Environmental Assessment

INITIAL ENVIRONMENTAL EXAMINATION

Project No. 44172-022

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TONGA: Tonga-Fiji Submarine Cable Project

Prepared by the Tonga Cable Limited and the Ministry of Finance and national Planning for the Asian Development Bank

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ENVIRONMENTAL ASSESSMENT

TONGA CABLE EXTENSION PROJECT: NUKU'ALOFA, HA'APAI & VAVA'U

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Prepared in accordance with Tongan Government EIA Regulations 2010, World Bank Operational Policies and ADB Safeguard Policies for Environmental Assessments

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Acronyms and Abbreviations

ADB	Asian Development Bank
BMH	Beach Man Hole
BU	Branching Unit
CBD	Convention on Biological Diversity
CCAM	Conformal Climate Atmospheric Modelling
CLC	Convention on Civil Liability
CMS	Convention on Migratory Species
CRS	Cable Route Survey
DA	Double Armour
DP	Dynamic Positioning
EA	Environmental Assessment
EAC	Environment Assessment Committee
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
FAD	Fish Aggregating Device
FAO	Food and Agricultural Organisation
GEF	Global Environment Fund
GIS	Geographic Information System
HAP	Ha'apai
HNS	Convention on Hazardous and Noxious Substances
HWM	High Water Mark
ICT	Information and Communication Technology
IPP	Indigenous Peoples Plan
IUCN	International Union for Conservation of Nature
KP	Kilometre Point
LAT	Lowest Atmospheric Tide
LiDAR	Light Detecting and Ranging
LP	Landing Point
LWP	Light Weight Protection
MARPOL	International Convention for the Prevention of Pollution from Ships
MEC	Ministry of Environment and Communication
MLSNR	Ministry of Lands, Survey and Natural Resources
MRS	Marine Route Survey
NBSAP	National Biodiversity Strategies and Action Plan
NGO	Non-Governmental Organisation
NM	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NUK	Nuku'alofa
OHS	Operational Health and Safety
OP	Operating Policy
OPRC	Oil Pollution Preparedness and Response Cooperation
PA	Ports Authority
PACCSAP	Pacific-Australian Climate Chance Science and Adaption Plan

PCR	Physical Cultural Resources
PEECS	Pacific Environmental and Ecotourism Consulting Services
PIA	Project Influence Area
RPL	Route Position List
SA	Single Armour
SMA	Special Managed Areas
SMD	Soil Machine Dynamics
SOPAC	SPC Applied Geosciences and Technology Division
SPC	Secretariat for the Pacific Community
SPREP	Secretariat for the Pacific Regional Environmental Program
SPS	Safeguards Policy Statement
TCC	Tonga Communications Company
TCL	Tonga Cable Ltd
TOP	Tongan Pa'anga
TOR	Terms of Reference
TS	Terminal Station
VAV	Vava'u
VEPA	Vava'u Environmental Protection Association
WB	World Bank
WD	Water Depth
WDCS	Whale and Dolphin Conservation Society
WWF	World Wildlife Fund

1. Executive Summary

1.1 Introduction

Tonga Cable Ltd (TCL), with permission from the Government of Tonga, will be tendering a contract to supply and install a new fibre optic cable system in Tonga to connect the outer island groups Ha'apai and Vava'u to the Tonga Cable that is currently installed between Fiji and Tongatapu. The proposed submarine cable system, the Tonga Cable Extension, consists of an approximately 390km-long fibre optic cable system that will establish the first submarine telecommunications system linking the outer islands of Tonga to the international network, via the Southern Cross Network. The proposed extension of the Tonga Cable would be commissioned and operated as a wholesale telecommunications business by TCL.

This project will provide an unrepeatered connection between Nuku'alofa and Vava'u with an unrepeatered branch also being laid to Ha'apai. The project is divided into three sections for the construction works: Section A is from a Beach Manhole (BMH) in Nuku'alofa to a Branching Unit (BU) which will be located approximately 50km to the west of the Landing Point (LP) in Ha'apai. Section B runs from the BMH in Ha'apai to the BU and Section C connects the BU to the BMH in Vava'u. This connection will improve and provide additional data transmission capability, reduce costs and supply the increasing demand for electronic communications from the outer islands.

The immediate objectives of the project are to improve the enabling environment for telecommunications and ICT (information and communication technology) in Tonga and promote increased access to infrastructure and services by reducing the costs of international connectivity. Expected sector-specific outcomes are: (i) increased volume of international, regional and national traffic and, (ii) decreases in average prices of international, regional and national communications.

The objectives of the Pacific Regional Connectivity Program as a whole is to reduce the cost and increase the availability of international bandwidth for participating countries, and thereby facilitate the development of a wide range of ICT applications to support social and economic development.

1.2 Project Activities

Project activity will consist of installation of the submarine cable, landing the cable at three locations: Nuku'alofa, Pangai (Ha'apai) and Neiafu (Vava'u). A BMH already exists in Nuku'alofa, but new BMHs and Landing/Terminal Stations will be constructed in Pangai and Neiafu and a new building to house the TCL offices will be built in Neiafu. Activities will also include connection of the system to the TS and the operation of the cable for its life span of 25 years.

Main Lay of Cable System – The Tonga Cable extension will be laid, in its entirety, within Tongan waters and no international boundaries are crossed. The ship will have a dynamic

positioning (DP) system that enables it to manoeuvre in the nearshore area without anchoring As noted in the discussion of the shore-end landing, smaller boats are typically required to assist the cable ship during the shore-end landing operations in Nuku'alofa, Ha'apai and Vava'u.

The main lay will be conducted 24 hours per day until the ship reaches shallow water where the shore-end landing operation will be carried out. During the main lay, the ship will operate at a speed of up to four knots and it is expected that the entire cable lay process, including shore end laying, will take between five-six days.

Shore-End Landing and Terrestrial Works – Shore end landings will be required in all three landing sites and consists of the following key activities:

Nuku'alofa

- Beach preparation and equipment staging
- Trench digging over 500m reef platform
- Cable landing operation
- Cable pull to BMH
- Post landing operations and trench restoration

Ha'apai

- Construction of a Landing Station
- Beach preparation (including trenching) and equipment staging
- Construction of BMH
- Cable landing operation
- Cable pull to BMH
- Cable reinforcement and pinning over reef pavement
- Post landing operations and trench restoration

Vava'u

- Construction of Terminal Station and TCL office facility
- Landing site preparation (including trenching) and equipment staging
- Construction of BMH
- Cable landing operation
- Cable pull to BMH
- Cable reinforcement at landing site approach
- Post landing operations and terrestrial restoration

At the hand over points in each of the sections, the end of the cable will be passed to a small local landing craft that will then pull the cable ashore along the planned route. The cable will be floated to shore at the surface using a series of buoys. As the cable comes ashore, crew of the small landing craft will remove the floats and allow the cable to settle on the seabed. Land-based operations for each of the sites will involve pulling the cable through conduits installed at the LPs to the BMHs in preparation for connection to the TS and are expected to take, on average, up to a maximum of five days per site.

All land- based equipment, tools, and waste material will be promptly removed from the site. The LP sites will be restored after the cables are pulled and secured.

Commissioning and Operations - Once installed, the cable requires no routine maintenance. In the unlikely event of a repair being required, this would be done using similar equipment and techniques as those described for the installation, in the water and on the beach.

Project Alternatives - Alternate landing sites, cable laying methods and cable system design have been considered and were dismissed for economical and environmental reasons. The project, as proposed by TCL, has been assessed as the preferred option for implementation.

1.3 Purpose of Report

TCL has commissioned PEECS to undertake an environmental impact assessment (EIA) for the proposed cable installation and all associated terrestrial activities including construction of the facility in Vava'u. As per the Terms of Reference for this assessment, PEECS have been contracted to provide the following services:

1. Undertake a full and detailed, qualitative and quantitative environmental analysis of the Tonga Cable Extension.
2. Prepare corresponding Environmental Management Plans for the design, laying, operations and maintenance phases of the project.
3. Submit a final and acceptable Environmental Assessment Report and Environmental Management Plan.

As this project is, in part, funded by the World Bank and Asian Development Bank (ADB) as part of the Pacific Regional Connectivity Program, this EIA will be carried out in accordance with their relevant operational and safeguard policies. This World Bank has given this project an Environmental Category B rating meaning that its potential adverse environmental impacts on human populations or environmentally important areas is less adverse than those of Category A projects. Under the World Bank Environmental Assessment Policy (OP4.01), the EIA for a Category B project includes examination of the positive and negative environmental impacts and recommends that measures are needed to prevent, minimise, mitigate or compensate for adverse impacts and improve environmental performance.

1.4 Impact Identification and Assessment

The approaches and methods employed during the EIA process involved a combination of desk, literature and field studies, meetings and investigations, expert and local knowledge all leading to analysis, assessment and preparation of the EIA report

Several government ministries were contacted as well as various public interests throughout the EIA process. This was done to present all relevant parties the information on the

project to determine areas of potential conflict and to encourage open dialogue on this very important development project.

The potential negative environmental impacts of this study have been thoroughly addressed and our findings indicate that those potential impacts identified range from moderate to negligible with the majority being identified as minor and of short duration. These potentially negative impacts have been identified mainly during the cable laying activities phase of the project and with good project management will be sufficiently mitigated. Following mitigation measures, the identified impacts would have residual impacts of minor to negligible.

No adverse socio or socio-economic impacts have been identified. Many positive impacts are expected from this project for the local economy and standard of living, which has been reflected in the comments recorded during the consultation meetings.

A summary matrix of the identified impacts is presented here along with the recommended mitigation measures. An environmental monitoring plan has been developed to aid environmental management of the project and provide the proponent with the opportunity to prevent any unforeseen adverse impacts.

1.4.1 Summary Impact Matrix

Impact Key:

Positive Impact
Negligable Adverse
Minor Adverse
Moderate Adverse
Major Adverse

		PROJECT ACTIONS										
		Construction Phase								Operational Phase		
		Landing Site Preparation				Cable Laying				Land	Submarine	
		Construction: Offices	Solid Waste Management	Trench and Manhole Construction	Trenching Restoration	Cable Laying Marine	Cable Laying Terrestrial	Cable Burial intertidal	Beach face Restoration	Office Operations	Cable Repair	Cable In Situ
Human & Built Environment	Employment and OHS											
	Recreation and Heritage											
	Traffic											
	Solid Waste											
	Air Quality											
	Noise and Vibration											
	Subsistence and Livelihoods											
Natural Environment	Aesthetics											
	Geological and Geotechnical											
	Water Resources and Management											
	Faunal Resources											
	Floral Resources											

1.4.2 Summary Mitigation Plan

Mitigation Measures: Construction Phase
A. General Measures
A-1 Occupational Health and Safety (OHS) signs should be displayed at sites of terrestrial construction.
A-2 OHS policy should be implemented on construction site to Tongan standards.
A-3 OHS policy should be implemented on cable laying vessel to international standards.
A-4 All measures should be taken to prevent marine pollution (including oil spills) as per the Marine Pollution Prevention Act and all listed international conventions.
A-5 Vessels will have Spill Prevention and Response Plans to prevent materials from entering the water and safety plans specific to the work area should be in place.
A-6 All heavy machinery used for terrestrial and intertidal construction works should be well maintained and recently serviced by a professional mechanic.
A-7 All intertidal excavations should be conducted during the mid-low-mid tide cycle to minimise the longshore drift of suspended sediments.
A-8 Chance findings of any heritage items or cultural resources during pre-construction or construction will result in the requirements of WB OP4.11 and ADB SPS being triggered.
B. Communications Plan
B-1 Communication plans should be developed for implementation in the pre-construction period. Communication plan should advise of the following: planned cable laying dates. planned terrestrial construction dates. minimum operating distances from cable laying vessels. individual considerations for specific landing sites. contact details for TCL team.
B-2 Communication plan should start one month before construction phase, and be repeated one week before construction phase. Communications should include (but not limited to): Ports Authority Nuku'alofa Marine Departments Nuku'alofa, Ha'apai and Vava'u Commercial Shipping Agents Nuku'alofa, Ha'apai and Vava'u Local communities in Ha'apai and Vava'u via local FM radio stations *Sports fisher clubs in Nuku'alofa and Vava'u *Tonga Whale Watch Operators Association in Vava'u for dissemination to Nuku'alofa and Ha'apai * for construction during July through October
C. Solid Waste Plan
C-1 Refuse disposal facilities should be installed at the construction sites with a separate bin allocated for recyclable materials. Currently, in Tonga locally recyclable materials include: aluminium cans, aluminium foil and glass bottles, scrap metal. Recyclable or any other reusable materials should be disposed of as follows: Nuku'alofa: GioRecycling in Nuku'alofa Ha'apai: Transhipped to GioRecycling in Nuku'alofa* Vava'u: GioRecycling in Neiafu

Mitigation Measures: Construction Phase
C-2 Separate all hazardous waste at the terrestrial construction sites. Hazardous waste includes: oil product, petroleum products, and chemicals. Hazardous waste should be disposed of as follows: Nuku'alofa: Tapuhia Landfill Ha'apai: Transhipped to Tapuhia Landfill in Nuku'alofa Vava'u: GioRecycling in Neiafu
C-3 Construction waste should first be sorted for reusable waste, then disposed of after consultation with the Ministry of Infrastructure offices on Vava'u and Ha'apai.
C-4 General garbage should be disposed of as follows: Nuku'alofa: Tapuhia Landfill Ha'apai: Non-toxic materials can be burned in situ and all non-burnable should be transhipped to Tapuhia Landfill* Vava'u: Kalaka site landfill * At the time of assessment plans were underway in Ha'apai to install a waste management scheme. Ministry of Infrastructure should be contacted before construction to verify methods of disposing of waste (construction, hazardous, recyclable and general).
C-5 Cable laying vessel will adhere to all regulations in the Marine Pollution Prevention Act in respect to the disposal of waste at sea.
D. Air Quality
D-1 Agreements with sub-contractors should include a clause to cover and secure any bulk transported construction material with tarpaulin, or similar, during transit.
D-2 All stockpiled and transported materials to be covered with secured tarpaulin (or similar) to protect air quality during dry periods and to prevent increases to sediment runoff during rain events.
D-3 (Only for implementation if drought conditions are not evident.) Use of hose pipe and spray nozzles to dampen dusty areas of the Vava'u office and TS construction site at times of heavy machinery use during dry spells.
E. Erosion: Ha'apai
E-1 Vegetation Line (excavation) - damage to the vegetation line can cause erosion. During trenching ensure only minimum width necessary for cable laying operations is excavated. Species growing along the vegetation line (*Ipomoea sp.*) is a common and hardy species of creeping vine, but care must be taken to ensure damage is minimal. No excavated materials should be stored on neighbouring sections of the vine to reduce extent of the impact.
E-2 Vegetation Line (restoration) - after refilling of the excavated trench, vegetation will eventually recolonise damaged area. To increase the rate of regeneration and to ensure site is restored to pre-construction conditions, if disturbed area is greater than 2m wide at the vegetation line, specimens of the same species should be transplanted to the restoration site.

Mitigation Measures: Construction Phase
E-3 Beachfront excavation - Excavation works should be conducted as close to low tide as possible. As with the vegetation line, excavations should only be as wide as the minimum operating width required. If the excavated area is likely to be exposed during the mid-high-mid tide cycle then excavated materials must be stored above the high water mark (HWM). Loss of material through ocean wash will lead to changes in the beach profile and this can be avoided if this mitigation measure is followed.
E-4 Trench should be a minimum of 1.5m deep along the length of the beach.
E-5 Trenches will be refilled with the same materials as excavated.
E-6 No solid concrete (or other material) should be constructed on the beach. Solid structures are known to change longshore drift patterns and cause changes in erosion patterns and rates.
E-7 Consideration should be given to moving the Ha'apai LP 2-3m north. This would take the LP and cable into the zone with a historically lower rate of coastal erosion.
F. Coral Colonies: Ha'apai
F-1 Marine Department should be advised of planned activities to coordinate with shipping agencies.
F-2 Weighted marker buoys should be placed in the areas indicated in Figure 100 (GPS coordinated can be found in Table 12) to mark the sandy channel through live coral colonies.
F-3 Small cable laying craft should be used to bring the cable to shore through the marked channel.
F-4 As the preferred measure, diver assistance should be considered during the cable laying process in the highlighted sections (Figure 100) to help guide the cable to a sandy substrate as it is cut from the surface buoys. A second option would be to use a post-lay diver survey along the cable route to identify and move sections of cable that may be in conflict with a live coral head. The second option would require more exertion underwater and may not be effective on trapped sections of cable, therefore it is the least preferred method.
G. Natural Hazard
G-1 The cable should be articulated and pinned to the Pangai reef pavement (Figure 25).
H. Endangered Species Plan
H-1 Plan should be implemented during the protected and endangered humpback whale migration and breeding season July through October.
H-2 The NOAA approved Marine Protected Species Protocols shall be implemented by an onboard observer during installation to identify and take actions (if needed) to avoid disturbance of or contact with an animal (humpback whale or marine turtle). The protocols are provided in Appendix 4. Key elements of the protocol include: onboard observer with responsibility for maintaining a watch for animals and the authority to suspend operations to avoid direct contact, emergency contacts for mammal and turtle stranding and reporting requirements for any incident that may occur.

Mitigation Measures: Construction Phase
I. Subsistence & Livelihood
I-1 A minimum of six moorings (three Neiafu and three Pangai) are to be installed in the locations shown in Figure 99.
I-2 The Marine Department of Tonga have issued minimum standards for the specifications of moorings to be laid in any harbour. Moorings must be 'dead man' design with two cement blocks chained together, one of which has the actual mooring chain and line attached.

Mitigation Measures: Operational and Maintenance Phase
J. General Measures
J-1 OHS policy for the workplace should be implemented in the new TCL offices in Neiafu. Training should be given as part of the induction process for all staff.
J-2 All measures should be taken to prevent marine pollution (including oils and spill) as per the Marine Pollution Prevention Act and all listed international conventions.
J-3 Maintenance vessels will have Spill Prevention and Response Plans to prevent materials from entering the water and safety plans specific to the work area should be in place.
J-4 Chance findings of any heritage items or cultural resources during maintenance works will result in the requirements of WB OP4.11 and ADB SPS being triggered.
K. Communications
K-1 For any required maintenance works a communications plan should be developed to include the following information: maintenance works dates. nature of works. minimum operating distances from vessels. contact details for TCL team.
K-2 Communications should include (but not limited to): Ports Authority Nuku'alofa Marine Departments Nuku'alofa, Ha'apai and Vava'u Commercial Shipping Agents Nuku'alofa, Ha'apai and Vava'u *Local communities in Ha'apai and Vava'u via local FM radio stations **Sports fisher clubs in Nuku'alofa and Vava'u **Tonga Whale Watch Operators Association in Vava'u for dissemination to Nuku'alofa and Ha'apai * for maintenance works within 5nm (9km) of shore only ** for maintenance works within 5nm (9km) of shore between the months of July through October.
L. Solid Waste
L-1 All operational refuse should be separated for recyclable materials. Suitable refuse bins should be provided to facilitate this and should be disposed of with the GioRecycling facility in Neiafu and in Ha'apai, transhipped to GioRecycling in Nuku'alofa*.
L-2 General garbage should be disposed of at the Kalaka landfill in Vava'u and in Ha'apai, transhipped to

Mitigation Measures: Operational and Maintenance Phase
Tapuhia Landfill in Nuku'alofa*. * At the time of assessment plans were underway in Ha'apai to install a waste management scheme. Ministry of Infrastructure should be contacted to verify methods of disposing of waste and recyclables in Ha'apai.
L-3 Cable maintenance vessels will adhere to all regulations in the Marine Pollution Prevention Act in respect to the disposal of waste at sea.
M. Endangered and Protected Species
M-1 For maintenance works during the humpback whale migration season of July through October and for maintenance works in less than 15km from shore, the Marine Protected Species Protocol should be implemented.
N. Coral Colonies
N-1 For maintenance within the area indicated on Figure 100, surface marker buoys and post maintenance diver surveys should be used to ensure that the cable is returned to the its pre-maintenance placement.

1.5 Conclusion

Following the assessment of the environmental and social economic impacts, as well as the potential impacts to the recreational uses and cultural heritage of the project area, it has been determined that the proposed project will have no significant adverse impacts provided that the Environmental Management Plan is implemented. It is the recommendation of this EIA report that the project should proceed as proposed with the appropriate mitigation measures and monitoring plan in place.

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2. Project Description

2.1 Introduction

The Tonga Cable Extension Project (project) is the second phase of the World Bank (WB) and Asian Development Bank (ADB) Pacific Regional Connectivity Program. The aim of this program is to reduce the cost and increase the availability of international bandwidth for participating countries, and thereby facilitate the development of a wide range of information and communication technology (ICT) applications to support social and economic development. The first phase of this program involved the laying of an international submarine fibre optic cable between Suva, Fiji and Nuku'alofa, Tonga (Figure 1) in June 2013 and the connection of the Tonga Cable ('cable') to the internet service providers in Tongatapu.

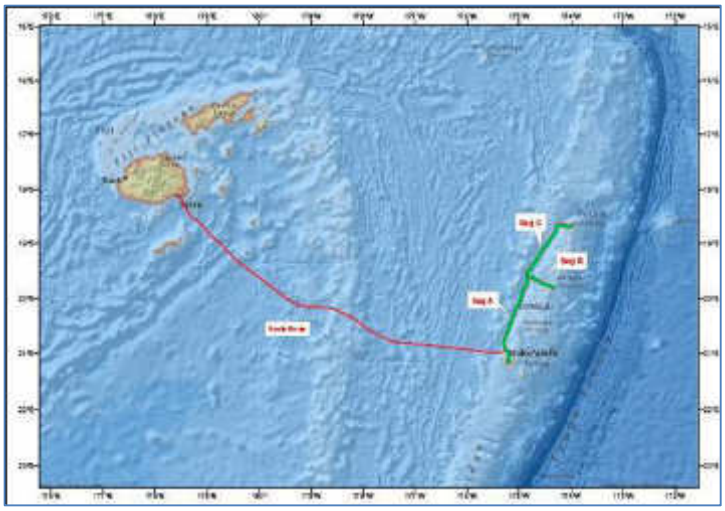

Figure 1: Tonga Cable Route including proposed cable extension (green)

The Tongan Cabinet has approved the extension of the cable and this second phase of the project is now underway. The second phase involves the cable being extended to two Tongan outer island groups, Ha'apai and Vava'u. The Tonga Cable extension will be comprised of three sections: Section A from Sopu in Nuku'alofa, Tongatapu to a Branching Unit (BU) 50km off the coast of Ha'apai, Section B from the BU to Pangai, Ha'apai and Section C from the BU to Neiafu, Vava'u (Figure 2).

For the remainder of this report, each of the landing site locations will be referred to by their town names: Nuku'alofa in Tongatapu, Pangai in Ha'apai and Neiafu in Vava'u.

At the landing sites, the cable will be run through conduit between the Landing Points (LP) and pulled through to the Beach Manholes (BMH). At this point, the ends of each cable section will be connected to the Terminal Stations (TS) in preparation for commissioning. The BMH and TS in Nuku'alofa is already operational at the TCL compound. In Pangai, a new BMH and TS, will be installed, while in Neiafu a BMH and new TCL compound, housing the TS and TCL offices, will be constructed.

The system will include 337km of unrepeatered cable between Nuku'alofa and Neiafu, plus 53km of unrepeatered cable to Pangai (Figure 3) with a new Terminal Station (TS) and office building facility also being constructed close to the LP in Neiafu. Table 1 lists these locations and approximate coordinates for the cable landings.

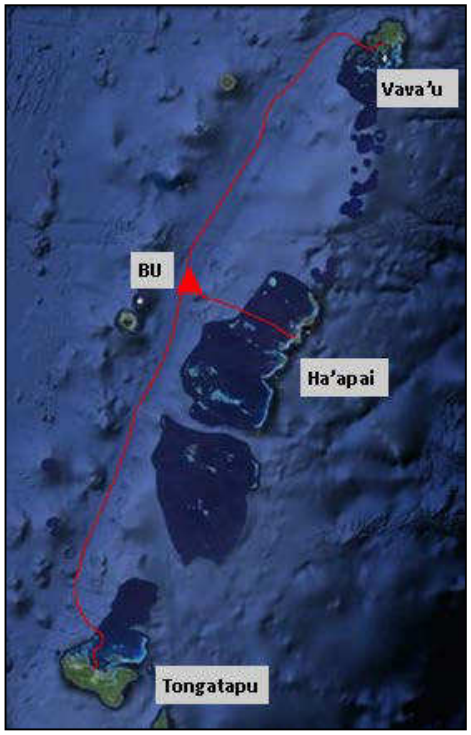

Figure 2: Planned Tonga Cable Extension route

Table 1: Coordinates of landing points, beach manholes and terminal stations for Sections A, B & C of the Tonga Cable

	Nuku'alofa	Pangai	Neiafu
Landing Point	21° 7.462'S 175° 13.155'W	19° 48.453'S 174° 21.10'W	18° 39.098'S 173° 59.174'W
Beach Manhole	21° 7.498'S 175° 13.160'W	19° 48.460'S 174° 21.080'W	18° 39.092'S 173° 59.162'W
Terminal Station	21° 7.502'S 175° 13.177'W	19° 48.466'S 174° 21.044'W	18° 39.075'S 173° 59.130'W

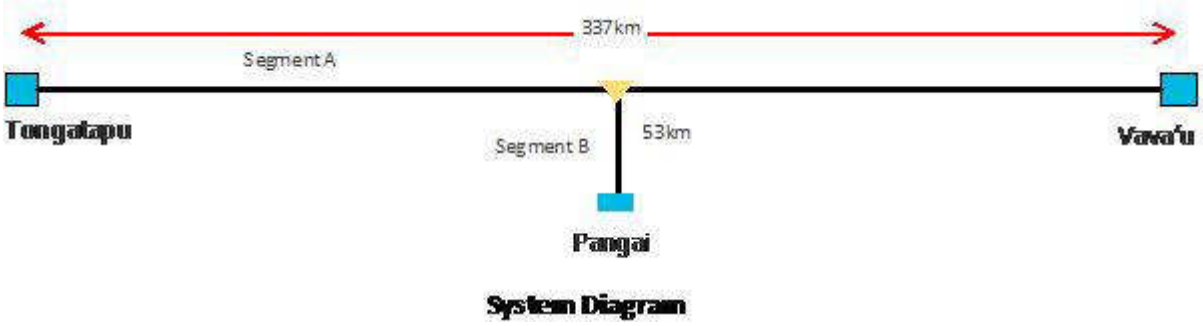

Figure 3: Schematic of Tonga Cable Extension system design (source: TCL)

Currently, internet services are provided to the outer islands via satellite systems by two providers: Tonga Telecommunications Company (TCC) and Digicel. The new cable will replace this system and connect the islands (via Nuku'alofa) to the Southern Cross Network through Fiji. It is expected to provide substantially higher capacity than the existing satellite links, and reduce international bandwidth costs. Once commissioned, the proposed cable will be operated as a point-of-contact service for local wholesale and retail providers (currently TCC and Digicel).

In March 2013, based on the outcomes their Cable Route Survey (CRS), Alcatel-Lucent completed a Marine Route Survey (MRS) of the proposed cable route. This survey investigated the bathymetry, seabed features and shallow geology along the proposed route and undertook a subsequent geotechnical sampling program. In addition to this, the Alcatel-Lucent completed a topographic survey at the landfalls. The Tonga Cable extension will comprise of a wholly new unrepeatered fibre optic cable system based on the specific requirements resulting from the CRS and MRS reports.

The following subsections of this chapter are largely informed by the CRS, MRS and from technical details provided by TCL.

2.2 Route and Project Site Description

The final planned cable route, as detailed in Alcatel-Lucent's' MRS has been mapped below (Figures 4, 5, 10, 14 and 20). Bathymetry for the entire route has also been provided through the MRS and in included in the maps

Landing site planning, as provided in the MRS and by TCL, has been depicted in the relevant images, and the terrestrial project sites are described separately in each section.

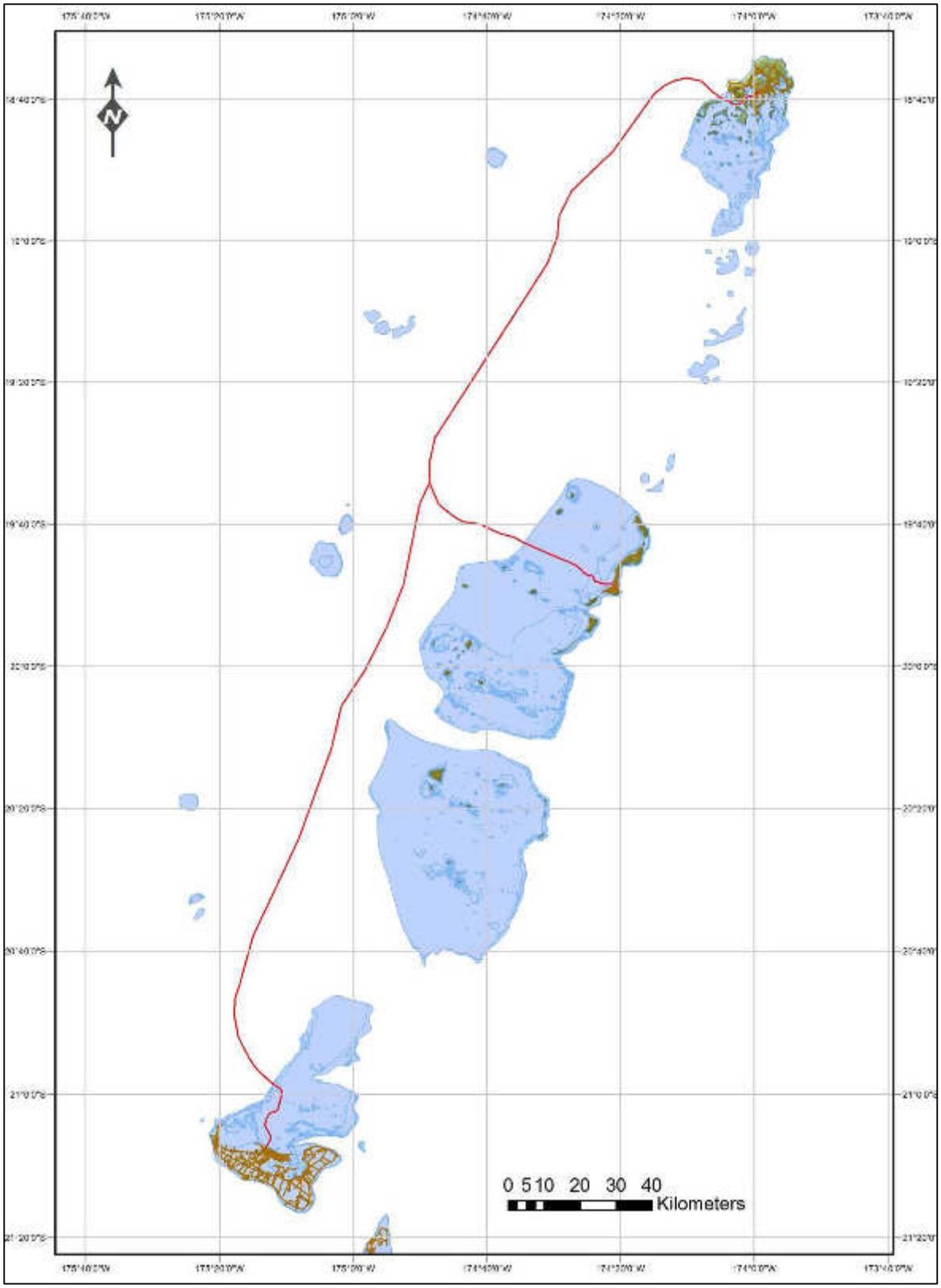

Figure 4: Tonga Cable Extension route plotted with Tongan reef systems using MRS route position list (RPL) data.

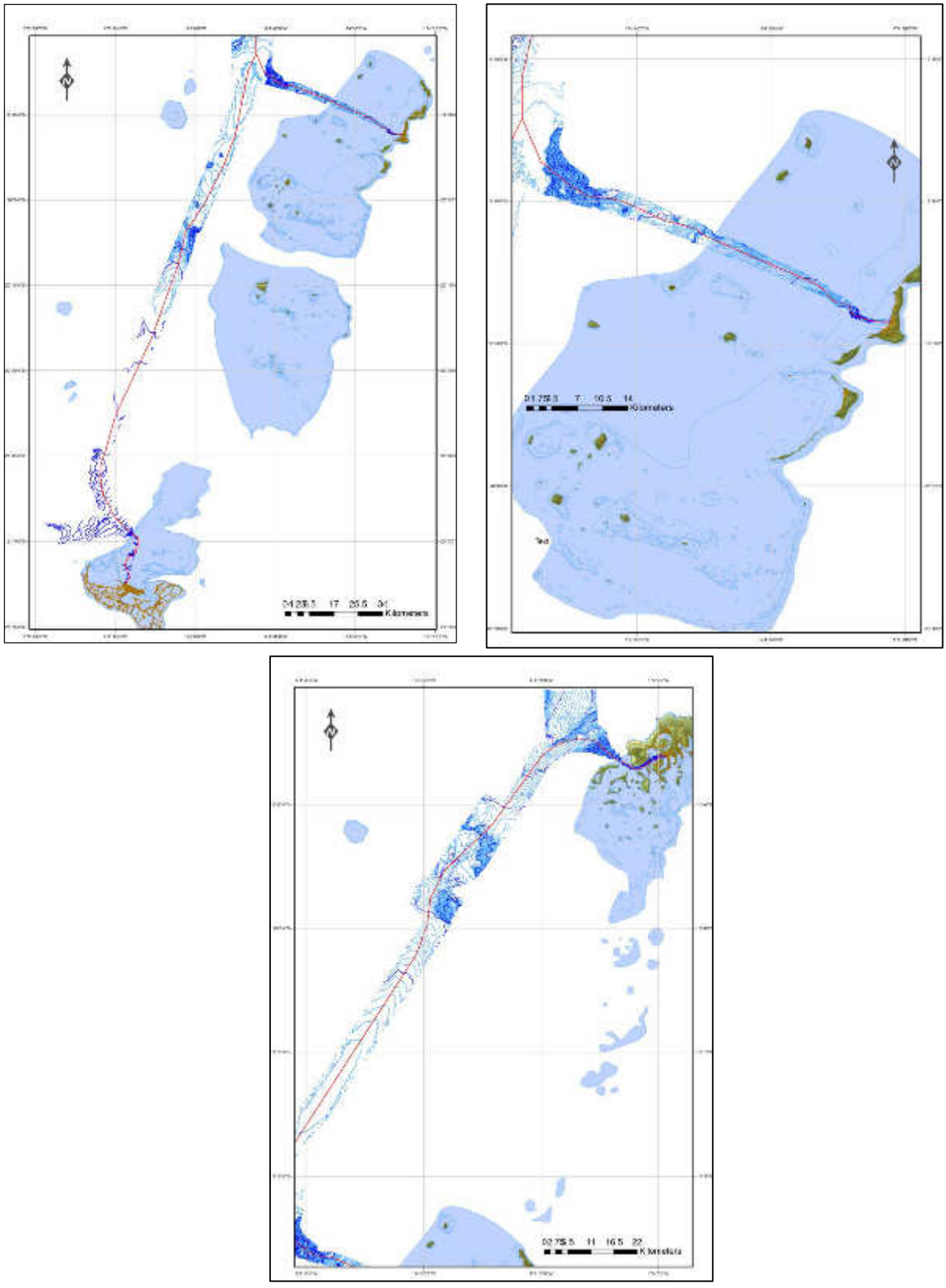

Figure 5: Tonga Cable route Sections A (t-l), B (t-r) and C (b-m) with bathymetry. Adapted from: MRS GIS data

2.2.1 Project Site Description: Tongatapu

The BMH (Figure 6) and TS in Nuku'alofa are already operational and currently house the commissioned Fiji-Tonga section of the Tonga Cable in the TCL compound 65m to the south of the LP. Leaving the TS, the route crosses the asphalt paved Vuna Road and enters a fenced off government owned area. The route then crosses a 2m wide footpath between the government owned area and the seawall before entering the landing beach (Figure 7).

