VULANI ISLAND LIMITED

Vulani Island Environmental Impact Assessment

Report prepared for:

VULANI ISLAND LIMITED

Report prepared by:

TONKIN & TAYLOR INTERNATIONAL LTD

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Job no: 23835

ENVIRONMENTAL IMPACT ASSESSMENT

OF THE

PROPOSED VULANI ISLAND DEVELOPMENT,

VULANI ISLAND, FIJI

Report prepared for:

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Photograph

Executive Summary

This is the summary of an environmental impact assessment report for the proposed Vulani Island Development, at the mouth of the Sabeto River, Nadi Bay. The project proponent is a Fiji-registered company called Vulani Island Limited. The owners of Vulani Island Ltd are two privately owned companies with a proven track record of coastal developments and civil engineering projects in both New Zealand and Fiji. The EIA team included five technical staff with specialist expertise in environmental impact assessment, environmental management, marine ecology and monitoring, mangrove and terrestrial ecology and social assessment.

The Development

The Vulani Island development is a new generation tourist development that is designed to meet the changing requirements of the tourist market. It is a destination project that offers a combination mixed residential and resort accommodation along with the key facilities of a marina, golf course and lagoon feature. The project proposes to set the standard for destination resorts in Fiji. The developer is committed to good environmental management as a key component of both the construction and the management of the development. The development is consistent with the `Step Change' approach advocated by the Government's current tourism policy document *`Fiji: Tourism Development Plan, 1998-2005'.*

The development will feature: residential sections; a resort apartment operation; hotels; golf course and a marina on the seaward side of the island with a navigation channel that provides all-tide access to Nadi Bay. Development features will include a commercial area and a 15 hectare lagoon. The development is designed to be undertaken in a series of stages. The final configuration will be influenced by the market demands of the visiting tourists and investors.

Vulani Island Limited is in the process of formalising an agreement with the Vanua Sabeto and Vanua Vuda, the qoliqoli the owners in the project area and to the north of the project area to ensure the long term protection of the mangroves and continuation of traditional uses.

The development will require large volumes of fill and coastal armouring to raise and protect the island from erosion and over-topping. The fill will be sourced from a combination of sources including the excavation of the marina and channels, and from off shore and from land based sources. It is estimated that 2,800,000m^3 of fill and 45,000m^3 of rock armouring will be required.

The design of buildings and infrastructure on the Island will incorporate best practices in respect of energy use and sustainable building components.

Construction and Operational Environmental Management Plans, to be approved by the Regulatory Authorities, will be prepared for the development.

Services

The development is to be connected to the existing telephone grid, power supply, and water mains on the Queen's Road. Vulani Island Limited is actively investigating alternative power sources such as solar for use in the development.

The project will either establish it own sewage treatment plant or connect with the upgraded Navakai Sewage Treatment Plant. If a sewage treatment is constructed the

plant will treat the sewage to such a standard to ensure that the water can be used for irrigation of the golf course and amenity areas around the project.

There will be no landfill or dump on the island, solid waste management will be a component of a Construction and Operational Environment Management Plans and will embody the principles of reduce, reuse, recycle. The plans will also prescribe effective offsite waste disposal methods, safe use of hazardous substances, and an on-going staff training programme.

Existing Environment

Vulani Island is a series low lying islands, mangroves and mud flats in the Sabeto River delta, all within an area of river delta mud and substantial mangrove wetlands. Over time the shape of the island changes in response to river flows, floods and storms.

Vulani Island supports no terrestrial habitats or fauna of conservation significance. The vegetation present is comprised almost entirely of exotic, secondary or invasive species, degraded by frequent fires and much of it prone to occasional inundation.

The mangroves of the Sabeto River delta are significant. They comprise a large area, are in a good state of ecological health and comprise one of the major areas of mangrove in the Nadi Bay locale.

The marine survey found no areas or sites of particularly sensitive or vulnerable ecology. No rare, endangered, significant marine species or communities of conservation significance were found. Water quality testing in the foreshore area indicated normal conditions for a river delta area.

An archaeological study by the Fiji Museum revealed three sites of importance to the Vanua of Sabeto. It is recommended these sites be protected if possible. It will be necessary to have a response procedure in place during the construction and operation phase of the development in the case of potential features of significance being uncovered.

Consultation

The consultation process involved meetings with the following key stakeholders: Apisalome Savu J.P./ Kolinio Naulago Ba Provincial Council; Veiseisei Village Resource Committee; Asst. Roko Nadi Mr Vuniani Dawai; Yavusa Leweiwavuwavu, Sabeto Village; residents along the Queens highway; Native Land & Fishery Commission; Sabeto Village; Lomolomo Village; Saunaka Village' and Viseisei Village.

While the local stakeholders are, in principle, supportive of the development they wish to see the development provide financial benefits for them in the form of employment opportunities and compensation for use of the qoliqoli.

Assessment

The environmental impact assessment process identified potential environmental effects arising from the project including: deteriorating water quality as a result of increased sediment from construction, wastewater effluents and runoff; loss of mangroves and marine habitats; solid waste disposal; sourcing construction materials, especially fill and rock; cyclone and storm surge issues; and, management of hazardous substances.

Hydrology/Hydraulics

The catchment flood contribution has been assessed using the Rational Method and potential effects on river flooding downstream of Queens Highway has been assessed

with HECRAS, a flood routing numerical model. The results show the proposed development does not have any significant effect on river flood levels. This is due to:

- The existing bridge at Queens Highway creating significant throttle to catchment flows;
- The maintenance of a 15 m wide mangrove buffer that provides significant attenuation of flows;
- The flat and low level of the river, with significant saline intrusion occurring far up river.

The tail water level dominating river flows during periods where storm surge increases bay levels significantly.

Coastal Processes

The coastal processes assessment has made recommendations on the dimensions, location and construction of the coastal structures and features. These will need to be strictly applied and any changes to the planned coastal works will need to be reviewed and approved by a qualified coastal processes-engineer. The overall development is likely to have a positive impact on the coastal processes by stabilising many of the shorelines and increasing the island surface elevation so that it is less likely to be overtopped during a cyclone event.

The development will also lead to a range of significant economic and employment benefits. Upgrading of local public infrastructure will be done in conjunction with Government, on a yet to be agreed Public Private Partnership. This arrangement will minimise the Governments exposure to significant cost outlays and will carry out any necessary upgrading of local public infrastructure. Government has no significant costs associated with this project.

Overall, the EIA study findings indicate that the proposed development should not result in any significant adverse environmental impact if the following recommendations are adhered to.

Environmental Management

1. Vulani Island Limited will be required to prepare a Construction Environmental Management Plan (CEMP). The plan is to include the transport of fill and rock armour to site and include procedures on the discovery of any archaeological site. No work can be undertaken until the CEMP and subsequent updates are approved by DoEnv/DTCP.
2. Vulani Island Limited be required to prepare an Operational Environmental Management Plan (OEMP) for the residential subdivision and marina. The OEMP should be approved by DoEnv within six months of the subdivision and marina being opened.
3. Vulani Island Limited be required to prepare additional Construction and Operational Environmental Management Plans for the later phases of the development that are not covered by this EIA, for example the hotel and apartment developments.
4. It is recommended that DoEnv establish a Monitoring Committee which would meet every two months to oversee the implementation of the CEMPs. The Committee should include a Vulani Island representative.

Sabeto River Mouth and Natacola River Mangroves

5. Vulani Island Ltd generally adopt a 15 m buffer zone/reserve area with no construction along the northern bank of the Sabeto River and southern bank of the Natacola River so as not interfere with the ongoing sediment movements associated with the river mouth.

6. That Vulani Island Limited endeavour to protect the mangroves of the northern bank of the Natacola River through an agreement with the fishing rights owners and a recognised conservation organisation. The agreement to result in a DoEnv-approved management plan. The aims of the plan to be: to conserve the area for the natural values of the site; to enable traditional uses by the fishing rights owners and to develop the conservation, educational and research potential of the area.

7. That Vulani Island Ltd demonstrate to the satisfaction of the Director Department of Town and Country Planning and Director Department of Lands that long-term protection of the mangroves that remain (after construction is completed) within the development leases is assured in the management deed of the Body Corporate that will be established to manage Vulani Island.

Building Design & Construction

The west coast of Viti Levu is subject to the passage of cyclones and the site is vulnerable to cyclones. It is recommended that all building design conforms with the Fiji National Building Code or another higher standard approved by the Department of Town and Country Planning.

8. Revetment crest levels should comply with the Coastal Processes Assessment recommended levels of 3.9m RL on the western side adjacent to the beach and 2.5m RL on the eastern side of the island.

9. Building platforms to be a minimum of 300mm above the surrounding heights and the developer to provide for the easy drainage of over-topping water through swales to the eastern shoreline.

10. Prior to any construction commencing, a geotechnical report from a suitable engineer will be provided to the Director Department of Town and Country Planning demonstrating that proposed work will be geotechnically feasible.

11. During construction it will be necessary to take measures to ensure that the marine environment is protected from discharges of: excessive sediment, storm water, solid or liquid wastes, and hazardous substances. Hence it is recommended that the developer ensures that:

    - stormwater runoff from the site is managed to minimise sediment-laden water being discharged to the foreshore;
    - there be no discharges to the western beach;
    - solid waste is contained on the site and transferred to an approved landfill;
    - temporary toilets and washing facilities are installed that treat and dispose of waste water in a way that is not damaging to the marine environment;
    - hazardous wastes are handled according to their existing guidelines and only by trained personnel; and,

- earthworks sites are rapidly revegetated.

Construction of Foreshore Structures

The developers propose to construct an access channel and headlands. In addition, they plan to maintain dredged channels that will provide access to Nadi Bay. Over time, replenishment of the beaches and maintenance dredging of the dredged areas is likely to be necessary. It is recommended that:

12. Foreshore structures are designed by a suitably qualified coastal engineer and follow the recommendations and design specifications of the coastal processes assessment that are included in this report. Any changes to the design specifications will need to be approved by a coastal processes engineer.

In order to preserve habitats, it is recommended that:

13. The design and construction method minimises disturbance to the mudflats and mangroves.
14. Construction equipment be kept in good order and their time in the foreshore area is kept at a minimum so as to minimise the leakage of fuel and oil.

Construction Materials

The developers propose to import a range of construction materials to the site, notably rocks for the foreshore barriers and bridge and top-dressing to provide for good plant growth. Sand will also be required. It is recommended that:

15. All construction materials imported to the island to come from an approved source.
16. Quarry rock rather than river rock to be used for all armouring requirements.

Construction Traffic

In order to minimise the disturbance and risks to the surrounding communities and road users from construction traffic it is recommended that the developer undertake the following:

17. Prepare a plan for the intersection with the Queen's Road that is to be approved by PWD prior to the commencement of any construction activity;
18. Ensure that contracts with suppliers and cartage contractors for the transport of bulk materials to site contains appropriate disciplinary procedures for: noisy vehicles, insecure loads, operating outside approved hours, exhaust emissions not meeting Fiji emission standards, speeding or unsafe use of vehicles. The developer shall demonstrate to the satisfaction of the Director, DoEnv that these provisions are in place prior to bulk cartage commencing;
19. Prepare a traffic management plan which demonstrates how traffic will be managed to minimise impacts and submit to the Director of DoEnv for approval;

Development Operation

The operation phase of the development will require careful management by the Body Corporate and resort operators of a range of potentially environmentally impacting activities including: the use and maintenance of the marine structures and dredged areas; wastewater treatment; solid waste management; use of hazardous substances; and

landscape management. In addition, contingency plans will be required for extreme weather events.

20. Prior to the management deed being enacted the Vulani Island shall demonstrate to the satisfaction of the Director Department of Town and Country Planning and Director Department of Lands that the sections of the management deed for the Body Corporate that deal with the development objectives for the site and the environmental management of the site need to be consistent with the undertakings given in this document and the Master Plan.

Marine-based Operational Effects

It will be necessary to carry out maintenance dredging of the marina, channels and swimming holes. These works will need to be carefully managed to minimise impacts. The dredge method, equipment and procedures will need to be detailed in the Operational Environmental Management Plans.

It will be necessary to manage the effects of the regular boat movement that will be associated with the marina. As a result it is recommended that:

21. Measures are taken to prevent spills in the marina including safe fuelling procedures and emergency procedures and equipment;
22. To reduce oil pollution, four-stroke outboard motors are used where possible instead of two-stroke motors; and
23. Boat traffic is limited to slow speeds to minimise erosive wakes.

Wastewater Treatment

The developers are yet to confirm how waste water from the development will be treated.

24. Prior to construction of the project commencing, the developer shall submit either confirmation from PWD that waste water will be treated at the Navakai waste Water Treatment Plant or supply plans for a sewage treatment plant to the Director of DoEnv and the Director of DTCP for approval. The plans will be accompanied by a peer review of suitably qualified waste water engineer confirming the design will meet treatment standards and the plant has sufficient capacity and contingencies for break downs and climatic events are addressed.
25. Prior to the marina becoming operational the developer shall submit to Director of DoEnv and the Director of DTCP for approval a plan demonstrating how bilge water from larger vessels is to be treated.

In addition, it is recommended that the developers ensure that stormwater discharges do not lead to contamination of the foreshore. This will require that:

26. Stormwater is properly treated prior to its discharge and that, where possible, the water is reused on the site; and
27. The use of cleaning chemicals and hazardous substances is minimised, that they are handled by trained personnel and that washing chemicals are bio-degradable and low in phosphates.

Water Supply

Confirmation of the availability of a water supply for the development remains to be confirmed. It is recommended that:

28. Details of an assured and adequate supply be forwarded to DoEnv and DTCP prior to development approval.

Regional Planning

The development of projects such as Vulani Island tends to attract development around the boundaries of the project area. If this development is not properly designed and controlled, it can have a detrimental impact on the resort development. It is recommended that:

29. A working party involving DT&CP, NLTB, Lautoka Rural Local Authority and the developer be establish to a develop a strategy to ensure that development adjacent to Vulani Island does not detract for the tourist experience at Vulani Island.

Cultural Sites

The archaeological investigation identified 2 sites of cultural importance and a possible third site.

30. That further assessment of these the 3 cultural sites identified by the Fiji Museum be undertaken in conjunction with the Fiji Museum. The assessment is to consider options and practicality of protecting these sites and the provision interpretive information.

1 Introduction

1.1 This Document

The Terms of Reference (ToR) for this study have been prepared by the Ministry of the Environment (DoEnv) and are attached as Appendix A. The EIA has been prepared over a 6 month period during which time: a specialist study of the marine environment was commissioned; consultation with the public and local community was undertaken; and water samples were taken from in front of the proposed resort site. The developers have also commissioned an independent study on coastal processes and cyclone issues and a geotechnical report. The EIA has been divided into six sections that are summarised below in Table 1. The format of this document broadly follows the process of how the EIA was undertaken.

SECTION	CONTENT
1. Introduction	Establishes background to EIA process
2. Proposed Development	Describes the development proposal
3. Existing Environment	Characterises the existing environment
4. Consultation	Presents the views of potentially affected parties
5. Assessment of Effects	Considers the impacts of the proposal. Describes how to avoid, remedy and mitigate adverse effects
6. Conclusion & Recommendations	Provides recommendations on how to avoid, remedy and mitigate adverse effects

Table 1: Components of the EIA Study

1.2 The EIA Study Team

This study and report has been prepared for Vulani Island Limited by Tonkin & Taylor International Limited a specialist Environmental and Engineering Consultancy with over 15 years experience in Fiji.

The EIA was managed by Ed Breese a principal of Tonkin & Taylor International Limited. The EIA project team is a combination of specialist Fiji-based consultants and Tonkin & Taylor International staff.

The project team and their task designations are set out in Table 2.

NAME	POSITION	QUALIFICATIONS	ROLE IN THE EIA STUDY
ED BREESE	Tonkin & Taylor International, Auckland	BA; Dip. Nat. Res., Univ. of Canterbury, New Zealand; MBA Massey University, New Zealand	Report writing, Environmental Impact, Environmental Management
HELEN SYKES	Principal, Resort Support Fiji	MSc., Marine Studies Programme, USP B.Tec. HNC in Applied Biology. Stockport College of Technology, England, 1984	Marine Resources Survey, Impact Assessment and Mitigation Measures
KOLINO MOCE QALO	Associate, Environment Consultants Fiji	Development Technology Institute; East-West Centre, Hawaii, USA.	Community Consultation
RICHARD REININ-HAMILL	Tonkin & Taylor International, Auckland	BE (Hons), Civil, 1985, Auckland University, New Zealand ME, Coastal, 1989 Delft Holland	Coastal process Assessment
SEPETI MATARARABA	The Fiji Museum	B.Sc. University of South Pacific.	Archaeologist and Fijian Cultural Specialist
& ELIA NAKORO		B.Sc. University of South Pacific.	Archaeological, Historic and Cultural Site Assessment
DICK WATLING	Principal, Environmental Consultants Fiji Ltd.	Ph.D. Applied Biology, Univ. of Cambridge, UK B.Sc. (Hons), Zoology, Bristol Univ. UK.	Terrestrial ecological resources

Table 2: The EIA Study Team

1.3 Project Overview

Vulani Island Limited, a Joint Venture between Hopper Fiji Ltd (Hoppers) and Hiway Stabilizers International Trust Co Ltd, wishes to the develop Vulani Island at the mouth of the Sabeto River for residential and tourism use (Figure 1). To develop the island, development approvals will be required from the Lautoka Rural Local Authority (on behalf of Department of Town and Country Planning) and Department of Lands. To accompany these applications for approval an Environmental Impact Assessment (EIA) on the proposed development is required. The terms of reference for the EIA are established by the Ministry of the Environment (MoE) on behalf of the Departments of Lands and Town and Country Planning. A copy of the terms of reference can be found in Appendix A.

The proposed Vulani Island development is located on a series of small islands on the southern side of the Sabeto River mouth. The site is approximately 9km north east of Nadi town. Vulani Island has been planned for resort development for a number of years. A number of environmental studies have been completed on the site. Approvals were granted for a development in the 1990s and significant earthworks were undertaken, but the project was not completed. Development licences have already been granted for Stages 1 and 2 of the project. Approval in principle has been granted by the Department

of Town & Country Planning for development's master plan subject to a number of conditions including the preparation of this EIA.

