised for construction or sold. Waste such as bottles, metal off-cuts, plastics and glasses etc., which cannot be recycled will be transported to Honiara for disposal in appropriate facilities in or near Honiara.

In addition, the following activities and issues will arise and be actively managed during the construction stage;

- Transport of materials to the site, creating noise and water traffic
- Air quality (fugitive emissions) and water quality
- Coastal erosion and sedimentation
- Pest and weed prevention and management
- Emergency response and management
- Enquiries
- Recording and reporting of complaints
- Training in the environment management plan for employees

### 1.3 ENVIRONMENTAL RISKS

The EIS identified the following key environmental effects that could result from the proposed project development and operations on the Vaghena Island site.

Risks	Design and Construction
1. Releases to air	<ul style="list-style-type: none"> <li>▪ ozone depleting substances</li> <li>▪ greenhouse gases</li> <li>▪ dusts</li> </ul>

	<ul style="list-style-type: none"> <li>▪ engine emissions</li> <li>▪ fumes from burning</li> <li>▪ volatiles from solvents, paints</li> </ul>
<b>2. Release to water</b>	<ul style="list-style-type: none"> <li>▪ spillages of bauxite during ship loading</li> <li>▪ Spillage of hydrocarbons from bulk carriers and outboard motors</li> <li>▪ soil erosion and generation of sediment</li> <li>▪ other pollution sources</li> <li>▪ contaminated land (surface water runoff and ground water pollution)</li> <li>▪ stormwater drainage and flooding</li> <li>▪ sewerage discharge and domestic wastewater (construction site)</li> </ul>
<b>3. Waste Management and Disposal</b>	<ul style="list-style-type: none"> <li>▪ construction wastes</li> <li>▪ litter/garbage</li> <li>▪ contaminated waste handling and disposal</li> </ul>
<b>4. Contamination of Land</b>	<ul style="list-style-type: none"> <li>▪ runoff from other areas of contaminated land</li> <li>▪ chemical storage</li> <li>▪ fuel installations</li> </ul>
<b>5. Impact on local Communities</b>	<ul style="list-style-type: none"> <li>▪ level of community communication</li> <li>▪ access and sea traffic disruptions</li> <li>▪ construction noise (impacts on nearby settlements)</li> <li>▪ dust</li> </ul>
<b>6. Ecological/Heritage Conservation</b>	<ul style="list-style-type: none"> <li>▪ identification and protection of ecosystems</li> <li>▪ noise impacts on conservation areas</li> <li>▪ impacts on endangered species</li> <li>▪ disturbance of flora and fauna</li> <li>▪ identification and protection of features of heritage significance</li> </ul>
<b>7. Emergencies</b>	<ul style="list-style-type: none"> <li>▪ environmental incidents (e.g. spills)</li> <li>▪ spill prevention control and counter measures plan</li> <li>▪ emergency response plan</li> <li>▪ evacuation plan during natural disasters</li> <li>▪ firefighting procedures</li> </ul>

Table 1.3-1 Summary of the Areas of Potential Environmental Risks

#### 1.4 Minimum Environmental Standards

Table 1.4-1 to Table 1.4-6 set out the minimum environmental standards and that must be achieved by employees, contractors and construction teams throughout the constructional stage.

Issue	Key Principle/Mitigation Standard	Minimum Mitigation Measures
<b>Temporary loss of terrestrial habitats</b>	Minimise removal of large vegetation/canopy layers and grassland areas surrounding the project	<ul style="list-style-type: none"> <li>▪ revegetation of exposed areas, excavated sites and sites where fill materials are stockpiled</li> <li>▪ revegetation of backfilled areas</li> </ul>
<b>Loss of endangered species</b>	Reserves/no-go areas to be specified outside active/planned project area	<ul style="list-style-type: none"> <li>▪ Identification of natural sites/likely habitats by local residents</li> <li>▪ minimum disturbances of natural</li> </ul>