Figure 6: (l) Interior of BMH in Nuku'alofa, and (r) external view of BMH design

The seawall is 0.8m high, made of large coral blocks and covered with loose vegetation (Figure 8). Articulated conduits to house the new cable were pre-laid during the construction phase of the Tonga-Fiji cable and join the BMH to the existing LP at 21° 7.462'S, 175° 13.155'W.

Figure 7: Tonga Cable route across reef platform, to the LP and terrestrial route through to TS

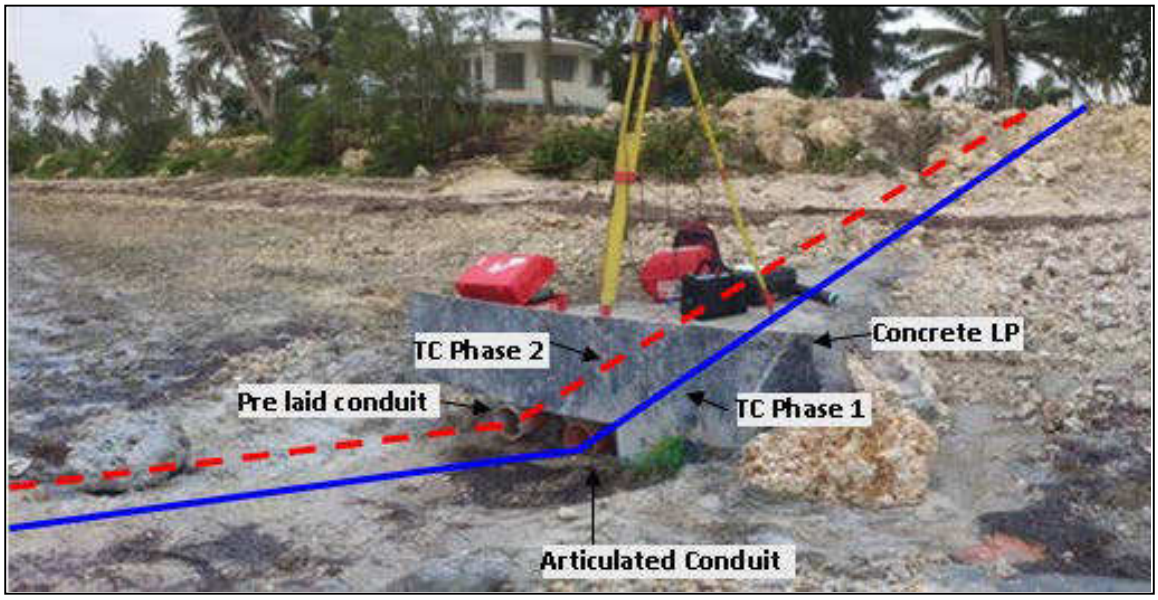

Figure 8: Construction works at LP, Nuku'alofa (2013). Planned new cable route is shown in red.

The LP is on a 5m wide gravelly sand beach and is marked by a concrete slab with the articulated ducts on the landing beach being protected by concrete (Figure 9).

Figure 9: LP in Nuku'alofa looking west along landing beach at low tide.

2.2.2 Route Description: Tongatapu to BU

From the LP and entering the sea, the route runs on the seafloor with very gentle sloped gradients. The first 500m of the route from the HWM is classified as a reef platform and has a water depth (WD) of 0m lowest astronomical tide (LAT) before reaching the reef crest and descending over a very steep coral reef edge (gradient in excess of 20°). From this point, the

route curves between the northeast and northwest to avoid unfavourable seafloor topography and to run within a legally designated 'Anchoring and Fishing Prohibited Zone' (Figure 10). Finally, the route heads to a northwest direction preparing to descend the Tonga Ridge perpendicularly and deepens towards the northeast along the route and comprises, generally, of very soft slightly sandy, silty clay with scattered low to high relief coral rock.

Figure 10: Inshore cable route with bathymetric data (Adapted from source: MRS GIS Data)

The planned route (Figure 5a) begins to descend the very steep Tongan Ridge (slope gradients in excess of 50°) towards the northwest over a rocky seafloor at approximately 20km along the route (kilometre point - KP20) from the LP dropping from 45m to 490m WD within 1km. The planned route continues along this path and from the 1000m at 28KP to the 50KP, the route continues to descend the uneven western flank of the Tonga Ridge. The route proceeds to the northwest and gradually turns to the north-northeast. At KP38, the route crosses from the Tongan Territorial Seas to the exclusive economic zone (EEZ) and reenters the Territorial Seas at KP52 and continues to the BU at KP189.

2.2.3 Project Site Description: Ha'apai

A new BMH is proposed for 19° 48.4596'S, 174° 21.0796'W (2.77m above LAT) in the northeast corner of the garden of the Ministry of Justice, near the junction of Holopeka Road and Faifekau Road (Figure 11). The garden has the foundations of a cyclone damaged wooden building along with occasional bushes and trees. The landing beach is located to the west of the Ministry of Justice and is separated by a fence.

Figure 11: Ministry of Justice grounds in Pangai with surveyed BMH location outlined in red.

The LP (Figure 12) is located at 19° 48.4528'S, 174° 21.0955'W on the landing beach, approximately 3.5m to the west of the garden. The landing beach is 10m wide at high tide and gently sloped. The north of the beach is flanked by an old broken jetty, while the south is flanked by large fallen trees and a private property with a retaining seawall.

Figure 12: Cable route from waterline to LP and onwards to BMH

The terrestrial area to the north of the proposed route is prone to flooding; however the BMH is located outside this vulnerable area (Figure 13). From the BMH, the planned route travels due east for approximately 110m along Faifekau Road to an area of undeveloped land adjoining the TCC compound. A new TS will be built at this location to house the connection of the Tonga Cable extension. Details of the TS are still in the developmental stage following a change of TS location from the TCC compound to a new nearby site (Figure 13)[1].

[1] Details of the TS will be provided and impacts assessed for insertion into the Final Draft EA

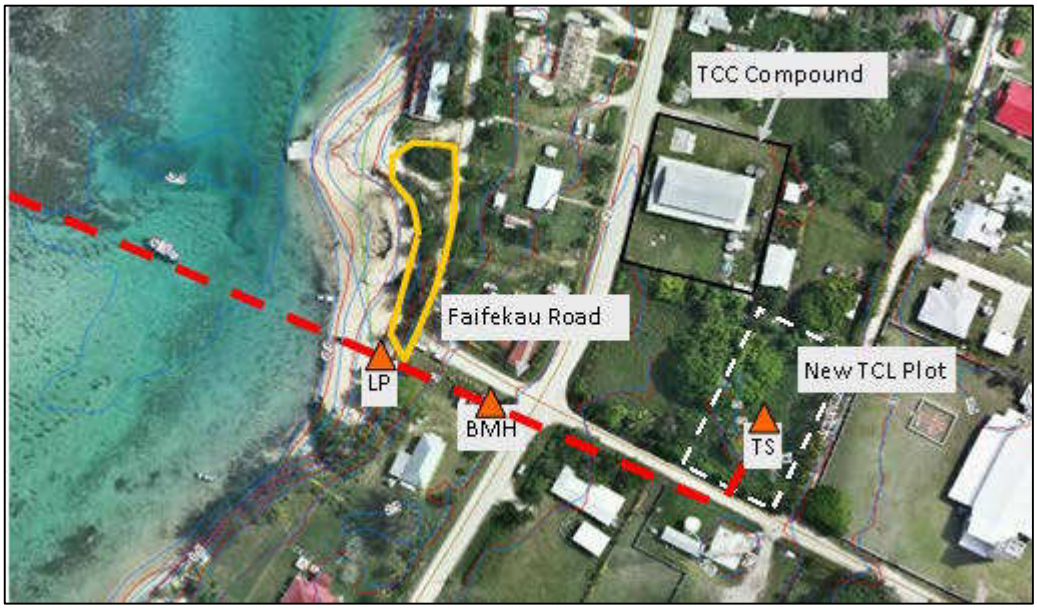

Figure 13: Google Earth imagery of Pangai project site. LP, BMH and proposed new TS location are shown. Flood prone area is outlined in yellow.

2.2.4 Route Description: Section B

The proposed route heads in a nearly west direction from the BMH to the LP and onwards to the sea. The route descends a moderate to steep (gradients up to 10°) coral reef crest (Figure 14).

The shallow sediment comprises predominantly loose sand/gravel with scattered patches of coral and seagrass. Beyond KP1.4 the proposed route descends rapidly along a seafloor with moderate to very steep slope gradients (in excess of 20°). The cable hand over point in Ha'apai can be found at KP5 and from that point the planned route (Figure 5b) heads in a north-westerly direction following a dog-leg pattern to descend along the axis of a channel with a broad base and very steep slopes on both sides. The cable continues to move towards the northwest, gradually deepening. At KP46, the route crossed the 1000m contour and at KP47 it starts descending the very steep Tongan Ridge, joining a semi-abyssal plain at KP50 in 1760m of water and connecting to the BU at KP57.

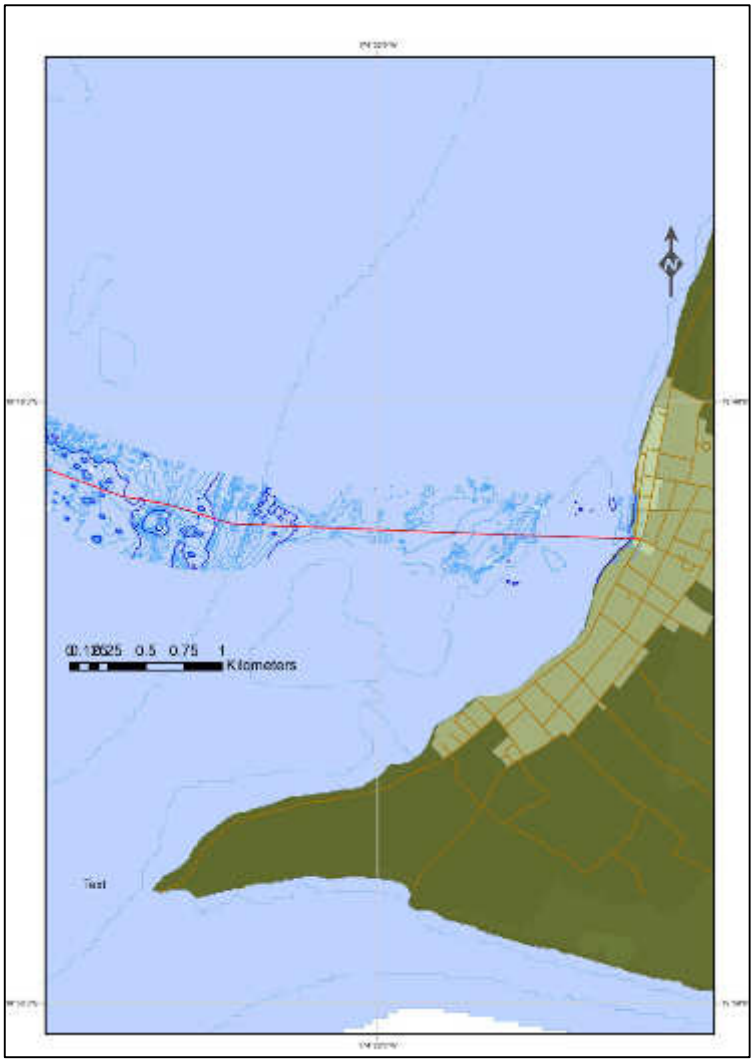

Figure 14: Pangai inshore cable route with bathymetry (Adapted from source: MRS GIS data)

2.2.5 Project Site Description: Vava'u

The project site in Neiafu is located at the northwest corner of the Halaevalu Wharf. The proposed route approaches the LP from a southwest direction. It runs over a rapidly rising seabed and is landed by passing through a seawall made of coral rock. The LP at 18° 39.096'S, 173° 59.170'W is located on concrete sealed reclaimed land bounded by fenced enclosures that were designed to be used as storage areas for fishermen. Approximately 35m to the northeast of the LP, the proposed route reaches the surveyed BMH. Following from the TS, the route ascends a steep slope (gradients between 30°-40°) for approximately 20m towards the north-northeast before terminating.

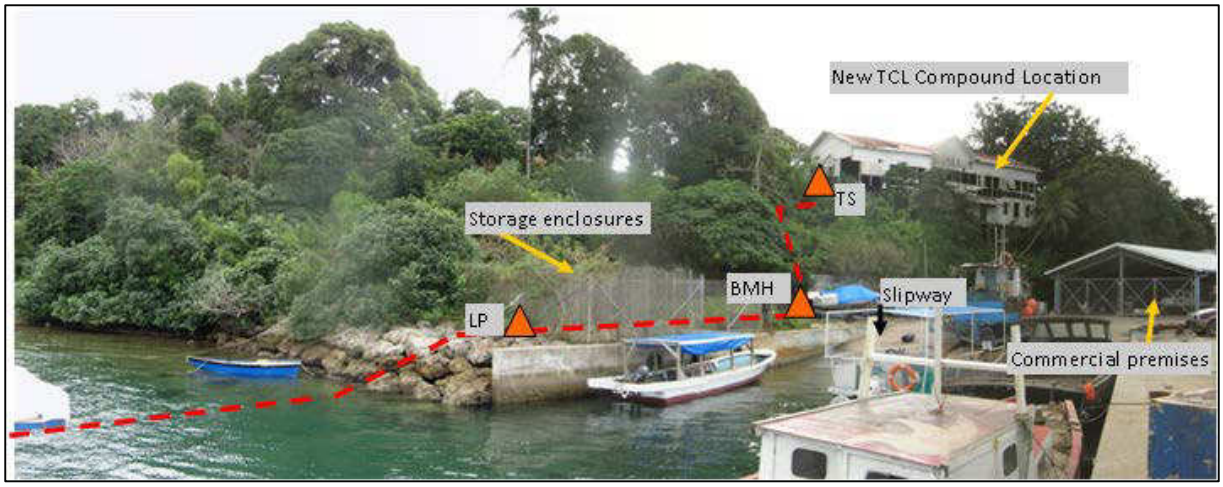

Figure 15: View from main dockside at Halaevalu Wharf looking along route towards new TCL site and BMH

Figure 16: Google Earth imagery of Neiafu project site with LP, BMH and TS

The new TS facility to be built in Neiafu is located on Fatafehi Road, approximately 55m northeast of the LP at Halaevalu Wharf (Figure 16). The site is a developed plot of land that formally housed the Vava'u Club. The clubhouse itself has recently been removed from the site following the degradation of the structural integrity, leaving the site as an abandoned and unsecured foundation slab and support pillars (Figure 17). The entire plot is approximately 500m^2 with the rear portion being formed of a steep slope of exposed soil, vegetative scrub and occasional palm trees (Figure 18).

Figure 17: View of Neiafu TS site from Fatafehi Road

The new building planned for Neiafu will house offices along with kitchen and bathroom facilities on the entry-level floor. The lower level of the building will consist of five rooms to house the TS and other technical aspects of operations. The entry-level floor of the building will open onto a supported balcony, overlooking the rear of the property. Externally, there will be chip seal driveway wrapping around the building and off-road parking for three vehicles. The chip sealed areas will be edged by landscaped sections and the entire complex will be surrounded by secured fencing. Septic tanks and soak away pits will be constructed to deal with all waste water.

A 2.5m high retaining wall can be found along the boundary between the site and the wharf. This wall plays and important role in retaining soil thereby limiting erosion. There is currently a large amount of debris and vegetation built up behind the wall that may be reducing its soil retaining function (Figure 18).

Surrounding buildings are a mixture of residential properties and commercial premises (Figure 19) with the eastern side of the site progressing towards the commercial center of Neiafu and the western side progressing towards the residential area of Mount Talau.

Fatafehi Road is a minor road leading from the outskirts of the Mount Talau residential area, to the main town of Neiafu. It is used by pedestrians and vehicles, however vehicle traffic levels are low compared to the relatively low level of traffic in Neiafu town itself. There are no pavements (pedestrian sidewalks) on the road and pedestrian traffic uses grass verges, or more commonly, the road itself.

Figure 18: View of Neiafu TS location from rear of Halaevalu Wharf. Retaining wall, slope and Vava'u Club foundations are shown

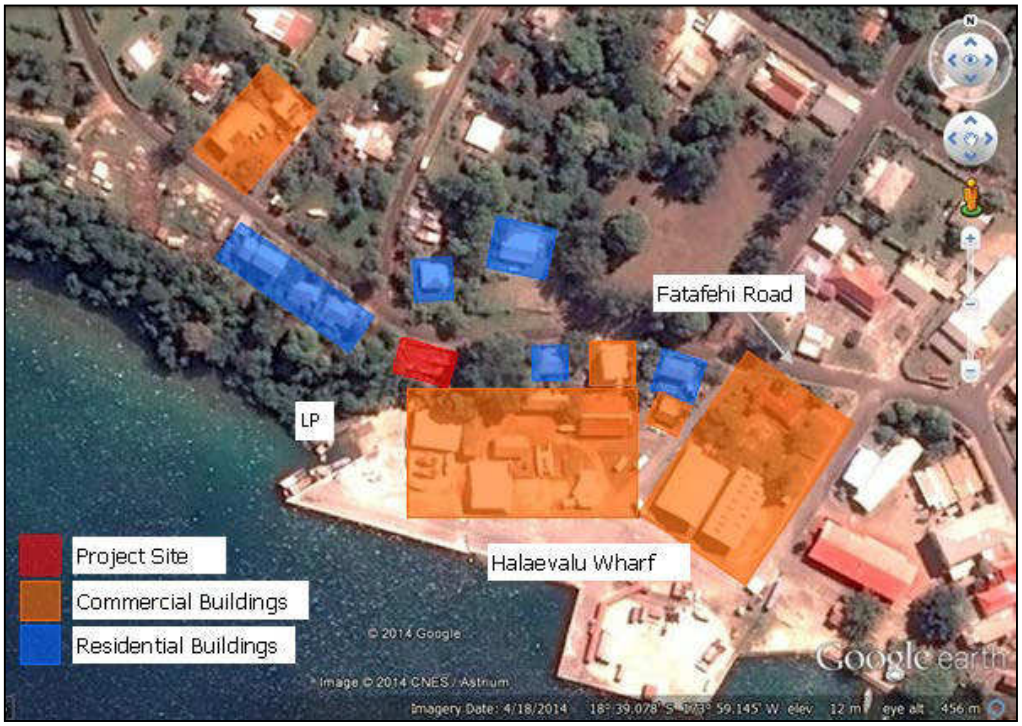

Figure 19: Distribution of commercial and residential properties in vicinity of Neiafu TS

2.2.6 Route Description: Section C

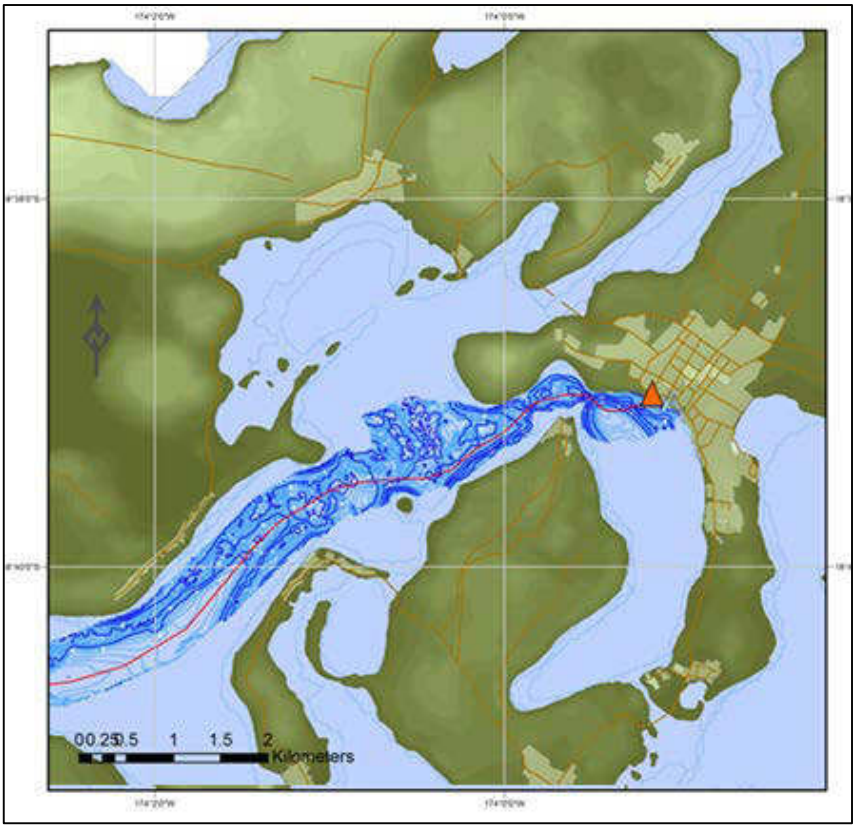

Figure 20: Neiafu inshore cable route with bathymetry. (Adapted from source: MRS GIS data)

Leaving the LP and moving southwest, the route makes a near 90° turn towards the northwest and shoals over a very steep rocky coral seabed with slope gradients up to 24°. The route then passes through the narrow harbour shipping entrance channel at KP0.6 that is surrounded by high relief rock and coral (Figure 21). From this point the route follows the rugged high relief seabed moving gradually southeast (Figure 20) until the cables hand over point at KP1.7, approximately 1km from the harbour entrance. The cable then proceeds to move southeasterly along a continuing rugged seabed until turning towards the northwest and exiting the island group through the Hunga Island northern pass at KP16 in approximately 100m of water. The cable route (Figure 5c) then travels progressively southeast and crosses the 1000m contour at KP16 before descending the Tongan Ridge. The route then shoals over a scarp that peaks at 150m between KP32 and KP54 before descending to 1470m and crossing the Territorial Sea and EEZ boundary at KP60. The route continues to progress southwest over a semi-abyssal plain until the BU at KP151.

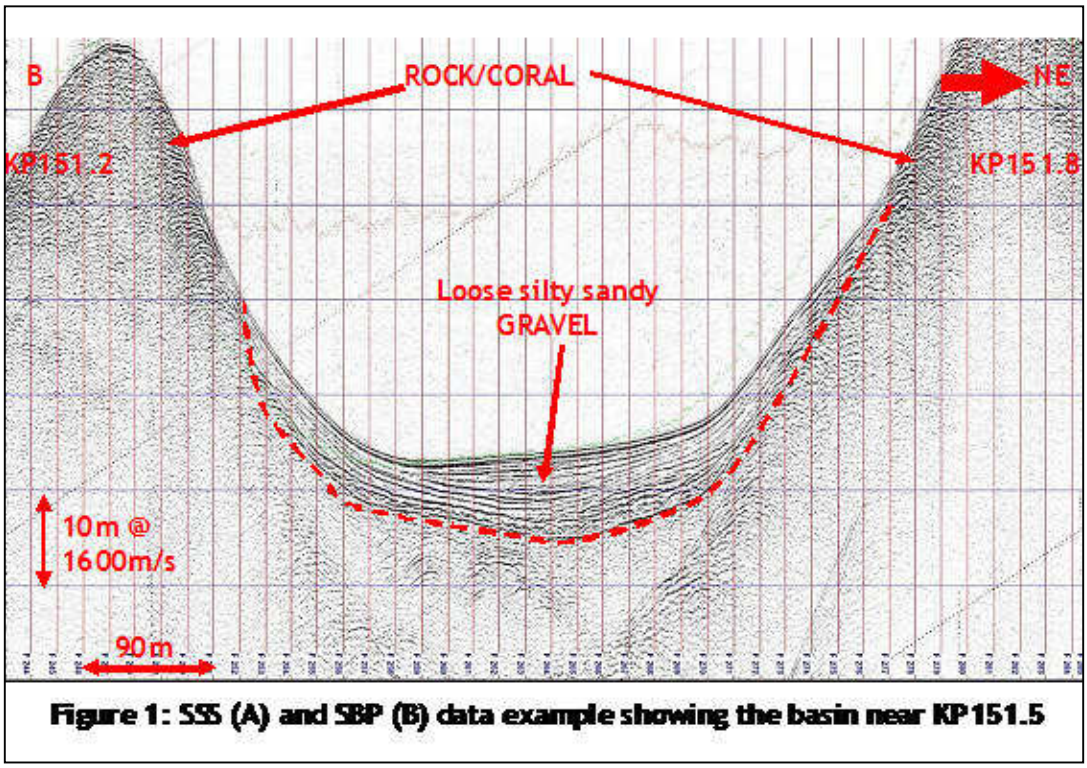

Figure 21: MRS scan of Neiafu harbour shipping entrance

2.3 The Beach ManHole

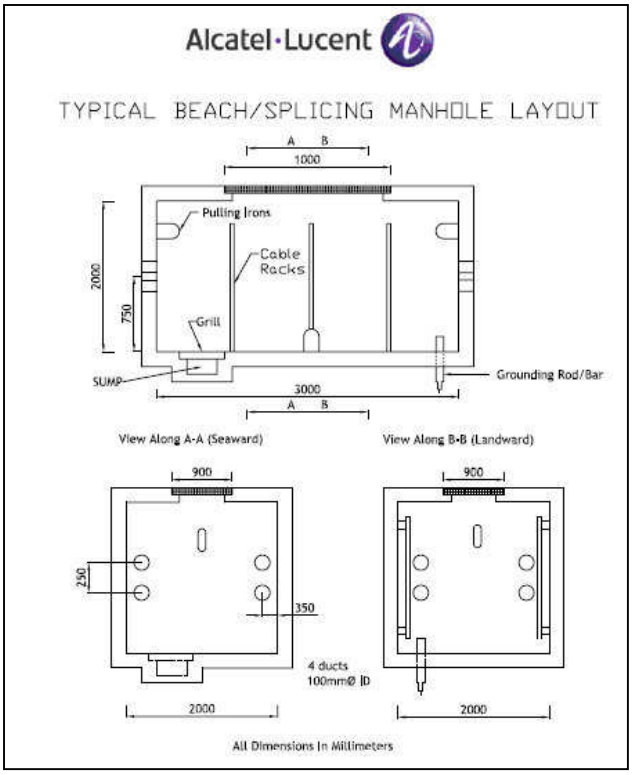

Figure 22: Design specifications of BMH

New BMHs will be constructed in Ha'apai and Vava'u to house the cable and in Nuku'alofa the existing BMH at the TCL terminal station site will be used. The proposed sites for the BMHs have been surveyed and detailed plans have been developed. The BMHs will be concrete structure, approximately 2m wide, 3m long and buried to a depth of 2m. Access will be at ground level through a 1m x 0.9m assess hatch in the roof. The BMH will contain ducts through which the cable will pass from its seaward to landward side and it will be supported within the structure on a series of racks (Figure 22).

2.4 Cable Characteristics and Installation Method

This section details the specifications of the cable system design and describes the various operations that are necessary to complete the installation process.

2.4.1 The Fibre Optic Cable

The cable is designed to operate for the full 25-year design life of the system. The system specifications (Figure 23) state that it will be an unrepeatered system and there will be a 3.6km length of stronger cable (LWP20 vs. LWP14) in Section C to allow for the deployment and recovery of the BU.

Figure 23: Tonga Cable extension system specifications (Source: TCL)

In total the cable system will be comprised of 37.2km of double armoured cable, 72.6km of single armoured cable and 178.9km of light weight protected cable. Figure 24 provides the design specifications of these cable types.

DA – refers to a Double Armour cable suitable for unrepeatered systems

SA - refers to a Single Armour cable suitable for unrepeatered systems

LWP – refers to Light Weight Protected cable suitable for unrepeatered systems

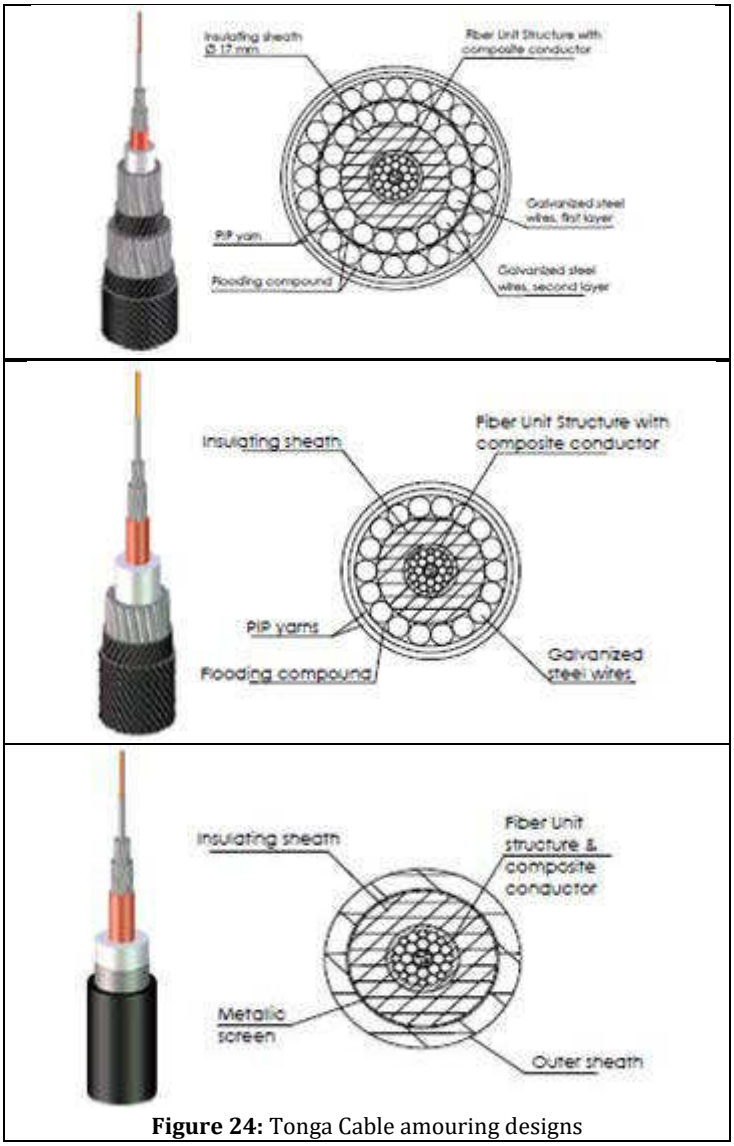

Figure 24: Tonga Cable amouring designs

Submarine telecommunications cables that are in current production by many suppliers use polyethylene for insulation. This material is exceptionally stable and hydrophobic. It is typically used in the transportation of water for human consumption in construction and domestic installations. It has no components that leach. The armour wires typically used are in carbon steel with a zinc coating to minimise the corrosion of the steel. Minimal chemical dissolution of the zinc can be expected at a very slow rate when exposed to the sea. The outer layers of the cable are designed to keep the galvanized wires protected from the seawater and consist of several layers of polypropylene yarn impregnated with bitumen. Polypropylene (like polyethylene) is a very common material used for the storage of potable water and similarly does not leach any material. The yarn is similar to that used in agricultural binding twine and some fishing netting.

2.4.2 Cable Protection Considerations

Figure 25: Articulation on submarine cables. Pinning on hard substrate is shown. (t)

It is possible to protect the cable in areas of vulnerability by encasing it with an articulated armouring (Figure 25b). Articulated piping serves to increase cable protection against chafing caused by wave action and will be of particular importance where the cable cannot avoid routing over rock or coral in area of shallow water wave action. It has already been determined that articulation will be used in the short section of shallow water immediately before the Vava'u LP. This section of the route is close to an anchorage zone and the articulations will serve to protect the cable from any anchor damage. There is also some merit in considering this (Figure 5a) for sections of the foreshore in Ha'apai where the cable will be laid over a raised pavement and be exposed to the wave action of storms.

2.4.3 Cable Installation

Main Lay Cable - The main lay will involve laying the cable along a pre-determined route using a special purpose cable ship. It is expected that the cable laying vessel will employ all of the latest technologies and equipment, including dynamic positioning systems that allow vessels to maintain accurate positioning and therefore do not need to deploy any anchors during installation operations.

Figure 26: Typical Cable Laying Vessel

Figure 27: Branching Unit (source: Alcatel-Lucent)

The Tonga Cable extension route is subdivided into three sections and will, likewise, be laid in three separate operations. Section A will be laid from the BMH in Nuku'alofa to the BU (Figure 27), Section B will be laid from the BMH in Ha'apai to the BU and Section C will start at the BU and finish at the BMH in Vava'u.

Once the laying of the seaward end of the cable has commenced from the main lay vessel, it is initially payed out slowly with the vessel moving slow-ahead until the cable reaches the seabed. This is the touch-down point and the from this point, the ship can increase its laying speed up to a practical maximum speed of about 6-8 knots. Occasional reductions of speed will be needed to control the tension in the cable and ensure cable laying is controlled. Once a steady state is achieved, the cable pay out speed should be approximately the ships speed plus 2-3% assuming consistent seabed topography.

Shore End Installation - With a draft of 7.22m, the main lay vessel cannot safely operate in waters less than 12-15m and will engage its dynamic positioning system while the shallow water and landward installations are completed. During this time, vessel will maintain an operating exclusion zone of 30m radius.

At the hand over points at each of the section ends, the end of the cable will be passed to a small local landing craft which will then pull the cable ashore along the planned route (Figure 28).

Figure 28: Cable landing operations, Tonga Cable 2013, Nuku'alofa

The cable will be floated to shore at the surface using a string of buoys. A temporary working area near the LP or BMH will allow equipment to be staged to pull sea cables from the beach or highway. A quadrant (Figure 29), secured by an excavator, will be used to mechanically pull the cable ashore for its placement into the conduit in the LP (Figure 30). As the cable comes ashore, crew of the small landing craft will remove the floats and allow the cable to settle on the seabed.

Figure 29: Cable pull quadrant, Tonga Cable, 2013, Nuku'alofa

Figure 30: Conduit installed at LP, Tonga Cable, 2013, Nuku'alofa

In Nuku'alofa, the terrestrial construction work has already been completed and it is expected that the cable can be landed at the LP and pulled through to the BMH within one day. In Ha'apai, the cable landing will be completed within one day. Once the cable is landed, the terrestrial works will commence and could take several days, depending on the conditions at the site and the capabilities of the machinery. In Vava'u, the TS construction is expected to be completed by the end of November 2014 and once the cable is landed, terrestrial works will commence, taking up to several days to complete, depending on the remaining work needed at the Halaevalu Wharf following TS construction.

All shore based equipment, tools, and waste material will be promptly removed from the site. The LP sites will be restored after the cables are pulled and secured.

2.5 Pre-installation Surveys and Studies

The design phase of the project has been completed to a stage where the final planned route has been surveyed and detailed route position lists (RPLs) have been developed for each section of the cable. This surveying was carried out using two separate studies:

- A Cable Route Study (CRS), comprising a detailed review of all factors affecting the routing of the cable, including physical, environmental, socio-economic and regulatory aspects.
- A Marine Route Survey (MRS), comprising separate sidescan, sonar diver video and grab sample surveys for the inshore and offshore sections. The report was completed in October 2012 and it discusses the survey operation carried out for the MRS and presents detailed results of the final cable route. It comprises a descriptive text and charts showing the bathymetry and geomorphology along the route (samples of data collected are shown in Figures 31 and 32), together with appendices of supporting information.