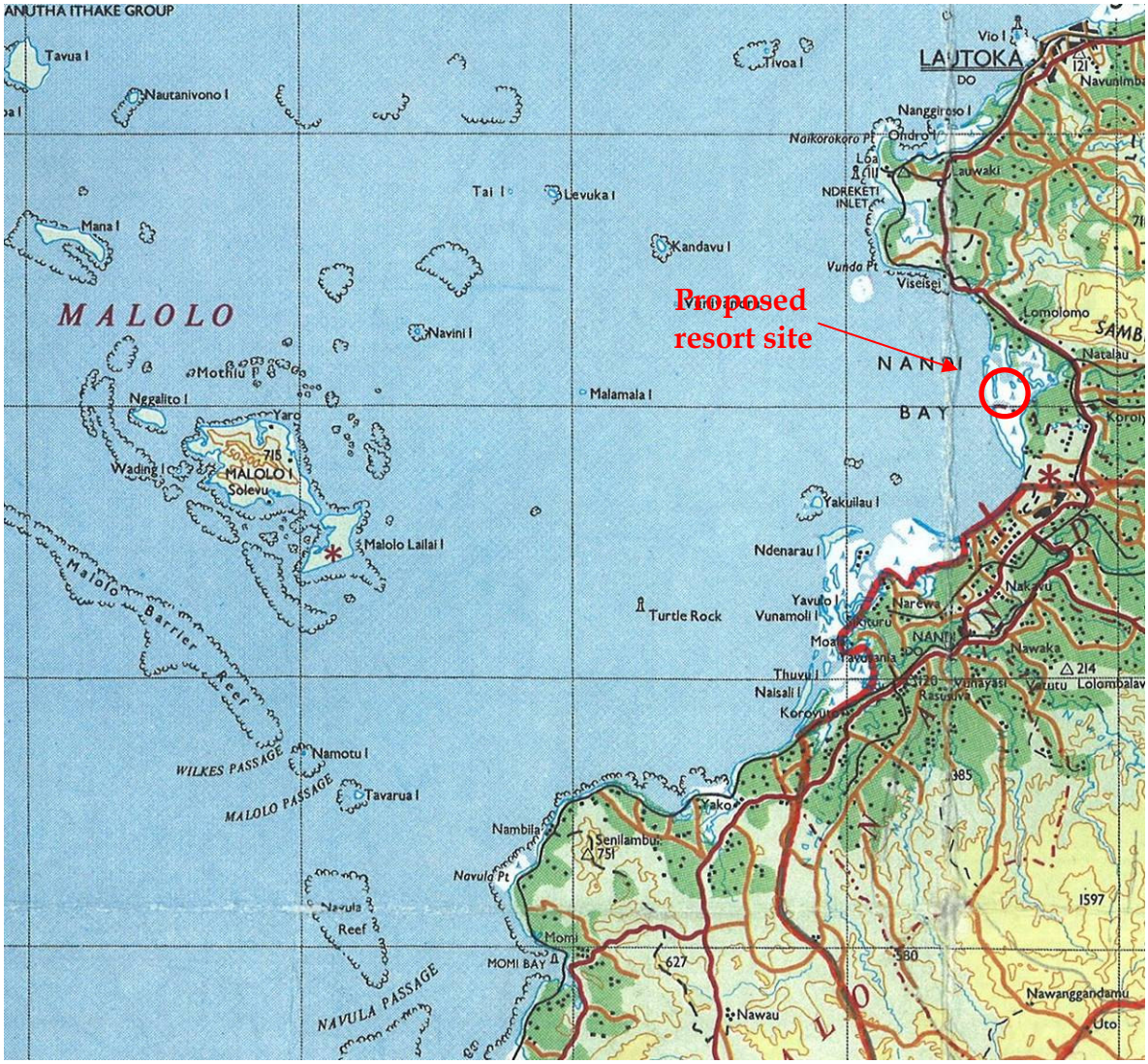

Figure 1 Project Location

A residential and tourist development is planned for the approximately 265 hectare site. The development would be similar to the model used by Tabua Investments on near-by Denarau Island, but on a slightly much smaller scale and with the benefit of learning from the Denarau's experiences. The key components of the development will be:

- Hotel zone with potential for 5 hotel complexes
- Residential areas developed around the marina, cannels and golf course with potential for approximately 650 single medium density units and 150 duplex units
- Apartment accommodation
- Commercial / retail centre
- 100 mixed berth marina with all tide access to Nadi Bay
- 18 hole championship standard course Golf course

- 15 hectare seawater lagoon.

The development will be constructed in a number of stages. The pace of development will be dependant on the commercial success of the previous stage. Vulani Island Limited currently anticipates that it will take approximately 10 years period for the development to be constructed to its full potential.

1.4 Project Proponent

The proposed development will be undertaken by Vulani Island Limited. Vulani Island Limited is a Company that has been specially set up for the development of the site. The Company is owned by Hopper Developments Ltd and Hiway Stabilizers Ltd. The combination of these companies brings together two reputable companies with specialist expertise in coastal development and civil infrastructure. Vulani Island Limited is a Fiji-based company with its registered office in Suva and a project office in Nadi.

1.4.1 Hopper Developments Ltd

Hopper Developments Ltd is a privately owned New Zealand land development established in 1953. The company is controlled by the family interests of father and son, Ian and Leigh Hopper. The company is based in Orewa near Auckland and has been involved in developments around Auckland's North Shore, the Hibiscus Coast, and Pauanui on the Coromandel East Coast.

Hopper Developments are active in most forms of residential development specialising in coastal lifestyle projects including residential land and housing. All projects undertaken by Hopper companies follow common principles. These encompass detailed planning, innovation, a high standard of construction and protection of the natural environment resulting in quality developments of lasting value. An example of a Hopper Developments project is Pauanui Waterways, New Zealand's first canal housing development. On completion the development will comprise 250 canal frontage properties each with the ability to install a boat ramp and jetty.

1.4.2 Hiway Stabilizers Ltd

Hiway Stabilizers are New Zealand's leading pavement stabilisation specialists responsible for pioneering the development of pavement stabilising in New Zealand. The Company is family owned by Boocock family and has been in business for over 30 years. The company has developed with an emphasis on technology, innovation, quality and service. The commitment of the company to its core values has been recognised by the following awards:

- 2000: Winner North Shore Business Excellence Award for Technology.
- 2002: Winner of Transit New Zealand Road Innovation Award.
- 2003: Named by the National Business Review as one of the top four most exciting construction companies in New Zealand.
- 2004: Winner of Transit New Zealand Road Innovation Award.
- 2006: Supreme Excellence Award for Project construction at New Zealand Roading Excellence Awards

The success of the company's core business has provided it with the opportunity to diversify in a number of different of different areas including the establishment of an

international arm. The company is already established in Fiji with a civil engineering company and investments in a number of tourist developments and agricultural enterprises.

1.5 Statement of Need

The Fijian economy is reliant on tourism with it contributing over 25% to GDP. In 2004, it was estimated than more 25% of paid employment was involved in the tourism sector with an estimated 45,000 jobs. The tourism industry is Fiji's largest foreign exchange earner, and earns more than the garment, gold, fishing and timber industries combined. However, investment in tourism and other areas of the Fijian economy remain at a very low level. With only 25-30% of school leavers currently employed, new tourist developments offer new employment opportunities (Ministry of Information, 2004). The proposed development provides for a range of employment opportunities both in construction and operation.

Government has recognised the need to revitalise the Tourism Industry and promote investment as indicated in its policy for this purpose, `Fiji: Tourism Development Plan 1998-2005'. The proposed development will be in accordance with the policy direction of the plan.

1.6 Approvals required

The project site covers a combination of state freehold land which is leased by the developer and mangroves as foreshore which is currently owned by the State. The terrestrial land is subject to the jurisdiction of the Lautoka Rural Local Authority, while unalienated foreshore is under the jurisdiction of the Department of Lands. Once a development lease is granted approvals for development activities come under jurisdiction of the Lautoka Rural Local Authority. The development must comply with a set of national legislation and associated planning considerations and consent procedures which are described below.

1.6.1 National Legislation

Fiji's principal statutes governing physical planning are the Town Planning Act 1946, as amended and the new Environmental Management Act 2005. The Town Planning Act provides for the development of land, buildings and other operations and for any material change in the use of land and buildings. The Act provides for the Director of Town & Country Planning and local authorities to have extensive responsibilities and discretion in the application of conditions for building approval. Where environmental issues are concerned the Director will call for advice from the Ministry of Environment, which is now guided by the recently enacted Environmental Management Act 2005.

Approval will be required from Town and Country Planning via the Lautoka Rural Local Authority for the rezoning of the site, subdivision, land use activities and any subsequent building on the site.

The Health and Safety at Work Act was enacted in 1996. This legislation identifies the responsibility of both employers and employees to improve work place safety. The legislation requires the preparation of health and safety plans that identify work place hazards and the appropriate action to deal with them. Training is identified as an important mechanism for improving safety in the workplace.

1.6.1.1 Environmental Management Act

The recently enacted Environmental Management Act 2005 provides for an effective enforcement and administrative framework for the Department of Environment. It creates new legal frameworks for:

- environmental impact assessment;
- integrated natural resource management; and
- waste management and pollution control.

Regulations for the Act have yet to be promulgated, and the Act only comes into force when the relevant sections are gazetted by the Minister responsible for the environment, at a time when he believes the Department has the capacity to enforce the Act. This has yet to be done.

In the future, the waste water and stormwater treatment and solid waste activities on site will need to comply with the Act.

1.6.1.2 Subdivision Act

The Subdivision of Land Act applies to those areas of land the Minister may declare by notice in the Gazette. In practice, any land undergoing subdivision is usually covered by this Act, with the exception of Suva and Lautoka which have additional by-laws that also apply. The proposed development's subdivision plans are subject to this Act. It is at the discretion of the Director of Town & Country Planning as to whether an EIA of the subdivision is required.

1.6.1.3 State Lands Act

To undertake any works in or to occupy or use a foreshore[1] area, consent is required from the Minister of Lands. The Minister of Lands may upon application grant a foreshore lease to occupy and use a foreshore area or a dredging licence to undertake dredging or reclamation activities in the foreshore area. This consent is granted under the provisions of the State Lands Act.

The Director of MoE may require that an application for a dredging licence and/or reclamation be accompanied by an environmental impact assessment (EIA). Before the Minister grants his consent to an application he has to be satisfied that the applicant has addressed the matter of fishing rights (qoliqoli) compensation for the traditional fishing rights owners. The level of compensation for fishing rights compensation is normally determined by the Agricultural Tribunal on application to the Department of Lands, however this procedure is currently under moratorium pending resolution of the proposed Qoliqoli Bill. This procedure may be waived by the Minister of Lands if a compensation agreement is agreed between the developer and the qoliqoli owners.

1.6.2 Public Reserve Allocation at Foreshore

1.6.2.1 Foreshore Reserve

The foreshore reserve is the portion of land above the mean high water mark allocated for public use so as to allow access along the coastline, particularly at high tide. In colonial

[1] Foreshore is taken to be below the Mean High Water Mark.

times, this reserve was 30 feet. In Fiji's Seventh Development plan (DP 7) this was increased to 100 feet, or approximately 30 metres. DP 7 reads:

> *Unlike river bank reserves, this policy has not been backed-up with specific legislation. To date, the imposition of foreshore reserves and their size has been at the discretion of the Director of Lands.*

1.6.2.2 Building Line Restriction

The building line refers to the distance between the structure to be erected and a public street, road or right-of-way. In the context of the foreshore, the building line is taken as 30m back from the mean high water. No building is permitted within the building line restriction unless the Director of Town & Country Planning approves a relaxation application.

1.7 Status of Consents

Table 3 provides a summary of the leases and consents that are required by the development and their approval status

LEASE/CONSENT	STATUS
Outline Development Consent from DTCP under Town Planning Act (covering zoning, land use activities and structures)	Concept plan approval received 16 December 2006.
Building permit from DTCP under Town Planning Act	Submission pending
Subdivision of site for residential lots and resorts by NLTB under the Subdivision Act	Submission pending
Formal Development Consent from DTCP under the Town Planning Act	Submission pending
Foreshore lease to occupy and use foreshore area from Minister of Lands under the Lands Act	Submission pending
Dredging licence for the foreshore area from Minister of Lands under the Land Act (included in the request for Foreshore lease)	Licence already granted for Stages 1 & 2. The licence may need a variation to allow for the latest marina and access channel configuration.
Application to Minister of Lands for waiver of fishing rights compensation procedure in cooperation with **qoliqoli** owners	Negotiations completed and settled with **qoliqoli** owners for Stages 1 and 2. For stage 3 agreement has been reached with the owners and awaiting processing by the Minister of Lands
Relaxation application for location of structures within the 30m building line restriction from mean high water mark, DTCP	An application for a relaxation maybe required for some of the sports bures required by the development.
Approval of Environmental Impact Assessment by DoEnv	Approval pending

Table 3: Status of Leases and Consents Required for the Development

Notice of approval from Departments of Lands for Stage 1 and 2 foreshore developments was issued in August 2006. Approval in principle for stage 3 was received from Lands Department in January 2007 and the issuing of a formal lease is pending.

2 Proposed development

2.1 Location

Vulani Island is state freehold located at the mouth of the delta of the Sabeto River approximately 9km due north of Nadi Town centre. Access to the site is off the Queen's Road.

2.2 Concept

The Vulani Island development aims to create an integrated resort community comprising several hotels, retail/commercial hub, marine/marina facilities, residential accommodation, international standard golf course and a range of other sporting and recreation facilities. In preparing the development concept a series of broad concept aims were identified to guide the design process. These broad aims can be summarised as follows:

- Maximise the strategic location of the site
- Ensure coastal and river processes are taken into consideration to ensure a safe, secure and sustainable development
- Provide for a variety of complimentary tourism uses and activities that utilise the features of the site
- Conserve and enhance the existing environment and natural resources to the extent practicable
- Provide for appropriate public access between the different areas of the development in particular including access to foreshore areas
- Ensure an appropriate building scale with subtle Fijian design themes and native landscaping throughout the development
- Provide a stimulus for local economy and employment opportunities throughout the staged development
- Provide local people with opportunities and skills within the construction and tourism industry
- Ensure any remaining cultural sites are not disturbed where possible and interpretation provided.

A conceptual outline for the project has been prepared and already submitted to DTCP as the project Master Plan. The current development concept for the project is shown in Figure 2. The development concept shows the key elements of the project and is a guide to the development of Vulani Island. The final mix of accommodation types, the number of hotels and the commercial area will vary over time in response to market preferences and knowledge gained in preceding stages of the development. The concept plan and the Master Plan are to ensure the overall integrity of the resort is not affected by changes in the development mix.

Figure 2: Vulani Island Resort – plus extra page

plus extra page ---

2.2.1 Access Road

Access from the Queen's Road will be a separated two lane road running through the centre of the site to the commercial/ retail centre located adjacent to the marina. The route of the access road will predominately follow the main access track that currently exists. The main access road will provide access to secondary roads that will provide access to all parts of the development. The access road will be a public road.

On the main access road there will be gatehouse. The gateway is designed to serve several purposes and these include:

- Establishing an arrival point for the island
- Controlling traffic and reinforcing the speed limits with on the island
- Providing a centralised location for security
- An information desk

The access road corridor and the gatehouse will be landscaped. The landscape design will help reinforce the sense of arrival to the island and reflect the overall qualities of the site.

2.2.2 Hotel Zone

The area designated for hotels is retained along the entire coastal strip and will potentially accommodate several distinct and separate establishments depending on hotel size. Grouping the hotels is considered appropriate in order to manage their more public nature and provides a highly desirable location and outlook set between the expanse of Nadi Bay and the proposed inland recreation lagoon. This hotel layout will enable tourists to select goods and services from variety of providers in close proximity. While Vulani Island Ltd has had discussions with interested hotel operators, no pre-conception exists as to the scale and height of structures sought by the industry. However, three storey structures would seem appropriate in the context of the site.

2.2.3 Recreation Lagoon

In developing tourist destinations it is important that they have a range of activities within and adjacent to the destination. In creating a tourist destination it is important to have points of difference from other destinations. To help differentiate Vulani Island from other destinations it is proposed that a 15ha salt water lagoon be constructed.

The existing natural coastal environment is not very attractive for swimming, particularly at low tide, in contrast the lagoon which will be maintained by an offshore source of fresh, clean salt water, will present an attractive natural looking amenity for use by hotel patrons, casual visitors and residents. It is intended to enhance the lagoon with quality landscaping and beach sands. With a high quality lagoon it is anticipated the adjoining hotels and residents will use the lagoon in preference to swimming pools.

2.2.4 Marina

It is intended to establish a 100 berth marina accessed off the Sabeto River. This facility will establish integrated boat haul out and servicing facilities in keeping with the scale of the marina. Town centre retail, associated car parking and tourist accommodation will also be integrated within the marina area. Current dredging permits have been issued to enable any channel works in the river to be undertaken.

2.2.5 Golf Course

An international standard golf course is an essential facility for Vulani. The Concept includes a golf course structured in a manner to attract a links label through its setting amongst fresh water lakes and salt water canals. The layout also establishes a high yield of golf course frontage residential allotments which will add value and desirability to the residential component, enabling sales and income to be generated in parallel with the expense of golf course construction.

2.2.6 Housing

Three types of residential development have been identified for the development; canal housing, golf course residential and town centre apartments. These three types of residential development reflect the current international demand.

Canal housing presents a very desirable form of residential development where boats can be moored at the edge of the property. Hopper has extensive experience in this form of development and recognizes the ability of canal housing to elevate the desirability and diversity of benefits to the project. Approximately 200 canal front residential allotments are to be created. Each of the canal allotment will have its own jetty.

Golf course housing also presents another desirable form of residential development. The location immediately to the golf course provides residents with open and expansive views across the golf course. Approximately 400 golf course residential lots are to be created. In addition there will be 50 over water bures and 150 duplex units.

The apartments in the town centre reflect the diversity of housing demand. The apartment in the town centre has the benefit of convenience in respect of location with access to facilities in the town centre and nearby hotels. The apartment also provides an opportunity for people to invest and possibly live on Vulani Island for a smaller investment than having a canal or golf course house.

It is envisaged that the owners of residential property on the island will be a combination of full time residents, occasional visitors and investors. As such many of the residential properties will be managed as holiday homes that will be available for rental when not required by the owners. This model is common in such tourist destinations as the Gold Coast or Noosa in Australia.

2.2.7 Town Centre

It is considered important that the island have a town centre where there is a mixture of retail and commercial activities. The town centre will be source of shopping and services for visitors and residents on the island. The town centre provides an opportunity for local businesses to be established and for the sale of locally sourced goods.

2.2.8 Public Access

Currently there is no public access to Vulani Island for recreational purposes. The access is limited to people fishing and crabbing. The development proposes to allow public access to the beach front. Access to the foreshore will be via defined corridors through the hotel zone. To allow for this public access public car parks will be located in the retail and marina areas. Public facilities for visitors will be integrated into the developments in these areas.