<p><b>Generation of suspended solids from bare ground and runoff into nearby depressed areas from roads and drains</b></p>	<p>Bunding, storm water by-pass drains and matting screens to be installed to prevent sediment laden water leaving the project area and entering depressed areas whilst channeling clear seepages/runoffs to natural drainage system.</p>	<p>environment beyond project area during clearing</p> <ul style="list-style-type: none"> <li>▪ silt fences and sediment control devices (hay bales wrapped in geotextile) are installed before construction</li> <li>▪ earthworks and land clearance to be minimised</li> <li>▪ storm water to be diverted around exposed area</li> </ul>
<p><b>Introduction of invasive species</b></p>	<p>Site activities to adhere to national/agreed standards Fill materials and materials transported from outside Vaghena to be screened for invasive species and pests</p>	<ul style="list-style-type: none"> <li>▪ employment of experienced supervisors and equipment operators</li> <li>▪ minimise use of imported fill and other materials from other islands</li> <li>▪ machinery to be cleaned prior to arriving on Vaghena</li> <li>▪ comply with Land Transportation Authority Act</li> </ul>
<p><b>Efficiency of control measures over time</b></p>	<p>Control measures should continue to reassessed to ensure that they are appropriate over the whole construction phase</p>	<ul style="list-style-type: none"> <li>▪ Control measures to be inspected and maintained in efficient operating condition</li> </ul>

**Table 1.4-1: Coastal Vegetation Removal/Landscaping/Excavation & Soil Placement**

Issue	Key Principle/Mitigation Standard	Minimum Mitigation Measures
<p><b>Runoff of suspended sediments from stockpiles</b></p>	<p>Stockpiles to be covered or designed so that stormwater run-off is collected and settled prior to discharge to the external environment</p>	<ul style="list-style-type: none"> <li>▪ No direct discharge of sediment laden water is acceptable</li> <li>▪ Stormwater should be diverted around stockpiles</li> </ul>
<p><b>Dust generation from stockpiles</b></p>	<p>Dust must not cause a hazard or nuisance to workers</p>	<ul style="list-style-type: none"> <li>▪ Stockpiles to be compacted or covered to prevent exposure and movement of particles</li> <li>▪ water sprays during dry weather/conditions</li> </ul>

**Table 1.4-2: Material Stockpiling**

Issue	Key Principle/Mitigation Standard	Minimum Mitigation Measures
<p><b>Pollution risk associated with the storage and use of fuels for vehicles/bulk carriers/outboard motors and generators</b></p>	<p>No oil, lubricants, fuel or containers should be drained or dumped onto the ground or into water ways</p> <p>Accidental spills to be minimised and procedures put in place to clean up any resulting environmental damage</p>	<ul style="list-style-type: none"> <li>▪ Keep an up to date list of the types and approximate quantities of fuels &amp; lubricants stored on site</li> <li>▪ Storage to be in accordance with Regulations</li> <li>▪ Ensure that the Material Safety Data Sheets for all hazardous materials are readily available</li> <li>▪ Bunding to capture 100% of contained</li> </ul>

	<p>Comply with applicable Acts, rules and regulations</p>	<p>fuel must be placed around Storage areas. Roofing to be incorporated, if required</p> <ul style="list-style-type: none"> <li>▪ Spill kits and emergency procedures to be used and employees trained</li> <li>▪ No deliberate discharge of oil, diesel or any hazardous materials to surrounding soil, water courses or sea</li> <li>▪ Proper offloading procedures from vessels with strict supervision</li> </ul>
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**Table 1.4-3: Fuel Storage and Use**

Issue	Key Principle/Mitigation Standard	Minimum Mitigation Measures
<p><b>Finding and disturbance of previously unknown sites</b></p>	<p>No sites shall be disturbed once identified</p>	<ul style="list-style-type: none"> <li>▪ Solomon Islands Museum to be notified of any discovered site</li> <li>▪ No work to be undertaken at that site until agreement is reached with the legally responsible parties</li> </ul>