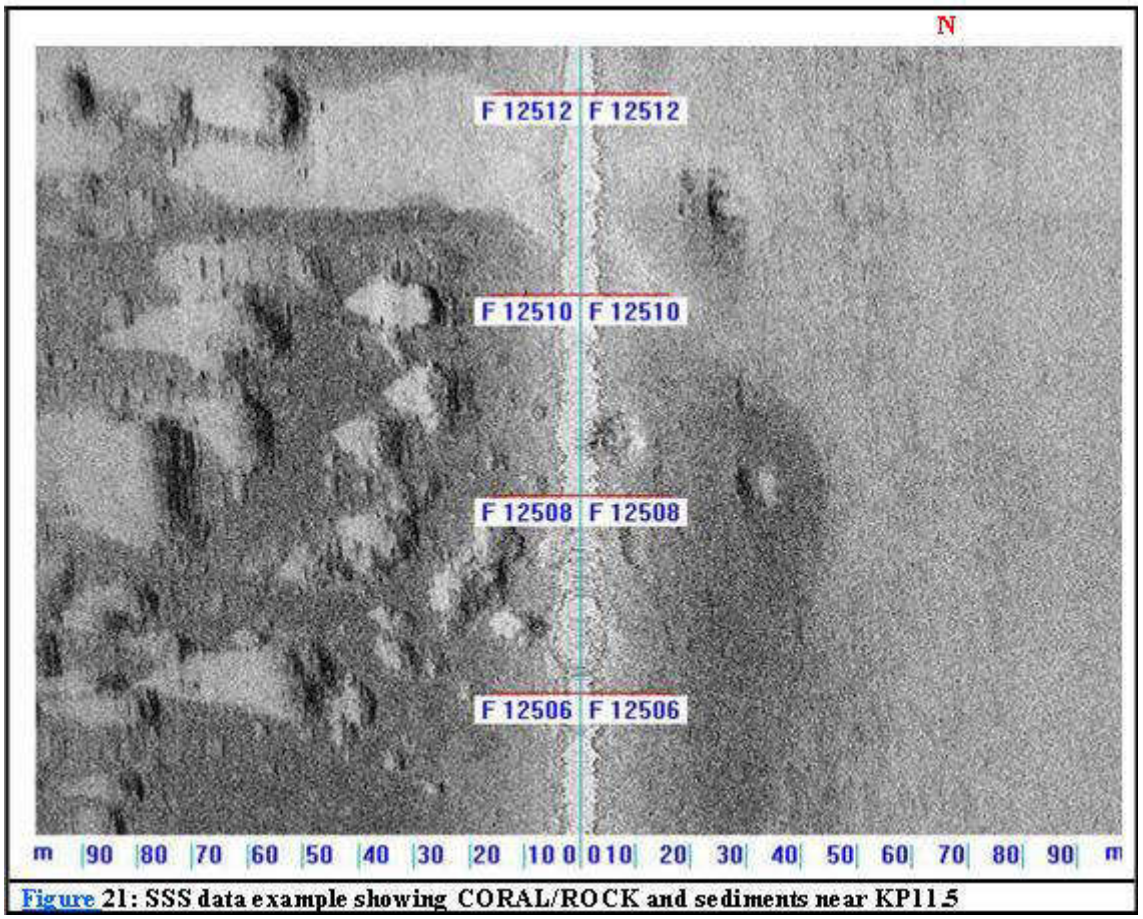

Figure 31: Sample MRS Sidescan Sonar output

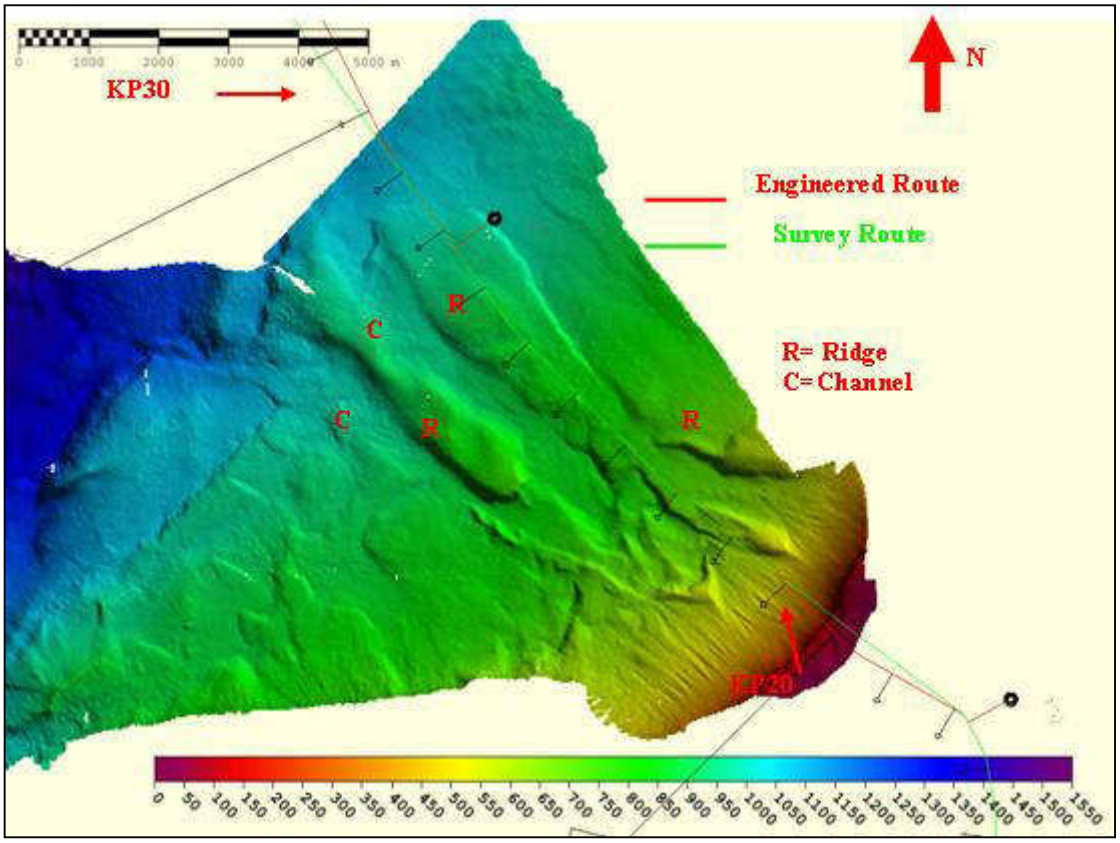

Figure 32: Example MRS sunlight bathymetry output

Following the marine route survey, the route was chosen to take in to account seabed features such as underwater canyons, scarps or seamounts.

2.6 Cable Maintenance

The design life of this system is 25 years and installed, the cable needs no routine maintenance. In the normal course of events, recovery should only be necessary if the cable becomes damaged from some external source. Recovery generally entails:

- Location and recovery of the cable using a specialize grapple.
- Lifting cable to the maintenance vessel.
- Replacement of damaged section – usually involved cutting and splicing a new length of cable (5km).
- Returning cable to seabed.

3. Analysis of Alternatives

3.1 Introduction

In consideration of this project, a number of alternatives were assessed, including the 'no action' alternative. The findings of these assessments are detailed in this chapter.

3.2 The 'no action' Alternative

The 'no action' alternative would avoid any of the potential environmental or social impacts associated with this development. However, if the 'no action' alternative were selected, the Pacific Regional Connectivity Program's objectives of reducing the cost and increasing the bandwidth for participating countries and facilitating the development of a wider range of ICT applications along with supporting social and economic development would not be met.

It is concluded that the 'no action' alternative should not be recommended.

3.3 Proposed Landing Site Alternatives

During the project construction for the Tonga–Fiji phase of the Tonga Cable, conduit was laid in preparation for this second phase of the project, therefore, for the purposes of this assessment, no alternatives have been considered for the Nuku'alofa landing site.

3.3.1 Alternate Landing Sites Ha'apai

Two beach locations were considered for the landing of Tonga Cable Section B. The first beach LP considered was just to the south of Muikuku Point at the end of the runway and the TS was proposed at the Salote Pilolevu Airport, 3km north of Pangai (Figure 33). The beach at this proposed LP experiences high levels of coastal erosion that makes it a vulnerable location. Additionally, the terrestrial route to the proposed TS at the airport would need to cross a large number of private properties in the village of Koulo and would cover a distance of just under 1km.

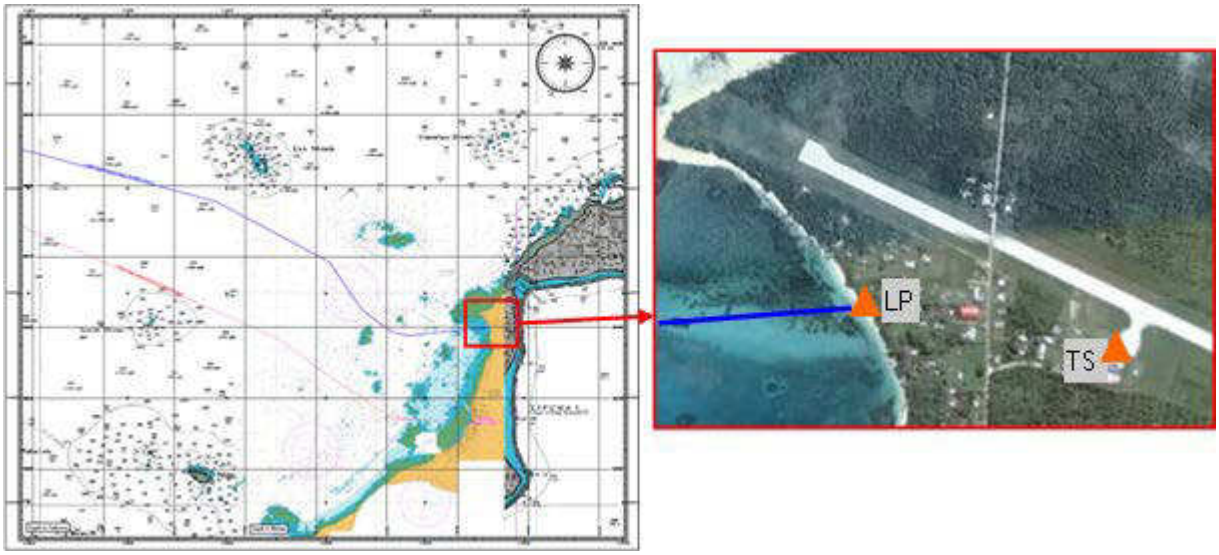

Figure 33: Proposed alternative landing site and route (blue), Ha'apai

The preferred alternative is a small, unnamed beach approximately 450m south of the main port (as described in section 2.2). This site was selected because of its easy access and ideal location for a direct landings and it shows very limited signs of erosion compared to most places along the western coast of Ha'apai due to the protection afforded from a reef pavement directly offshore. Additionally the BMH site could potentially be located in the grounds of the Ministry of Justice, which avoids any land ownership issue. Furthermore, the LP is less than 300m from the original chosen site for the TS in the TCC grounds.

3.3.2 Alternate Landing Sites: Vava'u

Two locations were considered for the landing of the Tonga Cable Section C in Vava'u. The first LP was at the base of Mount Talau (Figure 34) but was disregarded due to its difficult access for machineries and possible land ownership issues. This proposed LP is also located more than 4km from the proposed TS in Neiafu.

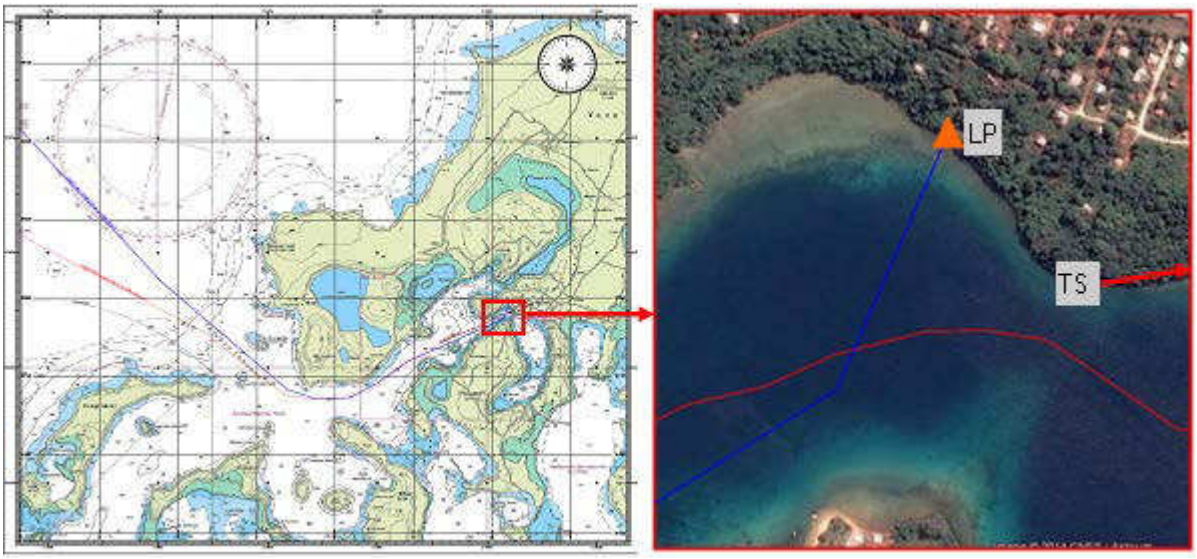

Figure 34: Proposed alternative landing sites and route (blue), Vava'u

The preferred alternative is in the town of Neiafu at the western end of the Halaevalu Wharf (as described in section 2.2). This site was selected because of its easy, direct access and ideally location for a direct landing. The site is currently administered by the Ministry of Fisheries, which avoids any land ownership issues.

Two locations were considered for the TS in Neiafu, the preferred option was to build a new office and TS facility on government owned property above the wharf. This option depended on being able to secure the rights to the property from the Government of Tonga. The secondary alternative was to build a new TS at the nearby TCC compound, 250m from the LP at Halaevalu Wharf. The preferred option is being implemented the land was allocated to TCL for use in the project.

3.4 Cable Design Alternatives

During the design phase of this project, a review was undertaken on whether to install a repeatered or unrepeatered cable for the Tonga Cable extension. Repeaters are a submerged housing that boosts the telecommunications signal at regular intervals along the cable. Each repeater is powered via an electric current that is fed into the submarine cable system from the shore based terminal stations. All telecommunications signals lose strength in proportion to the distance travelled, which explains why repeaters are only required on the longer (generally greater than 450km) submarine cable routes.

Unrepeatered systems are usually the solution implemented in shorter systems, such as this planned extension. Furthermore, repeaters and their associated power feeding equipment, greatly increase project costs. An unrepeatered system also has the added benefit of faster installation than a repeatered cable and less maintenance issues. For these reasons, an unrepeatered system is the preferred solution and the one chosen for installation.

3.5 Route Selection Criteria

Selection of the marine route requires intense review and evaluation of physical, regulatory and commercial information. The route design followed the initial general route developed around significant bathymetric features and then utilized desk surveys to provide a more detailed initial route (CRS report),. This route was then surveyed using sidescan and sonar technologies and video surveys of the near shore route to provide the final route adjustments and detail (MRS report).

Due to the engineering design process of the cable route, no alternatives were considered for the offshore route; instead the initial general route was refined and adjusted after survey.

In the inshore waters, there were two routes proposed for both Ha'apai and Vava'u, both of which correlated to the two proposed LP sites. The selection of the preferred LP option was the determining factor in the inshore route selection, with the route depending on the LP location.

3.6 Cable Submarine Installation Methods Alternatives

The CRS and MRS each assessed two methods of installing the cable on the sea floor: surface laying and plough burial. For the approaches to the landing site, the use of trenching was also considered as an option for cable installation.

Plough – The cable laying vessel will be equipped with a SMD-ALPHA Plough (Figure 35). The plough is launched from the stern of the vessel and lowered to the sea floor where it is towed by the vessel. The plough is designed to trench large diameter flexible products in a wide range of substrates. It can be used for post or simultaneous lay and burial. It is able to continuously vary its trench depth up to 3m. The plough works by lifting a wedge of soil and places the cable at the base of the trench. The 'spoil' from the trench is deposited either side of the trench. Specialised backfill features of the plough replace the spoil. The level of disturbance to the seabed from the use of a plough can be significant and can result in significant particle matter being suspended in the water column in WD less than 30m.

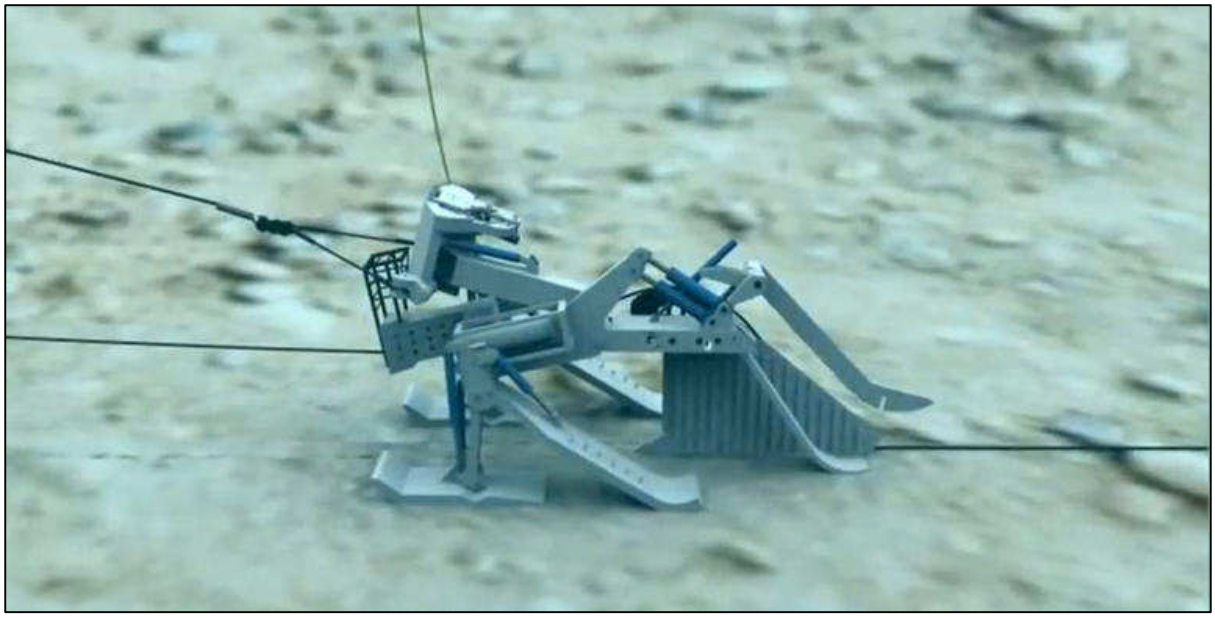

Figure 35: SMD Plough in deployment on the seabed

The plough itself can be up to 10m wide and can lay approximately 300-500m/hr. Cables can be buried in depths of up to 1500m, which is considered to be the maximum depths that bottom trawling fishing vessels can operate.

Inshore areas of the Tongan islands present poor plough burial conditions with widespread coral outcrops and coral heads and hard substrate under silt. The operating width of the plough would require significant sandy channels to avoid adverse impacts on coral communities.

In view of the above facts and the potential for significant adverse impacts relating to the use of the plough, it was recommended that the plough not be used for cable burial.

Surface Laying – the benefits of cable burial are to protect the cable from anthropogenic impacts such as bottom fishing/trawling or from anchoring of vessels. The risk presented to the

cable from damage by anchors in Nuku'alofa has been minimised by the relocation of the anchor zones for freight vessels awaiting pilotage. The risk of cable damage from vessels anchoring in Ha'apai and Vava'u can be reduced by the establishment of moorings away from the cable route. Fishing is assessed as posing very little to no threat.

In view of the above factors, the CRS and MRS recommended that the cable is surface laid at all landfalls, with the exception of the Sopu reef platform.

Figure 36: Reef platform trenching for cable burial, Tonga Cable, 2013, Nuku'alofa

Trenching – In relation to the Sopu reef platform, it was recommended that cable burial be examined as an alternative to surface laying due to the human use levels of the area. Trenching was considered as an alternative to surface laying in this location. Trenching is usually done with the use of a back hoe dredger (Figure 36) which has limited application in shallow water. This method can generally bury the cable up to 3m. Progress using this method is generally thought to be slow, averaging 200-300m/day subject to tides and currents.

Disturbance to the seabed can be relatively high (spill is typically assumed to be 5%-10% of the dredge volume) in local areas where tide/currents can wash the collected sediment off the top of the bucket. Trenching was selected as the preferred method of cable burial over the Sopu reef platform due to the shallow nature of the reef.

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4. Policy, Legislative and Regulatory Framework

4.1 Introduction

The policies, legislation, regulations and environmental standards of the Government of Tonga, which pertain to this development, along with all applicable World Bank and ADB safeguard policies have been researched and analysed, to ensure that the project complies with all policy, legal and regulatory requirements. The subject areas reviewed included environmental quality, health and safety, protection of sensitive areas, protection of endangered species, site selection and land use control at the regional, national and local levels, which relate to or should be considered within the framework of the project.

The regulatory framework for this project is the Communications Act 2000 that is administered by the Ministry of Environment, Energy, Climate Change, Disaster Management, Meteorology, Information and Communications (MEECCDMMIC). This Act provides the framework for the Ministry to establish the Department of Communications with functions that include the following:

- Advise the Minister on all matters concerning the national communications sector policy objectives.
- To implement, administer and enforce the provisions of this Act.
- To supervise and monitor communication sector activities.
- To ensure the observation and enforcement of international communications conventions and practices.
- To liaise with foreign governments on communications sector and other related matters.
- To determine such terms and conditions for network access arrangements between licenses.

The Department of Environment (within MEECCDMMIC) has the responsibility of administering the Environmental Impact Assessment Act 2003 and has established an Environmental Assessment Committee (EAC) to assess all developments proposed for Tonga and to determine the level of impact assessment that is necessary to proceed.

In this case, an EIA isn't automatically triggered by the legislation. However, as a requirement of the Asian Development Bank and the World Bank, a full quantitative and qualitative environmental impact assessment is necessary. This assessment fulfills all ADB/WB requirements as well as addressing all requirements of the Government of Tonga.

This section serves to review all relevant and applicable environmental laws of Tonga and all international laws protecting marine life, fisheries, marine protected areas, etc. and adequately identify the compliance requirements of these laws.

4.2 Applicable Tongan Policies, Legislations, Standards and Regulations

4.2.1 Environmental Management Act 2010

This Act defines the Tongan Government's role in relation to all environmental management and decision-making processes. It also enables the Ministry to liaise with all other Ministries and Departments in relation to meeting their obligations in relation to the protection of the environment and the development of natural resources of the Kingdom in ways that are consistent with the purposes of this Act. Those purposes include:

- Co-ordinate the role of Government in relation to all environmental management, including climate change issues, and decision-making processes.
- Promote meaningful public involvement in relation to issues of environment management, including climate change.
- Ensure the observance within the Kingdom of its international obligations relating to the protection of the environment.
- Promote the concept of sustainable development in relation to the environment and natural resources of the Kingdom.
- Facilitate an assessment of the impacts on the environment of any activity likely to affect it, prior to a proposed activity taking place.
- Promote the understanding, management, conservation and protection of the biological diversity of the Kingdom.
- Facilitate implementation of measures to increase the resilience of the Kingdom and its environment to climate change.

The Act defines the functions and powers of the Ministry in relation to its obligations towards environmental management. Those that can be considered to be in relation to this project are outlined below.

The functions of the Ministry as defined in the Act include:

- Monitoring impact on the environment.
- Conducting all matters necessary for the observance of the international and regional conventions to which the Kingdom is a party. The conventions applicable to this project are listed, along with the year that Tonga acceded, in the Schedule of this Act as being: Convention on Biological Diversity (1998), United Nations Framework Convention on Climate Change (1998) and the Convention for the Protection of the World Cultural and Natural Heritage (2004). These conventions are described in a later section of this chapter.
- Ensuring that the laws of the Kingdom relating to the management and protection of the environment and climate change adaptation and mitigation are reviewed, implemented and enforced.

The Ministry has been delegated the following powers that relate to this project:

- Grant approvals or any license or authority designated to the Minister under this Act or any regulations made under this Act or any other law relating to the management or protection of the environment.

- Approve any environmental plan or programme required to be prepared by the Ministry for submission to Government or to any other agency or body.
- Appoint a Director who will also act as an Environmental Officer for the purpose of this Act and who will be able to compile reports on impacts to the environment and monitor these impacts.
- Where an Environmental Officer reasonably suspects that an activity, matter or thing may be impacting on the environment, he may issue a notice requiring that any person apparently in control of or associated with the activity comply with any specific requirement.

4.2.2 Environmental Impact Assessment (EIA) Act 2003

The EIA Act is administered by the Department of Environment. This Act allows the Ministry to form the EAC and establishes the conditions under which an Environmental Impact Assessment is required. It is the role of the EAC to determine the environmental assessment level of all projects, to receive and review all documentation relating to the applications for environmental permits, to coordinate the review process of all EIAs and to determine the environmental conditions to be attached to any major projects.

4.2.3 Environmental Impact Assessment Regulations 2010

These regulations describe the process of determining the category of any proposed works and the required standards of any associated Environmental Impact Assessment that is determined to be necessary following the EAC review. The regulations define the following forms and their function in the EIA process:

Form 1: Determination of Category of Assessment. Submission of this form to the EAC is a requirement of all proposed projects and the level of information required is detailed on the form. The outcome of the Form 1 review will determine whether the activity is considered a Minor or Major project.
Form 2: Minor Environmental Impact Assessment. The EAC will list any guidelines they feel appropriate for the project and will request additional information, as appropriate. A full EIA is not necessary for these projects.
Form 3: Major Environmental Impact Assessments. This form details the requirements of an EIA and lists the specific considerations that must be addressed as part of the assessment. A copy of Form 3 is attached in Appendix 2 of this report.
Form 4: Committee Recommendation. Following a review of the Form 3 submission, the EAC will respond to the proponent within 30 days with an outcome of the EIA review process and any conditions or recommendations that are deemed necessary. This form confirms if all requirements of the EIA Act 2003 have been met.

The EIA regulations also stipulate the fee schedule associated with the submission of the forms. Form 1 has a TOP$10 fee for submission, Form 3 requires a TOP$250 fee on submission and upon completion of the final scoping by the EAC, the Minister requires a fee be levied of 1% of the total project costs as defined in Form 1.

4.2.4 Aquaculture Management Act 2003

This Act allows for the designation of areas for aquaculture management and may also declare any associated development buffer zones. In terms of compliance with this Act, the project must ensure that any activities that may take place within an aquaculture area or its associated, and gazetted, buffer zone be submitted to the Minister for written consent.

4.2.5 Bird and Fish Preservation Act 1988

This Act defines species of birds and fish (including turtles) that are protected from being killed, shot, captured, taken or destroyed within their defined protected time period. The Act also defines protected areas within which it is prohibited to:

- Discharge or cause to be discharged into the protected area any effluent or noxious or toxic liquid or substance.
- Erect any harbour, wharf, pier, jetty or other building works, temporary or permanent.
- Cut, damage, remove or destroy any mangrove.
- Erect any fish-fence, or set any fish trap; or trawl for fish (including shellfish) or engage in fishing for commercial purposes.
- Carry out any boring, drilling or dredging operations.

Within this Act, the Tongatapu Lagoon is the only defined protected area and does not fall within the Project Influence Area (PIA) for this assessment. The listed protected species are not recorded as occurring within the PIA for this development and therefore compliance is ensured.

4.2.6 Fisheries Management Act 2008

This Act provides for the sustainable management and extraction of fisheries resources and governs all aspects of the fishery industry within Tonga. It recognizes the importance of protecting marine ecosystems as a whole. This Act also governs the creation and management of Special Managed Areas (SMAs) within the Kingdom. Regulations for the provision of this Act include those for local fisheries, those for the processing and export of fisheries resources, those for the conservation of fisheries resources and the designation of SMAs. No aspect of this project is anticipated to contravene any compliance aspect of this Act.

4.2.7 Harbours Act (1988) CAP 137

This Act allows for the declaration of harbour areas by the Minister. This act determines:

- The master of any vessel arriving near or in any harbour shall 'bring to' on being approached or hailed or otherwise contacted by the harbour master and comply

with all reasonable directions issued by him as to the bringing of such vessel into harbour.

- No rubbish, ballast or earth may be thrown into the harbour without the permission of the harbour master or except at such a place and in such a manner as the harbour master may direct.
- No stones, coral, sand, earth or other material shall be removed from the beach or from any part of any harbour as ballast or for any other purpose without the permission of the harbour master.

4.2.8 Marine Pollution Prevention Act 2002

This Act provides for the prevention of and response to marine pollution and the dumping of wastes and other matter and to give effect to international marine pollution conventions. The Act, as a whole provides, for marine pollution prevention, marine pollution response, marine casualties, liability and compensation for oil pollution damage and regulates dumping and incineration of waste at sea.

This Act also lists a number of pollutants and identifies eight international conventions to which Tonga is a party. Within the listed conventions, the following have relevance to this project and are described later in this chapter: SPREP convention, London Convention, MARPOL, CLC, HNS Convention, OPRC Convention, FUND and the Intervention Convention.

4.2.9 Parks and Reserves Acts 1988 (CAP 89)

This Act provides for the establishment of a Parks and Reserves Authority and for the establishment, preservation and administration of parks and reserves. It enables the Parks and Reserves Authority to seek permission to declare any area or land or sea to be a protected area. The attached schedules to this Act define five marine reserves: Hakaumama'o Reef, Pangaimotu Reef, Monuafe Island Park and Reef, Ha'atafu Beach and Malinoa Island. The Parks and Reserves Declaration Amendment (1992) established the 'Eua National Park on 'Eua Island.

None of these marine reserves or parks are within the PIA of the proposed development.

4.2.10 Lands Act 2002 (CAP132)

This Act relates to the lands of the Kingdom, their ownership and tenure. In relation to this project, the Lands Act refers to restriction on disturbing and excavating on the foreshore, which is determined to belong to the Crown under the governance of the Minister of Lands. It may be a necessity to secure a permit at the cable landing sites for the cutting and removal of stone from the foreshore. The Removal of Sand Regulations associated with the Act state that the taking or removal of sand from foreshores without a permit is prohibited, which may need to be a consideration for the landing site in Ha'apai.

4.2.11 Continental Shelf Act 1988

This Act makes provisions as to the exploration, exploitation and protection of the continental shelf, the prevention of pollution in consequence of works in connection with the shelf, and for matters connected with those purposes. The stipulations of this Act, as it relates to this project state that the Prime Minister may, for the purpose of protecting any installation in a designated area, prohibit ships from entering, without his consent, a designated area. The Act also makes it an offence to damage or break any submarine cable.

4.3 International and Regional Policies

4.3.1 Submarine Telegraphs Convention

While Tonga is not a signatory to this convention, in the Continental Shelf Act CAP63, reference is made to application of the provisions of Article IV and paragraph 1 of Article VII of the Submarine Telegraphs Convention set out in the Schedule to the Submarine Telegraph Act, 1885 (UK) as being in force in Tonga.

This convention is a multilateral treaty that was signed in 1884 in order to protect submarine communications and makes it a punishable offence to damage submarine communication cables. The specific articles referred to in the Continental Shelf Act state:

Article IV: The owner of a cable who, on laying or repairing his own cable, breaks or injures another cable, must bear the cost of repairing the breakage or injury, without prejudice to application.

Paragraph 1, Article VII: Owners of ships or vessels who can prove that they have sacrificed an anchor, a net or other fishing gear in order to avoid injuring a submarine cable shall receive compensation from the owner of the cable.

4.3.2 Convention on Biological Diversity (CBD) (1998)

The CBD is a multilateral treaty with three goals:

1. Conservation of biodiversity
2. Sustainable use of its components, and
3. Fair and equitable sharing of benefits arising from genetic resources.

The convention was opened for signature at the Earth Summit in Rio de Janeiro in 1994 and was ratified by Tonga in 1998. As part of its obligations to the CBD, Tonga has developed a National Biodiversity Strategies and Action Plan (NBSAP) in which Tonga identifies several actions under the CBD in respect to the protection of marine ecosystems. When considered in relation to this project, actions include:

- Reducing the impact of land-based activities by prohibiting dumping and chemical discharges, prohibiting sand mining, conducting environmental assessments on development and reducing erosion.

- Increase the number of marine conservation areas (which is currently underway in Vava'u, but in an area not associated with this project).
- Promoting sustainable management of marine ecosystem.

4.3.3 Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The CMS aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an intergovernmental treaty under the United Nations Environment Program concerned with conservation of wildlife and habitats on a global scale.

Tonga is not yet a party to the CMS, however it has signed a Memorandum of Understanding (2010) with regard to Pacific Island Cetaceans. Within Tongan waters there are 14 species that are related to the CMS, including the humpback whales, and several shark and turtle species.

4.3.4 Convention for the Protection of the World Cultural and Natural Heritage (2004)

This convention founded the UNESCO World Heritage Site List (the List). To be a site on this List, it must be a place of special cultural or physical significance. The programme catalogues names and conserves sites of outstanding cultural or natural importance to the common heritage of humanity.

Tonga became a signatory to this convention in 2004 It does not have any approved sites on the List but does have two tentative items for consideration for the List, neither of which are in the geographic range impacted by this project.

4.3.5 United Nations Convention on the Law of the Sea

The convention lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole.

The convention was responsible for setting the limits of various areas, measured from a baseline. These areas are: Internal waters, Territorial waters (12nm), Archipelagic waters, Contiguous zone (24nm), EEZ (200nm) and the continental shelf.

The convention makes provisions related to submarine cables on the continental shelf. These provisions include:

- Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control

of pollution from pipelines, the Coastal State may not impede the laying or maintenance of such cables or pipelines.
- Nothing in this Part (Part VI, Article 79 of the convention) affects the right of Coastal States to establish conditions for cables or pipelines entering its territory or territorial seas
- When laying submarine cables or pipelines, States shall have due regard to cables or pipelines already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced.

The convention also makes provisions relating to breakages of submarine cables and liability for breakages, including indemnity for loss incurred in avoiding injury to a submarine cable.

With specific regard to the protection and preservation of the marine environment, Part XII includes the following Articles:

- 192: a general obligation of States to protect and preserve the marine environment
- 194: measures to prevent, reduce and control pollution
- 199: an obligation of States to develop and promote contingency plans for responding to pollution incidents in the marine environment
- 204: requires States to endeavour, as far as possible to monitor the effects of any activities that they permit in order to determine whether these activities are likely to pollute the marine environment
- 206: provides for States to conduct Environmental Impact Assessments of planned activities that have the potential to cause substantial pollution or significant and harmful changes to the marine environment

The following conventions all find their force of law in Tonga through the Marine Pollution Prevention Act 2004

4.3.6 The Convention for the Protection of Natural Resources and Environment of the South Pacific (SPREP or Noumea Convention) (1990)

This convention, along with its two protocols, entered into force in 1990. The convention is a comprehensive umbrella agreement for the protection, management and development of the marine and coastal environment of the South Pacific Region. As a signatory of the SPREP convention, Tonga has agreed to take all appropriate measures in conforming to international law to prevent, reduce and control pollution in the Convention Area from any source, and to ensure sound environmental management and development of natural resources.

4.3.7 Convention on the Prevention of Marine Pollution by dumping of Wastes and Other Matter (London Convention)

The London Convention is an agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention. It covers deliberate disposal at sea of wastes or other matter from vessels. Following an update of the London Convention

protocols in 1996, the convention adopted a restrictive precautionary approach to dumped materials and permits are required to dump only those materials that are listed on the reserve list. All other materials are to be disposed of on land.