2.2.9 Mangrove Protection

Vulani Island Ltd is aware of the importance of mangroves in the ecology of the marine environment and for mitigating the impacts of flood flows in rivers. The proposed development requires the conversion of approximately 130 ha of mangroves. To offset the impact of this conversion the company is proposing to retain a minimum 15m buffer zone along the north bank of the Sabeto and south bank of the Natacola Rivers. In addition, the Company is attempting the protection of approximately 50 ha mangroves on the northern side of the Natacola River. The mangroves in this area are within the Qoliqoli of Vanua of Vuda. The company is currently seeking agreement with Vanua of Vuda for support to obtain a lease over the mangrove area. The lease would restrict the use of the area to traditional uses and prevent any further development.

Vulani Island Limited propose to prepare a number of management plans to assist in the protection and enhancement of the mangroves. A draft management plan focussing on the Silver Culture Management is attached in Appendix B. An additional plan focussing on management issues is currently being prepared.

A new resort and residential development is proposed for Naisosovu Island which is to the south of Vulani Island. The developer of this development is also proposing a protecting the mangroves on the southern bank of Sabeto River through a similar lease arrangement.

2.2.10 Control

To ensure that the development and operation of the Vulani Island undertaken in accordance with the aims of the Master Plan a Body Corporate will be established. The Body Corporate will be responsible for;

- Ensuring all sale and lease agreements bind the owners into the rules of the Body Corporate
- Identification of development and building criteria to ensure buildings and activities on the island are complimentary and meet environmental standards established for the island
- Provision of services such refuse collection, maintaining common areas.

Initially the management of the Body Corporate will be undertaken by Vulani Island Limited. At some future stage, the Body Corporate may be taken over by a specialist management company. The activities of the Body Corporate are funded by levies on owners and leaseholders on the island and by charging for specific services.

2.2.11 Staging

The development of Vulani Island will be undertaken in 3 stages as shown in Table 4.

Stage	Activities	Timing
Stage 1	Marina and retail centre 100 golf course residential sections 50 canal sections 50 Duplexs Two 300 bed hotels 0ne 50 bed hotel	Completed December 2009

Stage	Activities	Timing
Stage 2	9 hole golf course Golf club house 100 golf course residential sections 70 canal sections 50 Duplexs 50 over water bures Two 300 bed hotels 0ne 100 bed hotel	Completed December 2012
Stage 3a	Additional 9 golf holes Golf club house 100 golf course residential sections 80 canal sections 50 Duplexes One 300 bed hotels	Completed December 2015
Stage 3b	100 golf course residential sections 0ne 75 bed hotel	Completed December 2017

Table 4: Development Stages

2.3 Construction Activities

The project requires the development of a number of key components which can be divided into marine structures and activities, land based structures and services. The marine structures include:

- The excavation to form the marina and canal areas
- Excavation of a channel to open water in Nadi Bay with training groynes
- Formation of headlands to provide beach protection
- Construction of lagoon
- Dredging of sand to provide fill

The land-based structures and activities include:

- Removal of mangroves and reclaiming land
- Raising the ground level of the island to provide safe building platforms (cyclones, coastal erosion etc)
- Building construction

The services activities include:

- Water, electricity, and telecommunications;
- Wastewater treatment;
- Roading and stormwater management

2.4 Marine activities

As part of the preliminary design work for the marine structures and to assess potential environmental impacts, a Coastal Process Assessment has been undertaken. This section summarises the assessment in the proposed design and construction of marine structures. The assessment report can be found in Appendix C.

2.4.1 Marina and Channel

It is proposed to build a marina for both public and private use. The number of berths in the marina and the vessel mix will be developed to respond to market demands. At this stage it is envisaged that the marina will have approximately 100 berths. Access to the marina will be from the Sabeto River. To provide all tide access to the marina, a channel will need to be created in the lower reaches of the Sabeto River and at its mouth.

To provide all tide access for a range of boat sizes, including commercial cruise vessels, such as MV Reef Escape and S.S. Spirit of the Pacific, as well as large motor launches, super yachts and yachts, the channel will need the dimensions set out in Table 5.

Name/type	Length (m)	Beam (m)	Draft (m)
MV Reef Escape	68	13.5	1.8
S.S. Spirit of the Pacific	33.14	6.24	3.35
95% motor launch[1] (USA)	19.7	5.4	1.6
95% 20 m yacht (Australia)[2]	20	5.7	2.9
95% 25 m yacht (Australia)[2]	25	6.5	3.0

Table 5: Standard dimensions of vessels using marina/canal

1. PIANC (2000). Standards for the use of inland waterways by recreational craft
2. AS 3962 (2001). Guidelines for design of marinas

The minimum draft for the channel is based on AS3962 which recommends:

- Vessel draft at MLWS + 0.5 x (boat wake/wave height)+ 0.3 m under-keel clearance + siltation allowance

Taking the 95% 25m long vessel into account, the following draft was derived:

- MLWS	-0.775 m
- Draft (95% vessel)	-3.0 m
- Boat wake	-0.25 m (i.e. 0.5 x 0.5 m)
- Under keel clearance	-0.3 m
- Siltation allowance	-0.5 m
Total	***-4.825m***

The required draft is rounded to 5m below MSL, similar to the present access channel at Denarau.

This draft is needed for both the access channel and the main marina body where large vessels will be moored. However, a reduced draft will be used in the canal water way

area and areas of the marina mooring area where power boats are moored. In these areas a draft of 3.0 m below MSL will be used.

In regard to channel width AS3962 recommends a minimum width of the greatest of:

a) 20 m

b) Length + 2 m, where L is the overall length of the longest boat in the marina

c) 5B, where B is the beach of the broadest mono-hull boat.

The ultimate sizing of the entrance channel is also dependent on the exposure to wind, waves and current, the number of boats, boat size and navigational requirements.

The Coastal Processes assessment recommends a base channel width of 50m with side slopes of 8(H):1(V). This provides a Channel width at vessel draft of 66m at MLWS which is similar to the length of the largest vessel and greater than 5B.

Once within the river mouth and past the bend, the channel base width could be narrowed to 40m and side slopes steepened to 4:1 as vessel speed will be reduced and the channel is more sheltered from wave action. This reduced width is still greater than the preferred channel width of 6B.

The channel will be formed by conventional dredging craft, such as a cutter suction dredge. Up to 500,000m^3 of sand will be dredged. The dredged material will be pumped onto the beach areas for beach nourishment, with excess sand used for ground raising within the development site. Pumping requires the formation of sand slurry, typically with 80% water and 20% solids. Due to the high permeability of the sand in the delta it is likely to dewater quickly with minimal discolouration of the adjacent water. However, some localised plume will be present around the fringes of the dewatering sand slurry.

2.4.2 Protection Works

The proposed design includes of protection works to increase stability of the spit at the mouth of the Sabeto River and the foreshore in front of Vulani Island.

To maintain beach stability headland groynes are required at either side of the proposed development. The headland at the Sabeto River also acts as a training groyne for the dredged navigation channel and will require armouring along the southern and western flanks. The northern headland will also require armouring along the northern and western flanks.

A further six headlands are required to form a stable beach environment along the remainder of the shoreline. Four of these headlands will be in the form of reclamations that will be armoured on the seaward side and will have development (buildings and infrastructure) on the crest and will extend some 100m to 150m from the existing shoreline. The remaining structures will be lower level rocky reefs that will be overtopped during cyclonic events and be located 50 to 80 m from the existing shoreline.

Figure 3 shows the proposed typical arrangement along the coastline. The reclamation headlands are designed with an eight metre wide berm at 2.0 m RL. During normal conditions this will provide pedestrian access close to the high tide line and reduce the visual impact of a high wall. The berm also has a coastal protection function, reducing wave run-up and overtopping and also reducing the required armour size.

Rock armour, sized to withstand 2%AEP cyclone wave impacts will be placed on the seaward side of the reclamations and on the headland groynes.

Figure 3: [insert here]

Plus extra page

Beach sand, dredged from the access channel to the marina will be placed between the headlands to form a wide beach that will further assist wave energy dissipation. The crest of the beach will have a berm some 15 to 25m wide, falling from 2.0 m RL at the existing shoreline to 1.5m at the seaward side. The beach will then slope at 30:1 down to around the -1m contour. Up to 160,000m^3 of sand will be placed along the coastline.

Protection works are also required along the river channels and within the marina/canal water way system. From the headland at the entrance to the Sabeto River to the marina precinct this is likely to take the form of a solid structure, either tipped rock or a more vertical wall structure. A spur groyne could be considered at the entrance to provide an anchor for two fillet beaches. This would reduce the extent of visible rock walls.

To minimise the extent of protection works for the remaining area and for the Natacola, it is recommended that generally a 15m wide buffer be provided from the existing river channel and that the existing mangrove vegetation be maintained in this area.

The protection works along these areas would then comprise an armoured bund. Rock armour is likely to be required to face bund on the outer side of bends, but in other areas bio-engineering using, appropriately vegetated slopes combined with geo-fabrics may be suitable (see Figure 3).

Figure 4 shows the general arrangement of the protection works for indicative locations of rock armour and bio-engineering options for bund protection.

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Figure 4 – [insert here]

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2.4.3 Lagoon

The salt water lagoon stretches along the backshore of the main beach and will be up to 15 hectares. It is seen as a key feature of the proposed development and will provide for both recreational and visual amenity. The lagoon will typically be around 1.2m deep and will have a range of edge types varying from beach, rocky outcrops and formed seawalls. Depths will also vary, and include deeper areas (up 4m deep) for managing water temperature and providing habitat. The base of the lagoon will be lined with imported coral sands. Assuming a 0.3 m thickness of coral sands, some 45,000m^3 of coral sand will be required.

Filtered salt water will be provided to the lagoon using beach filtration systems. This will remove fine suspended silts present in the waters of Nadi Bay. The beach filtration systems take the form of a series of slotted pipes installed under the beach. The pipes slope to a buried collection well that gravity feeds to a pumping station that will discharge the clean filtered water to the lagoon. Two systems are anticipated at the northern and southern ends of the lagoon. The location of these intakes is shown in Figure 3. Similar beach drainage systems have been installed around the world. A potential benefit of these systems can be to enhance beach stability. However, at this location the primary purpose is to provide clean filtered seawater.

Based on the water quality analysis of sea water off Vulani Island it is apparent that there will still be levels of nutrients in the filtered water. The water in the lagoon will need to be managed to avoid the risk of algal growth within the lagoon that will affect water clarity and appearance of the lagoon floor. The water quality will be managed by a combination of flushing (i.e. water exchange) and biological filtration.

It is proposed to replace $^1/_3$ of the water volume within the lagoon every two weeks. This will require a constant inflow of 50 l/s, but in reality variable pumping is likely, so up to 200 l/s will be provided (i.e. 100 l/s at each intake). The replacement of $^1/_3$ of the water every two weeks is commonly applied to aquarium environments to maintain good water quality. Water will come in through the two intakes at the northern and southern end of the lagoon and discharge over weirs in the central lagoon area into the marina and canal system. This will provide flushing of these areas and potentially reduce siltation effects by the formation of a saline density current.

The inflow rate of freshwater may alter as a result of groundwater intrusion into the lagoon. Should this occur the inflow rate would need to be increased to maintain a saline environment.

Bio-filtration is the removal of undesirable elements using plants and aquatic species. This technology has developed significantly over the last few decades (Blundell, 2005) using live sand and rock, macro algae, micro crustaceans, coral and aquatic species. It is proposed to involve several experts in the development of a sustainable bio-filtration system that will utilise key native reef species to manage the water quality of the lagoon. This will also provide an area of interest for recreational users of the lagoon. The ultimate configuration of water exchange and bio-filtration technology will be a balance of effectiveness and cost.

Salt water swimming pools will be constructed adjacent to the lagoon, taking water from the lagoon. Any further treatment of the salt water pools will be by Ozone, rather than chemical treatment.

2.4.4 Dredging of Fill Material

Preliminary geotechnical investigations indicate that sand offshore of Vulani Island may have potential for use as fill material to reclaim mangrove areas on the island and raise the level of the island. Further investigations are required to confirm the extent of the sand resource and its physical characteristics.

Should the sand be found to be suitable for fill, then approximately 500,000 m^3 of sand will be dredged. The sand will be dredged using a conventional dredging craft, such as a cutter suction dredge. The dredged material will be pumped into the reclamation areas. The sand will be pumped on shore as slurry. The water from the slurry will be decanted off and passed through a series of settling ponds to allow any residual sediments to settle before being discharged to either the Sabeto or Natacola rivers.

2.5 Land Based Elements

There are two main land based activities to be undertaken the removal of mangroves to allow for reclamation to form the golf course and residential areas and the raising of ground level to provide for safe building platforms.

2.5.1 Mangrove removal

The development requires the removal of 130 ha of mangroves. The removal of mangroves will be undertaken in a staged fashion. A bund will be formed around the area of mangroves to be removed. The bund will be formed of fill material and compacted. The purpose of the bunds is to provide access and isolate the mangrove area from the adjoining river area so any sediment caused by mangrove removal is retained within removal area. Depending upon ground conditions it may be possible to dewater the mangrove removal area. If so the mangroves and associated subsoil will be removed in the "dry". Depending upon the size of the mangroves the timber where possible the timber will be recovered and utilised in the project. The smaller mangroves may be mulched to reduce handling problems. The mulched vegetation will be set aside and allowed to compost. The subsoil will be removed and set aside to dewater before being used as fill material. The subsoil will only be used as non structural fill.

In the canal and marina area excavation of the sediment beneath the mangrove will continue until the design depth is reached. In areas where the land is to be reclaimed the excavation will be to a depth as established by the geotechnical engineers. The depth will relate to identification of suitable surface upon which placement of fill can be undertaken.

2.5.2 Placement of Fill

The placement of fill is required to raise the level of the island above sea level to provide a greater factor of safety in the event of cyclones or flooding. The fill that will be utilised will be a combination of sand dredged off shore and land based sources. A number of potential land based sources have been located in the general vicinity. Potential sites include existing quarry operations in the Sabeto Valley and Vuda Back Road area and new sites within these general locations. The final determination of the source or sources of land derived fill material will be physical properties, cost and haulage distance.

The requirements for the placement of fill are determined by the end use of the land being filled. The filling of open spaces areas such as the golf course is to a less rigorous standard than areas which will have roads or buildings. Prior to filling commencing fill areas may require geotextile to be placed. The fill material will be placed in layers and compacted.

The level of compaction as noted earlier will be determined by end use requirements. It is possible that areas may be overfilled initial as an effective method of improving ground conditions in preparation for building. This method is known as preloading.

2.5.3 Ground levels

There is potential for flooding on Vulani Island primarily due to tropical storms and cyclonic events. Vulani's location at the mouth of a river system, means flooding from the catchment is a concern, and typically coastal flooding will combine with catchment flooding. The Coastal Process Assessment has identified suitable levels to minimise adverse impacts from flooding events.

Table 6 sets out proposed building levels and their associated use. It combines surge, wind and wave set up with high tide and sea level rise. These levels are anticipated to be suitable both for catchment flooding and sea inundation events.

Definition	Level (m w.r.t. MSL)	Designation
0.2% AEP surge + beach front setup + 0.2m SLR	3.9	Key infrastructure on open coast, within 20 m of MHWS.
1% AEP surge + beach front setup + 0.2 m SLR	3.4	Minimum building platform level, key infrastructure
0.2% AEP surge + beach front setup	3.7	
0.2% AEP surge + bay setup + 0.2 m SLR	3.3	
1% AEP surge + beach front setup	3.2	
1% AEP surge + bay setup + 0.2 m SLR	2.8	Minimum building platform, residential
0.2% AEP surge + bay setup	3.1	
1% AEP surge + bay setup	2.6	
0.2% AEP storm surge	2.50	
1% AEP storm surge	2.00	Minimum "dry" ground elevation
Highest Astronomic Tide	1.12	
MHWS	0.74	

Table 6: Proposed building platform levels

To achieve the desired ground levels, approximately 2,800,000 m^3 of fill material will be required.

2.5.4 Stormwater

The island surface is to be shaped so that storm water is directed to the Sabeto and Natocola Rivers, as well as the canals and the marina. There will be no pipes discharging stormwater across the foreshore, as the land falls away to the east of the island.

The stormwater system will be designed for a 1 in 50 year rainfall event and cyclonic events. The stormwater for normal rainfall events will utilise open channels and detention areas. For cyclonic events the topography of the site will be used to direct overland flow to the rivers and canals.

2.5.5 Building Construction

There will be a significant number of buildings constructed on site. The design of these building will be accordance with design guidelines identified by Vulani Island Limited. These guidelines will prompt environmental design standards in regard to resource usage and sustainable building materials. The building activities will be controlled by the Construction Environmental Management plan for building activities as outlined in Section 5. 5.

2.6 Services

2.6.1 Roading

The main access road on Vulani Island will be a two-lane separated bitumen road with asphalt surface, pedestrian kerbs and drainage. All road profiles on the island will be designed to the relevant National Road Codes (PWD sealed standards) or equivalent standard. The intersection with the Queens Road shall be designed by a suitably qualified traffic engineer and approved by PWD.

2.6.2 Energy

The proposed development will be connected to the Fiji Electricity Authority's existing overhead line that runs along the Queens Road. The reticulation of electricity around the island will be by underground cable. FEA have indicated that 33kV feeder line running along the Queen's Road which could be rerouted to the site via a 33/11kV transformer.

Back-up diesel generators will be installed on the island at the hotel sites. Bulk diesel fuel will be stored within the hotel site area. The fuel store will be bunded. The installation of the generators and fuel storage will comply with industry standards.

In addition to generating electricity, the developers will explore the use of Solar panels for water heating throughout the development including the residential lots and the proposed hotels, in the guest units and the kitchen-central complex as well as using heat recovery techniques to capture waste heat from the generators to provide pre-heat to hot water calorifiers at the laundry.

The development will also have a LPG gas supply installed for water heating. This will involve the laying of gas pipework including excavation and backfill. The installation will comply with all industry standards.

2.6.3 Water

The developers plan to install a delivery main from the Public Works Department's (PWD) main reservoir on the Vuda Back Road to Vulani Island. A 200mm diameter main has already been constructed to the entrance to Vulani Island. This will provide sufficient water for the initial development. The developer in consultation with PWD will upgrade the existing line as the project develops.

Once the island is fully developed, the developers are planning for an estimated water consumption of 4.8 megalitres per day. This is based on average water consumption figures for hotels on mainland Fiji of 2000 litres/room/day and a domestic consumption rate of 1000 litres/house/day.

Additional water for irrigation purposes may also be available on site from ground water sources. The occurrence of freshwater springs on the island has been identified. No

investigations have yet been undertaken to determine the viability of these springs as a water source, but this merits further investigation.