**Table 1.4-4: Archeological and Cultural Site Disturbance**

Issue	Key Principle/Mitigation Standard	Minimum Mitigation Measures
<p><b>Noise of machinery associated with all construction activities</b></p>	<p>Minimal noise impacts on nearby residents and neighbourhoods</p>	<ul style="list-style-type: none"> <li>▪ working hours to be in accordance with the conditions of the development consent and relevant council requirements</li> <li>▪ equipment to be kept in good repair and condition</li> <li>▪ noise suppression equipment To be used where appropriate</li> <li>▪ site employees workers and visitors not to be exposed to excessive noise or hearing protection to be provided</li> <li>▪ use of complaints register and procedures to address issues as they arise</li> </ul>
<p><b>Dust generation from constructional activities</b></p>	<p>Dust must not cause a hazard or nuisance to nearby settlements</p>	<ul style="list-style-type: none"> <li>▪ areas of exposed earth to be minimised</li> <li>▪ water sprays used to control dust</li> </ul>

<b>Increased traffic associated with construction activities</b>	No significantly increased risk to other traffic operators/drivers/passengers/pedestrians	<ul style="list-style-type: none"> <li>▪ signage, notices regarding peak traffic times and movement of large equipment if outside the project area</li> <li>▪ awareness of water traffic activities to and from site</li> <li>▪ use of complaints register and procedures to address issues as they arise</li> </ul>
<b>Pollution risk from activities on site</b>	Develop appropriate storage, transport and use procedures and practices	<ul style="list-style-type: none"> <li>▪ Procedures to be in place for the disposal process for each of the following (packaging materials, used chemicals, redundant parts, oil and grease from machinery, solvents, paints, other waste)</li> <li>▪ Solid waste disposal taken off site</li> <li>▪ Keep list of all contaminants</li> </ul>
<b>Monitoring</b>	Monitoring shall be undertaken to address the concerns of the DOE, residents and nearby settlements	<ul style="list-style-type: none"> <li>▪ A complaints record of all issues raised by concerned parties in response to construction activities. The records, which will include the responses by the contractor will be kept by management.</li> </ul>

Table 1.4-5: General Construction Activities

Issue	Key Principle/Mitigation Standard	Minimum Measures	Mitigation
<b>Loss of herbal medicine and firewood collecting grounds</b>	Communities expectations that these issues will be addressed and resolved by negotiation	<ul style="list-style-type: none"> <li>▪ Setup communication network for discussing issues with nearby communities</li> </ul>	
<b>Health and Safety risks from all construction activities (water traffic, heavy machinery operating)</b>	<p>Health and safety risks to nearby residents to be minimized by appropriate designs and implementation</p> <p>All neighbours to be informed of potential hazards to their health and safety</p>	<ul style="list-style-type: none"> <li>▪ Refer to the sections above</li> </ul> <p>When discussing impacts from traffic hazards and construction activities</p>	
<b>Sediments affecting creeks and drainage systems</b>	Sediments discharges to be minimized through proper controls	<ul style="list-style-type: none"> <li>▪ Refer to earlier section discussing erosion and sediment control</li> </ul>	

Table 1.4-6: Community Impacts

## 1.5 Environmental Monitoring

Monitoring of the mining works and its impact on the surrounding areas is required during operational phase of the project to enable the adequacy of the CEMP, assessment of any potential impacts and risks and to implement proper mitigation and abatement measures.

The monitoring requirements are important to measure actual performance (i.e. specified limits to pre-selected indicators of change). Parameters to include:

- Water quality
- Habitat assessment
- Flora and fauna
- Sediment treatment ponds

SBL is responsible for implementing the monitoring program and the mitigation measures that may be required as a result of the monitoring results and outcomes. However it is also imperative that the drainage systems surrounding the site have to be monitored regularly by SBL according to monitoring plans in table 1.5-1

Table 1.5-1 provides the water quality and ecology monitoring plans. Monitoring locations are to be based on the baseline monitoring sites located to the north, east and west of the proposed developmental site.