4.3.8 International Convention for the Prevention of Pollution from Ships (MARPOL) 1972

This convention is the main international convention covering prevention of pollution in the marine environment by ships, from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 and updated by amendments throughout the years.

4.3.9 International Convention on Civil Liability for Oil Pollution Damage (CLC) 1992

This convention ensures that adequate, prompt and effective compensation is available to persons who suffer damage caused by oil spills.

4.3.10 The Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1990

This convention is an international maritime convention establishing measures for dealing with marine oil pollution incidents nationally and in cooperation with other countries.

4.4 World Bank and Asian Development Bank Requirements

All projects undertaken in cooperation with the World Bank and the Asian Development Bank are governed by a set of policies and statements that have been developed to ensure that activities are environmentally and socially sound. The following section outlines the applicable requirements.

4.4.1 Asian Development Bank (ADB) Safeguard Policy Statement

The ADB Safeguard Policy Statement (SPS) builds upon three previous safeguard policies on (i) the environment, (ii) involuntary resettlement and (iii) indigenous people and brings them into one single policy document that enhances consistency and coherence and more appropriately addresses environmental and social impacts and risks.

The SPS sets out policy objectives, scope and triggers, and principles for the three key safeguard areas:

i) *Environmental Safeguards* – the object of this requirement is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. The key requirements of this

safeguard element require a well-developed Environmental Assessment (EA) that encompasses early and effective screening, identification of direct, indirect cumulative and induced impacts along with a meaningful and participatory consultation process and a plan to avoid, minimise or mitigate any adverse impacts. Following from the EA there is an expectation for the project to implement and monitor the effectiveness of an Environmental Management Plan.

ii) *Involuntary Resettlement Safeguards* – this safeguard is designed to avoid involuntary resettlement wherever possible, to minimise involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels. The involuntary resettlement safeguard covers physical displacement and economic displacement. If involuntary resettlement is required for a project, a resettlement plan will be developed elaborating on displaced persons entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget and time-bound implementation schedule.

iii) *Indigenous Peoples Safeguards* – the object of this safeguard is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples' themselves so that they receive culturally appropriate social and economic benefits and they do not suffer adverse impacts as a result of projects and can actively participate in projects that affect them. Each project is screened to determine whether Indigenous Peoples' are present in or have collective attachment to the project area and whether impacts to Indigenous Peoples' are likely. If impacts are deemed likely, an Indigenous Peoples' Plan (IPP) that is based on a social impact assessment with the assistance of qualified and experienced experts, and that draws on indigenous knowledge and participation.

4.4.2 World Bank Operational Policies

i) World Bank Operational Policy 4.01 – *Environmental Assessment*
The WB requires and Environmental Assessment of Projects proposed for WB financing to help ensure that they are environmentally sound and sustainable, and thereby, improve decision-making. OP 4.01 requires (i) detailed qualitative and quantitative analysis to determine project impacts, (ii) determination of tangible measures to prevent, minimise, mitigate or compensate for those adverse impacts, (iii) public consultation and disclosure as part of the EA process and (iv) requires and Environmental Management Plan (EMP) to address set mitigation along with monitoring and institutional measures to be taken during design, implementation, operation and maintenance phases of the project.

ii) World Bank Operational Policy 4.04 – *Natural Habitats*
This policy requires the conservation of natural habitats and specifically prohibits the support of projects that involve significant conversion or degradation of critical habitats, as defined by the policy. The policy further requires the EA to identify impacts on biodiversity and species and to determine endemism, endangered species and to determine project impacts on these species and to propose acceptable mitigation and monitoring measures.

iii) World Bank Operations Policy 4.10 – *Indigenous Peoples*

This policy requires the Government of Tonga to engage in a process of free, prior and informed consultation with Indigenous Peoples (IP's), as described by the policy in situations where IP's are present in, or have collective attachment to, the project area and for the preparation of an Indigenous Peoples Plan (IPP) and /or Indigenous Peoples Planning Framework (IPPF).

iv) World Bank Operational Policy 4.11 – *Physical Cultural Resources (PCR)*
This policy seeks to avoid the disturbance and/or destruction of PCR as defined by this policy by the projects activities. PCR includes places of worship, buried artifacts, cemeteries, and archeological assets, etc. The policy further requires, (i) EA to undertake an exhaustive desk review and/or site investigation to pre-identify and locate PCR's in the PIA, (ii) EA/EMP to propose management measures and (iii) to include "chance find" clauses in civil works contracts during construction and maintenance stages.

v) World Bank Operational Policy 4.12 – *Involuntary Resettlement*
This policy addresses direct economic and social impacts from the projects activities that will cause (a) involuntary taking of land resulting in loss of income sources or of livelihoods and (b) involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons. This policy requires siting of project infrastructure to be so chosen as to avoid these impacts altogether or to minimise them to the extent possible. Where these cannot be avoided, the policy requires the preparation of either or both of these instruments (i) resettlement policy framework, (ii) Resettlement Action Plan, and for meaningful consultations with potentially affected people. The policy prohibits community donations of lands for location-specific infrastructure.

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5. Description of Baseline Conditions

5.1 Introduction

This section provides information on the physical, biological and socio-economic elements of the environment, which shall be the baseline data set used as benchmarks for future monitoring. The area considered for assessment of baseline conditions spans the entire length of the cable route, the landing sites and the terrestrial cable route and TS, inclusive of an extended potential impact area. This will be large enough in extent to include all potential direct and indirect impacts from the proposed project.

All data was obtained as a result of desktop study and field surveys.

5.2 Location and Setting (Influence Area)

The Kingdom of Tonga is comprised of over 170 islands, of which 36 are inhabited; spread over three main island groups (Tongatapu, Ha'apai and Vava'u) with several minor islands distributed over an area of the South Pacific Ocean approximately 800km long and 100km wide. Lying over 1,800km to the northeast of New Zealand and approximately 700km to the south east of Fiji, Tonga stretches from latitude 15°50'S to 23°50' S and longitudes 173°0'W to 176°0' W encompassing approximately 400,000km^2 of territorial waters, running in a north-south line (Figure 37). The total land area has been estimated to approximately 700km^2 (Roy, P.S., 1990).

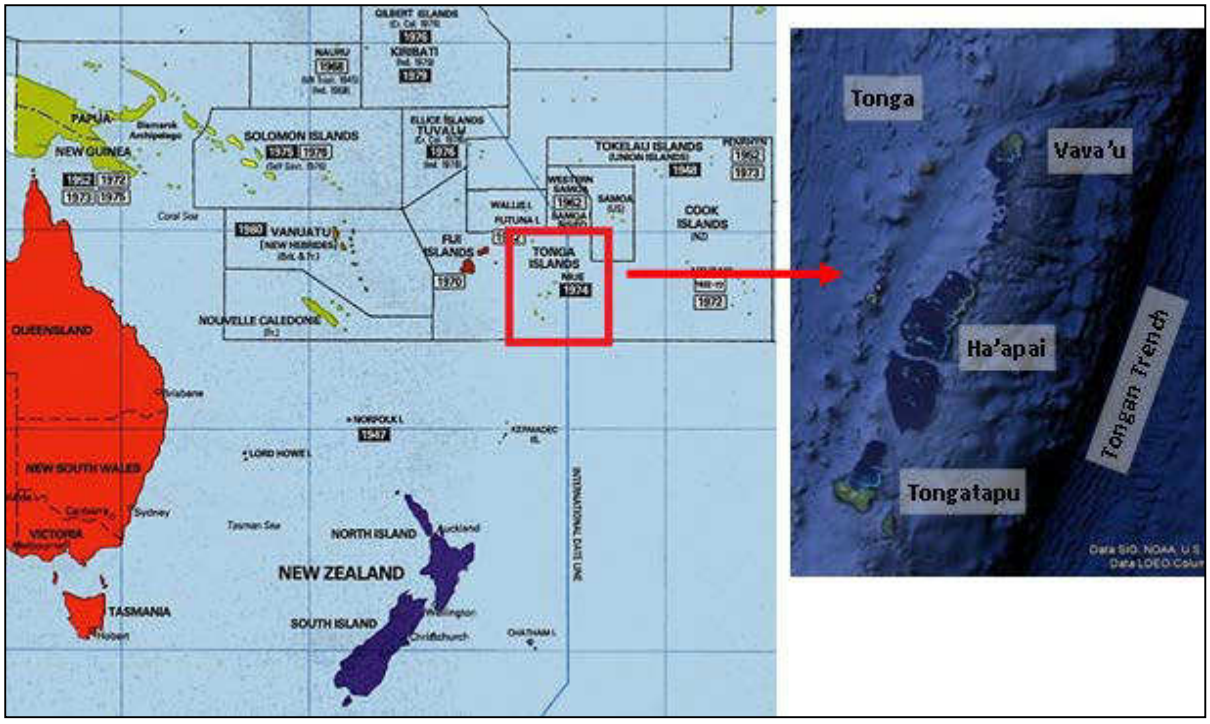

Figure 37: Geographic setting of Tonga within the context of the Pacific Islands

The islands are formed on the Tonga Ridge that is at the tectonic boundary of the Australia-India Plate and the subducting Pacific Plate. A little over 100km to the east and parallel to Tonga

is the Tonga Trench running from American Samoa in the north to New Zealand in the south and is deeper than 10km at its deepest point (Figure 38).

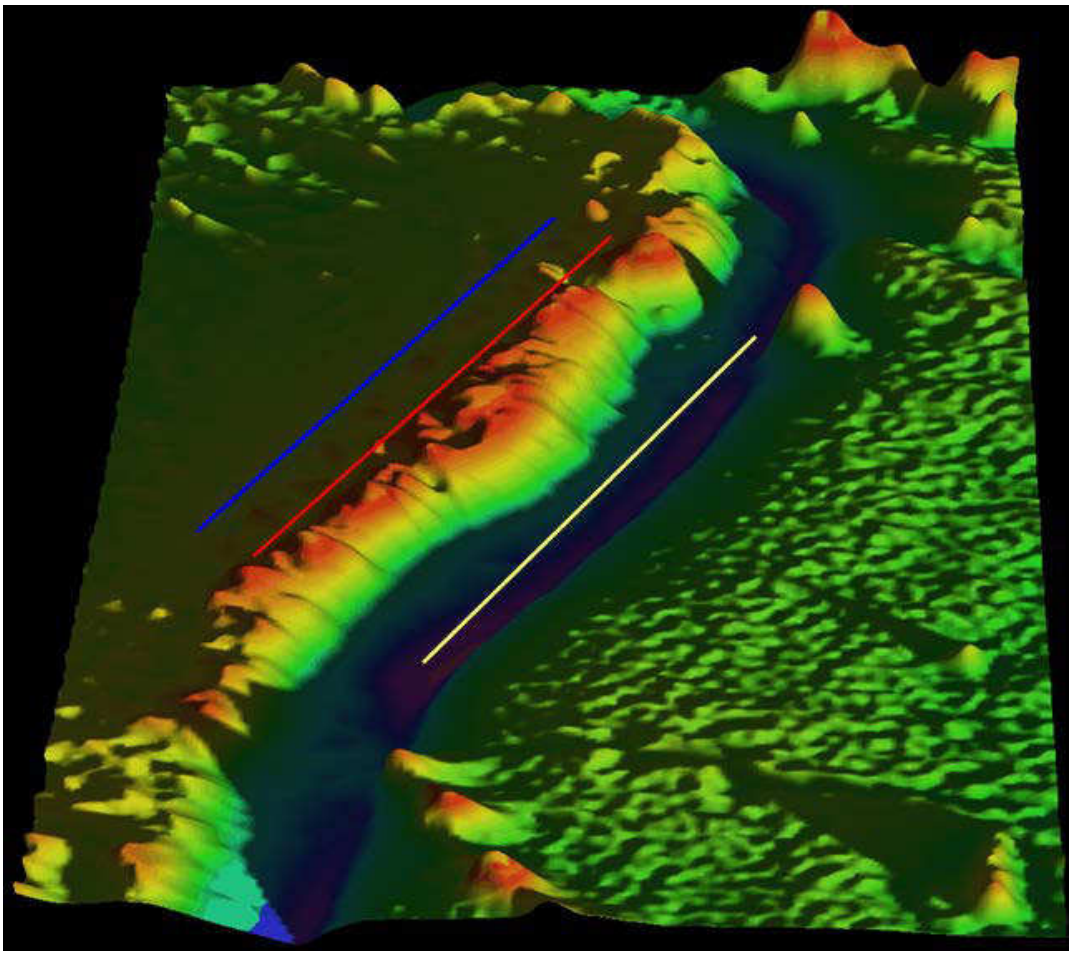

Figure 38: Bathymetric 3D mapping of Tongan Trench showing volcanic arc (blue line), Tongan Ridge (red line) and Tongan Trench (yellow line) (source: http://buccaneer.geo.orst.edu/dawn/djl/viz/)

The islands are mainly elevated coral reefs that cap the peaks of two parallel submarine ridges, with some having volcanic origin. The region is geologically active, with earthquakes a common occurrence and volcanic eruptions known in recent times. The three main island groups of Tonga are coralline and limestone islands. Tongatapu (265km^2) and Ha'apai (119km^2) are both formed of low lying coral limestone islands, although Ha'apai does have some elevated volcanic islands to the west. Vava'u (143km^2) is the northernmost of the three groups and is classified as raised coral limestone islands with some volcanic islands to the southwest. The minor island group of the Niuas (350km to the northwest of Vava'u) are volcanic in origin and cover an area of 71km^2 including lakes (Roy, P.S., 1990).

To determine the geographical scope of this EIA, it has first been necessary to determine the Project Influence Area (PIA). The PIA is defined through consideration of the project footprint including all ancillary project components and also considering project impacts on various environmental, economic and social components. For the purposes of this assessment, the PIA has been determined based on best practices from previous similar studies and by adopting a precautionary approach. With this in mind, the following guidelines have been followed in determining the PIA.

Table 2: Project influence areas delineations and conditions.

Environment	PIA
Offshore (>3nm from coastline)	The accuracy of the placement of the cable on the sea floor reduces as the depth increases and currents play a part. A 500m corridor either side of the cable is a good precautionary limit for a PIA
Inshore & Coastal Waters (<3nm from coastline)	As the accuracy of cable placement increases, the PIA reduces. Taking a precautionary approach, a 250m corridor either side of the cable (500m total) has been used for the foreshore PIA
Terminal stations	250m radius from the center point of new terrestrial buildings
Terrestrial cable route	A 50m corridor will be assessed for any terrestrial trenching activities.
Important Species Habitat	In specific regard to the migratory humpback whale population of Tonga, a 1km belt either side of the cable (2km in total) has been identified in WD less than 200m.

For ease of visual reference, the inshore PIAs and terrestrial PIAs have been mapped by individual section and are represented in Figures 39 – 42.

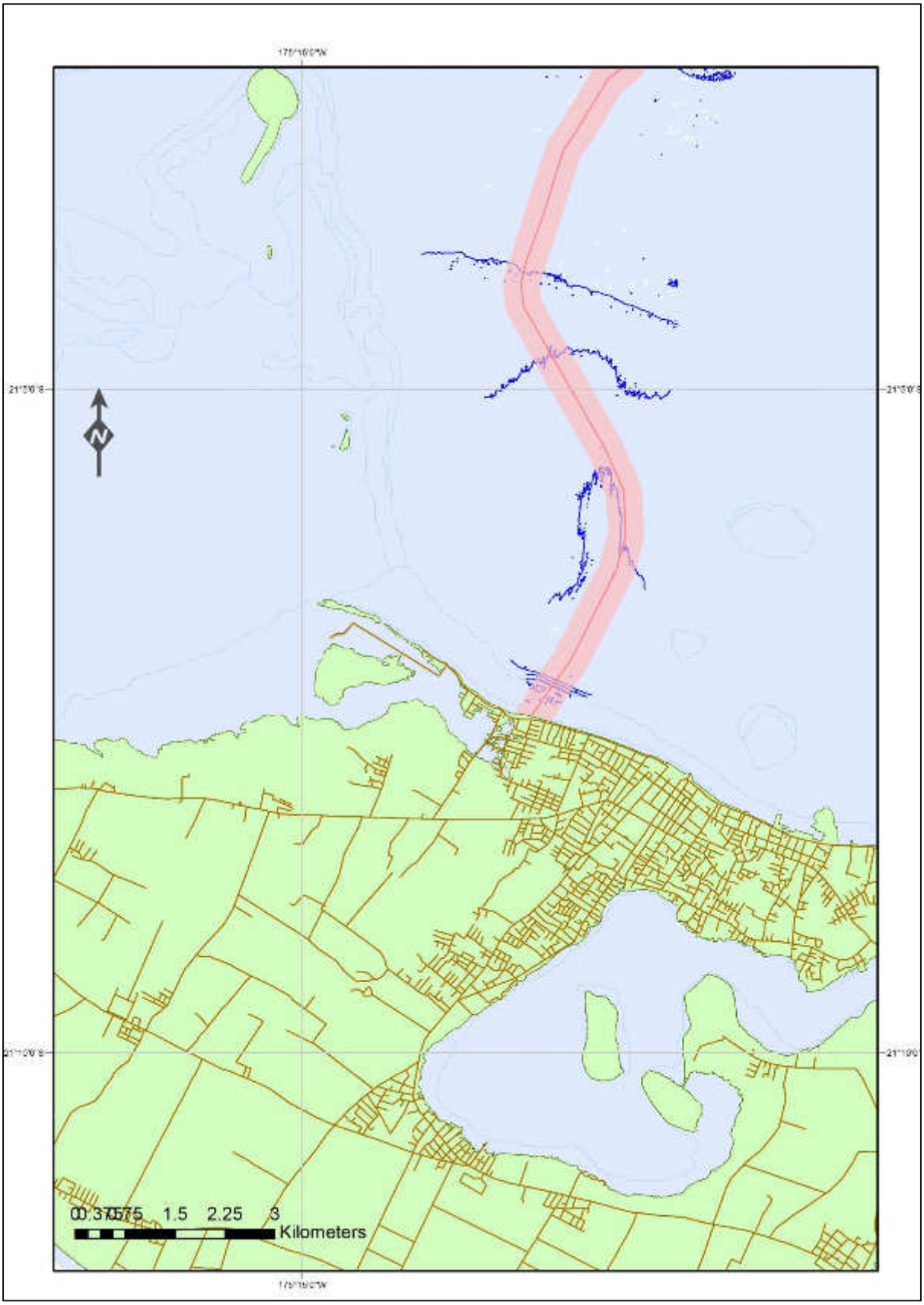

Figure 39: Nuku'alofa inshore PIA with bathymetry

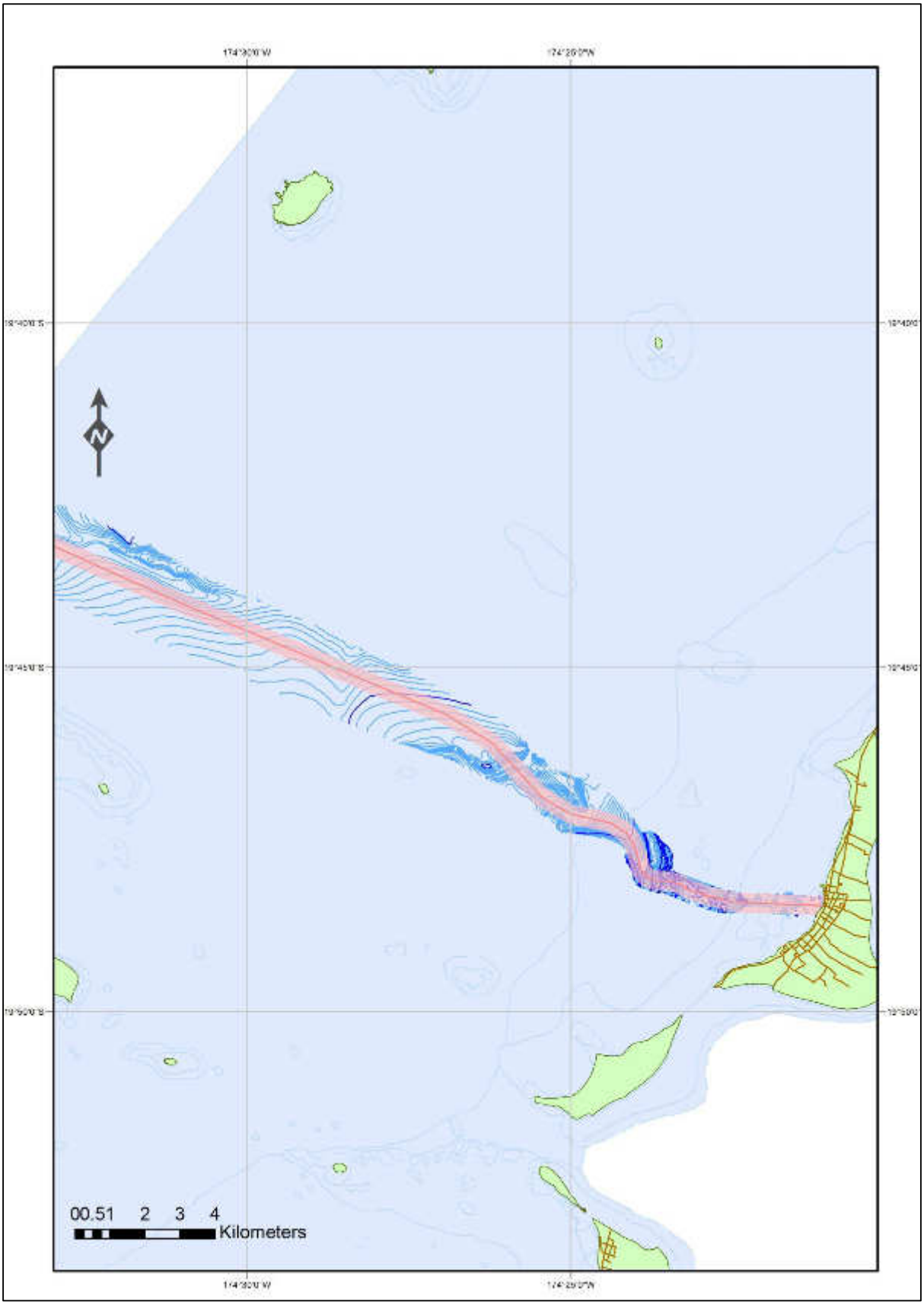

Figure 40: Ha'apai inshore PIA with bathymetry

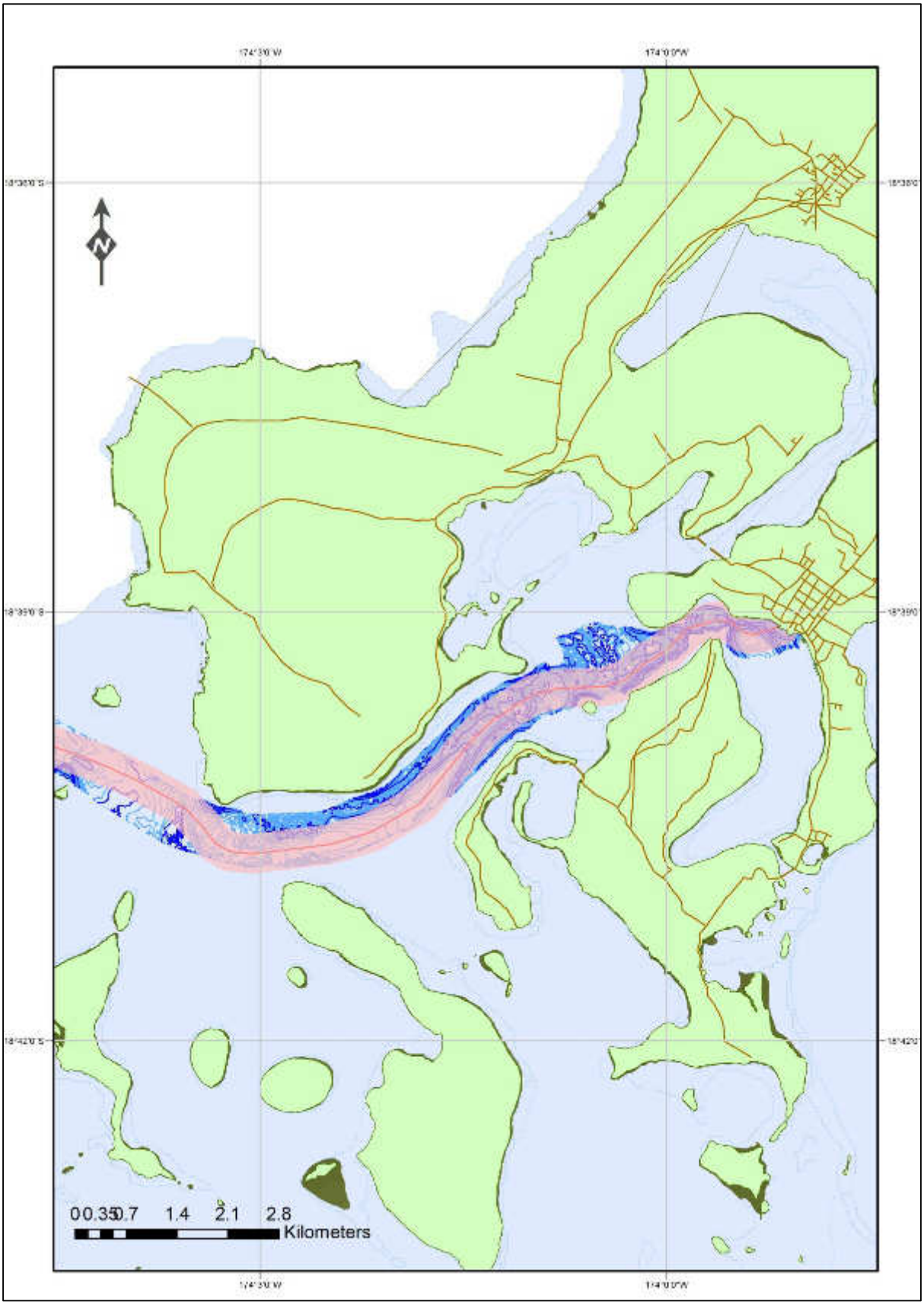

Figure 41: Vava'u inshore PIA with bathymetry

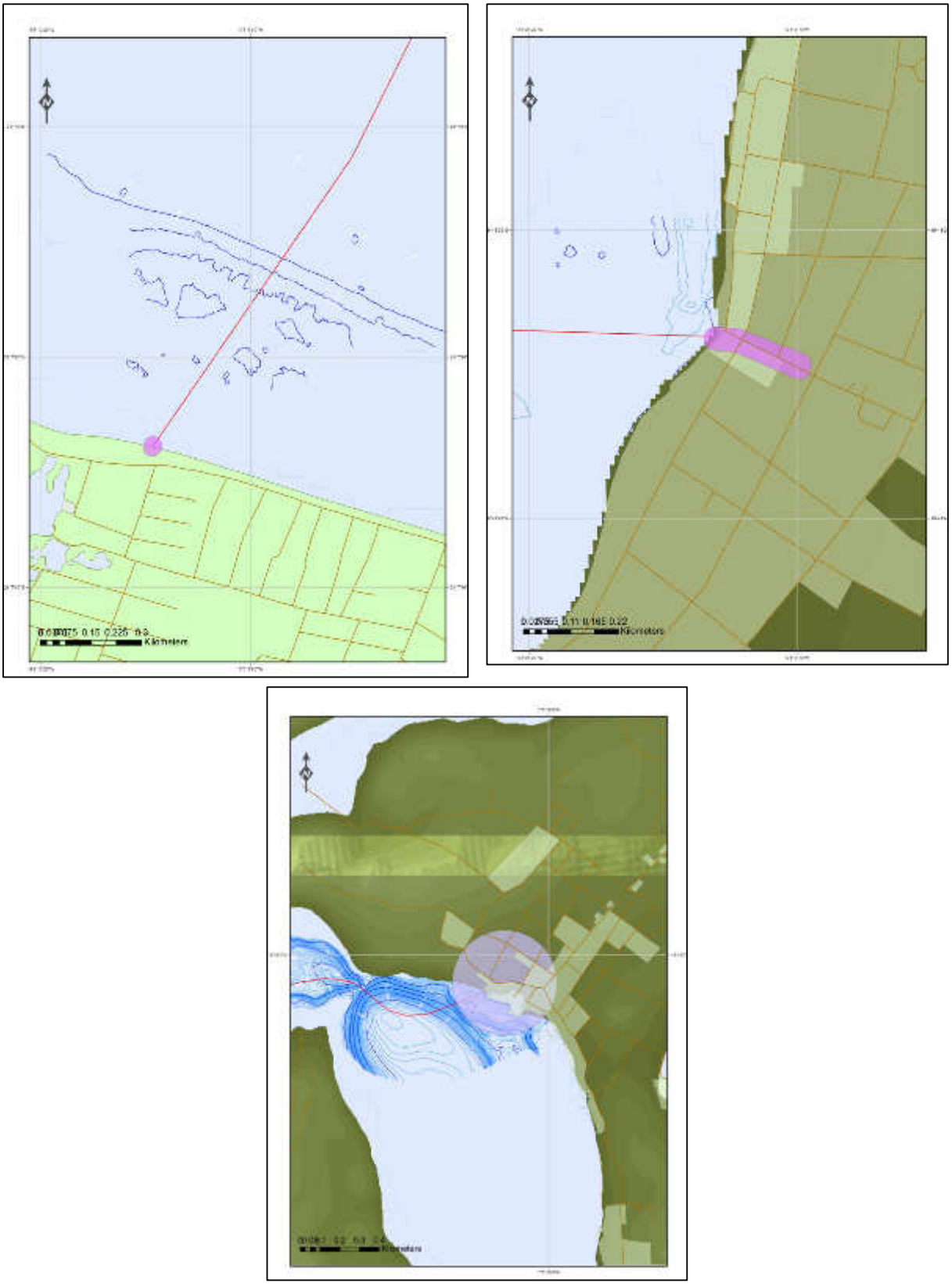

Figure 42: (tl) LP PIA in Nuku'alofa, (tr) Pangai terrestrial PIA from LP to TS, (b) Neiafu TS PIA, 250m radius from TS includes LP and BMH

5.3 Physical Environment

5.3.1 Meteorology

The climate of Tonga is tropical throughout the year and is divided into two predominant seasons, a wet (November - April) and dry (May-October) season. The weather patterns across the country lie in the region of influence associated with the South Pacific Convergence zone over northern Tonga, and rainfall associated with the jet stream and other extra-tropical weather features in southern Tonga. This has the general result of Tongatapu and Vava'u being wetter than the central island group of Ha'apai.

The annual rainfall for Tonga is approximately 2100mm per year (average across island groups), with 60-70% of that falling during the wet season. The wettest month is March and the driest month varies between June and July (Figure 43). Tonga lies within the tropical cyclone corridor although instances of major cyclones are relatively infrequent here in comparison to the rest of the region.

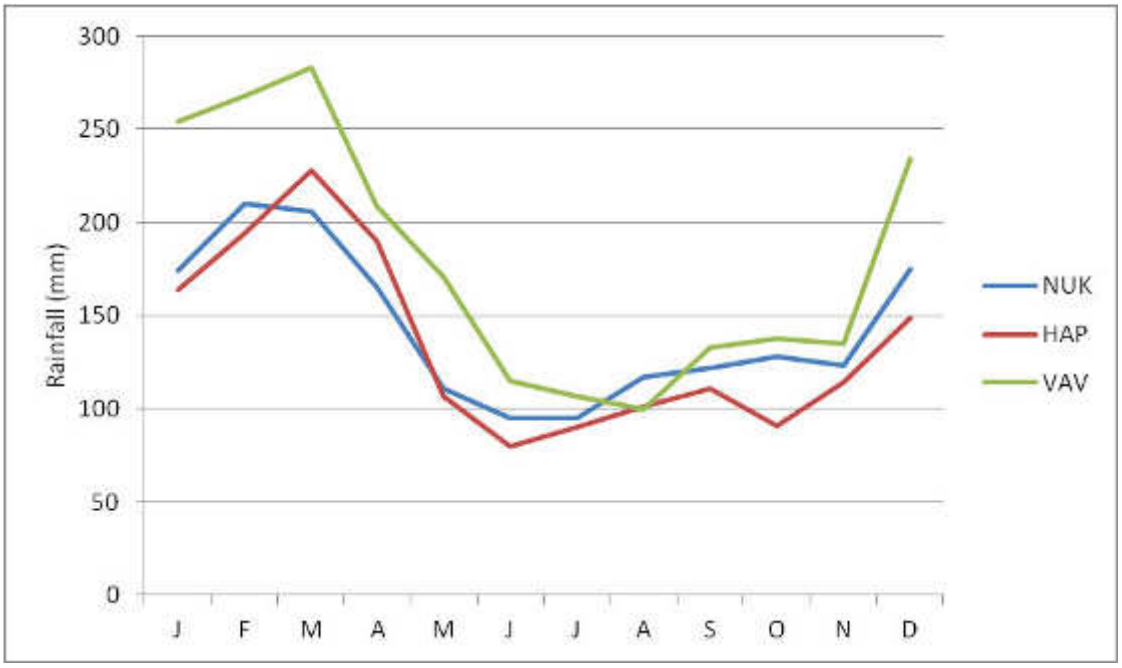

Figure 43: Monthly average rainfall (mm) for Tongatapu, Ha'apai and Vava'u

The mean annual temperature for Tonga varies across latitude between the ranges of 23-28°C while the mean humidity persists at 75%. Higher latitudes show higher mean temperatures, resulting in an average annual temperature in Vava'u of 26.5°C. Daily highest temperatures are generally highest in February, with the coolest months being July and August (Figure 44).

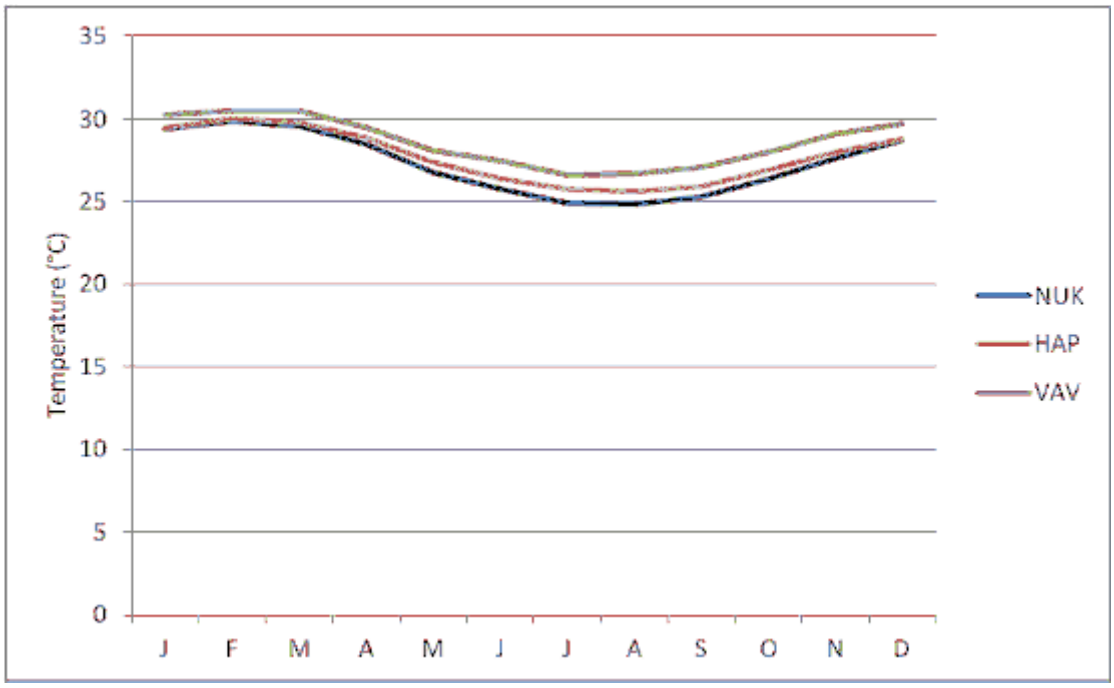

Figure 44: Monthly average temperature (°C) for Tongatapu, Ha'apai and Vava'u

Winds over Tonga (Figure 45) are dominated by the south east trades which generally blow between 12-15 knots although, the wind speeds tends to be a little stronger from May to October.