As part of the design requirements for the overall project Vulani Island Ltd will be requiring all developments on site to utilise best practice in respect of water usage such as low pressure water systems. In addition in the residential areas a requirement for water harvesting and storage may also be set as a development requirement.

2.6.4 Wastewater

At this stage a number of options are being considered for the treatment of waste water. The options are based around building a waste water treatment plant specifically for the development or utilising the PWD's Navakai Sewage Treatment Plant near Nadi.

The Navakai Sewerage Treatment Plant is currently operating at full capacity. It is scheduled to increase its capacity upgrade in the near future. The increased capacity is required to meet urban growth in the Nadi area and increased demand from a number of development projects. To utilise the Navakai Sewerage Treatment Plant a pressurised rising main would need to be constructed from Vulani Island to the outskirts of Nadi. The utilisation of the Navaki Plant is dependent upon the completion of the expansion works.

In the event that use of the Navaki plant is not feasible, Vulani Island Ltd will construct a waste water treatment plant on the leasehold land at the entrance to the island just off the Queens Road. The size of the plant is yet to be determined. The plant will be a modular unit so additional capacity can be added for later stages of the development. This also retains the flexibility for connecting to the Navaki plant at a later date.

Should a treatment plant be built by the developer, then the plant would need to be built to a standard that ensures tertiary treatment levels are achieved. In the absence of a Fijian water treatment standard, the standard would be required to meet a relevant Australian or New Zealand standard for waste water that is subject to reuse and potential human contact. The discharge from the plant would be either to ground as irrigation water or the Sabeto River.

During the construction phase, prior to the connection of the island to sewage treatment services, an initial septic tank sewage system will be established on the island to accommodate workers.

Vulani Island is considering the possibility of separating the grey water (showers, laundries etc) from black water (sewage). The reason for this is that the grey water with minimal treatment can be used for irrigation purposes. It also reduces the load the to the waste water treatment water which reduces capital costs and avoids paying for irrigation water. This approach is in line with the Developer's reuse and recycle philosophies.

2.6.5 Solid Waste

Management of solid waste generated by the development will embrace the following principles:

- Minimise the waste produced
- Maximise reuse and recycling
- Ensure safe storage, handling and use of hazardous or flammable materials and fuels

- Ensure effective and efficient disposal of waste; and
- Ongoing staff training in waste management.

Construction is a period when a considerable amount of waste is generated, which is often bulky and sometimes hazardous. Vulani Island Ltd. intends that all construction waste will be removed from the island on a regular basis as back loads on the vehicles bringing construction materials to the site. Non-recyclable waste will be sent to an approved landfill.

Once the operational phase commences, the Body Corporate that will be responsible for providing services to the residential subdivision on the island will be responsible for solid waste collection and disposal. The solid waste management activities will expand as the development progresses, for instance when the resort developments commence, waste management plans will be developed.

3 Existing Environment

The description of existing environment is divided into the following sections:

- Regional setting
- Physical environment
- Biological environment including terrestrial habitats and mangroves
- Marine environment
- Social setting
- Climate

3.1 Regional Setting

3.1.1 Location

Vulani Island is a series of islands in the Sabeto River delta. The sea frontage of the area is approximately 2km long. The islands appear to be less than 2m above sea level, with isolated mounds at about 3m.

3.1.2 Planning

The project complements the evolving national tourism policy and is in line with the 'Step Change' approach advocated by the Government's current tourism policy document 'Fiji: Tourism Development Plan 1998-2005'. It lies within the Plan's planning Zone A which is earmarked for the improvement and expansion of tourism areas and the provision of appropriate infrastructure.

3.1.3 Administration

Vulani Island lies within the Province of Ba. The Provincial Office and most administrative offices are located in Lautoka. Development planning and health issues are administered by the Nadi Rural Local Authority. The Authority does not currently raises rates and does not provide solid waste collection services.

3.1.4 Services

3.1.4.1 Access and Roading

Access to the development site is via a private road off the Queens Road just 500m east of the Sabeto River bridge. The access road is at a point where the Queens Road is two separated road way. The private road is unsealed and is approximately 3km long. The road provides access all the way to the foreshore.

3.1.4.2 Electricity Supply

The development site is not connected to the Fiji Electricity Authority national grid. A 11kV FEA power line does run along the Queens road at the entrance to the site. The Vuda substation the main substation for supplying the Lautoka/Nadi area is located about 10 km northeast of the site.

3.1.4.3 Telecommunication

There are no telecommunication services to the site. The landline phone network is available at Queens Road. The site has coverage within the Vodafone mobile network. Indications are the site will also be within the coverage area of any new mobile phone operators who wish to set up in Fiji.

3.1.4.4 Water Supply

The main water supply main from Vaturu Reservoir to Lautoka runs along the Queen's Road. In response to a request from an earlier developer of the site, PWD has laid a 200mm diameter water main to the entrance of the development.

3.1.4.5 Waste Management

There are currently no sewage treatment services available in the general Vulani Island area. The nearest sewage treatment plant is the Navakai Sewage Treatment Plant, located adjacent to the Nadi River to the southwest of Nadi town. In order to enable it to receive additional sewage, the Navakai Sewage Treatment Plant would need to be upgraded. Solid waste removal services are not provided to the general Vulani area. Residents are responsible for there own solid waste disposal. The nearest landfill is located near Lautoka.

3.2 Physical Environment

3.2.1 Topography

The proposed development site is located within the delta of the Sabeto and Natacola rivers which covers an area of approximately 255 hectares. The area comprises a combination of river channel, mangrove and mud flats and raised islands. Originally, there were over 20 raised islands that covered an area of approximately 50ha. The number of islands has decreased and land area increased as a result of previous development work on the island.

The island that forms the islands is generally low-lying being only 1 to 2 metres above sea level.

3.2.2 Geological

A detailed geotechnical investigation of the site is currently underway. In summary, Vulani Island is located in an area underlain by quaternary surficial deposits, sand, alluvium and colluvium. These materials being deposited at river deltas formed during previous variations in sea level.

Offshore sediments are typically clayey silts, sands and fine soft sediments. The beach and river delta areas comprise medium to fine terrestrially derived sands.

3.2.3 Coastal

The existing central and northern shoreline appears to be in an erosionary state. This is evidenced by vertical scarps and the presence of tree roots on the beach near the entrance to the Natacola. The southern beach area appears to have experienced recent deposition and is relatively stable. These factors, together with the small southerly trending spit at the entrance to the Sabeto and the offset channel suggest periodic transport to the south. It is likely that this is predominantly during tropical storms and cyclones, with ambient

conditions more likely to only have minor effects on longshore and cross-shore transport of sand.

The Sabeto River channel abuts Vulani Island and this may be a result of historic channel dredging. Again, most of the likely changes in the river will be as a result of cyclones or tropical storm activity.

The Natacola is a smaller, blind channel and is largely tidal. It is likely that this river mouth was once the main discharge from the catchment, but the discharge has moved to the south. It is likely that the cyclone bund protection works reduced fresh water supply to this outlet. The entrance to the Natacola is in a reasonably natural form, with a less well developed outlet channel.

3.2.4 Hydrology

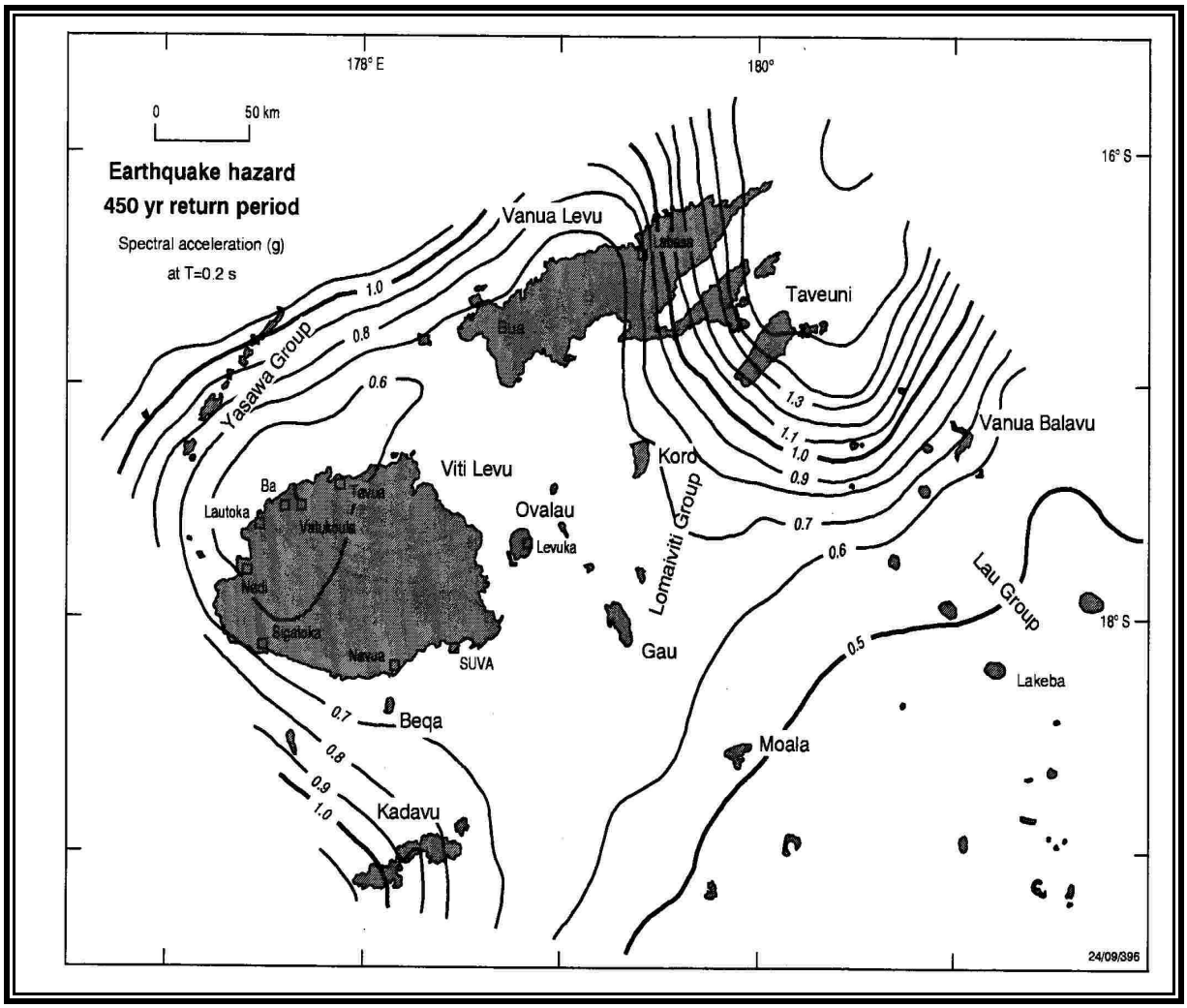
The Sabeto River and its catchment have been subject to considerable human modification over the past 100 years but particularly the last 30 years. Most of the natural bed of the lower and middle reaches of the river has been greatly modified due to the removal of sand and gravel, while in the upper reaches rock removal has been particularly damaging. As a result, the river's hydraulic characteristics have changed considerably, floods are likely to arrive much faster and there will be greater delivery of sediment. The lower and mid reaches of the catchment are through intensive agricultural uses – in particular sugar cane, tobacco and vegetables. As a result, the river in flood has high sediment loadings from channel erosion and runoff from adjoining land and nutrients from fertiliser.

The Sabeto River delta plays a key role in the hydrology of the Sabeto River, especially in regard to flood mitigation. The delta provides a large retention area for flood waters. The capacity of the delta area has already been significantly reduced by mangrove conversion. However, the ability for the delta to receive flood waters has been diminished by the construction of a bund along the Queens Road, the road rail bridges over the Sabeto River and the Lomolomo and Naisosovu seawalls. The seawalls were designed to prevent the landward migration of the sea during tropical cyclones. The combined effect of the seawall, bridges and bund is reduce the outflow of water which increases flooding upstream.

3.2.5 Seismicity

Fiji is within the seismically active Pacific Rim. The risk of earthquakes is relatively high by world standards. The activity is concentrated around the margins of the Fiji Platform, a relatively strong island arc fragment within weaker oceanic crust. The seismicity is associated with regional east-west extensional tectonics. Since the commencement of reliable recording of earthquakes began in 1918, potentially dangerous earthquakes with magnitudes greater than six have been recorded on average once in every three years. All of these earthquakes were located offshore (Everingham, 1986).

The earthquake hazard in Fiji is estimated to range from moderately low to very high. The earthquake hazard map for a 450 year return period is recommended as a basis for the National Building Code for Fiji regulations. As shown in Figure 5, the proposed Vulani Island development site lies in a low hazard zone of 0.6 spectral acceleration value contour. This means that proposed Vulani Island lies in a relatively seismically inactive part of the Fiji group.



Source: Jones (1998)

Figure 5 Seismicity Zonation for Fiji

3.3 Biological Setting Terrestrial and Mangrove

3.3.1 Habitat Changes

Prior to dredging and conversion work undertaken by previous recent owners of the site, Vulani comprised the core of the Sabeto River delta and the habitats consisted of extensive mangrove with small areas above the extreme high tide mark with a terrestrial vegetation. Former development works at the site have extended the terrestrial areas, especially the frontal beach levee and adjacent seaward areas and created larger tidal lagoons. The terrestrial areas have had some landscaping undertaken with the import of a variety of trees, though most of these have not survived.

3.3.2 Terrestrial Vegetation

Two terrestrial vegetation types can be distinguished:

- The coastal or beach levee; and,
- The islands within the mangrove

3.3.2.1 Coastal Beach Levee

This has been much modified by previous development works. However, trees, shrubs, grasses and vines, collectively making up a beach association, which extends along the two kilometre coastal strip between the Natacola and Sabeto River mouths in a belt that is up to 200-250 metres wide at its widest point. These merge with the mangrove associations to the east. There is an almost complete absence of the strand vegetation typical of island shorelines.

The sand-binding creepers, *Ipomoea brasiliensis* and *Canavalia maritima* are dominant on the edge of the beach. Other grasses and shrubs have also established themselves, and these include: *Cenchrus echinatus, Cyperus rotundus, Pennisetum polystachos, Thurea involuta, Lepturus repens, Scaevola taccada, Crotolaria mucronata, Wikstroemia,foetida, Vitex trifolia, Stachytarpheta, urticaefolia* and *Premna taitensis.* The woody, scrambling shrub, *Caesalpinia bonduca* is quite common. Vines which ascend some trees are: *Passiflora foetida, Ipomea tuba, Momordica charantia* and *Melothria ctrayana.*

There are small numbers of native trees on beach front including **Vutu** *Barringtonia asiatica*, **Tavola** *Terminalia catappa,* **Vau** *Hibiscus tiliaceus,* and **Vadra** *Pandanus tectorius, Tamarindus indica* and *Cocos nucifera.* Some Date Palm *Phoenix dactylifera* have colonised the site, this is an exotic palm now naturalised in only two or three populations Watling 2005.

3.3.2.2 Raised islands

Around 20 islands or levees, no more than 2-3 metres above sea level and varying in area constitute the Vulani `islands' of the Sabeto River delta. They have loam to sandy soils and some were once cultivated in sugar cane although they are now covered in grass, shrubs and secondary tree vegetation. The taller dominant trees of the raised areas are **Wiriwiri** *Gyrocarpus americanus*, and coconut though the commonest tree on the islands is the exotic Rain Tree *Paraserianthes saman*. In areas where houses once existed Tamarind *Tamarindus indica*, and Mango *Mangifera indica,* Lemon *Citrus lemon* and Mandarin *Citrus reticulata* and "saijan" drumstick *Moringa oleifera* are found. Occasional Uto *Artocarpus altilis,* Baka Ficus *obliqua* and Vesi *Intsia bijuga* are also present. Shorter trees present are Vaivai *Leucaena leucocephala*, Cevua *Vavaea amicorum,* Kura *Morinda citrifolia* and Dralakaka *Vitex trifolia.* The dominant grass of many raised areas was Guinea grass *Panicum maximum* , although "kambuta", knot grass *Paspalum distichum*, mission grass *Pennisetum polystachon*, airport grass *Chloris barbata,* and para grass *Brachiaria mutica* were also frequently encountered. Grassland herb species of plants dominating the area were *Cyperus lavanicus, Cyperus pilosus, Ludwiqia octovalvis* and sensitive plant *Mimosa pudica.*

At the edges of the raised islands the vegetation merges with the mangrove. In such areas the common vegetation consists of the fern *Acrostichum aureum,* large-leafed vine *Ipomoea tuba*, **sinu gaga** *Excoecaria aqallocha* and **duva** *Derris trifoliata.*

3.3.3 Character Trees

There are no character trees of note on the site.