▪ **Table 1.5-1: Water Quality and Drainage/Watershed Habitats**

Phase in Project	Frequency	Sampling parameters	Sampling sites
1. Pre Construction	1 round	Water quality:	S1
		Suspended solids	
		Turbidity	S2
		pH	
<u>Faecal coliform</u>	Daily	Habitat assessment	S1
		visual assessment of oil and grease	S1 and S2
		Temperature	
		BOD	
2. Sediment Treatment Devices	1 round after devices installed then quarterly	Water quality:	S1
		Suspended solids	
		Turbidity	S2
		pH	
<u>Faecal coliform</u>	Daily	Habitat assessment	S2
		Visual assessment of oil and grease and floating materials	S1 and S2
		Temperature	
		BOD	

## 1.6 External Communications

### 1.6.1 General Communications Matrix

Table 1.6.1-1 sets out the lines of communications for the neighbouring communities, potential employees, government stakeholders and other individuals in relation to complaints or enquiries during the construction of the project. Refer to *Sheet 1* for the Complaints/Enquiries form – at the end of this section.

▪ **Table 1.6.1-1: Communications Matrix**

Stakeholder	Main interest	Means of Contact	Key Contact
Neighbouring communities	Loss of herbal medicine, firewood, access to fishing grounds and waterway thoroughfare.	Complaints/enquiries to communities and its representatives	SBL
	Disturbance from construction activities, environmental and social issues	Complaints/enquiries to Community Representative	SBL
Potential Employees	Employment opportunities	Advertise key positions in local papers/noticeboards Maintain register of potential employees Recruitment of community members at the project site	SBL and Contractors
General public	General interest and concerns	Media updates-press release Complaints/inquiries	SBL
Government stakeholders	Environmental and socio-economic issues	Consultation Committee Envi-Green Pacific Consultants	SBL

The following measures are proposed to be implemented to assist with communications between the communities, contractors and SBL.

1. SBL responsible officers to be located at the site for the entire project to address concerns, assist with employment and communicate with the local residents.
2. SBL, together with the community consultation committee will hold meetings on 'as-required' basis to inform the neighboring community members of information on the next phase of the work to be carried out.
3. General communications regarding key hazards including large machines and shipping to be undertaken by SBL and contractors.
4. Employees will be educated with regard to occupational health and safety issues.

### 1.6.2 Complaints and Enquiry Process

All complaints are to be referred to the management at the SBL site office. Only nominated SBL employees will be authorised to discuss complaints with the complainant.

All complaints will be entered onto a Complaints/Enquiries Form (Sheet1) which will be filled by an SBL site manager or his/her representative.

**1.6.3 Schedule of External Reporting**

All external reports are to be submitted to external agencies through the key contacts in the communication matrix identified in section 1.6.3-1.

▪ **Table 1.6.3-1 Schedule of External Reporting**

ITEMS	FREQUENCY OF SUBMISSION	RESPONSIBLE TEAM MEMBER	SUBMIT TO:
CEMP	Prior to construction	SBL Site Manager	DOE
CEMP updates	As required	SBL Site Manager	Holders of controlled copies incl DOE
Changes in project activities	As required	SBL Site Manager	SBL,DOE
Incident report	Within 24hrs of incident	SBL Site Manager	SBL, DOE
Water Quality monitoring report	After completion of monitoring	SBL Site Manager	DOE
Other Monitoring Data	As required	SBL Site Manager	DOE

**1.7 Spill Procedures**

Incidents and spills of potentially hazardous materials including solvents, paints, petrol, chemicals and gasoline need urgent attention and proper handling/remediation.

▪ **Table 1.7-1 Spill procedures**

Procedure	Performance Indicator (s)	Responsibility
<ul style="list-style-type: none"> <li>▪ Spill kits to be readily available and specifically designed for the hazardous materials that will be used and stored on site</li> <li>▪ Procedures to handle oil and chemicals will be prepared by SBL before introduction to site</li> <li>▪ Inspection of site to ensure proper environmental controls are in place and operating effectively</li> </ul>	<ul style="list-style-type: none"> <li>▪ Emergency procedures and up to date safety manuals are available and provided at specific locations on site</li> <li>▪ Spill kits are available and located where necessary</li> </ul>	SBL Site Manager
<ul style="list-style-type: none"> <li>▪ Immediately contain contaminated material to prevent contamination of surrounding soil and waterways</li> <li>▪ Documented emergency procedure and management of incident plans. Non-compliance and complaints are to be reported by all employees including reporting the incident to the Site Manager if material harm has occurred</li> <li>▪ SBL to inform DOE within 24hrs if significant contamination of soil and water occurs</li> </ul>	<ul style="list-style-type: none"> <li>▪ Documented reporting is kept as a record with proper remedial actions taken.</li> <li>• Spills have been contained as much as possible with minimal impact on the environment</li> </ul>	All employees  SBL Site Management  SBL
<ul style="list-style-type: none"> <li>▪ Remove all contaminated materials from the</li> </ul>	<ul style="list-style-type: none"> <li>▪ No contaminated material</li> </ul>	SBL Site