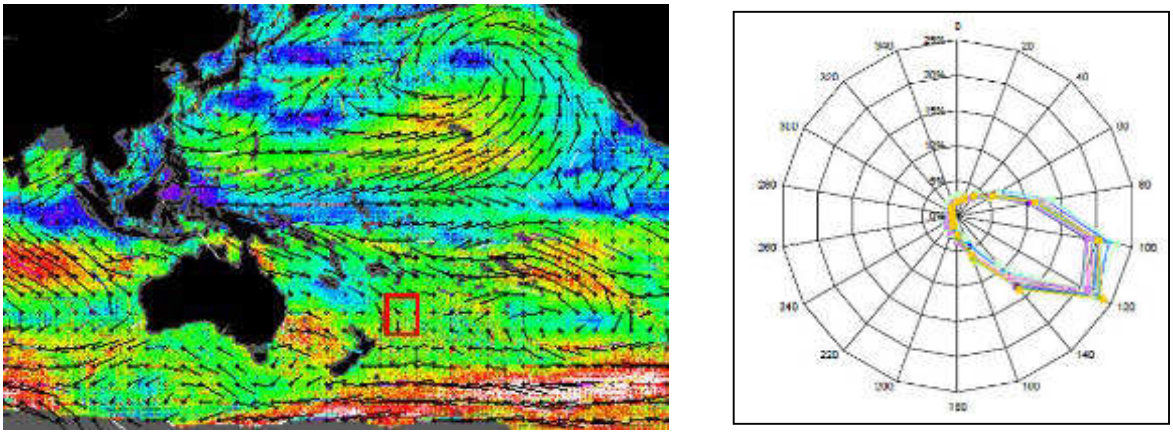

Figure 45: Global surface wind patterns (l) with Tonga highlighted in red and wind rose (r) showing wind direction and consistency for Tonga over one year.

Tropical storms and cyclones will also dramatically change both wind speed and direction as they pass during the November to April season. Cyclones and tropical depressions are at their most frequent in February, with an average of 1 or 2 cyclones affecting the 900km stretch of country each season. During El Niño years there is a noted increase in cyclonic activity with the 2002-2003 El Niño cyclone season bringing five cyclones through Tonga, with three of these causing severe damage to southern Tonga (Bouisset, S., & Hannaton, D, 2006). Cyclonic activity in relation to the project site is discussed in more detail later in this section.

5.3.2 Geological Resources

Tongatapu - The landing site at Nuku'alofa is in the area known as Sopu. The area is low lying and has a gentle relief. A 500m long reef platform (Figure 46) fronts the shoreline and at its back is a seawall comprised of coral rock and running for the length of this section of coast. The sea wall is approximately 2m above the high water level.

Figure 46: Gravel and sand beach at Nuku'alofa landing site, looking west with reef platform (low tide) and sea wall.

The soil in this area is formed from loose to compacted corals sand mixed with earth. This is covered with a looser layer of vegetation in undeveloped areas. The soil itself contains low levels of organic matter and has poor water retention qualities.

In the marine environment, the 500m-long reef flat fronting the beach, reaches a maximum depth of 0.3m LAT and has a sediment composition of silty gravelly sand with seagrass patches. As the route moves away from the reef flat, through the harbour basin, the depth increases and the sediment type changes to slightly sandy and silty clay.

Ha'apai - Sediment analysis of Lifuka Island (Kruger, 2012) indicates fine grains for beaches north of the main Pangai wharf and coarse sands for the beaches to the south. The Pangai LP is situated approximately 500m south of the main wharf, on a small beach, 100m long and 25m wide (Figure 47), to the immediate south of an old broken jetty. At the LP itself, the loose medium sand is dominated by coral sand (43%) with smaller amounts of coralline algae, foraminifera and mollusk formed sand.

In the terrestrial environment, Pangai, on Lifuka Island, is part of a low lying coral atoll chain that forms the majority of the islands in Ha'apai. The terrestrial PIA is found on the low level coastal sands substrate over a coral plateau. This area is characterized by grass overlying compacted sand. Approximately 400m landwards from the shoreline, the substrate type changes to raised limestone covered in volcanic ash soil (Figure 48).

Figure 47: Sandy beach at Pangai landings site with vegetation line and LP placement

In the marine environment, moving away from the HWM, the inshore cable route is comprised of sand and gravel with patches of seagrass for 140m until it reaches a raised pavement area, which is exposed at low tide. This pavement is flat rock area, covered with at least 20cm of sand and seagrass. Moving away from the pavement seawards, the sediment remains comprised of sand and seagrass with the inclusion of live and dead coral (Figure 48).

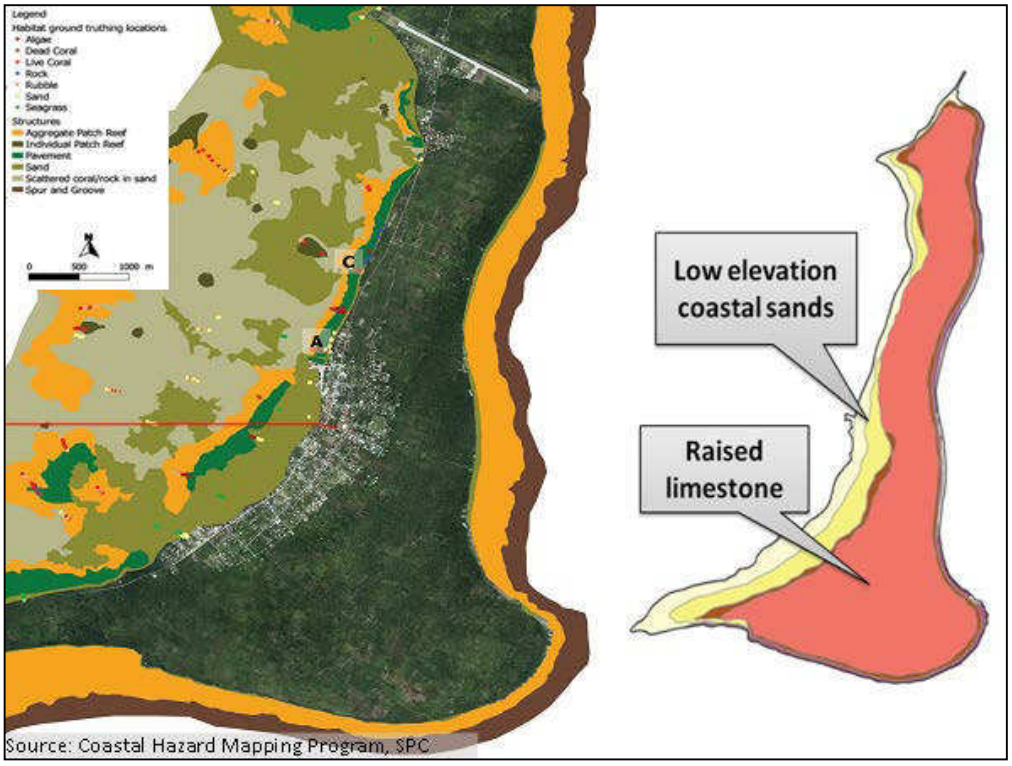

Figure 48: Terrestrial and marine substrate maps of Lifuka Island, Ha'apai (source: SOPAC)

Vava'u - The Vava'u group is a series of coral limestone islands, with impressive oblique cliffs along the northernmost coastline up to 200m in height. The LP is found on the southern coast of the main Greater Vava'u Island where the original coastline is at 4.5m above mean sea level. The LP of the Vava'u project site has been reclaimed and the filling material is unknown. On the reclaimed wharf area, the soil is comprised of loose gravel with scattered vegetation l over filling material. Moving up towards the TS, the substrate changes to loose soil with scatterings of coral gravel and rock (Figure 49). This soil composition is prevalent for all of the unpaved areas of the terrestrial project area.

Figure 49: (t) view from LP looking towards BMH and TS. (bl) Typical soil at BMH and (br) typical soil at TS

In the marine environment, moving away from the LP, the sediment is dominated by loose silty sand within the confines of the harbour. Leaving the harbour entrance and moving along the cable route the substrate type changes to predominantly rock interspersed with large patches of fine sediment and occasional boulders.

5.3.3 Cable Route Bathymetry

At the Nuku'alofa landing site, the inshore reef flat is exposed at low tide for 500m from the HWM. From this point, past the edge of the reef flat, there is a steadily declining seafloor down to 52m at 20KP. In Ha'apai, the inshore has a relatively consistent declining slope from the LP to the 44KP where depth reaches 800m. From this point the slope increases significantly. The Vava'u bathymetry is slightly more complex. The inshore route from the LP drops away steeply to 55m at KP0.4 before climbing again through the harbour entrance to 11m at KP1.2. Moving away from the harbour entrance, there is a steady decline until approximately 100m WD at KP 12, from where the slope increases significantly, passing 1000m WD before KP18.

Once the cable route leaves the inshore environment, for all landing sites, the route rapidly approaches depths in excess of 1000m for its entire offshore route.

5.3.4 Marine Hydrology

There is a paucity of data on the marine hydrology of Tonga, however, physical oceanography of Pacific Islands identifies that the wave climate of the region is dominated by a long period swell (average of 25 second interval) reaching the area from distant storms, by relatively low amplitude short period (average 2 second interval) waves generated by more local winds, and the occasional bursts of energy associated with intense local storms.

As waves reach the shallow waters of a reef and island, they shoal, increase in amplitude and eventually break. The short period, trade wind sea produces relatively small surf height because of the short wavelengths. Large surf is produced by the long period swell from distant storms because of the correspondingly long wavelength.

Waves in this region are generated from higher latitudes to the south and southwest (meteorological stations in Chatham Island and Campbell Island, New Zealand are the nearest applicable stations, Figure 50) and are the most important source area for ocean swell observed in the Tongan Island group. Wave climate studies using the records from the Waverider Buoy on the south coast of Tonga have shown that the waves on the south coast of Tongatapu are seasonal, reaching a maximum of 2m from May to July and decreasing to 1.5m during the summer months. The months with the highest average wave heights were also the months with most frequent southerly gales at Campbell (May) and Chatham Island (July).

Figure 50: Wave station locations in Tonga, Chatham Islands and Campbell Islands

Analysis of GEOSAT altimeter data for the South Pacific reveals that the Southern Tonga group has significant wave heights averaging about 2.2m in November to March, increasing to about 2.4m in May to September. The differences between the readings can be explained by the sheltered nature of the Waverider Buoy by 'Eua Island during periods of east to southeasterly waves.

5.3.5 Natural Hazard Vulnerability and Risks

Earthquakes - The Tonga Cable is at very minor risk from damage from seismic activity because it runs along the boundary of the Australia and Pacific Plates (the Tongan Trench) (Figure 51) and all of the landing points regularly experience seismic activity.

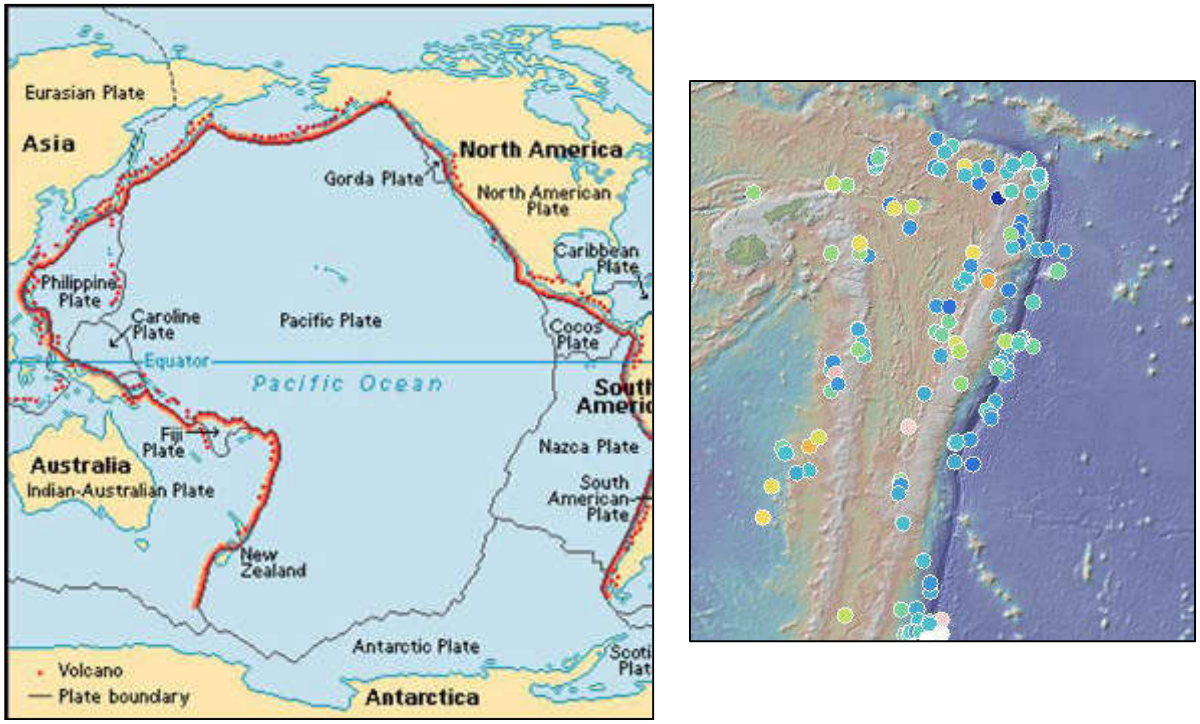

Figure 51: (l) Tectonic plate boundaries for the Pacific Ocean with volcano locations and (r) recorded earthquakes over magnitude 5 around the Tongan islands from 2010-2013 (Source: Princeton University Global Seismic Events accessed through GeoMap App)

There have been 50 recorded earthquakes of magnitude 5.5 and higher within the Tongan Islands in the period 2010 – 2013 (data provided by the Princeton University Global Seismic Events and accessed by GeoMap App)

Figure 52: Active volcanoes in the volcanic arc (source: Smithsonian Global Volcanism Project accessed through GeoMap App)

Volcanic Activity - The offshore route of sections A and C of the Tonga Cable Extension follow the western edge of the Tongan Ridge and sit at the base of a linear trough that is formed between the eastern edge of the ridge and a volcanic arc that runs the length of it. According to data released by the Smithsonian Institution Global Volcanism Program, there are seven volcanoes of interest that can be found along the cable route between Nuku'alofa and Vava'u (Figure 52). Of these seven, four are submarine, two have formed stratovolcano and one is a caldera. The cable passes an average of 20km to the east of each of the identified volcanoes.

Cyclones and Storm Surge Potential - Cyclones are a seasonal threat from November to April. In the period 1989 - 2014, 19 cyclones have tracked over the planned Tonga Cable extension route, with 13 of those making landfall: 10 in Ha'apai, two in Vava'u and one in Tongatapu. In terms of cable sections, the cyclone tracks (including re-curving cyclones) number 10 over Section A, four over Section B and eight over Section C. Of these, four have been Category 3 or higher (Figure 53).

The general tracks of cyclones affecting the project area are from the northwest, moving in a southeasterly direction.

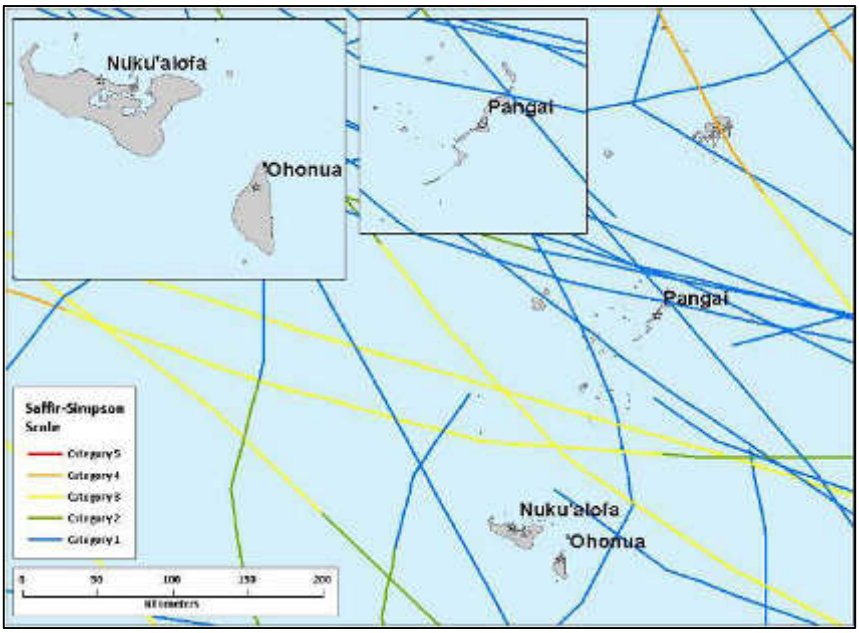

Figure 53: Category 3 and higher cyclone activity in Tonga 1945 – 2008 (World Bank, 2008)

Considerations have been given to issues related to storm water and potential for erosion during the construction and operational phase of the development. As such, recommendations have been made to minimise the risks during all phases of the project.

Storm surges, associated with tropical storms and cyclones have the potential to have the greatest impact on this project, especially at the landing sites in Ha'apai. The surges are caused by a combination of the effects of approaching low pressure areas associated with the tropical cyclone and the wind of the cyclone system causing water to pile up against coastlines.

Inundation models developed by SOPAC as part of the PASPA project indicate that the landing site in Ha'apai is vulnerable to inundation from storm generated waves greater than 1m based on topography and boundary conditions from the Tropical Cyclone Risk Model and Young's parametric wave model (Figure 54).

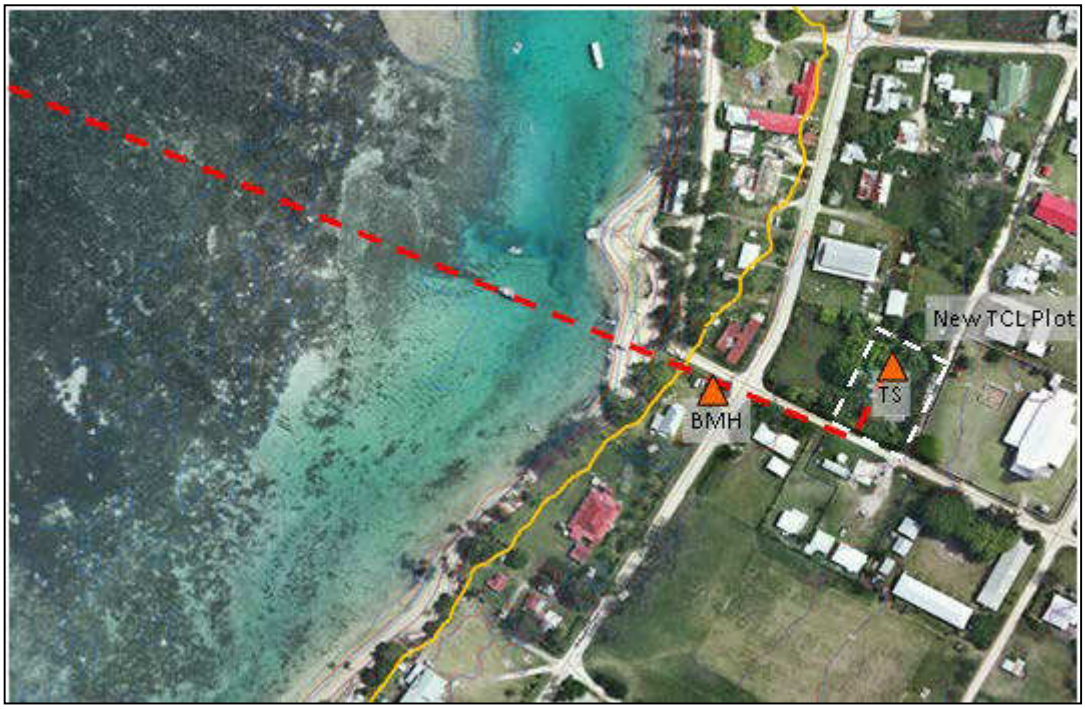

Figure 54: Google Earth imagery of Pangai with LiDar project coastal inundation vulnerability boundary marked in yellow. (source: Ministry of Lands and Natural Resources)

Coastal erosion due to storm surges is a noted vulnerability in Ha'apai. At the landing beach, erosion is lower than other areas of the coastline due, in part, to the protection afforded by the raised coral pavement on the foreshore. There is also a continuous vegetation line at the back of the beach that has an important role to play in stabilising the shore. At the LP, the vegetation is dominated by the common Beach Morning Glory (*Ipomoea pes-caprae*). This creeping ground vine is considered a pioneer plant as it helps to stabilise coastal sands, creating a habitat into which other species move.

Scour - Scour is an erosion process that is carried out by the tidal movement of water caused by the localized alteration in the transport rate, around marine structure. Scour can jeopardize the integrity of the installation where waves and current forces erode sediment (Figure 55).

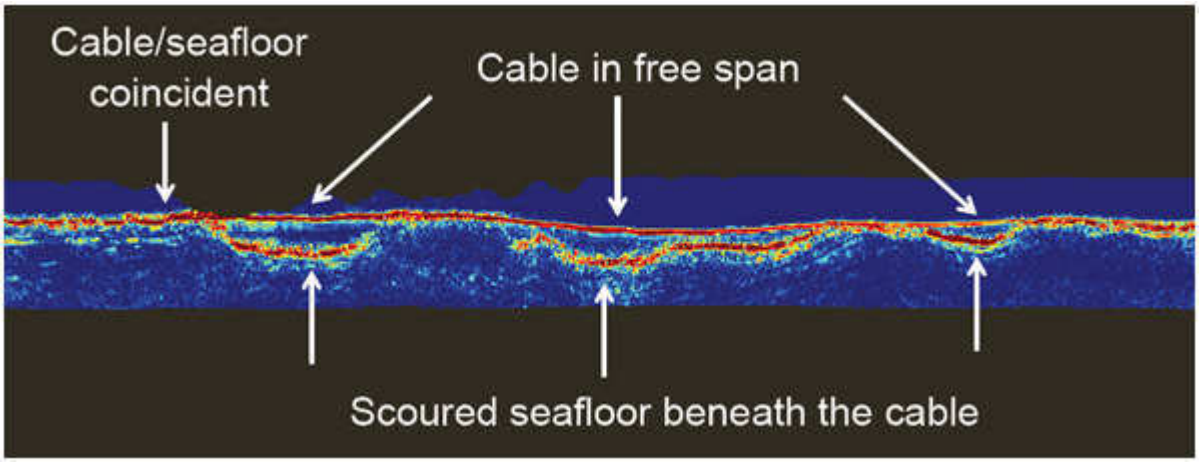

Figure 55: Scan imagery of cable scour on sea floor (source: http://www.pangeosubsea.com/pangeo-sub-bottom-imager).

For many seafloor structures scour can be a hazard but for submarine cables it can often be a benefit. Cables can settle into the seabed due to their own weight aided by scouring of sediment from around the cable by waves and currents. Movement of the cable on the seafloor, by current or wave action causes abrasion. It is recommended that, in surf zones, additional cable protection measures, such as amouring be used to increase the density and reduce the effect of wave action on the cable thereby decreasing the risk of abrasion and risk of damage to the cable.

Tsunamis - A tsunami, also known as a seismic sea wave, is a series of water waves caused by the displacement of a large volume of water. Tsunamis have a small wave height offshore and a very long wavelength, which is why they generally pass unnoticed at sea. They grow in height when they reach shallower water in a wave shoaling process.

These waves can be generated when the sea floor abruptly deforms and vertically displaces the overlying water. Tectonic earthquakes are a particular kind of earthquake that is associated with the Earth's crustal deformation. Sitting along the edge of the Tongan Trench, Tonga lies within the Pacific Ring of Fire, an area where a large number of earthquakes and volcanic eruptions occur in the basin of the Pacific Ocean. It is associated with a nearly continuous series of oceanic trenches, volcanic arcs and volcanic belts.

The most recent tsunami (2009) to affect the Tongan archipelago was generated by an 8.1 magnitude earthquake located within the Samoan Islands which sent three 6m high waves to Tonga (Figure 56). The majority of the damage in Tonga was to the northernmost islands of Niuatoputapu located 500km to the north of Nuku'alofa.

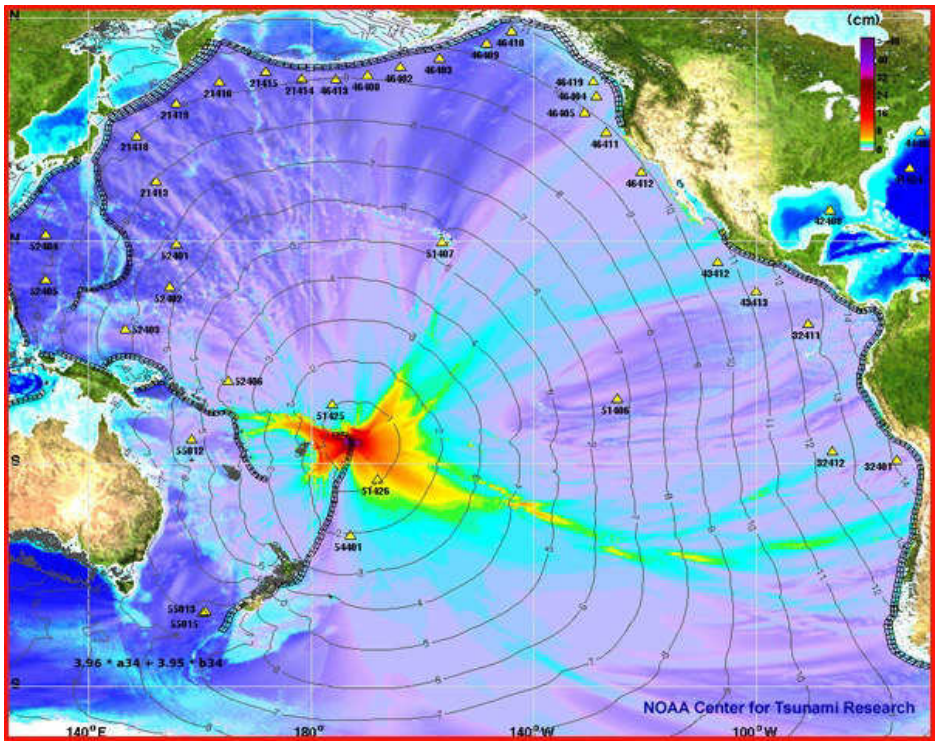

Figure 56: 2009 tsunami wave height and travel time (source: NOAA Center for Tsunami Research)

The landing points of Nuku'alofa and Ha'apai are found on low lying coastal stretches and are therefore more vulnerable to the impacts of tsunami.

5.3.6 Climate Change

The Pacific-Australia Climate Change Science and Adaptation Planning Project (PACCSAP) is using Conformal Climate Atmospheric Models (CCAM), at 60km downscaled dynamic modeling, to predict the possible impacts of climate change in the Pacific Islands over the coming 90 years. Dynamic downscaling is a methodology for providing more detailed climate projection information for a specific region, in this case at the 60km level.

Statistical downscaling models are also referred to in the PACCSAP report. These models can sometimes differ from the CCAM dynamic models as the statistical models are based on both observed local trends and large scale dynamically downscaled outputs. In addition, statistical downscaling is designed to deliver information at a given station and therefore takes into consideration local influences on climate and weather.

CCAM predictions have indicated that there could be a 2-3°C warming of air temperatures across the PACCSAP region by the end of the 21st century. However future temperature models of the Tonga region indicate that this increase could be in the region of 0.5°C by 2055, this is supported by statistical downscaling models which take locally sourced observation data to model from. The statistical downscaling indicates that the average temperature increase for Tonga's nearest neighbours, Fiji and Samoa, will experience a 0.5°C increase between 2020 and 2040.

Statistical modeling of the rainfall for Fiji and Samoa indicate that the number of rain days is projected to have little change by 2020-2040. However, median and 90th percentile results are projected to increase, suggesting that events may decline in frequency but increase in severity. This is supported by trends in observed data, which for Fiji, shows the median rainfall on rain days increases at the rate of 0.08 ± 0.02mm per year and the number of rain days decreases by 0.3 ± 0.1% per year over the observation period (1961 – 2009).

Using the CCAM dynamic downscaling models, the number of days of heavy rainfall is predicted to increase in the region to the north of Samoa, however, in Tonga the change is predicted to be in the region of ±1 days of heavy rainfall per year.

Wind speed, modeled using CCAM at 10m above sea surface shows a minimal decrease of 0.2mm per second by 2055 in Tongan waters and this is predicted to continue decreasing over time.

Tropical cyclone predictions indicate a decrease in the frequency of cyclone events in the southeast basin of the Pacific. Having said this, there is very little consistency between the six models used for the spatial patterns of the predicated change in wind hazard. There were some common trends shown in each model with most models indicating a reduction in cyclonic wind hazard north of 20°S and some regions of increased wind hazard south of 20°S (Figure 57).

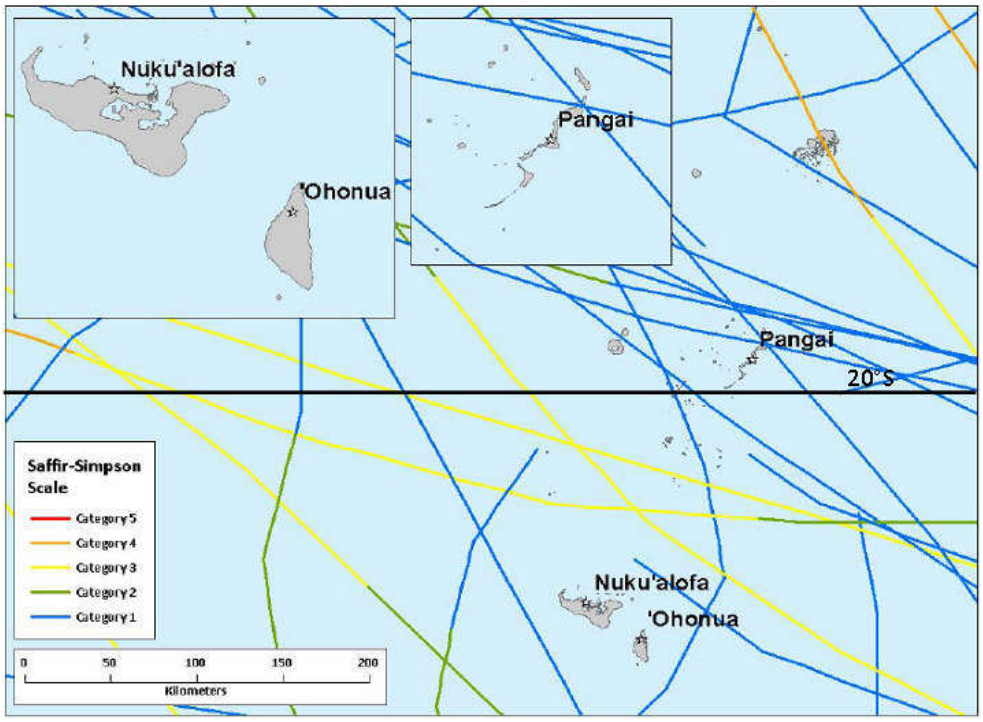

Figure 57: Historical cyclone activity (adapted from World Bank, 2008) with 20°S latitude shown

5.4 Biological Environment

5.4.1 Introduction

The planned cable route has been subject to a full marine survey (October 2012) that has identified the features of the sea floor for the whole length of the cable. Videos surveys by divers have provided an overview of the conditions directly along the cable route in the inshore environment.

During the course of this Environmental Assessment, the planned cable route has been subject to a literature review and gaps or paucity in biological data has been identified. Field investigations and literature reviews for the marine and terrestrial biological environment were undertaken with the purpose of determining whether or not there are any sensitive or otherwise important marine resources that could be impacted by the deployment. It was also determined if any mitigative actions would be required to ensure an environmentally sound deployment.

5.4.2 Terrestrial Environment

The proposed landing sites are predominantly peri-urban and the associated vegetation is dominated by grass areas and sporadic trees. There have been no rare animals or plants identified as inhabiting the proposed project site. Figure 58 shows photos of the landing site vegetation at all three locations.

Figure 58: Typical vegetation composition at landings sites in (l) Nuku'alofa, (m) Pangai and (r) Neiafu

5.4.3 Marine Environment

The PIA is divided over three separate island groups, each experiencing differing biological environments. As such, the three island groups are discussed separately in this section. The marine resources considered for this analysis include near shore (<15m water depth in Ha'apai and <25m water depth in Vava'u), inshore and coastal conditions.

5.4.3.1 Marine Environment: Nuku'alofa

Existing conditions on the Sopu reef platform were evaluated by the EA team along the proposed cable route, which was clearly delineated by an area of bare, disturbed substrate over the footprint of the 2013 Tonga Cable construction phase. The water depth contour to the platform edge is 0m LAT and is exposed at low tide.

The reef platform is surf exposed, tidal and owes its existence to calcified red algae that actively secretes limestone. Within the reef platform, the substrate is silty sand and gravel supporting large areas of seagrass dominated by *Halodule uninervis*. In the footprint area (Figure 59) the seagrass coverage is approximately 20%, while immediate areas outside the footprint have seagrass coverage up to 100% in areas of soft sediment. Where the substrate is harder, seagrass cover is replaced by brown macro algae (Figure 59).

Figure 59: (l) Google Earth imagery (image date January 2014) of 2013 Tonga Cable construction track and (r) areas of seagrass and macro algae regrowth

There is evidence of degraded water quality in the foreshore of the reef platform with an obvious increase in the cover of epiphytic algae on the blades of the seagrass.

The fauna of the reef platforms is dominated by benthic invertebrate species including the commercially important sea cucumber species *Holothuria atra*. Field surveys carried out during the course of this assessment determined that the numbers of *Holothuria atra* are low in the direct footprint of the cable route, with five individual specimens being observed over two 200m walking belt transects (Figure 60).

Figure 60: Walking transect routes along cable path on Nuku'alofa reef platform

The coral reefs surrounding Tongatapu are all fringing reef with most supporting areas of lagoon. A shallow lagoon (no more than 30m deep) extends 12km north of Tongatapu supporting extensive reefs and coral cays. The patch reefs in the northern lagoon vary in size from a few square meters to several kilometers in area. Studies of reefs in the area close to Nuku'alofa (Monu Reef, Figure 61) have shown a percentage live hard coral cover of up to 50%. Branching *Acropora* species are common corals on the reef crest, while reef slopes are dominated by *Echinophyllia* species (Figure 61).

Figure 61: Google Earth imagery of Monu Reef in relation to LP (orange triangle) and (r) typical dominant coral types at Monu Reef

In 1997, it was determined that the reefs near Nuku'alofa are quickly deteriorating, in part through unsustainable coastal development practices, and destructive and unsustainable fishing practices. The revisited Reefs at Risk (2011) report indicates that the reefs in Tongatapu are currently at high risk and have been subject to degradation since the first Reefs at Risk report was published in 1998. The Tongan Tourism Development Plan (Nicholas Clark & Associates, 1993) stated that the reefs along the immediate sea shore have been significantly altered by

coastal reclamation, sand mining, sea wall construction, dumping of refuse and waste water, and over fishing/over harvesting of resources.