3.3.4 Mangroves

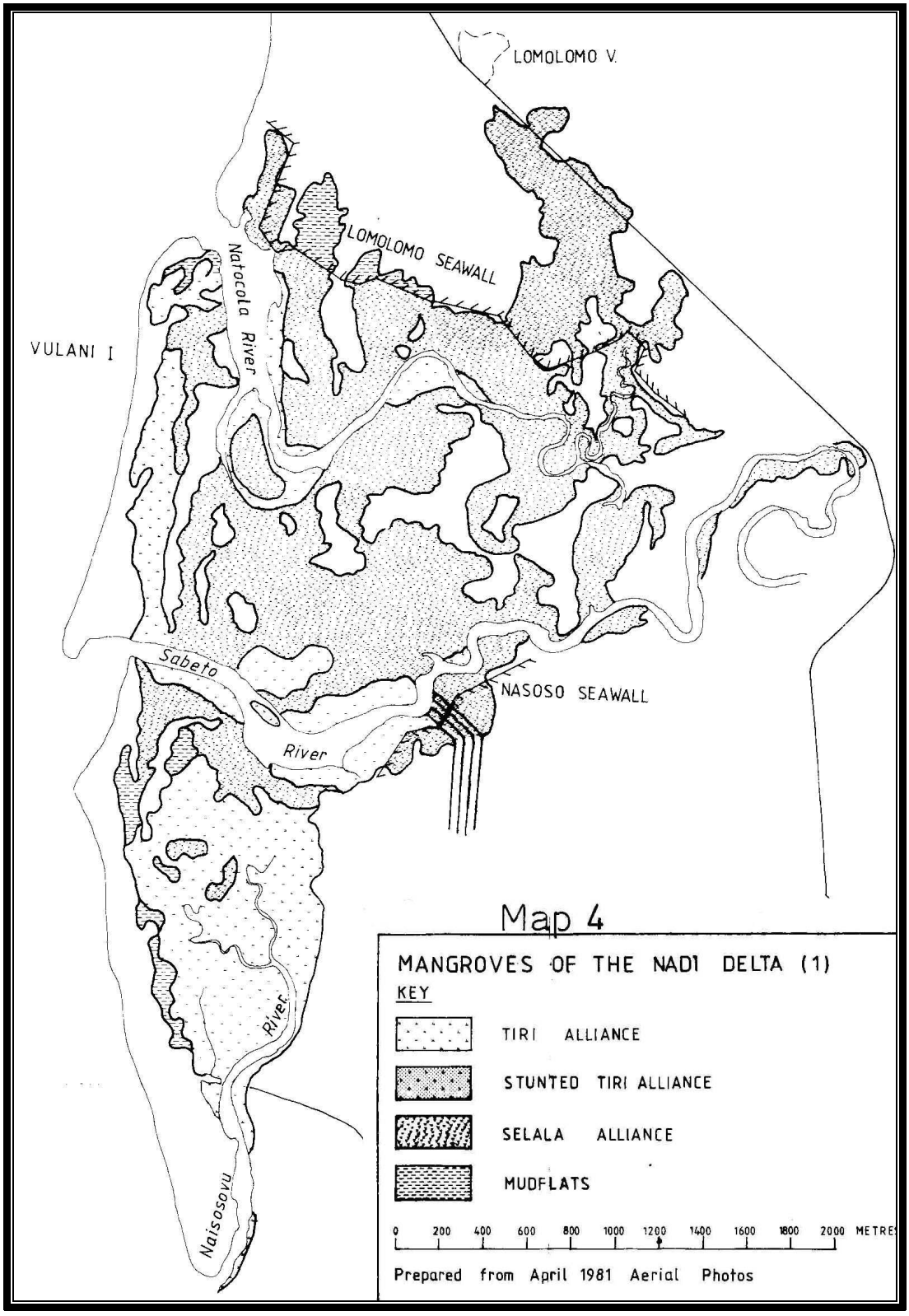
The Mangrove Plan for Fiji (MMPF) MMC (1986) divided the coastline of Viti Levu into 'Mangrove Locales' which are used for regional mangrove management. The Sabeto delta

lies within the Nadi Bay Locale which covers a 70 km stretch of coastline between Yako Village and Nacilau point.

The MMPF describes the mangroves of Nadi bay locale as being less vigorous than those of the south-eastern coast of Viti Levu and stunted areas of **Tiri** mangrove are extensive. This is a result of the marked and often severe dry season experienced by the area. Another consequence of the seasonal lack of rainfall is the formation of hyper-saline, barren mudflats in more elevated areas below at around MHWM.

Plate 1: Vigorous *Tiri* mangrove *Rhizophora samoensis* on the Bank of the Sabeto River

Two mangrove alliances have been identified in the Sabeto delta area (refer Plate 1). These are the Selala alliance dominated by *Rhizophora spp*. including the *Rhizophora x selala* hybrid, and the Tiri alliance dominated by *Rhizophora stylosa*. The Selala alliance is mainly found in the inland areas and is dominated by small trees of R.x selala, with a canopy varying from 3-4 metres but occasionally reaching figures 5 metres in height. There are also many mature trees of *R.x selala* reaching up to 15 metres. The Dogo mangrove, *Bruguiera gymnorrhiza* is also present. On the seaward side, now much disrupted by dredging and conversion activities, the mangrove was dominated by **Tiri** *R.stylosa*,, with a canopy from 2-3 metres, covering an area approximately 150 metres in length by 50 metres wide. A dense mangrove fringe of *R. samoensis*, approximately 15-20 metres wide at its widest portion and with a canopy height from 3-8 metres, extends along the Sabeto and Natacola River banks, especially in the more upstream areas. In the more exposed, seaward areas *R.stylosa* is more common. In certain areas along the river banks tall *R. x selala* trees tower above the lower *R. stylosa.* Other species present include **Dabi** *Xylocarpus granatum, Heritiera littoralis,* and the vine **Duva** *Derris trifoliata*. The mangrove distribution in the Sabeto River delta area is shown in Figure 6.



Source: Mangrove Management Plan for Fiji – Phase 2; 1987

Figure 6 Mangrove Alliances of the Sabeto River Delta

3.3.5 Wildlife

With one exception, no terrestrial wildlife species are restricted to mangroves in Fiji, and those species which do venture into them are generalist species of open habitats. The exception is the Mangrove Heron *Butorides striatus* which has been recorded at Vulani. The absence of any significant native terrestrial vegetation and habitats on the islands within the mangrove precludes the presence of any of Fiji's endemic or threatened species (ECF database). The birds noted on the fringes of Vulani and within the mangrove are listed in Table 7 and these comprise Viti Levu's common and generalist species. The absence of such habitats made further survey of reptiles and mammals unnecessary.

Of interest is the record of the Wandering Whistling Duck *(Dendrocygna arcuata)* which was collected at the mouth of the Sabeto River in June 1877 (Clunie 1983). It is the only Fijian bird which is definitely known to have become extinct in historical times. All four of the endemic species recorded are widespread Fijian birds and are in no way confined to or reliant on the habitat of the Vulani area.

The extensive offshore mudflats attract waders during the summer months. Golden Plover, **Dilio** *Pluvialis fulva* are the commonest, together with Wandering Tattler *Heteroscelus incanus* with Bar-tailed Godwits **Batibalavu** *Limosa lapponica* in smaller numbers. Black Duck **Ganiviti** *Anas superciliosa* are common. Crested Terns **Ico** *Sterna bergii* were the only seabirds noted during the survey.

		Residential Status	Origin	Endemicity	Migratory Status
LAND& FRESHWATER BIRDS					
Pacific Black Duck	*Anas superciliosa*	B	N		
Wandering Whistling-duck	*Dendrocygna arcuata*	X	N		
Reef Heron	*Egretta sacra*	B	N		
White-faced Heron	*Ardea novaehollandiae*	B	RA		
Mangrove Heron	*Butorides striatus*	B	N		
Fiji Goshawk	*Accipiter rufitorques*	B	N	E	
Swamp Harrier	*Circus approximans*	B	N		
White-throated Pigeon	*Columba vitiensis*	B	N		
Spotted Turtle-dove	*Streptopelia chinensis*	B	I		
Collared Lory	*Phigys solitarius*	B	N	E	
Barn Owl	*Tyto alba*	B	N		
White-rumped Swiftlet	*Aerodramus spodiopygia*	B	N		
White-collared Kingfisher	*Todiramphus chloris*	B	N		
Pacific Swallow	*Hirundo tahitica*	B	N		
Polynesian Triller	*Lalage maculosa*	B	N		
Red-vented Bulbul	*Pycnonotus cafer*	B	I		
Vanikoro Broadbill	*Myiagra vanikorensis*	B	N		
Silvereye	*Zosterops lateralis*	B	N		
Orange-breasted Myzomela	*Myzomela jugularis*	B	N	E	
Wattled Honeyeater	*Foulehaio carunculata*	B	N		
Red Avadavat	*Amandava amandava*	B	I		
Common Mynah	*Acridotheres tristis*	B	I		
Jungle Mynah	*Acridotheres fuscus*	B	I		
Fiji Woodswallow	*Artamus mentalis*	B	N	E	
SEABIRDS					
Crested Tern	*Sterna bergii*	B			
SHORE BIRDS					
Pacific Golden Plover	*Pluvialis fulva*	OW			A-NM
Bar-tailed Godwit	*Limosa lapponica*				A-NM
Wandering Tattler	*Heteroscelus incanus*	OW			A-NM
Ruddy Turnstone	*Arenaria interpres*	OW			A-NM

KEY:			
Residential Status:	B - breeds	**Endemicity:**	E - Fiji endemic
	V - vagrant		
	X - extinct	**Migratory Status:**	A-NM - annual migrant (northern)
	OW – migrant - small numbers over-winter		
Origin:	N - native	I - introduced	RA – Recent arrival

Table 7 Birds Observed in and adjacent to the Vulani Site

(Source: ECF Database; Details follow Watling, 2001)

3.3.6 Conservation Significance of the Flora and Fauna of Vulani

Vulani supports no terrestrial habitats or fauna of conservation significance. The vegetation present is comprised almost entirely of exotic, secondary or invasive species, degraded by cultivation, frequent fires and much of it prone to occasional inundation. Such habitats do not support endemic terrestrial Fijian fauna. The offshore sand flats provide extensive feeding areas for waders and the native Black Duck.

The mangroves of Vulani are significant. They are extensive, are in a good state of ecological health and comprise one of the last major areas of mangrove in the Nadi and Sabeto River deltas not subject to extensive conversion. The vegetation and wildlife surveys of Raj and Seeto 1984 and Watling in 1986 (for the Cobweb EIA (BFP 1990)), and this study have not revealed any unique habitats, vegetation communities, or plant or wildlife species of conservation significance.

3.4 Marine Environment

As part of the EIA process an assessment of marine resources was undertaken over a five day period between 16 and 20 October 2006. The results of the assessment can be found in the "Assessment of Marine Resources for proposed developments at Vulani Island" in Appendix D. The main findings of the assessment are as follows.

"*The estuaries and mangroves of the rivers in the Nadi Bay provide important feeding grounds for large invertebrates and juvenile deep sea fish. Uncontrolled mangrove clearance in the past has resulted in severe reduction of mature mangrove environments across Viti Levu, which is expected to have a long term, permanent, detrimental effect on marine life. As a result any remaining intact mangrove forest has an ever increasing conservation value.*

Previous studies have declared the Vulani Island mangroves to be of conservation significance and recommended that extensive clearing should not take place. Any development in such areas needs to be designed with a balance between development and preservation of adequate and mud environments.

It is possible to manage and landscape mangroves to preserve root systems while trimming foliage to open up views and access routes, and restrict clearances to inner, drier mangrove forests which have less value as marine habitats.

If development of this area is approved, preservation of a wide fringe of mangroves along the river banks is strongly recommended, as is the incorporation of areas of deeper mangrove forest into landscape design wherever possible. An active mangrove management plan including a nursery for all species found naturally, used for active replanting and landscaping is also recommended.

In the foreshore area, the most significant habitat is that of seagrass and invertebrate beds, in particular those found 20 to 300 metres from shore, from the centre of the northern end of the island. Disturbances in this area should be minimised. Further out to sea, and to the south of the island closer to the Sabeto River mouth, the sea bed appears to have no or sparser seagrass and invertebrate beds and is less likely to be adversely affected by disturbances.

The area is already sedimented, and there is no coral reef in the immediate vicinity of the development. The most turbid water is found closest to the Sabeto River estuary and within 1 km of the shoreline. The water is slightly less turbid from the centre of the island, north to the Natocola delta, and more than 1km from shore.

Juvenile sharks and fish which are known to rely on brackish river estuaries for breeding and feeding grounds, inhabit the turbid waters offshore, suggesting that this is a pupping ground for sharks and a feeding ground for many fish species when juveniles.

No bird life of especial significance was seen during the survey period.

3.5 Social Setting

3.5.1 Tenure

The freeholding of Vulani Island has been reported by Qalo 1990 as follows:

On 20 December 1820, when Ratu Nabukatavatava chief of the Kai Sabeto and 5 elders sold the land known as Na Vulani . The land was described as the enclosed by "on the Nadi side the river Na Buninui, on the Vuda side of the river Na Togoloa and on the other side by the sea at low water mark". The land was sold to Mathew Smith and one other.

The land formed part of the property of the Nalewewavu, an inferior division of the chief's tribe. *The sale was accompanied by a declaration on the title that the vendors had "good right full power and lawful and absolute authority to direct grant and convey said premises to the use and in the manner aforesaid.." and acknowledgements of payments made and received are well documented*

In 1879 a Royal Commission to investigate the legitimacy of land sold by native Fijians to Europeans before was Fiji ceded to the British on 10th October 1874.Before the commission Ratu Na Bukatavatava confirmed the legitimacy of the sale, a crown grant was given to for the land issued to Mathew Smith. Several years later the government advertised for Mathew Smith or any relative to come forward to claim the land. No one come forward to claim the land and in 1883 the Government claimed the land, and the title was granted to the Crown. Since then the land has become state leasehold.

A lease for a 99 year period over 125 acres of land has been granted by the government to Vulani Island limited. This lease expires in 2105.

3.5.2 Archaeological/Cultural

An archaeological investigation of the site was commissioned by Vulani Island Ltd as part of the EIA process. The investigation was undertaken in September and October 2006. The investigation was undertaken by staff of the Fiji Museum. The Museum staff undertook a general reconnaissance of the site. In addition an interview was held with Rt. Apisalome Savu, who is the Liuliu ni Yavusa for the people of Narokorokoyawa, which enabled the team to identify archaeological sites. The Archaeological report is attached as Appendix E.

During the field visit, the team was able to inspect eight sites that ancestrally belonged to the people of Narokorokoyawa. Six of these sites have been disturbed and are beneath the reclamation that was carried out by J. S. Hill while the remaining two are in the form of lakes that still exists today. A ninth site was identified but not inspected.

The field survey found pieces of pottery found scattered along the beach and also in the mangroves. There was a single piece of pottery found in the mangroves which has a design on it and according to most researchers; it would be considered as a carved paddle relief/heavily incised appliqué ware dating to be between 100BC and 1500AD.

The recommendations of the archaeological survey were as follows:

- *The two sites identified and are still of existence are the two lakes both of which hold fresh water. Should development continue, further work should be undertaken on determining the practicality of protecting these sites and providing an interpretation of the importance of the sites. These sites are important as they are the only cultural evidence and history that is left of the people of Vulani. This lake of freshwater is very significant since it is being surrounded by salt or sea water. This lake is what has been supporting the needs of the people in terms of cooking and life sustaining.*

- *Narewa site is located in the mangroves and according to the villagers has remained untouched. The existence and condition of this site should be confirmed. If the site still exists further work should be undertaken on determining the practicality of protecting the sites and providing an interpretation of the importance of the site.*

3.5.3 Current use

The land that forms the Island lies fallow and no cropping is undertaken. Nobody currently lives on the Island. The area is actively maintained by people from Sabeto Village employed by Vulani Island Limited.

Fishermen were observed fishing at the mouth of the Sabeto and also netting in the shallows off the beach. In addition the channels with in the mangroves are fished by women of the Sabeto Village and the mud flats used for gathering crabs.

3.5.4 Neighbours

To the west of the island is Nadi Bay. To the north on the opposite side of the Natacola River is an area of mangroves, which are the Qoloqoli of the Vanua of Vuda. Behind these mangroves is a number of sea walls that protect sugar cane growing areas. To the east are cane fields some of which are being converted for industrial and commercial activities. To the south is Naisosovu Island a similar area to Vulani Island, which is currently being proposed for a tourist and residential development. Along the southern bank of the Sabeto river is an area of mangroves which are the Qoloqoli of the Yavusa Ua from Saunaka Village. This development proposal for Naisosovu Island includes the protection of the area of mangroves along the southern side of the Sabeto River.

3.5.5 Fishing Rights

It appears that the Traditional Fishing Rights (TRF) for the area offshore of Vulani Island and the mangroves between the north bank of Sabeto River and the south bank of the Natacola River are registered with the Vanua of Sabeto. The fishing rights for the mangroves on the southern bank of the Sabeto River are registered with the Yavusa Ua which is a chiefly clan that resides in Saunaka Village. The fishing rights for mangroves on the north bank of Natacola River are registered with the Vanua of Vuda whose chiefly clan resides at Viseisei village. A copy of a plan showing the fishing right areas can be found in Appendix F.

3.5.6 Adjacent Tourism Development

Vulani Island is located on one of Fiji's most developed coasts, being close to Nadi town, the Coral Coast and the Mamanuca Islands, which are the focus of the largest tourism

developments in the country. The development would share Nadi Bay with a few other key developments, these include:

- Wailoaloa tourism area which provides a range of backpacker accommodation;
- Fantasy Island Development – a mid-sized mix of residential and tourism development;
- Denarau Island which supports a major resort complex with a marina, golf course, several hotel and apartment complex;
- Proposed Naisosovu Island development of two hotels and residential subdivision;
- Vuda Point tourist developments which include the First Landing, Anchorage and Vuda Marina.

3.6 Climate

The available meteorological data with the most relevance to Vulani Island comes from Nadi Airport which has the most comprehensive climate data for Fiji. The Nadi Airport meteorological station is situated approximately 1 kilometre from the coast at 16 metres above sea level, and lies approximately 5 kilometres south of Vulani Island. As such, it provides a data record that can be applied with confidence to the project site.

The climate of Vulani Island is typical of the dry seasonal climate of the western leeward side of Viti Levu. The southeast trade winds are a dominant feature, occurring all year round. The winds in general are light to moderate; but may on occasions become stronger for brief spells during the May to October period.

3.6.1 Rainfall

Rainfall is variable but with a distinct "wet" and "dry" seasons. The "wet" season occurs approximately between November and May and the "dry" between May and October. Average monthly rainfall for the "wet" season will be around 239 mm compared to 72 mm in the "dry" season (refer Table 8).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total Annual
Average	312	290	346	176	88	66	49	62	75	91	129	180	1864
Highest recorded	981	788	918	580	332	266	190	286	279	342	461	562	
Lowest recorded	13	46	76	22	1	0	0	0	0	2	4	22	
Highest 1 Day	356	340	301	190	141	120	122	170	125	269	119	271	

Source: FMS 2004

Table 8 Annual Rainfall (mm) Nadi Airport (1942-2003)

3.6.2 Potential Evapotranspiration

Average monthly potential evapotranspiration figures for Nadi Airport are given in Table 9. The annual average is 2198 mm/day. When this annual average is subtracted from the annual rainfall, a net water deficit of -334 mm/year is revealed. The deficit occurs in the nine month period from April through to December. The deficit ranges between an average of 40 and 127 mm/month.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
Mean Mthly	206	181	179	152	166	136	156	174	192	218	216	222	2198
Max daily	22.4	24.6	20.6	23.6	19	12.2	21.6	24.1	18.8	16.3	22.1	20.3	

Source: FMS. 2004

Table 9 Average Monthly Potential Evapotranspiration (mm), Nadi Airport

3.6.3 Temperature

Air temperature is relatively constant throughout the year according to the Nadi Airport records (Table 10). Mean daily temperatures range from 23.5°C in July to 27.2°C in January/February, with daily variation least during the wet season (November to April), and largest during the drier months (May to October).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Mean
Mean Daily Max	31.5	31.4	31.1	30.7	29.7	29.0	28.5	28.7	29.3	30.1	30.8	31.3	30.2
Mean Daily Min	22.8	22.8	22.7	21.9	20.3	19.3	18.5	18.6	19.5	20.5	21.5	22.3	20.9
Mean Daily Range	8.7	8.6	8.4	8.8	9.4	9.7	10.0	10.1	9.8	9.6	9.3	9.0	9.3
Mean Daily Mean	27.2	27.2	26.9	26.3	25.0	24.2	23.5	23.7	24.4	25.3	26.2	26.8	25.6
Highest Recorded	37.0	35.4	35.5	34.3	33.9	33.5	34.1	34.4	34.6	35.1	35.9	37.1	
Lowest Recorded	16.2	18.3	17.7	16.2	13.2	12.8	11.7	11.3	12.4	14.4	15.1	17.2	

Source: FMS. 2004

Table 10 Average Monthly Air Temperature (°C) Nadi Airport (1942-2003)

3.6.4 Wind

Wind speeds throughout Fiji are typical of the tropics with only small variation throughout the year. The average wind speed is slightly stronger during the dry season (May to October) (Table 11). This is because the South Pacific Convergence Zone is further north during this time which causes stronger south-east trade winds in the latitudes of Fiji. The wind speeds tend to be highest in the early afternoon when the land/sea temperature contrast is greatest and lowest during the night when the contrast is

at its lowest. Figure 7 shows that winds from the south and east dominate the wind regime at Nadi Airport. These winds occur around 47% of the time, and are almost always less than 18 knots in velocity. Winds from the southwest, west and northwest sectors occur around 22% of the time, most frequently during the afternoon. Wind speeds from these directions are less than 18 knots for 99% of the time, and between 3 and 10 knots 67% of the time. Calms occur about 23% of the time, most frequently at night.