incident site and dispose of in accordance with recommendations from environmental consultants or the DOE	is left at the incident site and visual damage is to be repaired	management
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**1.8 Incident Reporting**

Reporting requirements are important for assessing trends, reducing potential for reoccurrence and auditing of compliance with environmental performance objectives and corrective actions to rectify any deviations from performance standards.

Records should be kept to allow auditing and to target and encourage the use of preventative actions as well as corrective action following anynon-compliances.

▪ **Table 1.8-1 Incident Reporting**

Heading	Reported by	Recipient of report
Minor incident or near miss-no injuries or environment damage	SBL supervisor - written, immediately	Next up manager and Safety/Environment Officer records on file
Minor incident-failure of performance measure in CEMP, can easily be remedied, little damage	SBL supervisor - written, immediately	Next up manager and Safety/Environment Officer records on file Monthly report to SBL
Moderate incident-failure of performance measure in CEMP, breach of EIS approval  Can easily be remedied, some damage	SBL supervisor - written report to DOE by SBL  Manager or his/her representative	SBLManagement representative Safety/Environment Officer records on file  Monthly report to SBL
Major incident-one off or consistent failure of performance measure in CEMP, breach of EIS approval.  Not easily remedied, significant environmental damage	SBL supervisor-verbal, immediately, followed by written  SBL supervisor-verbal, followed by written report	SBL Management representative Safety/Environment Officer records on file Monthly report to SBL  SBL Management representative DOE

**1.9 Capacity Development and Training**

**1.9.1 Management and Operation of the CEMP**

All those responsible for the management and operation of the CEMP should be adequately trained in their responsibilities. Written evidence of training should be kept for inspection and auditing purposes.

**1.9.2 Construction, Maintenance and Monitoring of Environmental Protection and Discharge Treatment Devices**

Employees shall be trained by independent institutions/training centre (local and overseas s/competent employees) in areas of construction, maintenance and monitoring of environmental protection and water discharge treatment and control devices.

All records of training should be kept on site for inspection and auditing purposes

### 1.9.2 Low Lying Land Environmental Monitoring and Interpretation of Results

Monitoring of low-lying areas near to the project will be carried out by qualified personnel and technical experts who can be sub-contracted should the SBL personnel lack proper skills.

### 1.9.3 Spill Management and Emergency Procedure

All employees involved in the handling all of potentially hazardous materials must be trained in the use of personnel protective equipment, spill management and emergency procedures. Where training is not available locally, outside experts will be utilised to provide and facilitate training.

All records of training should be well kept on site for inspection and auditing purposes

### 1.9.5 Department of Environment Review

All monitoring results will be made available to the DOE on request. DOE will carry out auditing of results and duplicate monitoring at any time to ensure compliance with the CEMP as stipulated under the Solomon Environmental Regulations (2008) and any approvals issued.

#### Sheet 1 Complaints/Enquiries Form

Form 1		Enquiries/Complaints	
Name			
Contact Details:			
Date		Time	
Type of contact: <input type="checkbox"/> Phone <input type="checkbox"/> Fax <input type="checkbox"/> E-mail <input type="checkbox"/> Drop in			
Description of Complaints/Inquiry:			
(Attach additional description/evidence as required)			
Recorded By:			
Referred to:		Date of referral:	
Initial actions (complete within 1 business day)			
Agreed Follow Up Actions			

Action	Date completed	Signature
Distribution: Original → Communication Manager Copy 1 → Site Complaints/Enquiries file Copy 2 → Project Manager Additional Copies to those responsible for actions		
Actions Closed:		
----- Name	----- Signature	-----/-----/----- Date

**2.1 Operational Environment Management Plan (OEMP)**

**2.1.1 Purpose of OEMP**

The purpose of the Operational Environmental Management Plan (OEMP) is to monitor the adequacy of the environmental controls during the operational stage of the project, assess any adverse environmental impacts and to implement appropriate mitigation measures. The plan addresses all relevant requirements identified in the Environmental Impact Statement (EIS) Report.