The coral reef crest and slop at the outer edge of the Sopu reef platform measures 50m wide at the planned cable route, with a 300m wide area of coral found 100m further out from the reef slope. As with the original Tonga Cable lay, the new extension cable is planned to pass through sandy patches between the coral heads on the reef slope and it is not anticipated that this cable will cause any significant additional deterioration of the surrounding reefs systems.

Benthic mapping of the cable route has identified substrate type and is shown in Figure 62.

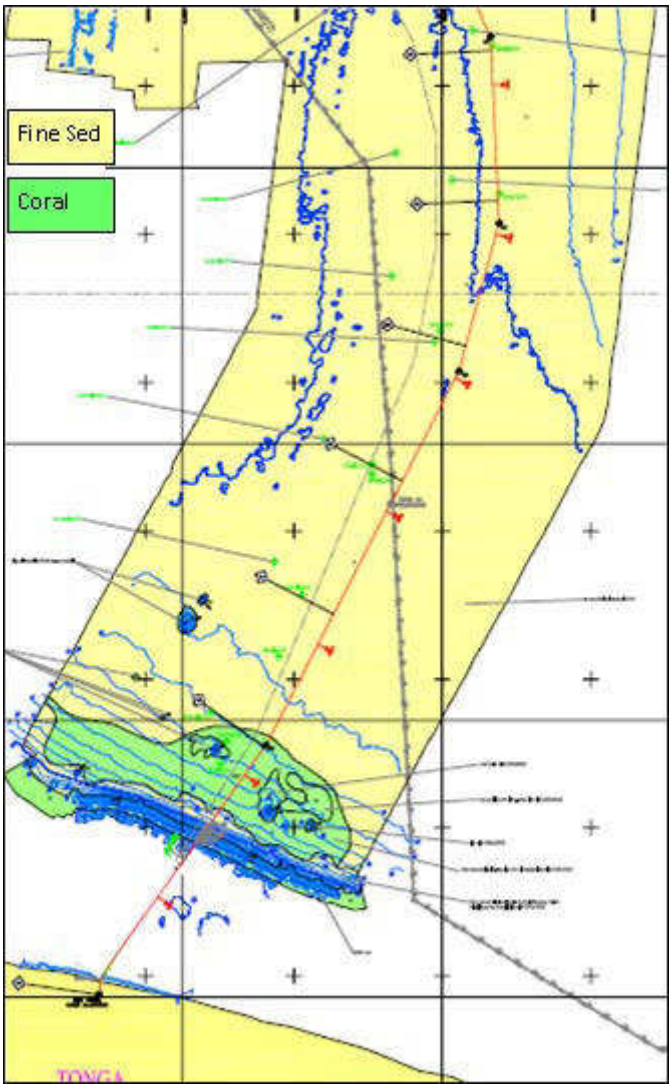

Figure 62: Nuku'alofa MRS substrate survey map (Adapted from source: MRS route charts)

5.4.3.2 Marine Environment: Ha'apai

There was a notable paucity in biological data for the Ha'apai cable route. To fill some of the gaps in this data and to provide a meaningful set of baseline conditions, it was elected to undertake marine field surveys in the nearshore waters of the planned route. The Reefs at Risk (2011) report indicates that the reefs in Ha'apai are among the least at risk within the Kingdom because of the relatively low levels of coastal development, the scattered nature of the reefs and the low population density.

Methodology - To determine the area of interest for field surveys, aerial photo interpretation techniques and the MRS bathymetric and substrate data were used to characterize marine substrate/life form differences and their spatial extents in relation to the planned route. The baseline information used for interpretation was obtained from Google Earth images of the study area (image date: 2004). Analysis was also made of the diver video survey that was taken in the near shore area during MRS site visits in 2012.

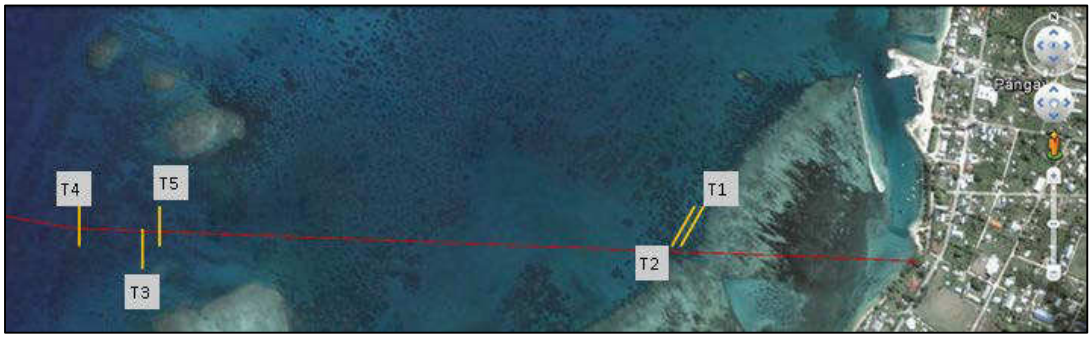

Figure 63: Google Earth imagery showing near shore route (Ha'apai) and diver survey transect locations

Based on the analysis of the aerial photographs and diver video, two survey locations were identified (Figure 63) and transect locations were selected using stratified sampling techniques (Table 3). Five 100m transects (T1 – T5) were marked running perpendicular and crossing the cable route with three surveys being carried out on each transect: reef fish population, benthic invertebrates and coral cover and health.

Table 3: Transect start points, water depth and transect length for diver surveys, Ha'apai

Transect number	Latitude	Longitude	Transect Depth	Transect Length
T1	19°48.431'S	174°21.484'W	12m	100m
T2	19°48.431'S	174°21.484'W	6m	100m
T3	19°48.455'S	174°22.325'W	12m	100m
T4	19°48.409'S	174°22.506'W	16m	100m
T5	19°48.410'S	174°22.307'W	8m	100m

Data was recorded by video and still photographs for further analysis and diver slates were used to capture specific species and data.

Results - Using the diver surveys, the following general transect observations were made for the planned Ha'apai cable route within the study site.

- In the foreshore area, corals that were alive in the 2012 video survey have been impacted by Cyclone Ian (January 2014) and are now largely dead (Figure 64). There are also a number of patches, in the same area, of old dead coral (>1yr) with algal cover.
- The shallow area close to shoreline has fragmented reefs with branching *Acropora* corals that do not offer hard substrate for coral placement.
- Coral reef areas surveyed are low in abundance of large targeted species of fish, such as parrotfish (Scarids), snappers (Lutjanids) and groupers (Seranids). Benthic invertebrates are also low in abundance and reefs not considered to be important fishing grounds for any species.
- T3 on the southern side of the planned cable route within the main shipping channel has large (average 1.5m height) and complex structures of scattered Porites coral heads down to approximately 15m WD (Fig 65).
- T4 and T5 bisected the planned cable route also recorded notable Porites coral assemblages; however, there were also wider sandy channels, which would be suitable for cable placement (Fig 66).
- The mouth of the shipping channel has extensive coral mounds towards the center and careful placement to the southern side of the channel will enable to cable to be placed along sandy substrate.

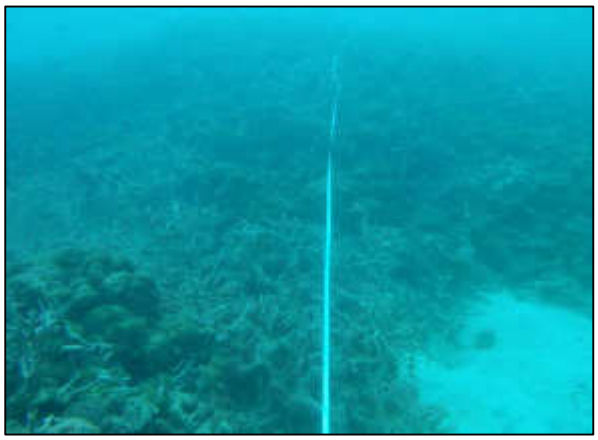

Figure 64: Figure showing general reef health on transect one, high occurrence of dead coral with algal growth and scattered *Acropora formasa* branching corals. Coral formations have small sized scattered *Acropora spicifera* plates.

Figure 65: Large *Porites lobata* coral heads extend from the channel marker out in to the shipping channel on the starboard side.

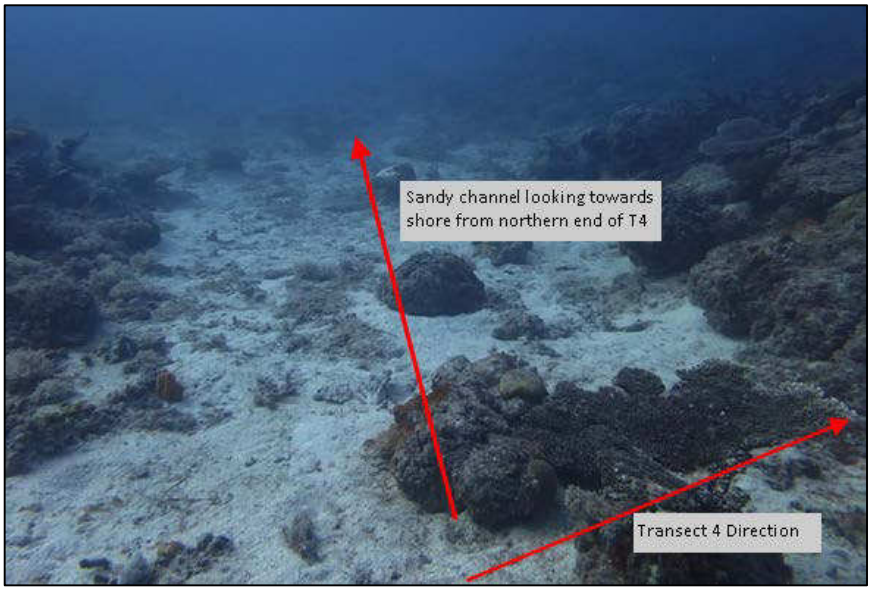

Figure 66: Sand channels extending from the ridge at the channel entrance are located on the starboard side of the channel.

The topography of the cable route from the harbour entrance towards the shoreline shows a predominantly sandy substrate with scattered low relief coral heads of varying health. It is not anticipated that these scattered coral heads will pose any problems for cable laying activities with the average distance between each being 10m; however care should be taken by the small landing craft when releasing the surface buoys to avoid contact with the corals as much as possible.

A shallow ridge of coral to the west of and parallel to the reef pavement (T1 and T2), is comprised of denser areas of structure although, coral health is intermittent due to presence of algal growth and broken corals, both old and recent (<1yr) damage. The dominant species here is *Acropora formosa,* a fragile branching coral that has a low resilience to bleaching and traumatic events such as cyclones and excessive water movement. Along the ridge there are breaks in the Acropora coral that will allow sufficient room for cable placement.

The substrate surveys revealed the four main attached benthic life forms are: living hard coral, macro algae, sponges and soft corals (Figure 67). On average, the hard coral cover for transects 1 to 4 was 25% with T1 having just 8% live coral cover. T1 and T2 had a high proportion of recently killed coral (19% of the substrate) but very little was observed on transects T3, T4 and T5 (4% cover on transect 3) (Table 4). This indicates that a recent event caused significant damage to the near shore areas, most likely Cyclone Ian in January 2014. This is in alignment with the areas shallower WD and its assemblage of more delicate branching coral species than the deeper and more resistant corals on T3, T4 and T5.

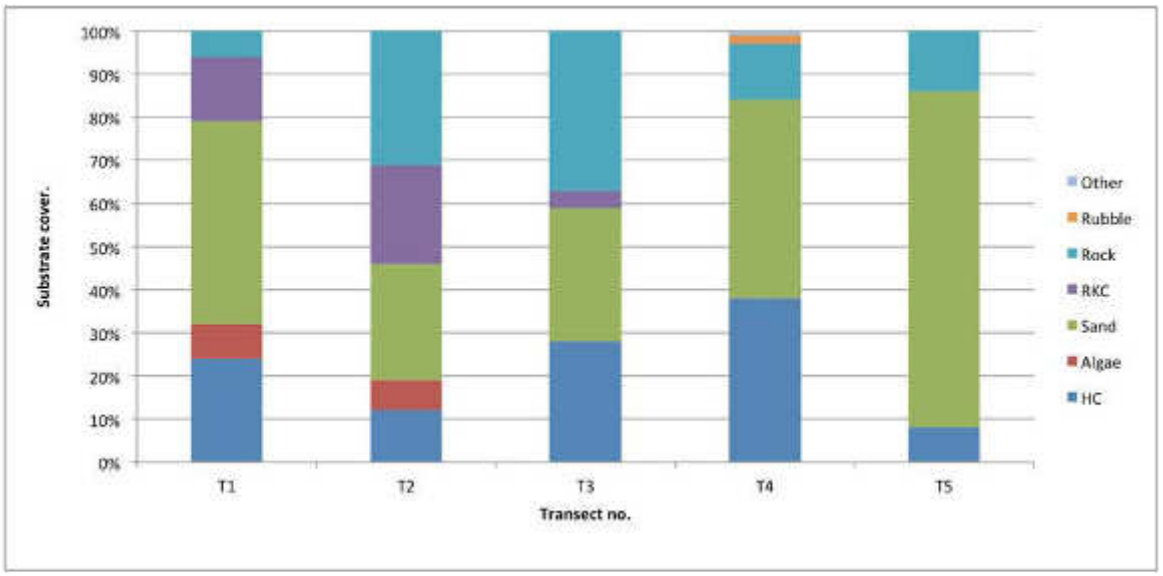

Figure 67: Graph showing substrate cover over the five transect areas surveyed. The data collected was to establish the percentage of HC - hard coral cover whether alive or in the stages of bleaching. Algae cover not including turf algae's that are linked to eutrophication and low resilience. For turf algae the substrate below the algae is recorded which is predominantly deceased coral of greater than 1 year. Sand is considered sediment of less than 0.5cm and falls easily through the water column. RKC represents recently killed coral that appears white but still shows corallite structures. Rock represents hard substrates including dead coral of greater than a year old and may be covered by turf algae, crustose coralline algae (CCA) etc. Rubble represents substrate of reef rocks that are between 0.5com and 15cm. Other includes patches of soft corals, anemones, tunicates and sponges.

Table 4: Percentage cover of each benthic life form or substrate type recorded on all transects

Transect No	Hard Coral living %	Algae %	Sand %	RKC %	Rock %	Rubble %	Other
1	24	8	46	15	6		
2	12	19	27	23	19		
3	28	0	31	4	37		
4	33	0	52	0	13	1	1
5	8	0	78	0	14	0	0

Plates summarising each transect can be found in Appendix 3.

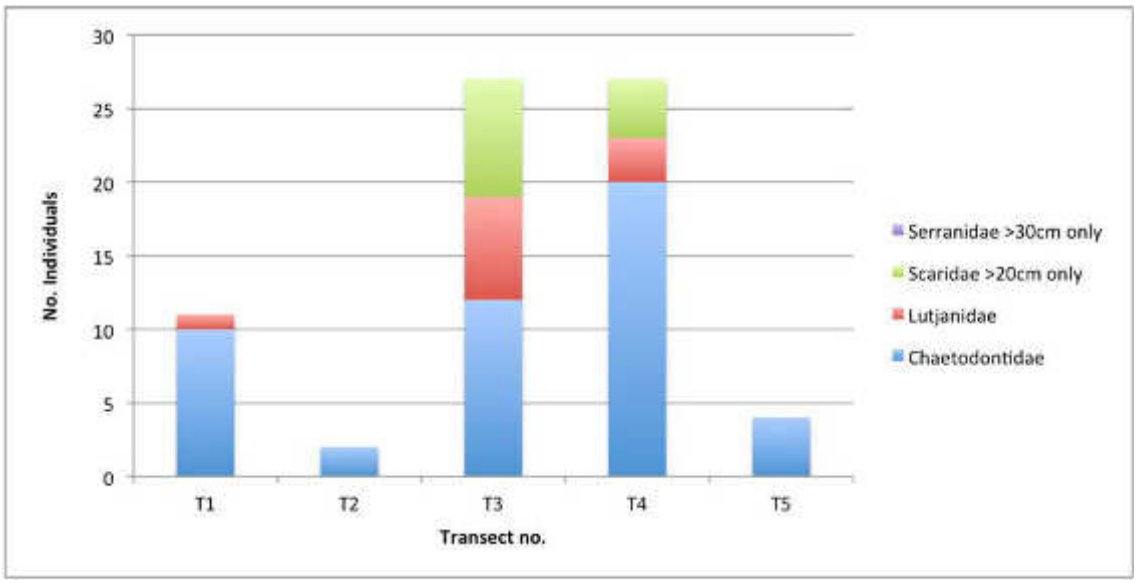

Figure 68: Commercially valuable species including Serranidae (grouper), Lutjanidae (snappers) and Scaridae (parrotfish) were recorded as to the importance of the area ecologically and economically for local fishermen. Chaetodontidae (butterflyfish) are indicators of reef health and condition.

Fish population surveys revealed a low density and abundance of commercially important and targeted fish species such as parrotfish (Scarids), snappers (Lutjanids) and groupers (Seranids) (Figure 68). In addition to this, there were no species of sea cucumber observed during the surveys. The presence of butterflyfish (Chaetodontidae) on all transects is a good indicator of coral health with T3 and T4 having the greatest diversity and abundance of target fish species. Fish families on the transects were dominated by non-commercial species: damselfishes (Pomacentreidae), wrasses (Labridae), mullet (Mullidae) and gobies (Gobiidae), which is a common feature of coral reefs in Tonga in close proximity to urban centers.

Benthic mapping of the cable route has identified substrate type and is shown in Figure 69.

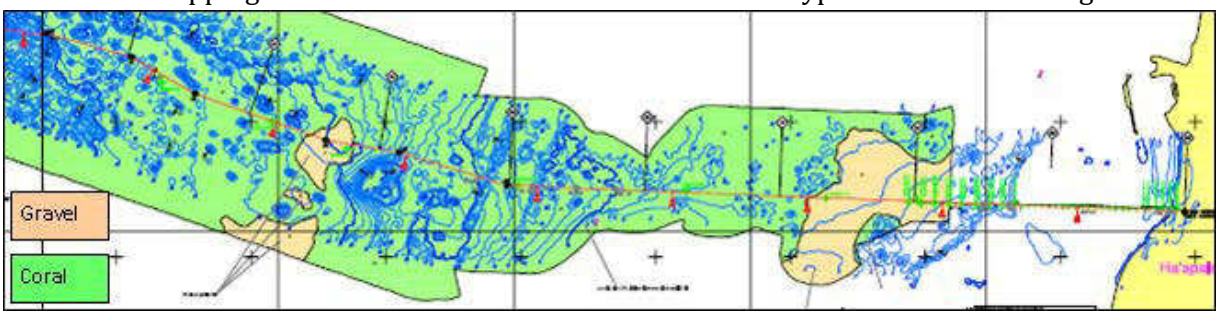

Figure 69: MRS Substrate survey of inshore cable route in Ha'apai. (Adapted from Source: MRS Cable Route Charts)

5.4.3.3 Marine Environment: Vava'u

Vava'u has been subject to numerous coral reef surveys in recent years and the shallow (<25m WD) areas of coral in the vicinity of the planned route have been relatively well documented when compared to Tongatapu or Ha'apai.

The Vava'u group is dominated by the main island of Vava'u that is indented on the southern coast by long narrow embayments. Fringing reefs are common around most of the islands except along island shorelines where cliffs descend directly into sheltered waters. Many of the

islands reefs are joined together by reef development and others have additional patch reefs and shoals resulting in a complex assemblage of reef configurations and habitats.

Coral reefs of the inner Neiafu harbour area have been geographically defined by Holthus (1996). The cable lands within the inner portion of Neiafu harbor, which is a semi enclosed basin surrounded by the fairly steep slopes of Vava'u Island, including Mount Talau in the northwest and the steep northeast coast of Pangaimotu. The main harbour entrance at the northwest end, through which the cable enters the harbour, is constricted by shoals and reef areas extending from Pangaimotu to Vava'u (Figure 71).

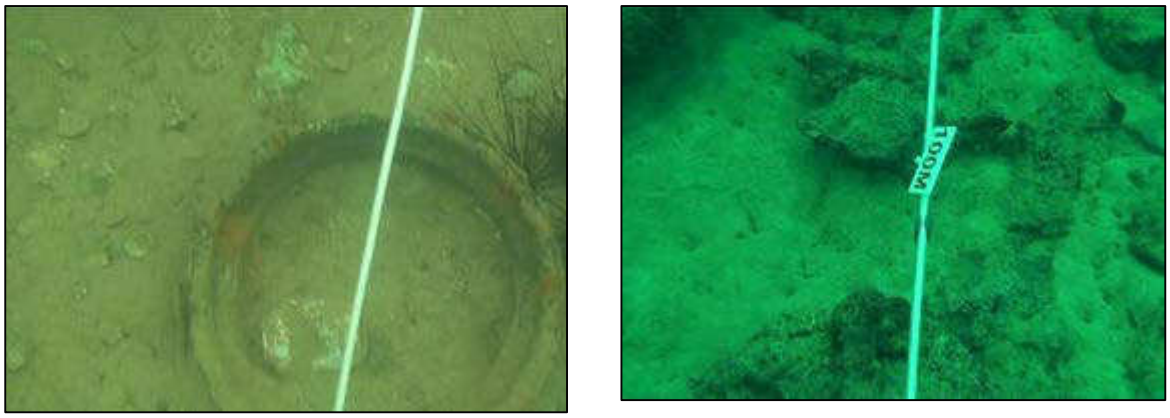

Figure 70: Video grabs from CRS diver survey of approach to LP in Neiafu harbour

The reefs of inner Neiafu Harbour are sediment dominated with scattered coral patches on the submerged reef terrace. In the vicinity of the landing site is a soft sediment area with low macro algae abundance and very low coral cover along the coast line (0% - 5%, Holthus 1996). The sediment in the harbour area, and at the landing site, is of an easily disturbed, silty nature (Figure 70). The harbour has a high flush rate (Figure 71) through current exchange and limited impacts from any suspended materials is expected due to the low level of coral cover and the absence of any benthic invertebrates such as clams or nearby (<1km) aquaculture facilities which may be impacted by sediment movement.

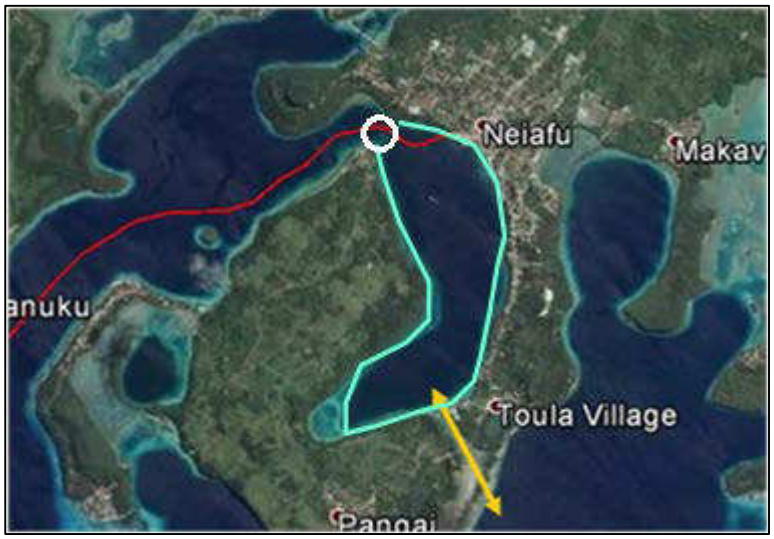

Figure 71: Google Earth imagery showing Neiafu harbour entrance (circled in white), no anchoring zone (boundary shown in blue) and site of water exchange (yellow)

The marine environment outside the Neiafu harbour is a deep and long channel providing the only access to the Neiafu harbour for all marine traffic. The MRS identified this channel as having an average depth of 85m WD over soft sediment and rock outcrops and is approximately 1km wide along its length. There are narrow fringing reefs that extend from the shoreline with little live coral cover. The reef substrate is primarily bare reef, rubble or dead standing Acropora, often with algal cover.

One coral reef area worth noting is that surrounding Lotuma Island close the village of 'Utungake. This area is under consideration for inclusion in the pending Special Managed Area (SMA) of 'Utungake, which is discussed later in this chapter. Lotuma Island is located in the main channel, close to the harbour entrance (Figure 72). The planned cable route is approximately 180m at the closest point north of the island, in approximately 50m of water. The coral reefs of Lotuma Island have approximately 0-5% live coral cover on the upper reef slope, increasing to 20-40% cover where hard substrate occurs. These are interspersed with open sand slopes and isolated reef rock and coral outcrops. The topography of the reef is a shallow plateau extending out to 20m from the island and then a gradual drop off to 30m with scattered coral heads from which the gradient steeply slopes away to 50m. There is no impact envisaged on the reef area during the construction phase of this project.

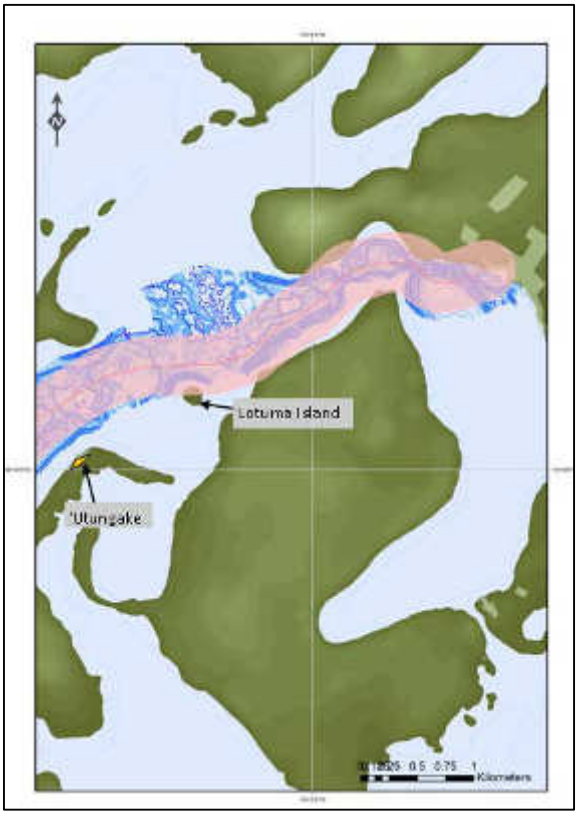

Figure 72: Lotuma Island in relation to cable route and PIA

Benthic mapping of the cable route has identified substrate type and is shown in Figure 73.

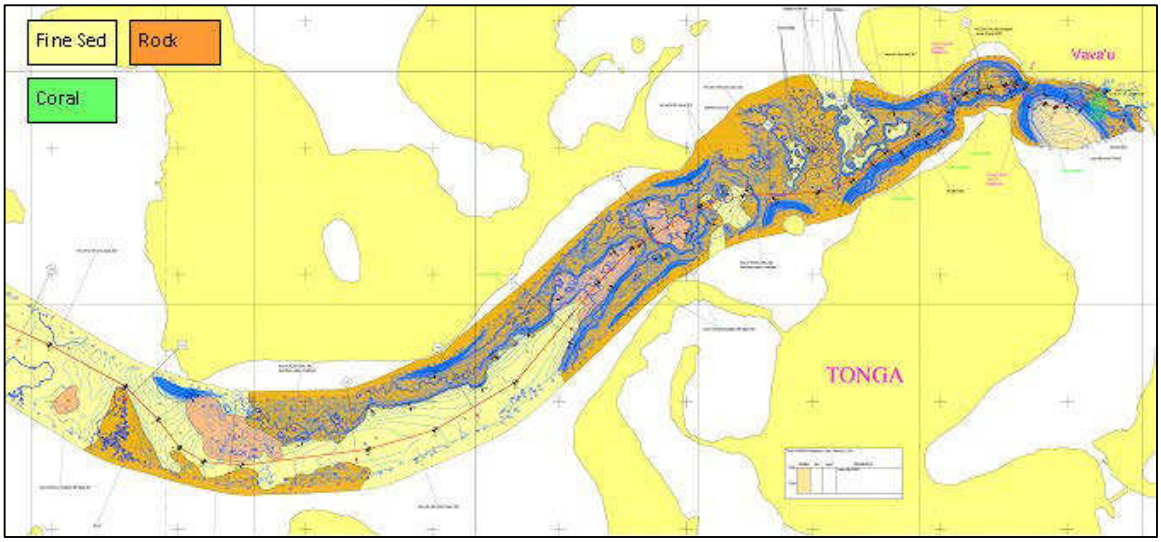

Figure 73: MRS substrate survey inshore route Vava'u (adapted from source: MRS cable route charts)

5.4.4 Specially Managed Areas

While there are no formal Marine Protected Areas within Tongan waters, there are community Special Managed Areas (SMAs) designated by the Ministry of Fisheries and run by committees formed from the local communities for the purpose of community based fisheries management in their coastal areas. These SMAs were developed in response to communities' general concern for declining fisheries resources that they significantly rely on for food and income. There are currently nine gazetted SMAs throughout the three islands groups, none of which are within or adjacent to the PIA (Figure 74).

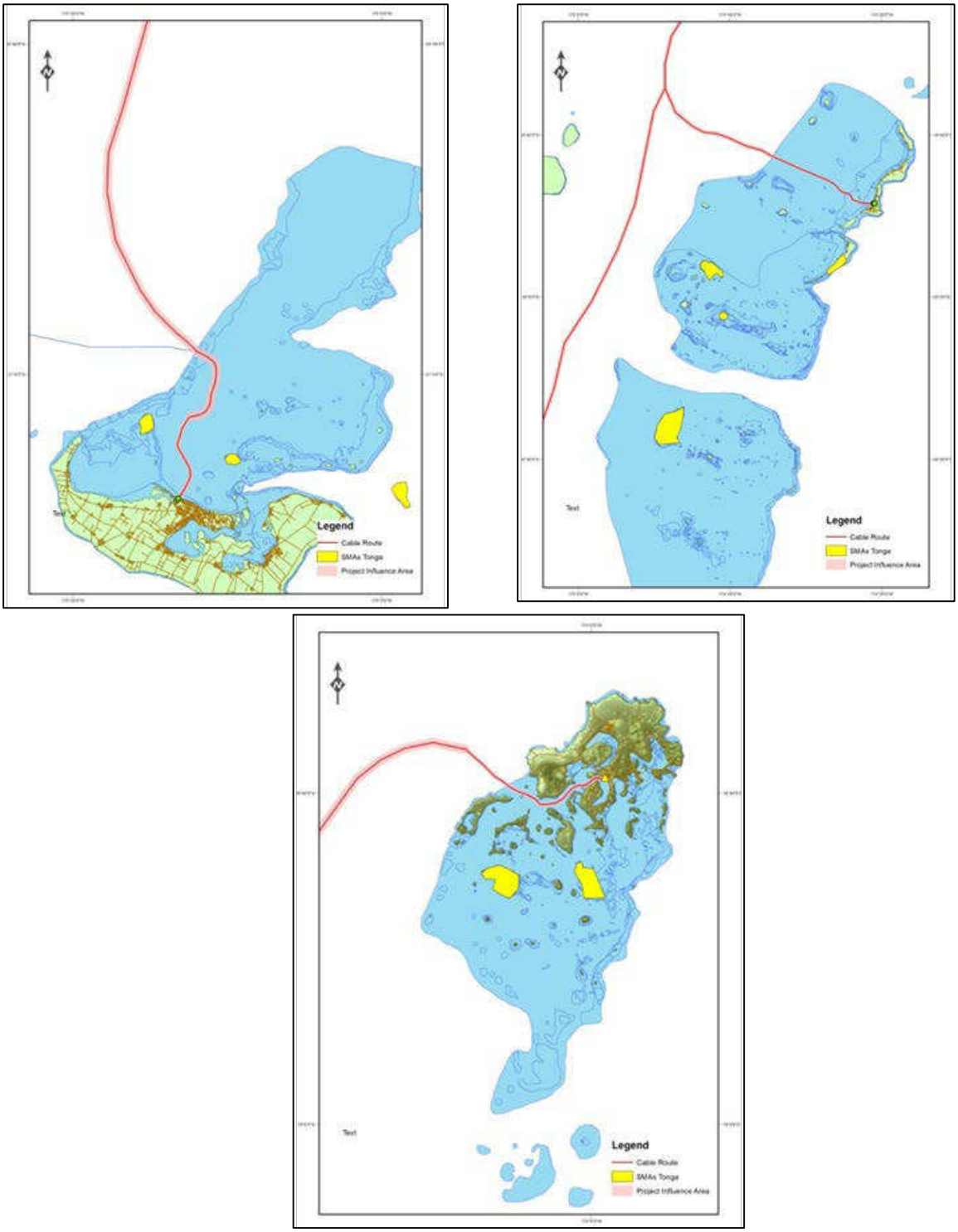

Figure 74: Gazetted SMAs (yellow) in Nuku'alofa, Ha'apai and Vava'u in relation to cable route

There are several other SMAs that have been tentatively approved by the Ministry of Fisheries and the Asian Development Bank. These pending SMAs, with the exception of one, lie outside the wider project area. In Vava'u, the village of 'Utungake has been granted their SMA application, however this process is in its earliest stage and they have not yet decided the location and extent of this SMA. Consultations with the Officer in Charge of Fisheries in Vava'u has identified that the new SMA could potentially include the island of Lotuma (Figure 72). While there are no impacts anticipated on the reefs or natural resources of Lotuma, there does

exist a strong set of baseline data for this reef should there be a need for future comparisons. No adverse impacts are expected to arise as a result of this project.

5.4.5 Protected and Endangered Species

All marine mammals have been protected in Tongan waters since 1978 by Royal Decree and the Fisheries Management (Conservation) Act 2008 fully protects all marine mammals from any disturbance or fishing.

While there are 14 marine mammal species recorded in Tonga, the most notable and abundant of these is, by far, the humpback whales (*Megaptera novaeangliae*) that migrate to Tonga each year from July through October from Antarctica to mate and breed in the shallow protected waters of Tongatapu, Ha'apai and Vava'u. The global population of humpback whales is generally considered to be in the IUCN Red List category of 'Least Concern', however, the Oceania subpopulation of humpback whales is considered by the IUCN to be 'Endangered' - facing a very high risk of extinction in the wild in the near future.

humpback whale calving and mating takes place in all three island groups, generally in waters of less than 200m depth. At the time of writing this Environmental Assessment, the dates for laying the fibre optic cable had yet to be finalised, therefore, to take a precautionary approach, the impact of laying the cable during the breeding season has been assessed.

Local knowledge of the humpback whale habitat within the project area indicates that Vava'u is the most densely whale populated area during the season, although anecdotally, it would seem that the distribution of whales is also significant in the waters of Ha'apai. The less sheltered waters around Tongatapu are not well known for encounters with humpback whales but they can often be found there, especially towards the beginning and end of the season.

A combination of field surveys and local expert knowledge has been used to assess the distribution of whales throughout the project site and thereby determine potential impacts. During August 2014 consultations were held with representative of the whale watch industry and with humpback whale ecology experts to define "hot spots" – areas of frequent occurrence or interactions with different assemblages of whales. The location and grouping type were recorded and are represented in Figure 75. Concurrent with the consultations, whale survey transects were carried out in Ha'apai and Vava'u.