At Nadi Airport, an anemograph has been recording wind speeds regularly since 1946. Average monthly wind speeds are shown in Table 11. Using the Nadi Airport wind data, a series of annual maximum gusts have been estimated by the Gumbel Method for different return periods (Table 12). For a 100-year return period, the extreme wind gust is predicted to be 131 knots. This means that in any given year there is a 1% chance of a 131 knot wind occurring. However, since the data record used for these estimates was only 39 years long (1946-1985), the estimates for the longer return periods are not very reliable. In addition, rare, very high gusts may have occurred during hurricanes in areas where the anemograph was not located. It is believed the rarest most intense hurricane gusts may approach 150 knots.

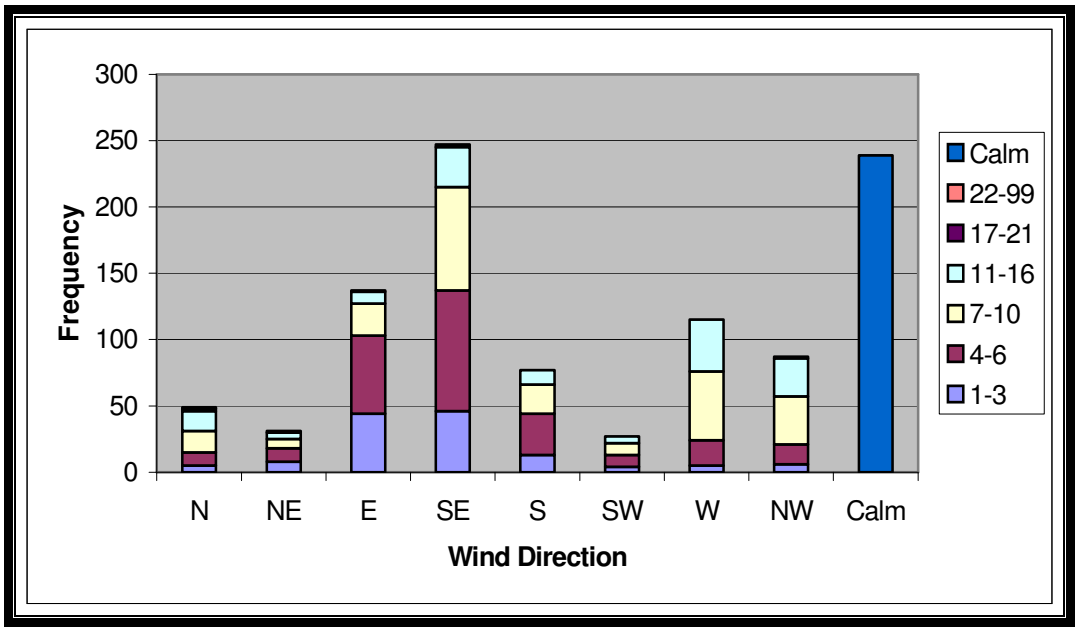
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year
5.5	5.1	5.0	4.6	5.2	5.2	5.5	6.0	6.1	6.6	5.8	5.5	5.6

Source FMS: 2004

Table 11 Average Wind speed at Nadi Airport (1962-2003)

	Return Period (years)					
Gust Speed	2	5	10	20	50	100
Knots	52	73	87	100	118	131
(m/s)	27	38	45	51	61	67

Table 12 Estimated Extreme Wind Gusts at Nadi Airport Source: FMS 1985



Source: FMS 1989a

Figure 7 Wind Direction Frequencies for Nadi Airport 1973-84

3.6.5 Tropical Cyclones

A tropical cyclone is a relatively small, intense and often violent depression which forms over warm tropical seas. It is most often accompanied by hurricane conditions with destructive winds and torrential rains. Tropical cyclones have a higher acceleration as the air spirals in than other types of cyclones (FMS 1984). Hurricane force winds (greater than 64 knots) are common and winds may gust to 150 knots in extreme cases. In addition to high winds and torrential rains, most cyclones in Fiji are also accompanied by storm surge. These phenomena and their effects are discussed in more detail in the next section.

In the 63-year period between 1940-2003, 90 cyclones have passed across Fiji. Fourteen of these cyclones have been classed as severe by the Fiji Meteorological Service (FMS 1982, 2003). In most parts of Fiji, individual localities experience the nearby passage of a tropical cyclone (within 70 km) two to three times a decade. However, not all will have destructive intensity at the time they pass, hence individual localities are likely to be exposed to moderate to severe damage about once every 1-2 decades. Figure 8 shows the track of hurricanes over Fiji in the two decades to 1997.

3.6.6 Wind Damage

Wind damage is proportionate to the speed, gustiness and duration of a wind. The pressure (force per unit area) on a flat surface facing the wind is proportional to the square of the wind speed. This means a 100 knot wind may exert up to four times as much pressure as a 50 knot wind. In addition to the pressure exerted by the wind, there is a partial vacuum on the leeward side of the obstacle facing the wind which gives rise to an outward suction effect. The wind pressure and suction effect therefore act in the same direction.

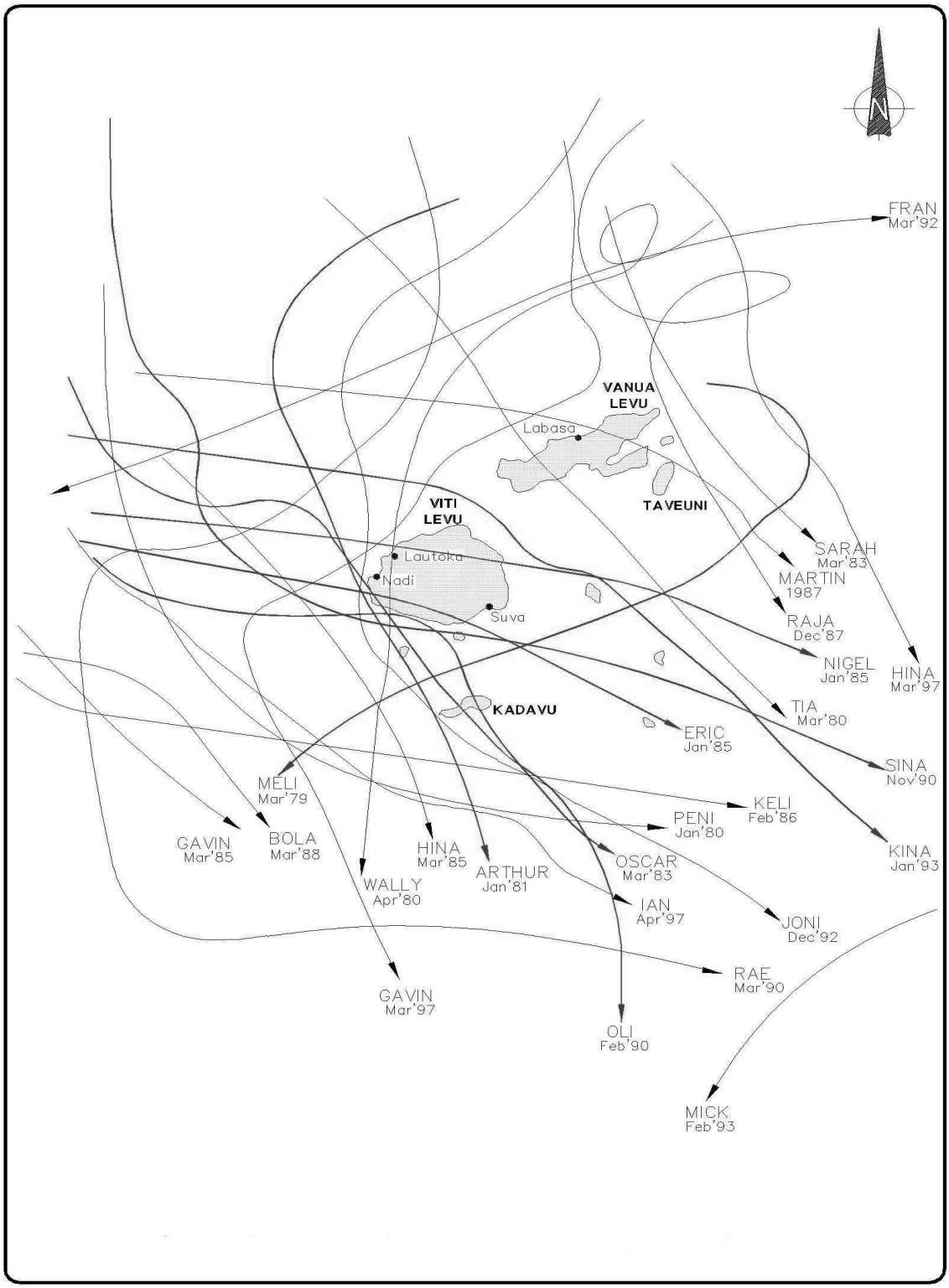


Figure 8 Cyclone paths 1977 to 1997

The duration of hurricane force winds associated with a cyclone will depend on the size of the cyclone and the rate at which it moves. In extreme cases where a cyclone actually stops moving, hurricane force winds could last for one to two days (FMS 1984).

3.6.7 Flood Damage

Tropical cyclones are almost always associated with torrential rain. If a cyclone is fast-moving flooding may not be serious. If the cyclone is slow-moving (10 knots or less) the associated prolonged, high-intensity rainfall can lead to severe flooding. Flooding can be aggravated by a number of factors associated with tropical cycles such as: storm surges, high tides and wind direction. In the rare case of a slow-moving cyclone being centred in a location that directs storm or hurricane-force winds up the mouth of a river, flooding in the area can be severely aggravated due to the winds blocking the seaward flow of floodwater.

3.6.8 Storm Surge

Storm surge is a temporary rise in the level of the sea, other than that caused by astronomical tides, that sometimes results in the flooding of coastal areas. There are three main factors that cause storm surge. The first is the very low atmospheric pressure of a cyclone which causes the water level to rise approximately 10 mm above mean sea level for every millibar of pressure drop below standard atmospheric pressure. The rise in sea level due to pressure drop and wind set-up reaches its maximum at 10 to 25 kilometres to the left of the track of the cyclone as it passes. The surge may take an hour to reach its peak and an hour to subside. The second factor that causes storm surge is the piling-up of water against a coast, driven by the hurricane-force winds that circulate the cyclone centre (wind set-up). The third contributing factor is the movement of water towards the coast as a result of breaking waves (wave set-up).

The cyclone-related sea level rise that causes storm surges may in itself cause flooding of coastal areas and delta regions. At high tide, the rise in sea level is likely to submerge any reefs which normally protect coastal areas from waves. Huge waves produced by the cyclone's violent winds may then sweep ashore unhindered and cause damage to heights far above those reached by storm surf alone. Local factors that influence the scale of the surge include the topography of the sea bottom and the shape of the coastline and channels. Factors that favour a high storm surge include: a long coastline; a gradually sloping ocean floor; and rapid movement of the cyclone directly towards the coast. Bays and inlets along the coast are particularly vulnerable.

Historical data on storm surges in Fiji are not very reliable. The recorded extremes experienced during the last two decades are in the order of 3-4 metres. Estimates of storm surge heights associated with tropical cyclones since 1972 are presented in Table 13.

EVENT	ESTIMATED STORM - SURGE HEIGHTS	LOCATION
23-25 Oct 1972 Bebe	*	NW Viti Levu
1979 Meli	2-3 metres	Nayau/Southern Viti Levu
31 Jan-2 Feb 1975 Val	*	
5-6 April 1975 Betty	2 metres	Viwa /SW Coastal Viti Levu
28-30 Dec 1978 Fay	*	Lau Group
24 Mar 1980 Tia	*	Savusavu, Vanua Levu
4 Feb-2 Mar 1983 Oscar	3-4 metres	Nadi Bay, Momi, Beqa
14-19 Jan 1985 Eric	2-3 metres	Lautoka/Vuda
14-12 Jan 1985 Nigel	2 metres	Viwa Island/ NW Viti Levu
10-18 March 1985 Hina	1 metre	Southwest Viti Levu
22 –31 Dec 1987 Raja	*	Most of Vanua Levu, Lau Group
25 Feb– 3 Mar 2001 Paula	2 – 3 metres	Southwest Viti Levu, Kadavu, Southern Lau
12 – 15 Jan 2003 Ami	*	North Vanua Levu

Source: Krishna 1989, FMS 2003, Mc Gree *in lit*. (* - No estimates available but surge known to have occurred)

Table 13 Estimates of Storm Surge Heights since 1972

3.6.9 Tsunami

Eleven tsunamis have been recorded in the Fiji group since 1877, three of which were generated within Fiji waters. In the Suva area, three out of the total eleven produced waves of significant heights, these heights rose to: 2m in 1877 and 1.8m in both 1881 and 1953. There are no tsunami height data for western Viti Levu.

The most damaging tsunami in Fiji followed the 1953 Suva earthquake which had its epicenter located in the Kadavu Passage near Beqa Island. The height of this tsunami was approximately 2m in Suva and close to 5m at Nakasaleka on Kadavu Island. There were fatalities in both locations. Considerable reef damage was also reported as a result of the tsunami (Wells 1988). This tsunami would have had a more severe effect had it occurred at high tide.

3.6.10 Sea Level Rise

Although the debate about climate change continues, there is widespread scientific acceptance that climate change will cause an alteration in sea level. The widely accepted view by scientists is that a sea level rise of 1m by 2100 should be anticipated. There is evidence available to show changes in mean sea level around Fiji, as well as changes in mean air and sea temperatures. The coastal process assessment (Appendix C) recommends an allowance for sea level rise due to Greenhouse/Global Warming effects of 100-200 mm.

3.6.11 Climatic Implications for Vulani Island

Vulani Island has distinct climate-related opportunities and constraints in respect of development. In summary these are:

Opportunities:

- High sunshine hours
- Seasonal rainfall
- Trade winds provide cross breezes.

Constraints:

- Evapo-transpiration deficit for most of the year
- Exposed to prevailing cyclone tracks
- Exposed to fluctuations in water levels due to hydrological processes
- Exposed to tsunami and storm surge.

4 Consultation

A community consultation was undertaken of the proposed development. This section summarises the parties consulted with and the issues they raised in respect of the proposed development. The full Community Consultation report can be found in Appendix F.

4.1 Parties Consulted

The parties consulted were as follows:

- Apisalome Savu /Kolinio Naulago
- Sabeto, Yavusa Leweiwavuwavu
- Ba Provincial Council
- Veiseisei Resource Committee
- Asst. Roko Nadi, Mr Vuniani Dawai
- Resident along the Queen's highway
- Native Land & Fishery Commission
- Sabeto Village
- Lomolomo Village
- Saunaka Village
- Viseisei Village

4.2 Issues

The consultation process identified issues of direct relevance to the Environment Impact Assessment. Some of the issues are outside the scope of the study, but are relevant to the traditional owners of the island. The issues of relevance can be divided into positive and negative.

The positive issues being:

- Monetary benefit through the Goodwill payment.
- Monetary benefit through lease and compensation.
- Potential for Employment.
- Education benefit through scholarship.
- Potential for business venture.

The negative issues being:

- Loss of land.
- Loss of Fishing Right.
- Loss of Marine resources.
- Pollution of Fishing ground due to waste water runoff.

Issues that should be considered are:

- Sewage treatment plant to be provided.
- Solid waste dump to be provided.
- Incinerator to be provided.

The conclusions of the social impact report were as follows;

- The traditional landowners (Yavusa Leweiwavuwavu) support the development. They have put forward issues and concerns that they hope could be considered by the developer and the government.
- The meeting in Lomolomo Village clearly identified the women of Lomolomo are the main users of the qoliqoli. They do not want the mangrove destroyed. The mangrove is a source of income and food to them.
- The residents interview identified 10 household do not use the mangrove, while 9 use it as source of income and food. The residents see this proposed development as a possibility to better their standard of living, through employment, small business opportunity.
- Taukei Naua, the Turaga of Saunaka want to be compensated for damages caused to their Qoliqoli through the Vulani development.
- It was indicated by the Chairman of the Vanua of Vuda resource committee, Mr Viliame Nato that the Vanua could agree to the proposed development if their qoliqoli area (mangrove) becomes a reserve and if it can earn money for the owners.

5 Assessment of Environmental Impact Assessment & Mitigation Measures

The community consultation, the terms of reference prepared by DoEnv and the environmental impact assessment process have identified matters that need to be considered in terms of potential environmental effects arising from the project and the opportunities to avoid, remedy, or mitigate the adverse effects.

The potential effects can be both positive and negative. This section considers effects in regard to the following:

- Construction on the land and in the marine environment
- Operation of the development in the land and marine environment
- Coastal processes
- Hydrology/hydraulics
- Waste water treatment
- Solid waste management
- Removal of mangroves
- Extreme weather
- Access to the development site
- Off site impacts
- Hazardous substances.
- Public Access

The development of environmental management plans for the construction and operation phases of the development are discussed at the end of this section. In addition, Section 5.3 outlines the positive economic effects that are likely to result from the development.