SBL, through implementation of this OEMP, will operate the project with due regard for protecting the natural and social environment. SBL will be required to:

- Comply with the relevant environmental legislation as stipulated in the Environmental Regulations 2008.
- Fulfill all commitments in the OEMP
- Promote environmental awareness and understanding among employees and contractors through:
  - Regular training and awareness
  - Assignment of roles under this OEMP
  - Linking performance indicators of employees to overall performance
- Foster a shared sense of responsibility for environmental performance amongst all project participants
- Monitor environmental performance and implement continuous improvement plans to meet the requirements of the OEMP
- Continue to liaise with stakeholders involved in the project including the DOE

**2.1.2 Scope of OEMP**

The scope of the operational environmental management plan will include the following:

- environmental awareness programs
- training in environmentally responsible work practices
- regular environmental reviews
- use of native plant species
- recycling programs
- energy management program
- compliance with relevant environmental legislation

**2.1.3 Format and Function of the OEMP**

This OEMP forms part of the overall operational plan of the proposed Vaghena Bauxite Project. It is a key part of the Environmental Management Plan (EMP).

Monitoring should occur throughout the construction, operational and (where appropriate) decommissioning phases of project to ensure that management commitments and licensing agreements are complied with, to enable ameliorative measures to be taken if unexpected impacts are detected and to facilitate best practice environmental management.

Monitoring programs and management feedback systems are to be part of the overall environment management system in place for the duration of the project.

**2.1.4 Approval Schedule**

▪ **Table 2.1.4-1: Approval Schedule of the OEMP**

Task	Timeline
OEMP framework approval by DOE	OEMP lodged with EIS for approval at the same time
OEMP finalized prior to operation and approval by DOE	OEMP lodged with EIS and for approval 1 month prior to commencement of the operations phase
OEMP implemented	Throughout the operational stage

**2.1.5 Project Overview**

The project will be designed to safeguard the environment and infrastructure that support economic opportunities for the local people of Vaghena Island and other communities in the vicinity of the proposed project area. The project is planned to have a lifespan of about 20 years. Construction and mining will commence once the Mining Lease has been granted and subject to the prior grant of Development Consent by DOE.

**2.2 Roles and Responsibilities**

This section describes the organizational structures and responsibilities of individuals involved with the implementation of the OEMP, listed in Table 2.2-1.

▪ **Table 2.2-1 Responsibilities of Relevant Parties/Positions**

Party/Position	Responsibilities/Tasks
SBL	<ul style="list-style-type: none"> <li>▫ Implementation, monitoring and compliance with the OEMP including the performance of the operations phase against design and permits</li> </ul>

	<ul style="list-style-type: none"> <li>▫ Reviewing the performance against the OEMP and implementation of adjustments to improve efficiency and the application techniques/systems for the improving the environmental management of site activities</li> <li>▫ Reporting to DOE</li> <li>▫ Compliance of operational activities with the EIS guidelines and approval conditions</li> </ul>
<b>Water Sampling SBL or Sub-Contractor (s)</b>	<ul style="list-style-type: none"> <li>▫ Implementation of all monitoring programs set out in the OEMP</li> <li>▫ Reporting to SBL management.</li> </ul>

**2.3 Environmental Risks**

1. Changes in water quality of the surrounding waterways and its impact on the creek and/or watershed ecosystem.
2. Alteration of storm water flows due to new drainage systems therefore changing watershed conditions such as rising water table and sediment movements
3. Temporary loss of fish stocks in the marine aquatic ecosystems and habitats
4. Habitat changes within the project area and surrounding areas
5. Social community integration with influx of employees and non-local peoples

**2.4 Environmental Monitoring**

SBL will be responsible for implementing the monitoring programs and the mitigation measures that may be required as a consequence of the monitoring results. Monitoring and analysis work may be sub-contracted to third party environmental consultants.