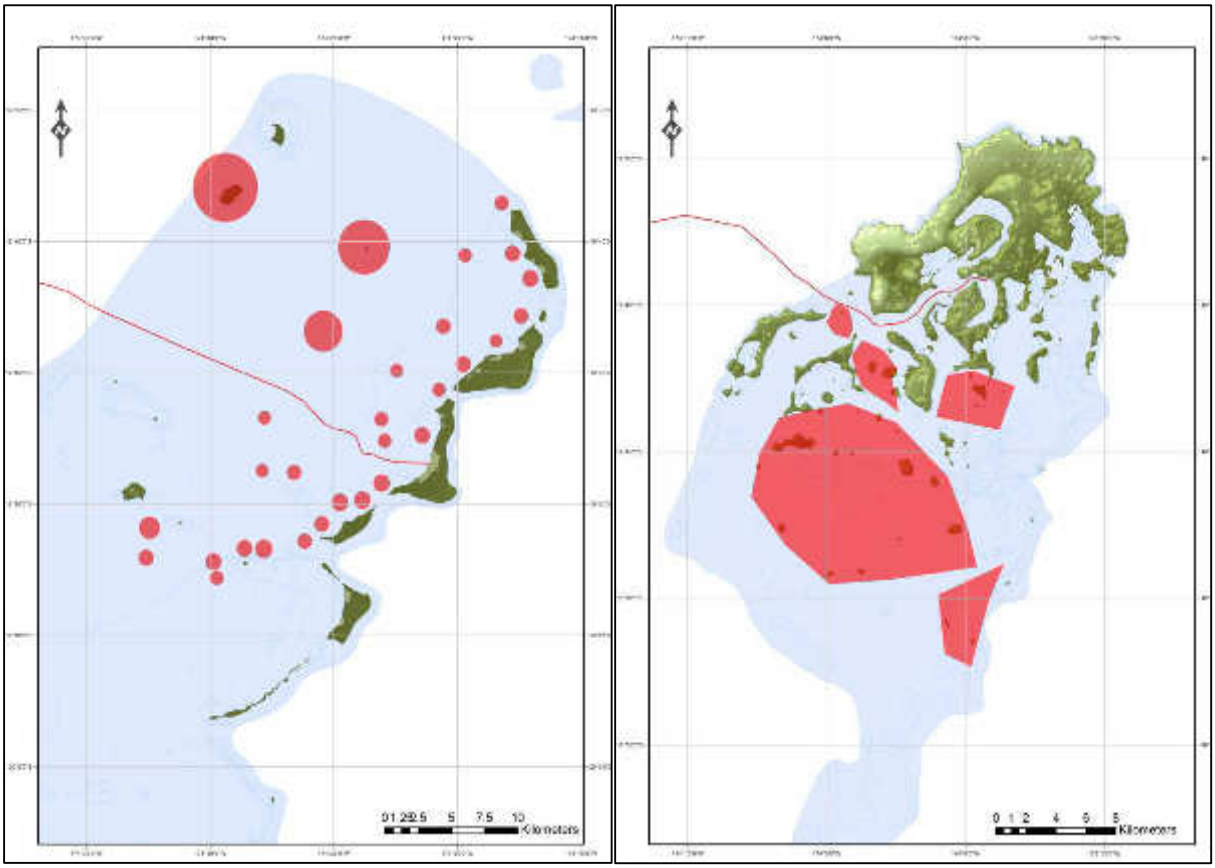

Figure 75: humpback whale mother and calf pair preferred habitats in Ha'apai and Vava'u

It has been determined that important areas in Ha'apai for whale interactions during July through October are around the sea mounts. This was indicated by operators and was also noted during field surveys that increasing whale sightings were associated with proximity to sea mounts and shallower coastal areas.

While there were no marine mammals observed during rudimentary field surveys of the planned cable route into Vava'u, whale watch operators noted that they have had interactions with mother and calf groupings in the channel entrance and that, on occasion, the whales have entered the channel and harbour area. The majority of whale activity is concentrated in the middle and southern group of islands of Vava'u, with mother and calf pairs preferring the middle area between the eastern side of Hunga Island and the Ovaka channel. Sightings of mother and calf pairs on the northern side of the Hunga Island have been noted in previous years, however the mother and calf pairs stay in the shallow and sheltered waters close to the island. Habitat areas that have been deemed important for humpback whales (Lindsay R, 2014 draft) include up to 3km of the west and north of Hunga Island. The cable at its closest point to Hunga Island will be at 1.28km off the north coast, however no adverse impact should occur to the habitat directly and recommended vessel observations and protocols will be followed to minimise stress to marine mammals sighted close to the vessel during the cable laying.

A further potential impact to be considered with marine mammals is that of entanglement. Between 1877 and 1955 there are 16 recorded instances of cable damage from cetacean species. The majority resulted from sperm whales as identified by their remains entangled in the cable and mostly at sites where repairs had been made. However, whale entanglements

have nowadays ceased completely. In a recent review of 5,740 cable faults, for the period 1956 to 2006 (Wood and Carter, 2008), not one whale entanglement was noted.

Marine turtles are also protected in Tongan waters under the Fisheries Management (Conservation) Regulations 2008, although males (over 45cm carapace lengths) of certain species are subject to open fishing seasons during February to August each year. Green turtles (*Chelonia mydas*, IUCN Red List category: endangered) and hawksbill turtles (*Eretmochelys imbricata,* IUCN Red List category: critically endangered) are known to nest in Ha'apai and Vava'u (Figure 76), although occurrences of nesting activity is very low and distributed over scattered outer islands (SPREP). The peak nesting season is from December to January each year. The planned route is not in conflict with any turtle nesting locations or known foraging grounds. No adverse impacts are anticipated from this project.

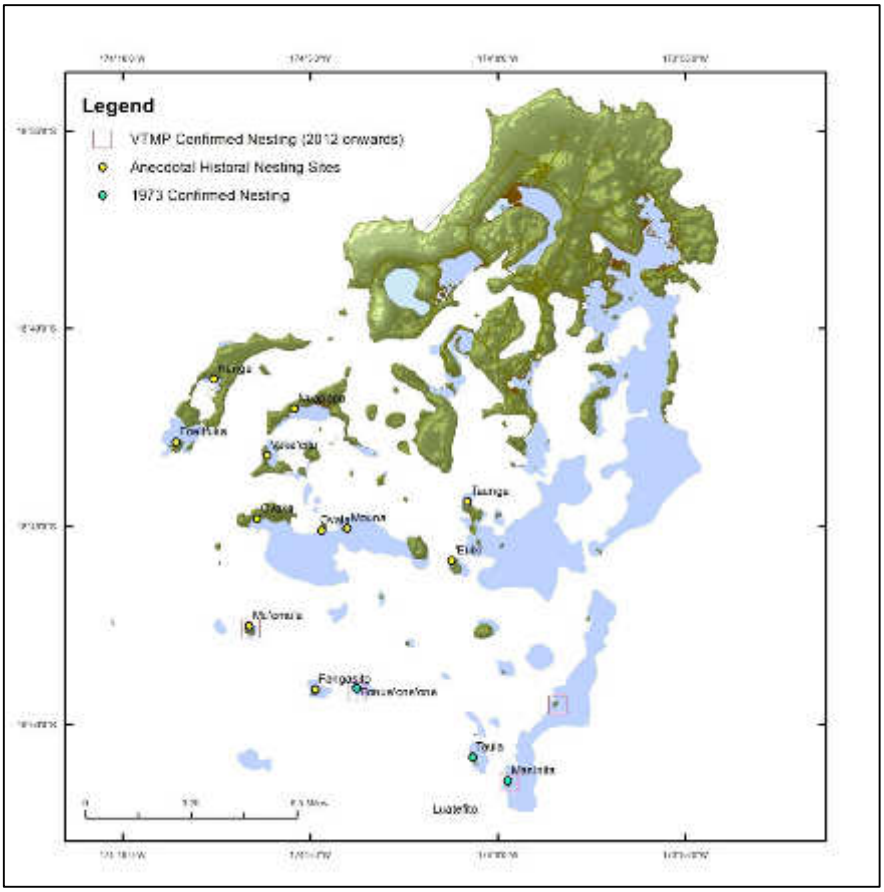

Figure 76: Marine turtle nesting map for Vava'u (source: Vava'u Environmental Protection Association, Turtle Monitoring Project)

6. Socio-Cultural and Socio-Economic Environment

6.1 Introduction

The landing sites in all three locations are within residential and commercial mixed properties with very limited direct tourist activities. The landing site beaches are not considered to be of high tourist value, but could be considered to have a recreational use. The commercial aspects of the terrestrial areas are limited to a few small retail shops, a number of government offices and the maritime activities associated with the wharf in Vava'u.

6.2 Cultural Heritage Resources

The island groups of Tongatapu, Ha'apai and Vava'u have various cultural heritage sites scattered throughout, however, there is no cultural heritage resources located within the immediate geographic sphere of influence of this project.

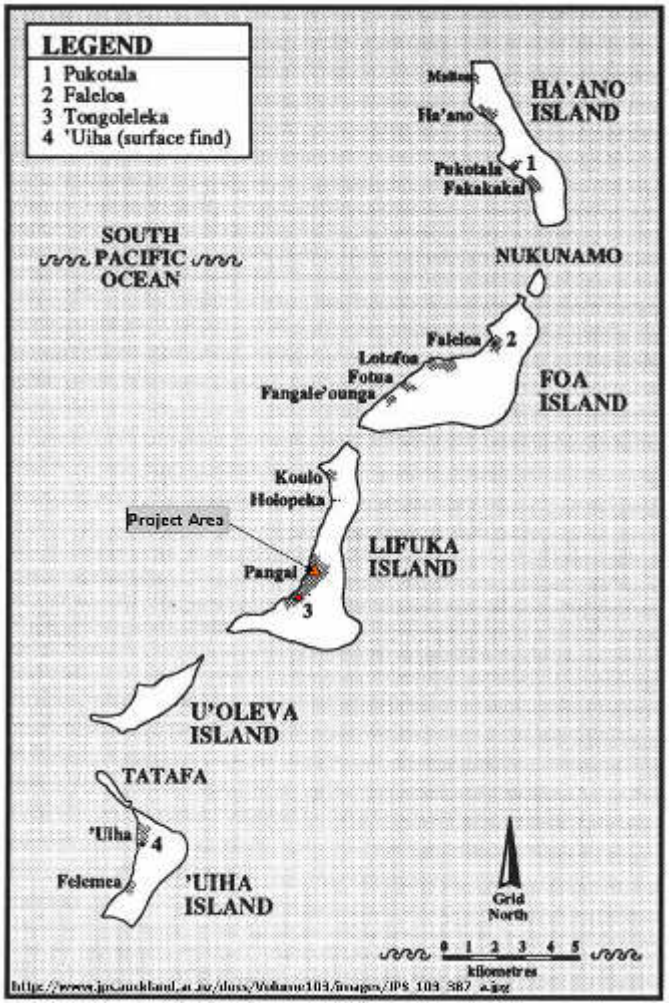

Figure 77: Northern Ha'apai islands and early eastern Lapita site locations.

In Ha'apai there are several archeological sites of importance for Lapita pottery finds. This pottery is found throughout the Polynesian islands and in Tonga, the pottery dates from 850BC. Archeologists use the pottery finds to trace the movement of Polynesians throughout the region and attempt to track the initial migrations of peoples. The closest identified site to the project area is in Pangai (Figure 77), approximately 1.5km southeast and well outside the PIA.

While no impacts are anticipated to the cultural heritage resources of Tonga, mitigation measures have been designed to handle "chance finds" of archeological items.

6.3 Fishing

Up to the early 1960s domestic demand for fish was almost wholly met through catches from the country's reefs and lagoons. Subsequently, however, increases in population and fishing effort, and the growth of the cash economy have led to overfishing in many inshore areas. Some traditionally important fish, especially mullet, have been reduced to a small fraction of their earlier abundance, and inshore invertebrates such as bêche-de-mer, lobsters and giant clams have undergone sever declines. These problems are found throughout Tonga, but are most acute close to population centers or in easily accessible fishing areas.

According to the FAO, Tonga's fisheries can be placed in six categories. These categories and their proportional associated production (metric tonnes) are estimated as:

Coastal Commercial	54%
Coastal Subsistence	30%
Offshore: Locally Based	15%
Offshore: Foreign Based	0%
Freshwater	<1%
Aquaculture	<1%

Tonga faces many challenges within its fishing industry stemming from the increasing exploitation of the coastal resources, especially those close to urban markets like those in Nuku'alofa, Pangai and Neiafu. In the offshore environment, there are decreasing numbers of locally based longline vessels and associated employment. These vessels primarily target tuna species however they are currently suffering from declining catch sizes year after year. There are positive steps being made within the country to improve the situation and efforts are being made to manage fisheries resources.

The inshore fishery is dominated by four main methods: diving/spear fishing, gill netting, bottom fishing and reef gleaning. Spear fishing targets reef fishes, while the 19 registered bottom fishing vessels target deep water snappers, groupers, trevallies, jacks and jobfish. Reef gleaning is traditionally undertaken by the women of the community and surveyed coastal households showed that most women carried out some form of gleaning.

In a World Bank study, residents of six coastal communities in Tonga were asked to name the three subsistence fishery resources most important to them. Seven resources were the most often cited: finfish, octopus, lobster, bêche-de-mer, giant clams, seaweed and Anadara (Figure 78).

Figure 78: Cited important fisheries resources (l-r) finfish, octopus, bêche-de-mer, giant clam, lobster, limu (seaweed) and Anadara

In relation to the project area, bêche-de-mer collection occurs on the Sopu reef platform in the vicinity of the proposed route. The Sopu area does exhibits signs of over harvesting of these organisms and is therefore considered to be a degraded fishing ground. The Pangai nearshore area has at least one fish trap located less than 200m to the south (Figure 79) of the proposed route. No reef gleaning or bêche-de-mer harvesting occurs in this area. No fishing occurs in the vicinity of the Neiafu landing site.

Figure 79: Pangai fish trap in relation to cable route

6.4 Aquaculture

The Ministry of Fisheries has developed an aquaculture program in Nuku'alofa and Vava'u primarily focusing on the customary significance and improvement of livelihood that this program can bring.

Currently Tonga has aquaculture programs focusing on Wing Pearl Oyster (*Pteria penguin*) farming, Giant Clam (*Tridacna derasa*) cultivation, live rock and coral cultivation (Figure 80) and the cultivation of other edible species such as urchins (*Tripneustes sp.*) and seaweed ('Limufuofua')

Figure 80: (l-r) Wing Pearl Oyster, Giant Clam and Live Coral aquaculture operations

The main success of the aquaculture program, and the most relevant activity to this project, is the oyster farming that occurs in Nuku'alofa and Vava'u. The oysters are filter-feeding organisms that are vulnerable to the effects of siltation. The farms consist of a free hanging series of ropes, supported at the surface by buoys. There are currently two farm areas in Vava'u (Figure 81) (one midway down the Neiafu harbour and one in the water surrounding Lotuma Island) with a total of three rope systems in place. In Nuku'alofa, there is one oyster farm

located outside the reef platform in Sopu, about 100m from the small boat passage that will be used during the laying of this cable and, as with the previous cable placement, no significant impacts are envisaged.

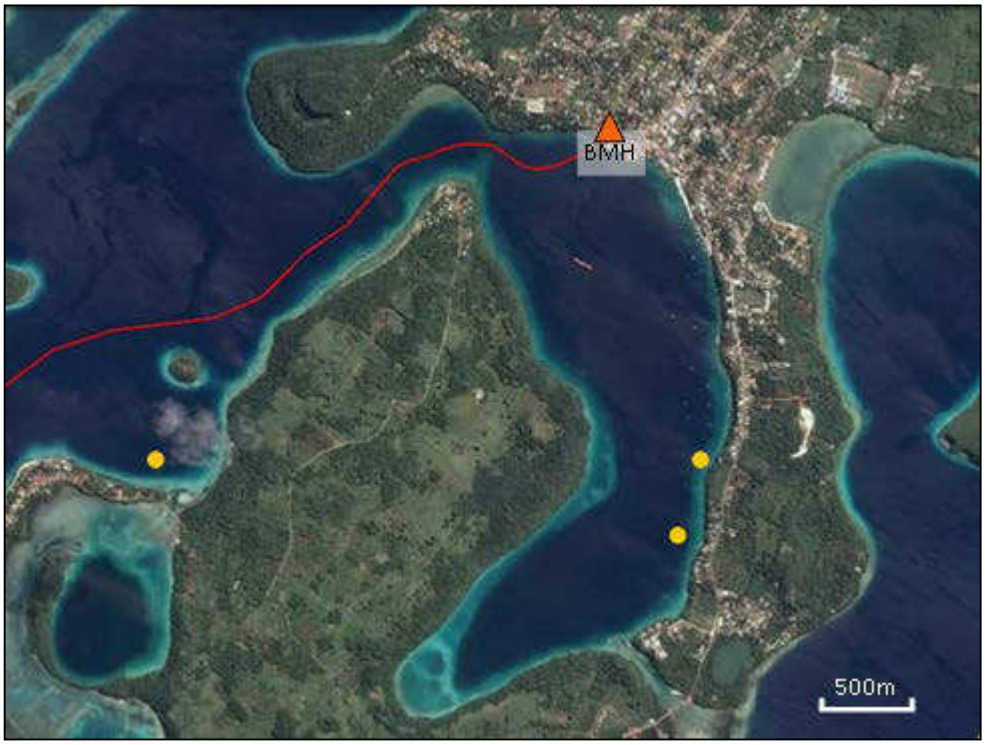

Figure 81: Oyster farm locations (yellow markers) in Vava'u

6.5 Marine Traffic Analysis

Commercial Shipping - There are three commercial harbours within the project area, one each in Nuku'alofa, Pangai and Neiafu (Figure 82). The proposed cable route passes through the harbour in each of the landing points and lands within the commercial wharf area in Neiafu.

Annual reports are published by the Ports Authority in Nuku'alofa documenting the level of commercial shipping in each port. On average, there are 150 cargo vessels and cruise ships that visit Nuku'alofa each year. Numbers for Vava'u and Ha'apai are significantly lower and include the inter-island ferry ships (which are excluded in the Nuku'alofa figures) but vary between 10-12 visits per month in Ha'apai and between 13-15 visits per month to Vava'u.

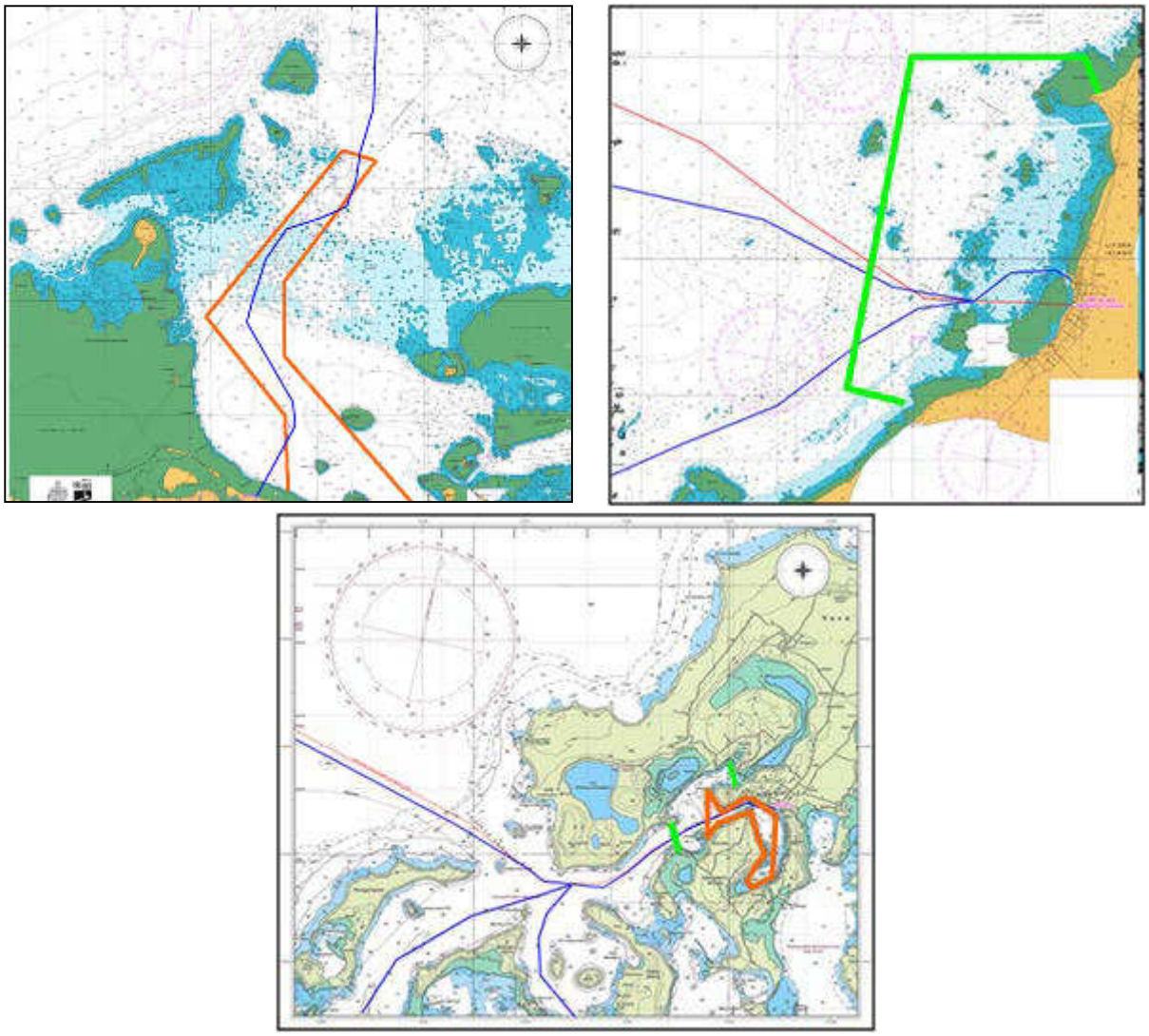

Figure 82: (tl) Nuku'alofa harbour chart – no anchor/no fishing zone marked in orange. (tr) Ha'apai harbour chart with harbour boundaries marked in green and (b) Vava'u chart with harbour limits marked in green and no anchoring zone marked in orange.

No anchoring areas are defined in Nuku'alofa and Vava'u, which will allow a certain level of protection for the cable (Figure 82). During the laying of the original Tonga Cable in 2013, the Tonga Ports Authority relocated their usual anchoring areas for container ships awaiting pilotage to accommodate the cable and therefore, there are now no potential conflicts between the cable route and commercial shipping anchorage areas.

During meetings with the Ports Authority in Nuku'alofa, the future possibility of dredging the shipping entrance channels was not ruled out. However, it is important to note that these have been long discussed plans which are not yet scheduled and which do not appear in the Ministry of Infrastructures Investment Plan 2013-2023.

Recreational Boating - There are several tourism industries that operate in the marine environment. Most notably, these are the commercial game fishing vessels and the licensed whale watching/swimming vessels.

Game fishing activities take place in Vava'u and Tongatapu. There are seven licensed game fishing vessels in Vava'u and two licensed vessels operating in Tongatapu. The Vava'u Sports Fishing Club has installed three fish aggregating devices (FADs) (Figure 83) along the western edge of the Vava'u island group (Table 5). These FADs are built from a collection of surface buoys, which are moored in deep (>200m) water. They have a swing radius of about 1.8km and are locally known navigational hazards (Figure 84). These FADs and their swing radius have been mapped in relation to the proposed cable route and do not appear to be in conflict with the route.

Table 5: Fish aggregating device (FAD) locations, Vava'u

FAD Name	Location
Northern FAD	18° 33.390'S, 174° 03.800'W
Middle FAD	18° 35.650'S, 174° 08.650'W
Southern FAD	18° 42.000'S, 174° 12.100'W

Figure 83: Surface view of the FAD buoy system in Vava'u. Pictured: Middle FAD

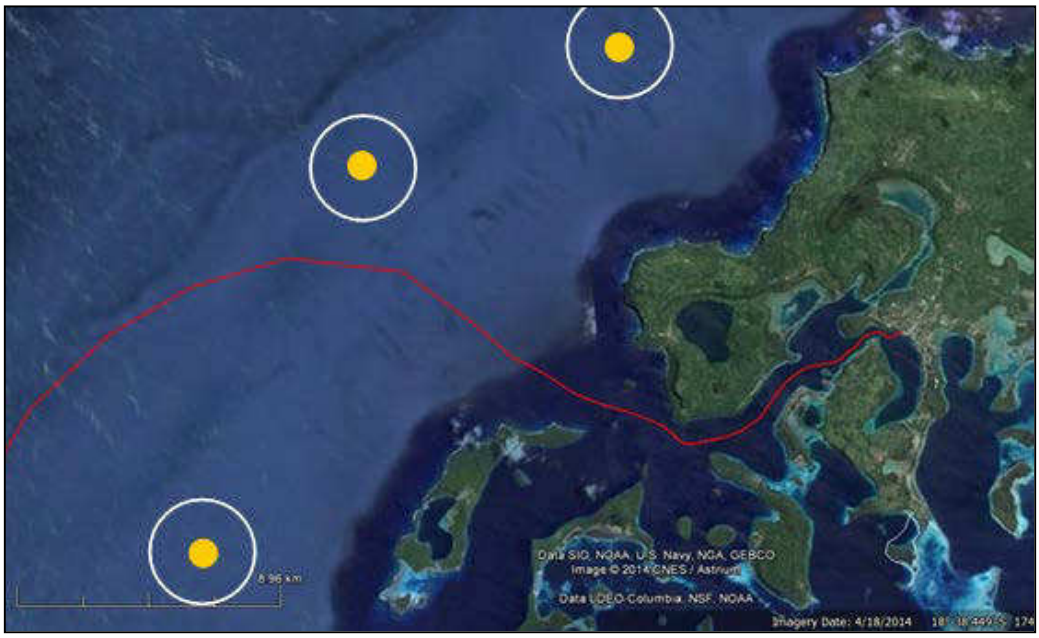

Figure 84: FAD locations with 1.8km swing radius mapped

The majority of the games fishing boats are trolling for tuna and billfish species, with some bottom fishing with weighted hooks. Game fishing tends to be concentrated within 7-13km off shore with occasional visits to offshore seamounts. The game fishing vessels do operate all year, however, the most intense activity is during the winter months of June to November.

Whale watch vessels (Figure 85) operate in all three of the island groups. There are currently more than 25 licensed vessels with the majority of them focused in Vava'u. These vessels operate in the inshore waters of their respective island groups for six days a week between July and October each year.

Figure 85: Whale watching vessel, Vava'u

The whale watching and swimming industry is Tonga's second largest source of revenue and, as such, is a vital industry generating an estimated TOP$1.3 million per year. Meetings with the Tonga Whale Watch Operators Association have indicated that, should cable laying activities be scheduled during this period, the operations within the coastal waters are not expected to have any negative impact on their daily movements, as long as advance notification of dates and duration are given to operators.

Tonga, specifically Vava'u, also receives high numbers of visiting yachts between May and November each year. In Vava'u, there is an average of 550 yachts per year visiting throughout the season, staying for an average of 23 days, with an average of three crew per boat, representing 33,500 people nights per year. While there have not been any economic surveys carried out on the yachting industry in Vava'u (Figure 86), the visitor numbers indicate that this is another important marine industry.

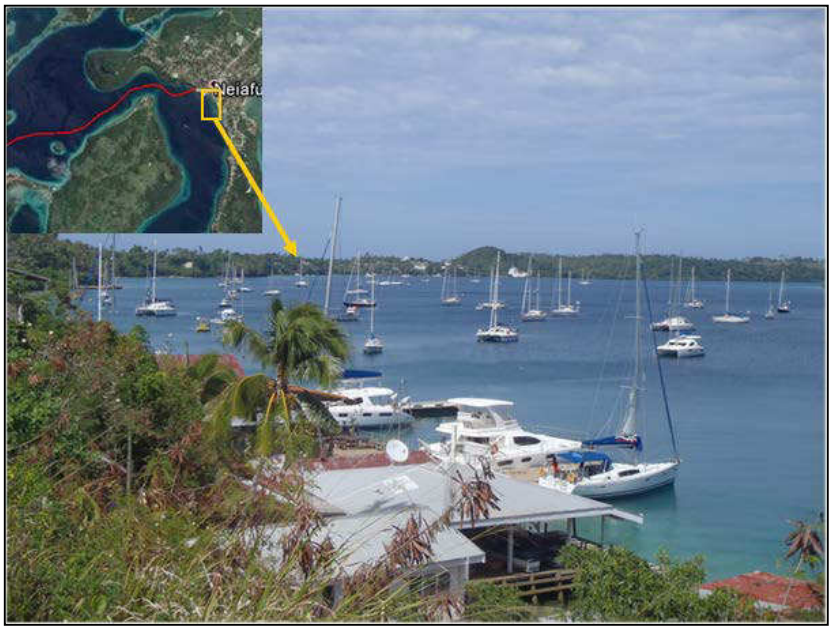

Figure 86: Yacht mooring field within Neiafu harbour, located to the south of the planned cable route

6.6 Land Use

The LP in Nuku'alofa has already been constructed and there are no trenching works needed in the terrestrial setting. The public road that is between the LP and the TS will not be impacted by the laying of the extension cable. The land on which the TS stands is owned by government and lands in the immediate vicinity are predominantly private residential properties and public access land. At the beach LP there is some use from small local vessels that moor and anchor on the reef platform, however none of these vessels are set in the proposed cable route.

The LP in Ha'apai is a public access beach that is used to anchor small fishing vessels and other local craft. The proposed location for the BMH is within the property of the Ministry of Justice building and the terrestrial trenching will be on, or alongside, public roads. The proposed site for the TS in Ha'apai is on Government land that has already been allocated for use in this project. Surrounding land uses are predominantly commercial with telecommunications, government offices and municipal facilities (fire station and police station) all bordering the project site.

There is some recreational value to the LP beach. Public use has been, mainly, at the back of the beach under the shade of several large trees, to the north of the LP. In the time between the site surveys conducted for the CRS and the site visit for this assessment, several of these trees have had much of their foliage and upper branches cut, possibly following damage from Cyclone Ian, reducing the recreational value of the area.

The LP in Vava'u is at the western side of the Halaevalu Wharf, which is currently under the management of the Ministry of Fisheries. The eastern side of the wharf has been given over to the management of the Fishermen Council and there is currently a review underway by the Ministry to sign the storage area, dockside and slipway to the management of the Council. There was no indication from the Fisheries Department of when this review might be completed but it is not expected to have any impact on this project.

6.7 Public Consultation

In keeping with the approach to get feedback from the community, additional stakeholders were identified and interviewed. Due to the nature of the project the stakeholders surveyed were users of the marine environment in the project areas and users of the terrestrial environment in the PIA. Their perceptions, views and concerns are considered vital and are therefore a critical component to be included in this assessment. Across the island groups, representatives from government departments, tourism representatives, local fishermen, business owners and local residents were consulted and their comments recorded.

The possible impact on livelihood of persons interviewed was perceived to be nil by all respondents. All respondents were aware of the original Tonga Cable that was laid in 2013 and most made comment as to the benefit that the new cable would bring to Vava'u and Ha'apai. Tourism operators, specifically the whale watch operators, the Ports Authority and the Fisheries Departments have all requested advanced notification of the planned cable laying activities so that they are able to effectively communicate the information to their relevant parties.

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7. Determination of Potential Impacts

7.1 Introduction

The planned Tonga Cable extension has the potential to create a variety of impacts if it is implemented. These potential impacts can be either positive or negative depending on the receptors involved and other parameters. The impact of this project on the physical, biological and social environment has been assessed using methodology described in this chapter.

The impact assessment process initially involves identification of the project's activities and potential environmental and social impacts resulting from each activity during the project phases. A project activity could include site preparation, construction, reinstatement, operation and maintenance. Within this EIA, an impact is defined as "any change to the physical, biological or social environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services."

7.1.1 Impact Identification Methods

In assessing the potential impacts, various measures are used. These include consultations with relevant stakeholders, desktop surveys of proposed project area, expert knowledge, review of project documentation and impact matrices. Each potential impact is evaluated according to the following:

Defined Parameters:

- *Activity* – phase of the development that the action takes place in.
- *Environmental Receptor* – sensitive component of the ecosystem that reacts to or is influenced by environmental stressors.

Scaled Parameters:

- *Magnitude* – A measure of how adverse or beneficial any effect may be.

Scale	Description
Low	Negligible affect when component, or its perceived use/value to the community, is slightly altered.
Medium	Component is altered to a lesser extent but doesn't compromise its presence in altered environment, or components use or value to community is partially limited.
Major	Component is completely destroyed or altered significantly, or when its use/value to community is significantly altered.

- *Duration* – the length of time that the activity might result in an impact.

Scale	Description
Short Term	Component will be affected for a limited period.
Intermittent	Component will, at first, have difficulty adjusting to altered environment but will eventually return to pre-project levels.
Long Term	Component will be affected for the lifespan of the project enough to compromise the survival of a local species or use of a component by the populations

- *Extent* – The spatial extent of the potential impact.

Scale	Description
Limited	Relatively restricted areas such as the construction site facilities.
Local	<1km radius.
Regional	Impact exceeds local boundary and has potential to impact nearby community (1-10km).
National	Impact has potential to impact entire island or island groups.
International	Impacts that may be considered as affecting the global population.

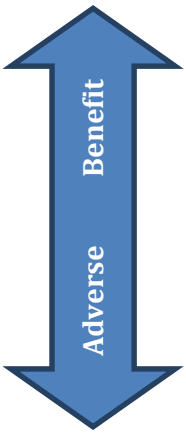
- *Significance* – A measure of the importance of an effect.

Scale	Description
Minor	The impact is short term and cause negligible impact on the environment.
Moderate	Impacts give rise to some concern, may cause long term environmental problems but are likely short term and acceptable.
Major	Impact is long term, large scale environmental risk.

- *Likelihood* – The chance of occurrence of the identified potential impact.

Likelihood	Description	Probability
None	Impact is very unlikely to occur	<2%
Low	Impact probably won't occur	2-10%
Medium	Impact might occur	10-50%
High	Impact will probably occur	50-90%
Certain	Impact is expected to occur	>90%

- *Significance Level* – Rating of the level of impact after assessment of all the above parameters:



	Likelihood			
Benefit	**Low**	**Medium**	**High**	**Certain**
High	Minor	Moderate	Major	Major
Medium	Minor	Moderate	Moderate	Major
Low	Minor	Minor	Moderate	Moderate
Adverse				
Low	Minor	Minor	Moderate	Moderate
Medium	Minor	Moderate	Moderate	Major
High	Minor	Moderate	Major	Major

- *Mitigation* – Measures taken to reduce the adverse impacts on the environment.

For identified adverse impacts, effective mitigations are needed to eliminate or reduce them to an acceptable level. In determining the level of effectiveness of mitigation measures, the following will be taken into account:

Measure	Description
Prevent	The most effective way to eliminate any adverse impact is to prevent the creation of the impact at the source. The prevention method is the approach favoured by both the World Bank and ADB.
Reduce	If prevention is not possible then mitigation measures will attempt to minimise impacts at their source
Rectify	Restoring temporary impacts to pre-construction or better state
Precautionary	Measures to reduce construction impacts
Compensatory	Provide suitable, replacement or substitute resources of greater or equivalent value

7.2 Identified Impacts & Mitigation

In the following subsections, the key environmental and social impacts have been categorised into those related to the construction phase of the project and the operational phase.

Potential impacts on the social or "human and built" environment are considered to comprise those impacts on the following aspects:

- Employment and occupational health and safety (OHS)
- Recreation and heritage
- Traffic
- Solid waste
- Air quality
- Noise and vibration
- Subsistence and livelihoods

Potential impacts on the physical and biological, or natural environment are considered to comprise those impacts on the following aspects:

- Aesthetics
- Geological and geotechnical
- Water quality, surface water hydrology and ground water
- Faunal resources
- Floral resources

7.2.1 Impacts during Design Phase

All design work for the project was completed in advance of this Environmental Assessment and therefore, does not fall within the remit of this assessment. The design phase consisted of the CRS, the MRS and the development of building plans for the new TS to be constructed in Neiafu.