5.1 Construction Effects

5.1.1 Marine-based Construction Effects

Marine-based construction activities on site have the potential to cause adverse effects. Table 14 identifies the potential adverse effects and how these may be mitigated. The potential effects from these construction activities are:

- The discharge of sediment to the marine environment
- Loss of marine habitat
- Deterioration in water quality;

The potential for the generation of sediment comes from two sources; the first is the excavation of the marina and access channel, excavation of fill material and construction of headlands. The second is the runoff from the placement of excavated material on land. The excavation of the fill material and access channel has the greatest potential to produce sediment as this is the greatest area of excavation. The amount of sediment generated is

influenced by the excavation technique. Generally a suction dredge produces the least sediment as the sediment is caught in the water which is used to transport the sediment. Excavation by hydraulic excavator or drag lines produces more sediment, particularly if working in deep water, but this depends on the material being excavated. The information available on the material to be excavated suggests that a significant amount of fine material will be encountered. To reduce the potential for the movement of sediment from the excavation area to the surrounding environment the following actions can be taken:

- Minimising excavation work when the tide is out-going;
- Undertaking excavation work at low tide or on the first half of a flood tide;
- Using silt curtain to retain sediment within the work area;
- Constructing connections to deep water only at the end of the excavation process.

To minimise the discharge of sediment from areas were the excavated material has been placed the runoff will require treatment to settle out sediment before being discharged back to the sea. The required scale of treatment is dependent upon the excavation technique used. The use of a suction dredge produces a continuous stream of water requiring treatment. The volume of water from hydraulic excavators and drag lines is significantly less.

The loss of marine habitat due to marine-based construction activity would be of a temporary nature. Although, the marine communities in the areas that are to be excavated will be destroyed, these areas can be recolonised once excavation is completed. There is also the potential for an increase in biodiversity as the newly created deeper water provides a different environment.

The construction activities have the potential to adversely impact on water quality due to the discharge of oil, fuel and other substances. These discharges could be from spills or poorly maintained construction equipment.

Activity	**Potential Adverse Effect**	**Mitigation Measure**
Excavation in marine environment	Discharge of suspended sediment into the marine environment Loss of habitat – mangroves; foreshore for wading birds	Placing a sediment control fence to contain sediment discharges from construction works where possible. Excavation/dredging works to be undertaken when the tide is out or in the first half of the flood tide. Mangroves only to be removed immediately in advance of construction activities in the mangrove area. Bunding-off excavation areas where possible (e.g. eastern access channel). Ensuring excavation activities are restricted to excavation area.
Placement of excavated marine material on land	Discharge of sediment to marine environment	Treatment of discharges by sediment retention structures
Construction of Marina, Bridges,	Beach erosion/ alterations in sand	Design of foreshore structures be undertaken by suitably qualified coastal engineer to minimise

Activity	Potential Adverse Effect	Mitigation Measure
Revetments, and Channels	deposition patterns Loss of shellfish and invertebrate habitat	impacts. Pilings are preferred to solid structures where possible.
Beach enhancement	Unconsolidated sediments impacting on the marine environment	Removal of fine fraction of sand that can generate suspended sediment prior to placing sand on beach. Water from washing of sand to remove fine fraction to be discharged to settling ponds. Sand placement to be performed at low tide.
Construction and operation of temporary bridge	Obstruction of access to fishing grounds for three local subsistence fishermen	Negotiate a suitable resolution with the fishermen prior to the construction of the temporary bridge.
Operation of dredging equipment and construction of foreshore structures	Contamination of marine water from vehicles operating in marine area	Ensuring construction equipment is kept in good 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.
Deepening/ dredging channels, and marina	Habitat reduction, alterations in drainage patterns and feeding grounds for fish and shore birds, sedimentation and creation of deeper habitat	Minimise dredging. Use a suction dredge. Other mud and sand flats in the foreshore lease to be preserved.

Table 14: Summary of Potential Effects and Mitigation Measures for Marine-based Construction Activities

5.1.2 Land-based Construction Effects

Construction activities on-site have the potential to cause adverse effects. Table 15 identifies the potential adverse effects 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 artefacts during construction will be included in the Construction Environmental Management Plan (CEMP).

Activity	Potential Adverse Effect	Mitigation Measure
Site clearance	Loss of vegetation	There are no character trees or vegetation of special interest, nonetheless the Principal should physically mark any trees which could be retained.

Activity	Potential Adverse Effect	Mitigation Measure
		Earthworks are required over the entire area of the island. This should be planned to be done progressively in defined areas with final levels, top dressing and grassing over completed before progressing to the next area.
	Discovery of archaeological site or remains	Include a protocol in the CEMP to stop work and get advice from the Fiji Museum if such sites are discovered.
Earthworks	Discharge of suspended sediment into the marine environment	Ensure that all stormwater from earthworks passes through sediment traps or ponds prior to discharging to the foreshore. All discharges should be to the eastern coast of the island and not to the western beach.
Cement batching	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 minimise the amount of stormwater generated on the batching site. All stormwater generated from the area (including wash-off from concrete trucks) to be directed to a sediment pond. If the sediment pond needs to emptied of water, the pH will be tested by the Construction Site Manager and adjusted if required. Clean water will then be 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.
Use and storage of hazardous substances	Contamination of surface and marine water	Ensure that hazardous substances are used by trained personnel and store all such substances away from the beach and under cover away from direct sunlight. Ensure spill kits are readily available on site.
Waste disposal	Littering of site	Waste materials will be collected up on a regular basis and transported to the mainland for disposal at an approved landfill.
Sewage disposal	Discharge of contaminants to marine environment	Temporary toilets and washing facilities will be installed for the construction workers that will ensure that wastewater is treated and not discharged directly to ground or the foreshore.

Table 15: Summary of Potential Effects and Mitigation Measures for Land-based Construction Activities

5.1.3 Loss of mangroves

There has been significant modification within Nadi Bay over time with the loss of mangrove areas. The initial loss was due primarily due construction of seawalls to extend sugar cane growing areas. Over the past 20 years or so the loss has been primarily

associated with the creation of land for commercial, residential and tourist development. The Coastal Process assessment Appendix C shows that the area of mangrove based on a comparison of the initial area identified in 1986 (Watling, 1986) and a satellite image from 2005. Table 16 shows the resulting changes in area.

Type	Southern Nadi Bay Locale (hectares)		Northern Nadi Bay Locale (hectares)		Total (hectares)	
	1986	2005	1986	2005	1986	2005
Tiri Alliance	126.1	97.8	142.4	120.4	268.5	218.2
Stunted Tiri	84.2	61.4	_	_	84.2	61.4
Selala Alliance	638.5	497.2	299.4	233.1	937.9	730.3
Mudflats	81.5	45.4	20.2	8.9	101.7	54.3

Table 16 Changes in mangroves and mudflat areas from 1986 to 2005

A range of activities, including agricultural land conversion and resort development has resulted in some 19% to 27% reduction in mangrove area and a 50% reduction in mudflats within Nadi Bay. The present area of Vulani has been extensively modified by previous developers over this time frame and included the removal of mangroves and modification of mudflat area. Contained within Appendix C is a series of aerial photos which show the loss of mangroves between 1986 and 2005.

The proposed activities will result in the loss approximately 130 ha of mangroves. The majority of mangroves to be lost are from the Selala Alliance. This will increase the loss of this type of mangrove in the Nadi Bay Locale to 64% of what was occurring in 1986. The developers intend to offset this loss by:

1. endeavouring leasing the entire mangrove area on the northern bank of the Natacola River and managing it for its conservation and enhancement as well as allowing the traditional uses to continue this represents an area of 58 ha;
2. ensuring that there will be no changes to the hydraulics of the existing Sabeto and Natacola rivers by retaining generally a minimum 15m buffer;
3. co-operating with the adjacent Nasosovu development and their intention to protect 95 ha of mangrove on the southern bank of the Sabeto River.

To minimise the construction effects Table 17 identifies potential mitigation measures.

Activity	Potential Adverse Effect	Mitigation Measure
Mangrove removal	Habitat reduction and coastal erosion, loss of future fish and invertebrate stocks	Ensuring mangrove removal is restricted by clear demarcation of construction area. During dredging and construction ensure existing mangroves are protected through measures specified in the CEMP. Include penalties in contract documents for unnecessary damage to mangroves.

Activity	Potential Adverse Effect	Mitigation Measure
		A Mangrove Management Plan to be developed to ensure ongoing protection of mangrove areas
		Replanting of any disturbed areas.
		Replanting disturbed areas.

Table 17: Summary of Potential Effects and Mitigation Measures for Mangrove Removal

5.1.4 Geotechnical Considerations

Major earthworks are required over most of the island to raise it to the design height. Current geotechnical knowledge indicates that dredged material from around the island may be suitable for this purpose.

Detailed geotechnical investigation are currently underway which will provide advice on the suitability and handling on material and information on design for buildings and structures.

5.1.5 Off-site Sources of Materials

The developers will need to import to the island significant volumes of fill and large rocks for armour. The sources of the fill and armour rock will need to come from a DoEnv-approved source. The developer has identified that river boulder rocks will not be used in the development.

Activity	Potential Adverse Effect	Mitigation Measure
Transport of machinery and materials to site	Dust pollution to residential communities on route	Contracts with suppliers and cartage contractors will contain disciplinary procedures for insecure loads.
	Noise pollution to residential Communities on route	Prepare traffic management plan for approval by DoE. Plan to show how traffic impacts to be minimised.
		Contracts with suppliers and cartage contractors will contain disciplinary procedures for vehicles operating outside agreed hours or in unfit condition.

Table 18: Summary of Potential Effects and Mitigation Measures for Transporting Construction Materials to Site

5.2 Effects on Coastal Processes

The Coastal Processes Assessment (Appendix C) has identified that the proposed works will have little impact on the coastal processes. The report has identified that the access channel and marina / canal waterways will be prone to sedimentation.

5.2.1 Access channel

The access channel is most at risk during cyclonic events, where large changes to the river delta may occur and sediment be deposited in the channel. The frequency of this will be entirely dependent upon the frequency of cyclones impacting on Nadi Bay. Based on

historic data, cyclones are likely every 5 to 10 years. The sediment retained within the access channel is likely to be fine to medium sands, as finer sediments will be retained in suspension. The quantity of infilling is not able to be accurately predicted, but is likely to vary from 40,000 m^3 to 150,000 m^3 per cyclone event. Suitable sands will be excavated using conventional dredging plant and used to renourish the resorts open coast beaches. If sand is not required for this purpose, it will be disposed of to a land based source.

In between cyclone events and during calm conditions, siltation of the channel is possible, with fine sediments settling out. The deposition of this fine material is not expected to have any significant effect on navigation and is unlikely to exceed the 0.5 m siltation allowance provided in the access channel design depth.

5.2.2 Marina and canal water way

Siltation of the marina and canal water way will occur as a result both of settlement of the sediment laden water within the river system that occur on a regular (daily) basis as well as the effects of catchment flooding and cyclonic events.

The configuration of the marina and canal system is such that river waters may be diverted into the marina and canal system during a rising tide, although by directing the flow from the lagoon into the marina area, the saline wedge may assist in reducing sedimentation rates.

An estimation of annual sedimentation has been made, taking into account the water exchange into and out of the water body each tide with an average suspended sedimentation concentration of 35 mg/l for the periods May to November (i.e. the periods with no significant rainfall) and average suspended sediment concentrations of 250 mg/l for the remaining period. A base concentration of 10 mg/l was assumed, meaning that over the dry period some 25 mg/l will settle out in the marina area, while during periods of higher suspended sediment concentration up to 240 mg/l may be deposited.

The resulting sediment accumulation balance is shown in Table 19. The results suggest in the order of 15,000 m^3/yr could accumulate the marina and canal area that equates to an average deposition rate of 7.5 cm/yr. This is an average rate and there are likely to be areas of both higher and lower sedimentation. However, based on the average rate and the 0.5 m sedimentation allowance, dredging would be required every 5 to 10 years.

The sediment accumulation within the marina and canal system will be largely silts and muds and will be unsuitable for beach nourishment purposes. This material will be excavated and removed to a land based source.

Month	Days	No tides	Suspended sediment (mg/l)	Sediment retained (mg/l)	Sediment Settled (mg/l)	Mass/month (T/month)
Jan	31	60	250	10	240	3,578
Feb	28	54	250	10	240	3,232
March	31	60	250	10	240	3,578
April	30	58	250	10	240	3,463
May	31	60	35	10	25	373
June	30	58	35	10	25	361
July	31	60	35	10	25	373

Month	Days	No tides	Suspended sediment (mg/l)	Sediment retained (mg/l)	Sediment Settled (mg/l)	Mass/month (T/month)	
August	31	60	35	10	25	373	
September	30	58	35	10	25	361	
October	31	60	35	10	25	373	
November	30	58	35	10	25	361	
December	31	60	250	10	240	3,578	
Total		705				20,003	T/yr
Density (assumed)						1,400	kg/m^3
Volume						14,288	m^3
Sedimentation rate						0.075	m/yr

(Source: Coastal Process Assessment Report)

Table 19 Sedimentation assessment of canal and marina area

5.3 Hydrology/Hydraulics

The proposed development has the potential to adversely affect adjacent land. This potential effect has been avoided at the Natacola River mouth by limiting disturbance in the vicinity of the river delta. In fact, the proposed headland and open coast controls will reinforce the coastline at this location and reduce the risk of shoreline retreat occurring to the north as a result of a landward moving delta.

The access channel alters the delta at the Sabeto River entrance. This access channel will modify the existing delta, focussing river flows through the access channel, rather than the more diffusive discharge that currently occurs. This is likely to result in a landward migration of the delta to the south of the river, resulting in accumulation along the coastline to the south of the Sabeto River mouth.

The access channel could also result in down cutting of the river, affecting the adjacent river banks. The armouring of the dredged channel as it intersects the existing river entrance will prevent down cutting, avoiding this potential effect.

There is also a risk of increased flood risk to adjacent land due to the building up of land in the project area reducing flood storage. This may be of concern during high rainfall and storm surge events. However, during periods of high storm surge the tailwater level will extend back to the highway, or even further landward as evident by the saline wedge intrusion. Therefore, the existing highway bridge is likely to be the most significant control for coastal storm surges and development seaward of the highway is unlikely to have any significant effect on levels.

Similarly, during high rainfall and catchment flooding, similar to the recent flooding event recorded in February, there are high water levels in the vicinity of the bridge under Queens Highway, but these high levels rapidly dissipate seaward of the highway. The proposed development is likely to reduce the rate of stormwater dissipation. However, this potential effect is reduced by maintaining a 15 m wide mangrove buffer that also assists in dissipating energy.

5.4 Operational Effects

5.4.1 Marine-based Operational Effects

Marine based operational activities on site have the potential to cause adverse effects. Table 20 identifies the potential adverse effects and how these may be mitigated.

Activity	Potential Adverse Effect	Mitigation Measure
Marina Operation	Discharge of fuels and other pollutants into marine environment	If fuelling facilities are to be located in the marina the tanks will be bunded, only trained staff allowed to operate them and fuel spill kits will be readily available. The OEMP to identify acceptable servicing activities that can be undertaken in the marina. The aspects of the OEMP that have relevance to the conduct of island guests and residents will be included in contracts for purchasing of berths or land on the island. Sewage pumping facilities for boat users will be provided.
Craft use	Exhaust fumes from 2-stroke motors causes oil pollution	Encourage use of 4-stroke motors where possible
	Wakes from fast boats can cause sediment erosion resulting in land loss and increased sedimentation.	Ensure all boat traffic is limited to slow speeds within the marine area between the island and the mainland, designate and enforce "no wake" zones. Exposed cuts in the marina and access channels will be armoured or shaped to prevent shoreline erosion from boat wake.
Maintenance dredging of channel and beach replenishment	Unconsolidated sediments impacting on the marine environment	Suction dredge to be used to extract material Removal of fine fraction of sand that can generate suspended sediment prior to placing sand on beach. Water from washing of sand to remove fine fraction to be discharged to settling ponds. Sand placement to be performed at low tide.
	Contamination of marine water from vehicles operating in marine area	Ensuring construction equipment is keep in good order with no oil leakages. No parking of construction in marine area when not in use. No storage of fuel, oil or grease in marine area.
	Habitat reduction, alterations in drainage patterns and feeding grounds for fish and birds, creation of deeper	Minimise dredging. Suction dredge to be used to extract material. Other mudflats in the area should be preserved.

Activity	Potential Adverse Effect	Mitigation Measure
	habitat	

Table 20: Summary of Potential Effects and Mitigation Measures for Operation Activities likely to Impact on the Marine Environment

5.4.2 Waste Water Treatment

Table 21 identifies the potential adverse effects that can arise from waste water treatment and disposal and how these may be mitigated.

Activity	Potential Adverse Effect	Mitigation Measure
Grey water use	Poor treatment can lead to elevated levels of chemicals discharged to the marine environment	Ensuring that biodegrable washing chemicals are used. Low or No-Phosphate detergents such as Simple Green or Black & Gold should be used. The use of bleaches should be minimised. Scrub decks and jetties with hot water rather than bleach. Ensuring effective treatment for grey water so the water can be safely disposed.
Stormwater disposal	Sedimentation and reduction of water salinity affecting marine life	Storm water to be reused or channelled back onto gardens, or treated to remove sediment and excess nutrients prior to being allowed to run directly into the sea.
Transfer of sewage from development site to PWD infrastructure	Leaks and pump failures lead to overflows of untreated sewage to the environment	Include an operational plan with appropriate contingencies in the OEMP.

Table 21: Summary of Potential Effects and Mitigation Measures for Wastewater Treatment

5.4.3 Water Supply

Adequacy of the proposed water supply to the development remains to be confirmed. A confirmed water supply is a prerequisite for development approval and details of the supply will need to be forwarded to DoEnv and DTCP for approval once confirmed.

5.4.4 Solid Waste Management Effects

The proposed waste management for the development is described in detail in Section 2.6.5. The collection of solid waste will be undertaken as a responsibility of the Body Corporate. This responsibility should also include the collection of litter. On the basis that the waste management measures recommended in Section 2.6.5 are implemented, no adverse effects should result from waste management operations on site.

5.4.5 Extreme Weather Effects

The proposed resort site is low-lying and exposed to the prevailing 'cyclone quarter'. Table 22 identifies potential effects and mitigation measures in respect of site drainage, flooding and storm surges.