▪ **Table 2.4-1 Environmental Monitoring Programme**

Location (Refer to plate 1.0)	Monitoring Sites	Monitoring Frequency	Parameters
S1	1m below surface	June and December annually	<ul style="list-style-type: none"> <li>▫ Temperature and DO</li> <li>▫ Clarity</li> <li>▫ pH</li> <li>▫ Nitrates</li> <li>▫ Orthophosphate</li> <li>▫ Total phosphate</li> <li>▫ Turbidity</li> <li>▫ BOD</li> <li>▫ Total Suspended solids</li> <li>▫ Conductivity</li> <li>▫ Faecal coliform</li> </ul>
S2	2m below surface	June and December annually	<ul style="list-style-type: none"> <li>▫ Temperature and DO</li> <li>▫ Clarity</li> <li>▫ pH</li> <li>▫ Nitrates</li> <li>▫ Orthophosphate</li> <li>▫ Total phosphate</li> <li>▫ Turbidity</li> </ul>

			<ul style="list-style-type: none"> <li>▪ BOD</li> <li>▪ Total Suspended solids</li> <li>▪ Conductivity</li> <li>▪ Faecal coliform</li> </ul>
S3	1m below surface	June and December annually	<ul style="list-style-type: none"> <li>▪ Temperature and DO</li> <li>▪ Clarity</li> <li>▪ pH</li> <li>▪ Nitrates</li> <li>▪ Orthophosphate</li> <li>▪ Total phosphate</li> <li>▪ Turbidity</li> <li>▪ BOD</li> <li>▪ Total Suspended solids</li> <li>▪ Conductivity</li> <li>▪ Faecal coliform</li> </ul>

## 2.5 Reporting

All external reports are to be submitted to external agencies through the key contact identified in the communications matrix in section 2.6.1 of the CEMP.

### Table 2.5-1 Schedule of Reporting

Type of Report	Frequency of Submission	Responsible Team Member	Submit To:
OEMP	Prior to operation	SBL Manager,	DOE
OEMP updates (including alterations in management/monitoring procedures)	As required	SBL Manager,	SBL employees DOE
Incident report (refer to incident procedures)	Within 24hrs of incident	SBL Supervisor	SBL Manager DOE
Water monitoring reports	After completion of periodic program	SBL Manager	DOE

## 2.6 Spill Procedures

Incidents and spills of potentially hazardous materials including solvents, paints, petrol, chemicals and gasoline need urgent attention and proper handling in order to reduce risks of injuries and environmental damage.

### Table 2.6-1 Spill procedures

Procedure	Performance Indicator(s)	Responsibility
<ul style="list-style-type: none"> <li>▪ Spill kits to be readily available and specifically designed for the hazardous materials that will be used and stored onsite</li> <li>▪ Procedures to handle oil and chemicals will be prepared SBL before introduction to site</li> <li>▪ Inspection of site to ensure proper environmental controls are in place and operating effectively</li> </ul>	<ul style="list-style-type: none"> <li>▪ Emergency and up to date safety manuals are available at specific locations on site</li> <li>▪ Spill kits are available and located where necessary</li> </ul>	SBL Manager
<ul style="list-style-type: none"> <li>▪ Immediately contain contaminated material</li> </ul>	<ul style="list-style-type: none"> <li>▪ Documented reporting is kept as a</li> </ul>	All employees

<p>to prevent contamination of surrounding soil and waterways</p> <ul style="list-style-type: none"> <li>▪ Documented emergency procedure and management of incident plans. Non-compliance and complaints are to be reported by all employees including reporting the incident to the Site Manager if material harm has occurred</li> <li>▪ SBL to inform DOE within 24hrs if significant contamination of soil and water occurs</li> </ul>	<p>record with the proper actions taken.</p> <ul style="list-style-type: none"> <li>▪ Spills have been contained as much as possible with minimal impact on the environment</li> </ul>	<p>SBL site management</p> <p>SBL</p>
<ul style="list-style-type: none"> <li>▪ Remove all contaminated materials from site and dispose in accordance with recommendations from environmental consultants or the DOE</li> </ul>	<ul style="list-style-type: none"> <li>▪ No contaminated material is left on site and visual damage is repaired</li> </ul>	<p>SBL site management</p>

## 2.7 Incident Reporting

Reporting requirements are important for assessing trends, reducing potential for reoccurrence and auditing of compliance with environmental performance objectives and corrective actions to rectify any deviations from performance standards.

Records should be kept to allow auditing and to target and encourage the use of preventative actions as well as corrective action following any non-compliances.

Heading	Reported by	Recipient of report
Minor incident or near miss-no injuries or environment damage	SBL supervisor - written, immediately	Next up manager and Safety/Environment Officer records on file
Minor incident-failure of performance measure in CEMP, can easily be remedied, little damage	SBL supervisor - written, immediately	Next up manager and Safety/Environment Officer records on file Monthly report to SBL
Moderate incident-failure of performance measure in CEMP, breach of EIS approval  Can easily be remedied, some damage	SBL supervisor - written report to DOE by SBL Manager or his/her representative	SBL Management representative Safety/Environment Officer records on file Monthly report to SBL
Major incident-one off or consistent failure of performance measure in CEMP, breach of EIS approval.  Not easily remedied, significant environmental damage	SBL supervisor-verbal, immediately, followed by written  SBL supervisor-verbal, followed by written report	SBL Management representative Safety/Environment Officer records on file Monthly report to SBL  SBL Management representative DOE

**Table 2.7-1 Incident Reporting**

## 2.8 Capacity Development and Training

### 2.8.1 Management and Operation of the OEMP

All those responsible for the management and operation of the OEMP should be adequately trained for their responsibilities. Evidence of training should be well kept for inspection and auditing purposes.

The SBL contractors are committed to upgrade the environment standard of the site right from the onset of the phase I to the full operational of the Vaghena mine site. It will support the activities engaged by other communities. It is also envisaged that after completion of tenure ship, the proposed newly constructed road will be given to Government and the same may be utilized by the people.

- Current environmental initiatives being undertaken
- Environmental risks of the operation
- Products and services, including inputs (raw materials, energy sources etc) and outputs (products, services, wastes).
- Overall environmental status of the mine site
- Any improvement that can be made short, medium and long term
- The public perception of the mine site

### 2.8.2 Coastal and Sea Environmental Monitoring and Interpretation of Results

Coastal and hydrological monitoring shall be carried out by qualified personnel and technical experts. These programs may involve the use of external consultants.

Environmental evaluation and monitoring are all specialist functions required for environmental assessments and reviews. SBL plans to use *Envi-Green Pacific Consultancy* and other qualified consultants to ensure scientifically consistent monitoring of the project site is undertaken during construction and throughout the operations phases. The environmental philosophy to be adopted for the project will be aligned with the International standard ISO 14004 and will encompass the following:

- Assessment, control and reduction of the impact of the activity concerned on the various sections of the environment.
- Energy management, saving and choice
- Raw materials management, savings, choice and transportation, water management and savings
- Waste avoidance, recycling, reuse, transportation and disposal
- Evaluation, control and reduction of noise within and outside the site
- Environmental performance and practices of employees, contractors, sub-contractors and suppliers
- Prevention performance and limitation of environmental accidents
- Contingency procedures in cases of environmental accidents
- Employee information and training on environmental issues
- Assimilation of external information on environmental issues

### **2.8.3 Spill Management and Emergency Procedures**

All employees and contractors involved in the handling all of potentially hazardous materials must be trained in the use of personnel protective equipment, spill management and emergency procedures. Where training is not available locally, outside experts will be utilised to provide and facilitate training.

All records of training should be well kept on site for inspection and auditing purposes

### **2.8.4 Department of Environment Review**

All monitoring shall be made available to the DOE on request. DOE will carry out auditing of results and duplicate monitoring at any time to ensure compliance with the OEMP as stipulated under the Environmental Regulations (2008) and any other approvals issued.