Activity	Potential Adverse Effect	Mitigation Measure
Storm surges	Damage to buildings and other facilities. Visitor and resident safety. Foreshore erosion	Ensure that revetment crest levels on the east and west coasts are in accordance with the Coastal Processes Assessment (Appendix C) and that all habitable buildings are at least 300 mm above surrounding levels For the hotels, draw up a cyclone contingency plan for guests and staff during cyclones and train staff to implement the plan Monitoring of the health and extent of littoral vegetation and ensuring protection Installation of revetments on the western side of the island in accordance with coastal processes assessment Plan for maintenance dredging of the constructed foreshore lagoons and replenishment of the western beaches
Cyclones	Potential damage to buildings from cyclones	Ensure that structural plans are to the appropriate cyclone standard Ensure that revetment crest levels on the east and west coasts are in accordance with the Coastal Processes Assessment (Appendix C) and that all habitable buildings are at least 300 mm above surrounding levels For the hotels, draw up a cyclone contingency plan for guests and staff during cyclones and train staff to implement the plan
Sabeto River floods coinciding with high tide	Floodwaters affecting the island	Ensure that revetment crest levels on the east and west coasts are in accordance with the Coastal Processes Assessment (Appendix C) and that all habitable buildings are at least 300 mm above surrounding levels For the hotels, draw up a flood contingency plan for guests and staff during floods and train staff to implement the plan

Table 22: Summary of Potential Effects and Mitigation Measures for Storm Surges, Cyclones and Flooding

5.4.6 Access to the Site

The access to the site is off the Queen's Highway one of the busiest roads in Fiji. The vehicle movements associated with the development and operation will only be minor in the context of existing traffic volumes. There is potential for conflict between the vehicles leaving and entering the Vulani Island site and the regular traffic flows on the Queen's

Highway. The proposed design features of the intersection with Queen's Highway described in Section 2. 6.1 will ensure there is no adverse immpacts on road safety.

5.4.7 Hazardous Substances Effects

Operation activities of the Body Corporate, hotel management and residents will require the use of hazardous substances. Table 23 identifies the potential adverse effects that could arise from the handling of these substances and mitigation options.

Activity	Potential Adverse Effect	Mitigation Measure
Resort Operation	Discharge of contaminants	Draw up procedures to be included in the OEMP to cover the safe disposal and handling of liquid wastes, chemicals and other potential contaminants and train staff in these procedures. Source and use less hazardous substances if practical. No bulk storage of hazardous goods within 30m of high water.
Gardening	Nutrient and chemical discharges to the marine environment	Draw up Landscaping Guidelines to be included in the OEMP to minimise the use of fertilisers and pesticides/herbicides. Regularly train relevant staff in Landscaping Guidelines.
Fuel handling	Discharge of contaminants	Draw up bulk fuel storage spill plan, ensure clean up materials are stored on site, and practice implementation. Install only above ground bulk fuel storage with appropriate bunding. No bulk storage of fuel within 30m of high water.

Table 23: Summary of Potential Effects and Mitigation Measures for the Use of Hazardous Substances

5.4.8 Public Access

As discussed earlier there is currently no public access to Vulani Island for recreational purposes. The area is used by members of the local villages for fishing and crabbing. The proposed development will significantly improve beach access opportunities for the public.

5.4.9 Carrying Capacity

The ToR identifies that consideration be given to the potential carrying capacity of the development. The carrying capacity of an area is strongly influenced by social factors in terms of respect of the visitor's experience. The intensity of the development is similar to that currently experienced at Denarau. The area has sufficient capacity to accommodate the level of the development with a projected population of between 4000 and 800 when development is completed and fully utilised. This represents approximately 300m^2 per person. In reality, the intensity of use will differ with the hotel areas having greater density of people compared to the golf course. In considering the carrying capacity,

consideration needs to be given to the development being sustainable in terms of infrastructure, e.g. having sufficient water and power and being able to dispose of its wastes.

Preliminary discussion with PWD and FEA have shown that water and power can be supplied to Vulani Island. Options are available in respect of treating the wastes produced by the development.

5.5 Economics and Employment

The development will lead to a range of economic and employment benefits. These include the following:

- Increased employment – employment opportunities will be significant with the employment of around 100 people during the civil works construction phase and an excess of 1000 jobs during the construction phase for the buildings and marina and the subsequent operational phase. This is a significant contribution in the current circumstances of national under-employment;
- Additional jobs in service industries;
- An increase in Fiji's foreign exchange earnings;
- Increased VAT collections;
- Contributions to employment levies and Fijian National Provident Fund;
- Purchase of local goods and services for resort and villa construction; and,
- Ongoing payment of various government taxes.

Government has no significant costs associated with this project.

5.6 Environmental Management

Vulani Island Ltd has committed to implementing Construction and Operational Environmental Management Plans for the proposed development (CEMP and OEMP respectively). These plans are to be approved by the DoEnv. The CEMP will be submitted to DoEnv one month prior to the commencement of construction. Once the plans are approved, Vulani Island Ltd will be responsible for ensuring that the plans are conformed with.

The Construction Environmental Management Plan (CEMP) will detail the operational and management mechanisms by which adverse effects identified in this EIA are avoided, remedied or mitigated during the critical construction period. The scope of the CEMP is outlined in Table 24. While an overall CEMP will address the planned construction work described in this report, separate CEMPs will be necessary for certain components of the development. In particular, a separate CEMP will be necessary for the coastal works. This is because this work is environmentally sensitive and involves different control measures to construction on land.

Furthermore, if the developers implement their sewage treatment contingency plan and establish their own treatment plant near to the development, a separate EIA may be required and a CEMP would then be required for these works. The same will apply when the residential and hotel building development phases commence. For the building

works it is envisage a standard CEMP and given to the owner of each building project to modify to fit the requirements of their individual projects.

Section	Important Inclusions
Introduction	Purpose and objectives of the CEMP
Site Description	Identification of Sensitive Habitats
Project Description	Activity-based identification of significant environmentally impacting activities
Site Organisation & Management	Environment management responsibilities – personnel and structure
Management of marine construction	Design and operational requirements
Management of land based construction	Design and operational requirements
Contractors' responsibilities and obligations	Specifications for inclusion in contracts
Archaeological	Procedures on the finding of any archaeological site
Monitoring	Rationale, location, parameters, methodology, equipment, calibration
Audit	Schedule
Records and Reporting	Detailed
Contingencies	Responses to incidents
Forms & Contractor Acknowledgement	Template forms and Contractor Agreement in Appendices

Table 24: Outline scope of the Construction Environmental Management Plan

OEMPs will be prepared by the Body Corporate for its maintenance works on the island, and by the tourist resorts for their operations. These will need to be submitted to DoEnv for approval. An outline scope for these plans is provided in Table 25.

Section	Important Inclusions
Introduction	Purpose and objectives of the OEMP
Site Description	Identification of Sensitive Habitats
Operational Activities	Activity-based and identification of significant environmentally impacting activities
Organisation & Management	Environment management responsibilities – personnel and structure

Section	Important Inclusions
Management of marine based activities	Procedures
Management of land based activities	Procedures
Monitoring	Rationale, location, parameters, methodology, equipment, calibration
Audit	Schedule
Records and Reporting	Detailed
Contingencies	Responses to incidents

Table 25 Outline Scope of the Operational Environmental Management Plan

5.7 Monitoring

The implementation of the CEMP and OEMP will be monitored through regular meetings of a Monitoring Committee as established by DoEnv and comprising people involved in the implementation and supervision of the plans. A monitoring report for the CEMP will be submitted to the DoEnv and DTCP on an agreed basis. A monitoring report for the OEMP will be submitted every six months.

As part of the environmental assessment process water quality monitoring sampling locations have been established and initial surveys have been conducted of the marine environment so as to characterise the habitats and communities present. The Construction and Operational Management Plans will include the requirement for periodic monitoring and evaluation of water quality and the status of the marine and mangrove communities so as to determine whether the development is having any significant impact on the surrounding marine environment. The CEMP will establish fixed marine community monitoring quadrates. The results of this monitoring will be presented in a report and submitted to DoEnv on a monthly basis during the construction period and a six monthly basis during the operation period.

Vulani Island Limited may be constructing a wastewater treatment plant. This will require monitoring. This will be undertaken monthly until such time as the DoEnv agrees that the system is working well. It is recommended that monitoring thereafter is quarterly. The following parameters must be monitored:

- Faecal Coliform;
- Biochemical Oxygen Demand; and
- Total Suspended Solids.

In addition, there will be regular monitoring of the seawater lagoon to ensure that the water quality meets the operational requirements of the lagoon. The monitoring will include:

- Faecal Coliform;
- Biochemical Oxygen Demand; and
- Total Suspended Solids
- Salinity
- Nutrients.

6 Conclusion

The proposed Vulani Island development is located on Vulani Island, on the west coast of Viti Levu. The general location is an area of significant existing tourism development. The island is currently uninhabited and, although undeveloped, it is highly modified.

The site is a long narrow sand spit within the delta area of the Sabeto River. The foreshore area surrounding the island is characterised by delta muds and silts, and a substantial mangrove forest. On its seaward side there is a gentle sloping beach. The island's shores are in a continual process of change, influenced by river flows, sediment delivery and storms. This is particularly evident at the island's far northern and southern points.

The ground level of the island will be raised and headlands constructed to minimise the risk of wave attack and flooding and to prevent coastal erosion. Fill will be obtained from the planned dredging works. A marina and access channel will be constructed in the marine environment.

To construct the golf course and residential areas, 130 ha of mangroves will need to be converted. To offset this loss, the developer is trying to lease the 58 ha of mangroves to the north of the site. The lease will be the mechanism for ensuring the long term protection of these mangroves. In addition a minimum of a 15m buffer will be retained on the south bank of Natacola River and north bank of the Sabeto River.

The Vulani Island development is a large, mixed residential and resort development. It is at the forefront of a new generation of tourist developments which propose to cement Fiji's future as an internationally attractive tourist destination. The developer recognises the need for good environmental management as a key component of both the construction and the management of the development's residential community as well as the resort hotels. The development is consistent with the `Step Change' approach advocated by the Government's current tourism policy document *`Fiji: Tourism Development Plan, 1998-2005'*.

The findings of this EIA are that if the Vulani Island development proceeds as described and in accordance with the recommendations outlined in this report, it will not result in any significant adverse environmental impact.

6.1 Recommendations

Environmental Management

1. Vulani Island Limited be required to prepare a Construction Environmental Management Plan (CEMP). The plan is to include the transport of fill and rock armour to site and include procedures on the discovery of any archaeological site. No work can be undertaken until the CEMP and subsequent updates are approved by DoEnv/DTCP.
2. Vulani Island Limited be required to prepare an Operational Environmental Management Plan (OEMP) for the residential subdivision and marina. The OEMP should be approved by DoEnv within six months of the subdivision and marina being opened.
3. Vulani Island Limited be required to prepare additional Construction and Operational Environmental Management Plans for the later phases of the

development that are not covered by this EIA, for example the hotel and apartment developments.

4. It is recommended that DoEnv establish a Monitoring Committee which would meet every two months to oversee the implementation of the CEMPs.

Sabeto River Mouth and Natacola River Mangroves

5. Vulani Island Ltd generally adopt a 15 m buffer zone/reserve area with no construction along the northern bank of the Sabeto River and southern bank of the Natacola River so as not interfere with the ongoing sediment movements associated with the river mouth.

6. That Vulani Island Ltd demonstrate to the satisfaction of the Director Department of Town and Country Planning and Director Department of Lands that long-term protection of the mangroves that remain (after construction is completed) within the development leases is assured in the management deed of the Body Corporate that will be established to manage Vulani Island.

Hydrology/Hydraulics

The catchment flood contribution has been assessed using the Rational Method and potential effects on river flooding downstream of Queens Highway has been assessed with HECRAS, a flood routing numerical model. The results show the proposed development does not have any significant effect on river flood levels. This is due to:

- The existing bridge at Queens Highway creating significant throttle to catchment flows;
- The maintenance of a 15 m wide mangrove buffer that provides significant attenuation of flows;
- The flat and low level of the river, with significant saline intrusion occurring far up river.

The tail water level dominating river flows during periods where storm surge increases bay levels significantly.

Coastal Processes

The coastal processes assessment has made recommendations on the dimensions, location and construction of the coastal structures and features. These will need to be strictly applied and any changes to the planned coastal works will need to be reviewed and approved by a qualified coastal processes-engineer. The overall development is likely to have a positive impact on the coastal processes by stabilising many of the shorelines and increasing the island surface elevation so that it is less likely to be overtopped during a cyclone event.

The development will also lead to a range of significant economic and employment benefits. Upgrading of local public infrastructure will be done in conjunction with Government, on a yet to be agreed Public Private Partnership. This arrangement will minimise the Governments exposure to significant cost outlays and will carry out any necessary upgrading of local public infrastructure. Government has no significant costs associated with this project.

Overall, the EIA study findings indicate that the proposed development should not result in any significant adverse environmental impact if the following recommendations are adhered to.

Building Design & Construction

The west coast of Viti Levu is subject to the passage of cyclones and the site is vulnerable to cyclones. It is recommended that all building design conforms with the Fiji National Building Code or another higher standard approved by the Department of Town and Country Planning.

7. Revetment crest levels should comply with the Coastal Processes Assessment recommended levels of 3.9m RL on the western side adjacent to the beach and 2.5m RL on the eastern side of the island.
8. Building platforms to be a minimum of 300mm above the surrounding heights and the developer to provide for the easy drainage of over-topping water through swales to the eastern shoreline.
9. Prior to any construction commencing, a geotechnical report from a suitable engineer will be provided to the Director Department of Town and Country Planning demonstrating that proposed work will be geotechnically feasible.
10. During construction it will be necessary to take measures to ensure that the marine environment is protected from discharges of: excessive sediment, storm water, solid or liquid wastes, and hazardous substances. Hence it is recommended that the developer ensures that:
    - stormwater runoff from the site is managed to minimise sediment-laden water being discharged to the foreshore;
    - there be no discharges to the western beach;
    - solid waste is contained on the site and transferred to an approved landfill;
    - temporary toilets and washing facilities are installed that treat and dispose of waste water in a way that is not damaging to the marine environment;
    - hazardous wastes are handled according to their existing guidelines and only by trained personnel; and,
    - earthworks sites are rapidly revegetated.

Construction of Foreshore Structures

The developers propose to construct an access channel and headlands. In addition, they plan to maintain dredged channels that will provide access to Nadi Bay. Over time, replenishment of the beaches and maintenance dredging of the dredged areas is likely to be necessary. It is recommended that:

11. Foreshore structures are designed by a suitably qualified coastal engineer and follow the recommendations and design specifications of the coastal processes assessment that are included in this report. Any changes to the design specifications will need to be approved by a coastal processes engineer.

In order to preserve habitats, it is recommended that:

12. The design and construction method minimises disturbance to the mudflats and mangroves.
13. Construction equipment be kept in good order and their time in the foreshore area is kept at a minimum so as to minimise the leakage of fuel and oil.

Construction Materials

The developers propose to import a range of construction materials to the site, notably rocks for the foreshore barriers and bridge and top-dressing to provide for good plant growth. Sand will also be required. It is recommended that:

14. All construction materials imported to the island to come from an approved source.
15. Quarry rock rather than river rock to be used for all armouring requirements.

Construction Traffic

In order to minimise the disturbance and risks to the surrounding communities and road users from construction traffic it is recommended that the developer undertake the following:

16. Prepare a plan for the intersection with the Queen's Road that is to be approved by PWD prior to the commencement of any construction activity;
17. Ensure that contracts with suppliers and cartage contractors for the transport of bulk materials to site contains appropriate disciplinary procedures for: noisy vehicles, insecure loads, operating outside approved hours, exhaust emissions not meeting Fiji emission standards, speeding or unsafe use of vehicles. The developer shall demonstrate to the satisfaction of the Director, DoEnv that these provisions are in place prior to bulk cartage commencing;
18. Prepare a traffic management plan which demonstrates how traffic will be managed to minimise impacts and submit to the Director of DoEnv for approval;

Development Operation

The operation phase of the development will require the careful management by the Body Corporate and resort operators of a range of potentially environmentally impacting activities including: the use and maintenance of the marine structures and dredged areas; wastewater treatment; solid waste management; use of hazardous substances; and landscape management. In addition, contingency plans will be required for extreme weather events.

19. Prior to the management deed being enacted the Vulani Island shall demonstrate to the satisfaction of the Director Department of Town and Country Planning and Director Department of Lands that the sections of the management deed for the Body Corporate that deal with the development objectives for the site and the environmental management of the site need to be consistent with the undertakings given in this document and the Master Plan.

Marine-based Operational Effects

It will be necessary to carry out maintenance dredging of the marina, channels and swimming holes. These works will need to be carefully managed to minimise impacts. The dredge method, equipment and procedures will need to be detailed in the Operational Environmental Management Plans.

It will be necessary to manage the effects of the regular boat movement that will be associated with the marina. As a result it is recommended that:

20. Measures are taken to prevent spills in the marina including safe fuelling procedures and emergency procedures and equipment;

21. To reduce oil pollution, four-stroke outboard motors are used where possible instead of two-stroke motors; and

22. Boat traffic is limited to slow speeds to minimise erosive wakes.

Wastewater Treatment

The developers are yet to confirm how waster water from the development will be treated.

23. Prior to construction of the project commencing, the developer shall submit either confirmation from PWD that waste water will be treated at the Navakai waste Water Treatment Plant or supply plans for a sewage treatment plant to the CEO of DoEnv and the Director of DTCP for approval. The plans will be accompanied by a peer review of suitably qualified waste water engineer confirming the design will meet treatment standards and the plant has sufficient capacity and contingencies for break downs and climatic events are addressed.

24. Prior to the marina becoming operational the developer shall submit to Director of DoEnv and the Director of DTCP for approval a plan demonstrating how bilge water from larger vessels is to be treated.

In addition, it is recommended that the developers ensure that stormwater discharges do not lead to contamination of the foreshore. This will require that:

25. Stormwater is properly treated prior to its discharge and that, where possible, the water is reused on the site.

26. The use of cleaning chemicals and hazardous substances is minimised, that they are handled by trained personnel and that washing chemicals are bio-degradable and low in phosphates.

Water Supply

Confirmation of the availability of a water supply for the development remains to be confirmed. It is recommended that:

27. Details of an assured and adequate supply be forwarded to DoEnv and DTCP prior to development approval.

Regional Planning

The development of projects such as Vulani Island tends to attract development around the boundaries of the project area. If this development is not properly designed and controlled, it can have a detrimental impact on the resort development. It is recommended that:

28. A working party involving DT&CP, NLTB, Lautoka Rural Local Authority and the developer be establish to a develop a strategy to ensure that development adjacent to Vulani Island does not detract for the tourist experience at Vulani Island.

Cultural Sites

The archaeological investigation identified 2 sites of cultural importance and a possible third site.

29. That further assessment of these the 3 cultural sites identified by the Fiji Museum be undertaken in conjunction with the Fiji Museum. The assessment is to consider options and practicality of protecting these sites and the provision interpretive information.

7 Applicability

This report has been prepared for the benefit of Vulani Island Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR INTERNATIONAL LTD
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