MRS activities involved the use of sonar scanning equipment and have been the subject of an earlier EA carried out for the initial Tonga Cable phase 1 project. This EA was completed in August 2010 by Landcare Research, New Zealand and copies are available from TCL.

7.2.2 Impacts During Construction Phase

Construction Impacts to the Human and Built Environment

Employment and OHS - It is expected that there will be some short term employment opportunities generated during the construction phase at each of the landing sites in the terrestrial environment. Employment opportunities are expected to be higher at the Vava'u landing site due to the construction of the new office and Terminal Station facilities.

Risks are always associated with works involving heavy materials and machinery and this is applicable during construction works in each of the landing sites. Appropriate Operational Healthy and Safety (OHS) policies and working practices should be in place to minimise the risks associated with these works.

Recreation and Heritage - While the landing sites at Nuku'alofa and Vava'u are not considered to be recreational areas, there is some value in recognizing the LP at Ha'apai as having associated recreational use. Observations during the field surveys indicated that the shaded tree line and derelict walls at the northern end of the beach (Figure 87), at the vegetation line, are used for respite from the sun.

The direct area of the LP is not used for this same purpose, and no impact to the recreational value of the beach during construction is anticipated, however appropriate signage may be considered during construction to advise beach users of the works.

Figure 87: Tree line at back of landing beach, to the north of the LP. Shade area has been reduced following cutting of larger trees

There are no expected adverse impacts to any physical or cultural heritage resources during the construction phase of this project as no culturally significant sites have been identified within the PIA. It is, however, a requirement of World Bank OP 4.11 and ADB SPS that should there be any chance findings of items relating to the heritage of Tonga, the requirements of both these policies are triggered.

Traffic - During the construction phase of the project, it is expected that there will be minimal disruption to traffic flow at the landing sites in Ha'apai and Vava'u. As there is no construction needed in Nuku'alofa, no disruption is expected. The disruption to the traffic flow is not anticipated to be significant.

During cable laying activities, the main lay vessel will maintain a 30m radius exclusion zone with other marine vessels for safety reasons. Additionally, it is possible that there will be 5 hour window during the shore end cable installation, when large commercial vessels will not be able to pass through the entrance to the Neiafu harbour. Careful coordination with the Marine and Ports Department and shipping agencies should be able to manage this without any adverse impacts on commercial activity. The Ports Authority of Nuku'alofa and Marine Departments of Vava'u and Ha'apai have advised that they do not anticipate any adverse impacts to their daily operations, in relation to commercial vessel traffic.

Smaller marine craft (whale watch vessels, sailing yachts and local fishing boats) operate at all three of the islands, however, the topography in Vava'u makes this island group more vulnerable to disruptions in small marine traffic during inshore cable laying activities. Consultations with these stakeholder groups and with the Neiafu Marine and Ports Department has indicated that, with appropriate advance notification of works to enable information to be fully disseminated, there are no envisioned adverse impacts expected.

Solid Waste - Waste materials will be generated during the course of the construction phase of this project. To avoid any potential adverse impacts from the introduction of waste into the environment, adequate waste management plans should be adopted. Waste management plans for Vava'u and Nuku'alofa can be handled on each of the respective islands, however, waste materials in Ha'apai will require a more considered management plan.

It is recommended that for each of the construction sites, all construction generated waste be sorted for hazardous and recyclable, reusable and recoverable materials. In Neiafu and Nuku'alofa, recyclable materials should be disposed of at the local Gio Recycling (Figure 88) facilities and any hazardous waste (such as oil or petroleum products) should be disposed of at the appropriate facility, Tapuhia landfill in Nuku'alofa and Gio Recycling in Vava'u. General and unusable waste can then be disposed of at the municipal facilities.

Figure 88: Gio Recycling located in Nuku'alofa and Vava'u

At the time of this assessment, Ha'apai does not have any waste management facilities and as such, following separation of the recyclable/reusable and hazardous materials, all waste will

need to be shipped to the facilities in Nuku'alofa via the local inter-island ferries or cargo vessels. As of April 2014, consultants were being hired to support the Ministry of Infrastructure in the selection of a landfill site to handle general construction waste and limited hazardous materials. This would be a suitable alternative to transporting waste, should the facility be available at the time of construction.

All vessels should, under the Marine Pollution Prevention Act 2002, ensure that no pollutants or ballast water are discharged into Tongan waters. In addition to this, under MARPOL, vessels may not dispose of general garbage within 12 nautical miles of shore.

Air Quality - There is the possibility that construction activity in Pangai and Neiafu (trenching and office construction) could result in an increased level of airborne dust particles in the localized area, especially during prolonged periods with no rainfall.

It is also possible that dust particles could become airborne in the wider area during transportation to and from the construction site in Neiafu.

Any adverse impacts to the air quality in relation to construction dusts would be short term in nature, however in order to minimise any impact, mitigation measures should be implemented. It is recommended that any stored construction materials be covered with tarpaulin sheeting (or similar) and any transported construction materials be similarly covered during transit (Figure 89). It is also recommended that water is sprinkled on any dry dusty areas at the Neiafu site before heavy equipment is used on them, however, this should not be done if drought conditions prevail.

Figure 89: Recommended dust containment mitigation measure for Neiafu construction site

The project will also result in the emission of carbon into the atmosphere through the burning of fossil fuels by construction machinery and, most notably, by the cable laying vessel. The shipping industry is responsible for a significant proportion of the global climate change problem with each freight vessel producing approximately 10g/tonne-km. Having said this, on a global scale, the level of carbon emissions produced by Tonga is insignificant at 1.5 tonne per capita, contributing less than 0.01% of the world total. The addition of this carbon loading will not significantly increase Tonga's overall emissions.

Noise and Vibrations - It can be expected that usual levels of noise associated with construction will be produced by the project during this phase. It is not anticipated that this will present a significant adverse impact. However to minimise any disturbance to nearby residences, heavy construction works should be timed to coincide with regular working hours.

Noise generated during cable laying vessel activities have the possibility to exert some impact on local cetacean populations within Tonga waters, particularly during the humpback whale breeding season between July and October. This will be discussed under the Faunal Impacts section of this chapter.

Subsistence and Livelihoods

Vava'u: There are no subsistence or livelihood activities that will be directly impacted at the landing site or inshore area of Neiafu. There are several potential conflicts with the storage of smaller fishing vessels that need to be considered and mitigation measures may be appropriate in some instances to prevent impact. Small fishing vessels that are usually anchored to the immediate north of the planned LP (Figure 90) have the potential to entangle their ground tackle on the cable. While this potential impact has been assessed as very unlikely and, therefore, not very significant, it is recommended that TCL install several moorings capable of holding small vessels in the current anchorage location. Conversations with the Marine Department have indicated that the installation of several small moorings will not be a problem and that an application should be submitted to the Marine Department in Nuku'alofa.

Figure 90: Popular anchorage area (shaded yellow) for local fishing boats in Neiafu

The entrance to the slipway at the LP in Neiafu is frequently used by larger fishing vessels (approximately 8-12m) to berth while unloading and to store between fishing trips. This is not the designated location for these vessels and they frequently cause limitations on the access to the slipway, however, the lack of permanent fenders installed on the main Halaevalu Wharf

dockside means that the fishing vessels are not able to securely bring their boats alongside in the nearby designated area. It may be necessary to request the vessels vacate the LP side of the slipway for a maximum of one day during the cable landing activities. Given that there are alternative docks for the vessels to use within the immediate vicinity on the wharf, no negative impacts are anticipated. It is, however, recommended that sufficient notice be given to all fishermen to enable them to arrange alternate docks to use for the time period concerned, if necessary.

Nuku'alofa: The Sopu reef platform is a site used by local fishermen to harvest the sea cucumber species *Holoturia atra* during the July to September open season. The project will require a 60cm wide and 1.5m deep trench to be dug along the 500m length of the reef platform. This is the same route that was trenched during 2013 for the cable laying activities associated with phase 1 of the Tonga Cable Project Excavator movements on the reef platform in 2013 resulted in an approximately 12m wide area of disturbance on the surface and it is anticipated that this same strip will be the working area for the excavator during construction for this roject (Figure 91).

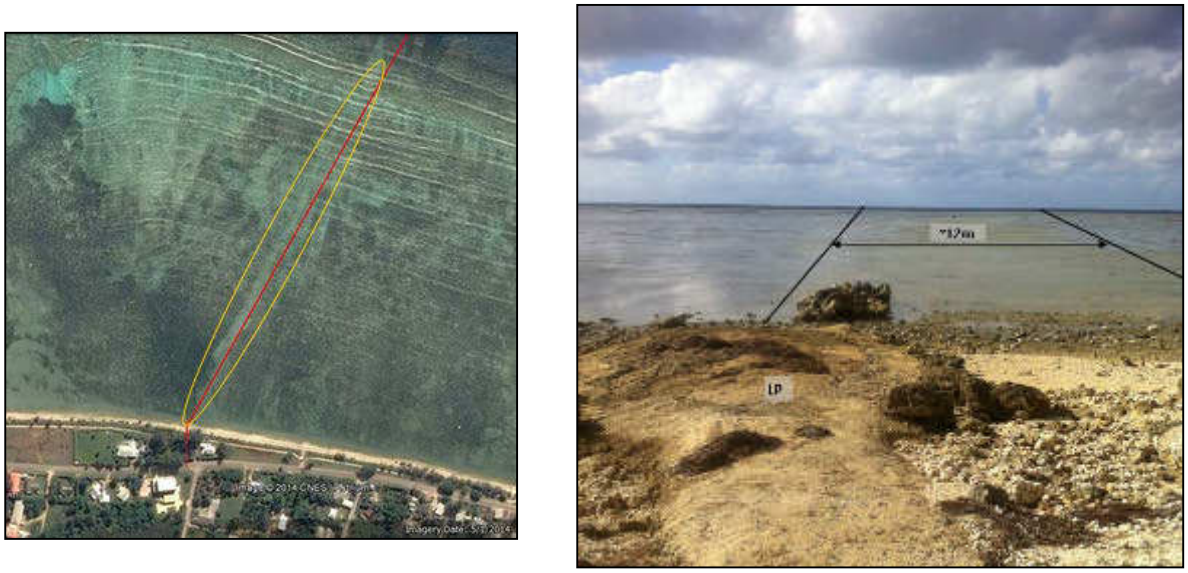


Figure 91: (l) location of reef platform trenching for this project and view of cleared 2013 path from the LP in Nuku'alofa (r)

Field surveys for this assessment have shown that only a small number of sea cucumbers of various species have recruited back into the disturbed area within the past 12 month and it is, therefore, still considered to be a disturbed habitat which will have no noticeable adverse impact on livelihoods generated through sea cucumber harvesting.

Small fishing vessels (<8m) are often anchored along the reef platform (Figure 92). The use of the reef platform for anchoring was not impacted during the 2013 construction activities and it is envisioned there will be no impact during these works.

Figure 92: Locations of fishing vessels anchored on reef platform from Google Earth imagery dated January 2014

Ha'apai: Consultations with the Fisheries Department and with local fishermen have concluded that there are no important fishing activities taking place in the proposed landing site and that there will be no adverse direct or indirect impacts to fishing generated livelihoods.

There are two sites where pandanus leaves are tied to soak in the ocean near to the proposed route. The proposed activities will not limit access to these areas and no negative impact is expected in relation to this traditional activity.

A fishing trap is located to the south of the proposed route (Figure 79). The proposed activities will have no adverse impacts on the access to this fishing trap or to its function.

Local ferries and fishing vessels frequently anchor at the beach and use this area to store their vessels (Figure 93). While it is understood that the anchors of these small vessels would not be able to damage the cable itself, there is the possibility than an anchor could become entangled on it. It is therefore the intention of TCL to install moorings in the area for the use of these local vessels. This would prevent any possible adverse impact on either the cable or the anchoring activities.

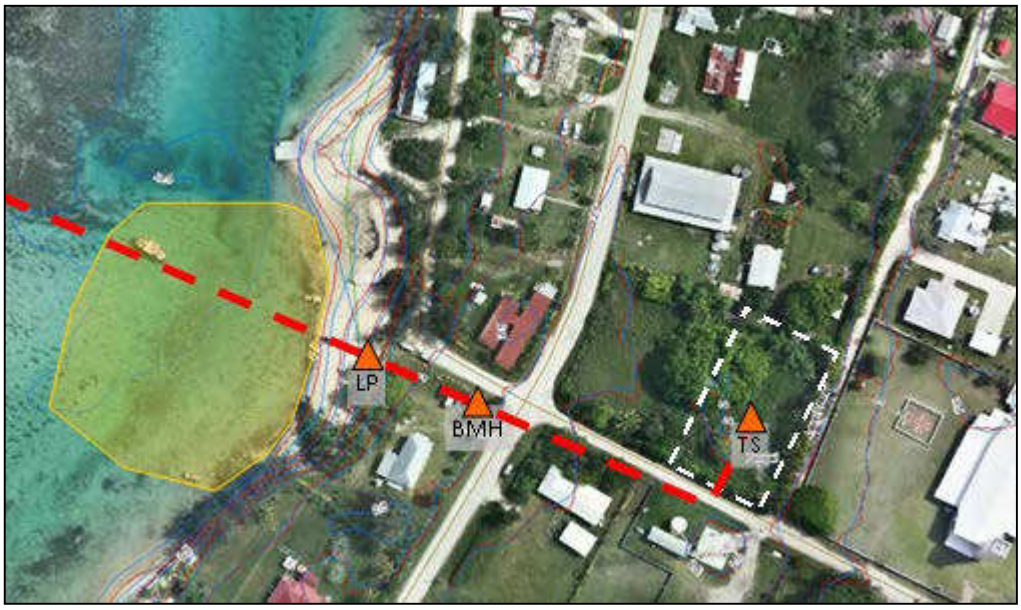


Figure 93: Popular anchoring locations for local boats at the landing beach area in Pangai

Construction Impacts to the Natural Environment

Aesthetics - Trenching at the beach face in Ha'apai has the potential to cause minor adverse aesthetic impacts in the short term; however, considerate restoration after construction will prevent any longer term adverse impact.

Geology and Geotechnical - The landing site in Ha'apai is within an area of the coastline that has been identified as being vulnerable to erosion and has been the subject of climate change vulnerability studies. Beach face trenching at the landing site has the potential to adversely impact the rate of erosion through disturbance to the beach profile and disturbance at the vegetation line (Figure 94). The coastal sand stabilisation benefits of the Beach Morning Glory will, potentially, be reduced by the construction works and restoration will be an important aspect of mitigating for this.

Figure 94: Ranges of Beach Morning Glory (r) and Ti plant (l) at vegetation line in Pangai. LP will be located behind vegetation line

Mitigation measures can be taken to minimise the impact during construction by ensuring that the footprint of the trench is kept to a minimum and by endeavoring to complete works in a timely manner.

In addition to this, the LP is on the border between erosion zones with the area on the northern side of the route eroding at a significantly slower rate (0.4m/yr) than areas to the south of the route (1.2m/yr) (Figure 95).

It is recommended that the cable be laid more towards the north, as is reasonably possible, to take this into account. Project engineers should take future erosion rates into consideration when judging the depth at which the cable is buried during construction.

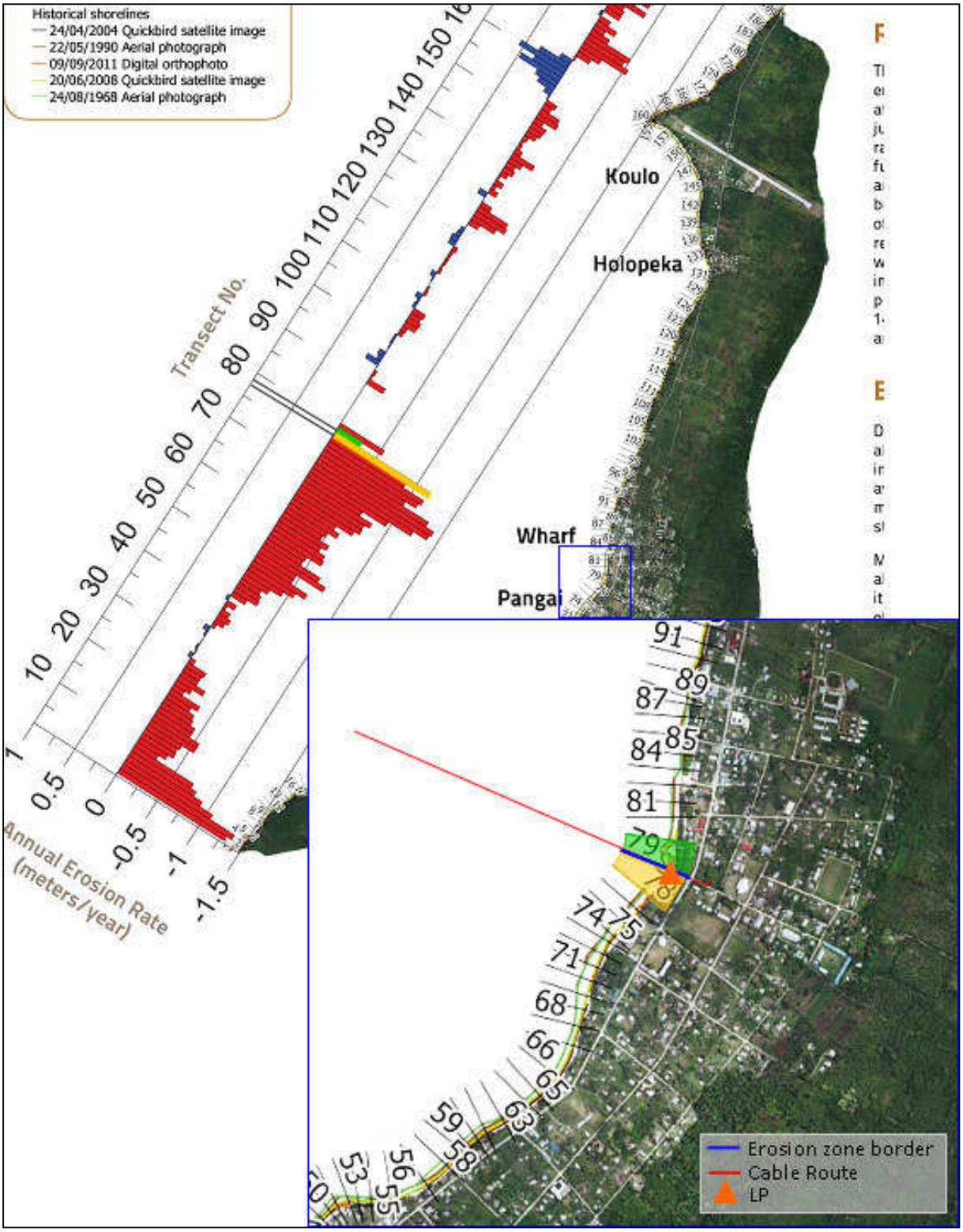


Figure 95: PASAP project coastal vulnerability assessment in Lifuka, Ha'apai. Zoned historical coastline erosion rates are recorded. Cable route LP falls on the border of 78 (yellow) and 79 (green). Their associated bar on the chart is also highlighted.

Water Quality, Surface Water Hydrology and Groundwater - The laying of the cable in the marine environment, throughout its length, could result in suspension of marine sediments, however, as there is no cable burial planned for the majority of the route, this suspension is not considered likely to create any adverse impacts.

The sediments disturbed during the trenching process on the Sopu reef platform, will result in localized increases in turbidity. This will temporarily reduce the light available and adversely impact the photosynthesis of the seagrass blades, which will be discussed in the Floral Impacts section later in this chapter. Mitigation measures for this impact have already been integrated into the construction plan by ensuring that trenching activities on the reef flat are timed to coincide with low tide cycle.

Faunal Resources:

Potential direct impacts to live coral - The inshore route of Section B passes through areas of live coral outcrops, as identified in Chapter 5. The laying of the cable in this coral colonised area has the potential to cause damage to the live corals through direct contact and/or prolonged abrasion. The area of greatest concern is dominated by *Porites sp* (Figure 96). This family of coral is known to be common throughout the tropical oceans of the world and is considered to be among the least vulnerable to the impacts of sedimentation. In addition the potential damage to the corals, laying the cable over large coral outcrops would constitute an unstable surface and would render the cable vulnerable to movement from minimal changes in the sea state (Figure 98).

Figure 96: Large *Porites lobata* coral heads extend from the channel marker out in to the shipping channel on the starboard side.

Figure 97: Healthy stands of predominantly *Acropora formosa* in scattered coral patches running parallel to the shoreline.

It is possible to implement mitigation measures that would prevent this impact. They include using weighted buoys to mark the sandy channels through the coral patches, using diver assistance to guide the cable as it descends and conducting a post-lay diver survey in critical areas. Careful management of laying the cable for this section of the route will prevent this potentially moderate impact. Further details on this mitigation measure are provided in the Environmental Management Plan (Chapter 8).

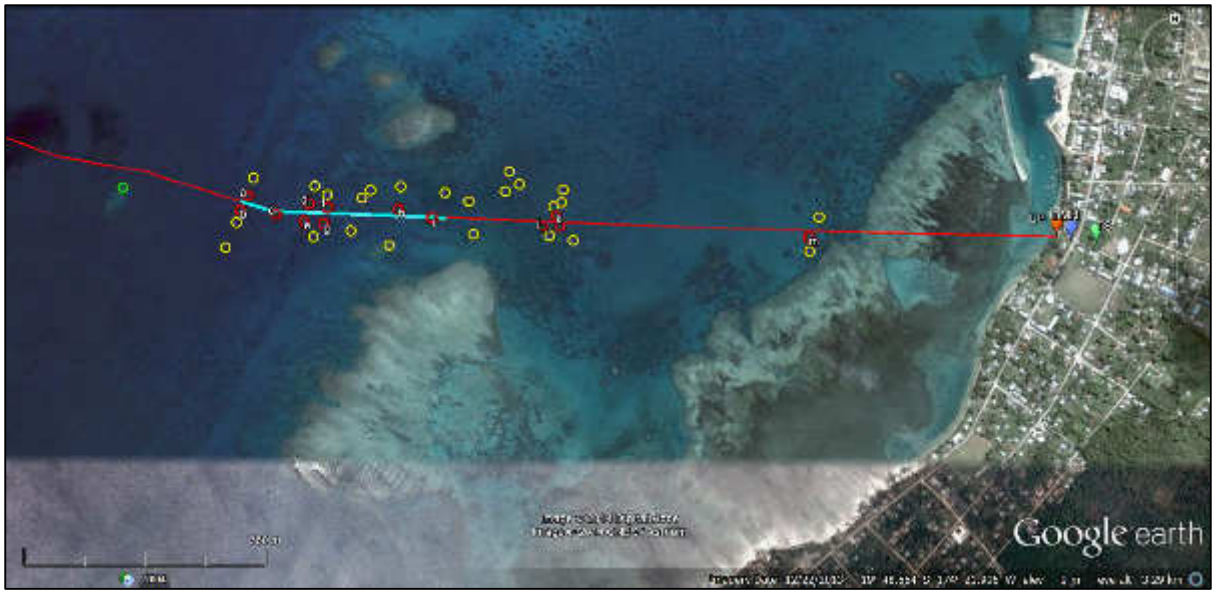


Figure 98: Identified coral patch reef to be avoided during cable laying activities. Green marker indicates large shallow seamount that needs to be avoided, red markers indicate placement for surface marker buoys (see EMP), blue cable section marks area for diver assisted cable placement.

It is also important to note that there are large dead coral structures close to shore that would provide an unstable substrate for the cable. Weighted buoys can be used to mark and avoid these structures.

Disturbance from noise or activity on endangered or protected species - There is potential for this project to have some short term, minor adverse impact on the cetaceans within the project influence area. Whale and dolphin species use sound to communicate with each other, to find prey and to navigate within their range. Due to the limitations of the other senses within the marine environment, sound is often the primary means of communication. In recent decades, human activities have dramatically increased the amount of additional noise, or noise pollution, in the marine environment. Noise generated from human developments such as pile-driving, dredging, seismic survey, sonar surveys and gas exploration are continually adding to the pressure. One impact of noise pollution has been the reduction of the "acoustic bubble" – the distance over which vocalizations can travel and be heard. For example, in 1942 the acoustic bubble of a blue whale was 1,600km in 2012 this had shrunk to 160km.

Previous acoustic studies on the impacts of submarine cable laying activities have been conducted using the dB_{ht}(Species) metric that has been developed as a means of quantifying the potential behavioural impact on a species in the underwater environment (Subacoustic, 2012). This measure uses $90dB_{ht}$(Species) as the minimum sound threshold at which avoidance reaction will be elicited from all members of a population. This study concluded that for the type of operations proposed in the Tonga Cable extension program, the impact range for marine cetacean species at $90dB_{ht}$(Species) was a maximum of 41m radius from the vessel. Additionally, the $75dB_{ht}$(Species) threshold (where avoidance reaction will be elicited from 85% of the population) is defined as a maximum of 370m from the noise-generating vessel.

When compared to other sources of underwater noise, predicted impact ranges for the cable laying operations are much smaller than those predicted for other typical activities such as impact piling or seismic operations.

Records from the Hawaiian Island humpback Whale National Marine Sanctuary have shown that animals tend to avoid vessels of this size. The vessels movements will be predictable and it will be moving along a predefined path at a consistent speed of up to 4kt along the route. Similarly, the activity from the support boats and divers tend to be avoided by marine species. These activities will be completed over a short period of time less than a week, during which the actual activity will be intermittent (e.g., positioning the vessel, landing the cable, removing the floats).

A further potential impact on marine cetaceans during the construction phase of the project is the potential for entanglement with the cable. The short period of time that the cable will remain in the water column before it reaches the seafloor makes entanglement a very unlikely occurrence and therefore is a very unlikely impact.

As a means of preventing collision or other contact with the humpback whale, or any other protected species, it is recommended that the Hawaiian Marine Protected Species Protection Protocol be implemented by an onboard observer should the operations be scheduled to take place in the humpback whale breeding season. The full protocols are attached in Appendix 4 but the key elements are: onboard observer with responsibility for maintaining a watch for animals and the authority to suspend operations to avoid direct contact, emergency contacts for mammal and turtle stranding, and reporting requirements for any incident that may occur. These protocols have been reviewed and approved by NOAA.

Potential impacts on benthic invertebrates – There are no anticipated adverse impact on benthic invertebrates in the Pangai or Neiafu landing sites. At the Nuku'alofa site, recovery of the population of benthic invertebrates (notably sea cucumbers and starfish) has been recorded in Chapter 5 and show slow regeneration after one year, compared to areas outside the direct impact zone from 2013. Retrenching of this area for the Tonga Cable extension will remove the benthic invertebrates that have re-colonised but this is not considered to be a significant adverse impact due to the low numbers present and the evident ability of the species to re-colonise the area after disturbance.

Potential impacts on terrestrial bird species - There is the potential for construction noise levels to disturb some of the natural behaviours of land birds in the immediate vicinity, however field studies at the landing sites have not recorded any rare or endemic species, or species that might be vulnerable to disturbance and, therefore this is not considered to present a significant adverse impact to the local bird population

Floral Resources - No significant adverse impacts are envisioned for terrestrial flora.

Seagrasses in Nuku'alofa at the Sopu reef flat are showing some signs of recovery following the trenching works in 2013. However, the level of recovery is still low and a repeat of these works is not anticipated to bring about any additional adverse impacts as recovery of the seagrass in this area is proven.

There are areas of seagrass near the landing site in Ha'apai that will potentially be impacted in the short term by the placement of the cable. However, it is anticipated that the cable will bury itself over time and any adverse impact will be insignificant, limited both spatially and temporally.

7.2.3 Impacts During Operational and Maintenance Phases

Impacts to the Human and Built Environment

Employment – It is expected that, after the construction phase, there will be a small number of direct employment opportunities generated in the new Vava'u office and TS facility for the life of the project.

Employment (indirect) – when fully implemented, the project may indirectly result in jobs being realized through increased telecommunications and other related industries on the island. There is also the opportunity for Ha'apai and Vava'u to develop a more skilled and knowledgeable workforce through an increased opportunity to participate more reliably and consistently with information sharing in an online environment. Cheaper communication services will enable this service to be affordable to more people, improving the opportunities presented to them.

Solid Waste Management – During the operational phase of the project, waste will continue to be generated through the office facility in Vava'u. The waste will be of a commercial rather than industrial nature and, providing that a robust waste management plan is implemented, then the impact will be minimal. Waste management planning needs to account for recyclable materials separation and also allow for the fact that there are no garbage collection facilities and it remains the responsibility of TCL to dispose of their own solid waste appropriately.

Impacts to the Natural Environment

Aesthetics – the planned development of the disused building plot in Neiafu for the new TS and office facilities will transform an abandoned and unsecured site into a functioning and well-designed commercial building. The aesthetics of the local area have been taken into consideration when designing the building. From the road, the building will be one storey high and in line with the surrounding premises. From the water, the building will present an attractive alternative to its current state and the building has been designed to take advantage of the natural surroundings. This will be a positive development for the Mount Talau area of Neiafu and has the full support of the local community.

Geological and Geotechnical

Erosion Control Vava'u – The development of the new office and TS facility will enable the rain water runoff to be better managed at that site and will ensure that the retaining wall at the rear of the property maintains its function and integrity through regular maintenance and clearing of vegetative build up. This management will reduce the risk of sedimentation in the foreshore area of the harbour and will bring about a positive impact.

Wave Effect Ha'apai: Approximately 150m offshore from the LP in Ha'apai, the cable traverses a raised pavement that is exposed at low tide. This shallow area is covered by a thin layer (estimated to be approximately 0.2m deep) of loose sediment and is exposed to regular wave action. At this depth, the cable is vulnerable to the impacts of wave action, particularly

during storm events. In addition to the potential vulnerability of the cable, repeated movement of the cable during storm events will suspend sediments, potentially on a regular basis. If the cable is articulated and pinned in place to the raised pavement, this could prevent the negative impact from occurring.

7.2.4 Impact Tables

Tables 6 and 7 detail the assessment outcomes for all identified potential impacts. Significance levels, both pre and post mitigation, are given to help gauge the effectiveness of mitigation measures. Table 6 details the identified impacts during the construction phase while Table 7 deals with operational and maintenance phases.

Table 6: Impact table for construction phase of project

Project Activity	Environmental Receptor	Potential Impact: Construction Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
1. Employment & OHS							
Construction and Operational	Human	**1-1** Employment opportunities will be available during all phases of the construction for local businesses and, as a result, residents. In addition to this, employment opportunities will persist during the operational phase of the project at the new offices in Vava'u and through the existing offices in Nuku'alofa .	Low, Long Term, National	Certain & Direct and Indirect	Major Positive	No Mitigation Necessary	Major Positive
Operational	Human	**1-2** With the implementation of the fibre optic cable, improved and cheaper telecommunications access will be experienced in both Vava'u and Ha'apai that will bring positive impacts to businesses and residents.	Major, Long Term, National	Certain & Indirect	Major Positive	No Mitigation Necessary	Major Positive
Construction, Operational and Maintenance	Human	**1-3** Occupation Health and Safety risks are associated with any working condition. This is primarily important where workers interact with moving and heavy machinery.	Low, Short Term & Limited	Low & Direct	Minor Negative	Appropriate OSH policy should be implemented and OSH training should be offered	Minor Positive
2. Recreation & Heritage							
Construction	Human	**2-1** There are no known heritage resources occurring at the proposed landing sites that may be adversely impacted.	No Impact			Chance findings of heritage resources during the course of the project will trigger WB OP4.11 and the ADB SPS	
Construction and Maintenance	Human	**2-2** The landing site in Ha'apai could be considered recreational with occasion use from local residents observed, mostly in the shaded area to the north of the LP and at the back of the beach. No works will directly impact this area.	Low, Short Term & Local	Low & Indirect	Minor Negative	All appropriate signage and barriers should be used during activities associated with the cable lay.	Minor Negative
3. Traffic							
Pre-Construction and Construction	Human	**3-1** The existing main roads will be used to deliver and remove any materials, and equipment to and from the proposed landing sites and the Vava'u building construction site. It is expected that the added vehicles and the frequency of their movement will be minimal.	Low, Short Term & Local	Low & Direct	Minor Negative	No Mitigation Necessary	Minor Negative

Project Activity	Environmental Receptor	Potential Impact: Construction Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
Construction	Human	**3-2** It is expected that there will be disruption to terrestrial traffic flow in Ha'apai, where construction is planned alongside a short stretch of paved road.	Low, Short Term & Local	Low & Direct	Minor Negative	All appropriate signage and barriers should be used during activities associated with the cable lay on paved and unpaved roads.	Minor Negative
Construction and Maintenance	Human	**3-3** It is expected that there will be disruption to marine traffic (commercial and recreational) in the immediate vicinity of the cable laying vessel during inshore operations at each of the landing sites.	Medium, Short Term & Local	Medium & Direct	Minor Negative	Notification should be given to the Marine Departments and Ports Authority in each island group at least one month in advance to enable effective communication from the Ministry to all relevant user groups of the marine environment.	Negligible
4. Solid Waste							
Construction and Operational	Human	**4-1** Solid waste generated during cable laying activities, trenching, manhole construction, office operations and other waste that may be generated during this project may impact at the waste handling facilities.	Med, Short Term & Regional	Med & Direct	Minor Negative	All solid waste generated should be collected, handled and disposed of appropriately. Solid waste removal should be facilitated by using the local municipal facilities, and where none exist, upon the advice of the responsible ministry.	Minor Negative
Operational	Human	**4-2** The disposal of grey and black water generated at the site has the potential to impact the soil and groundwater quality.	Low, Long Term & Limited	Low & Direct	Minor Negative	Septic tanks and soak away pits have been included in the design and construction of the new office facility. All installed water treatment tanks or pits will be constructed to recommended government standard.	No Impact
5. Air Quality							
Pre Construction and Construction	Human and Fauna	**5-1** It is possible that small amounts of dust particles will be produced during the trenching and manhole construction activities in Ha'apai and Vava'u.	Medium, Short Term & Local	Medium & Direct	Minor Negative	The use of water should be considered to sprinkle over the construction site and ground any dust particles during prolonged dry spells. In addition to this, any materials that are to be transported should be covered using tarpaulins to avoid dust particles becoming airborne during transit.	Negligible

Project Activity	Environmental Receptor	Potential Impact: Construction Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
Pre Construction and Construction	Human and Fauna	**5-2** Dust particles are likely to be airborne in the local vicinity of the office construction site in Vava'u.	Medium, Short Term & Regional	Medium & Direct	Minor Negative	The use of water should be considered to sprinkle over the construction site and ground any dust particles during prolonged dry spells. In addition to this, any materials that are to be transported, should be covered using tarpaulins to avoid dust particle	Negligible
Construction and Maintenance	Human	**5-3** Exhaust emissions generated from the cable laying vessel are expected.	Medium, Short Term & International	Low & Direct	Minor Negative	*Emissions from commercial shipping are known to contribute towards carbon loading of the atmosphere. At the scale of this project, there are no appropriate mitigations to consider.*	Minor Negative
Construction	Human and Fauna	**5-4** Emissions from heavy machinery can be expected at the landing sites potentially resulting in an adverse impact on air quality.	Low, Short Term & Local	Low & Direct	Minor Negative	Ensure all equipment is well maintained and inspected prior to use at the site. Any vehicles emitting excessive exhaust fumes should be removed from the site.	Minor Negative
6. Noise and Vibration							
Pre Construction and Construction	Human	**6-1** Various mechanical equipment, vehicles and site equipment may generate noise that may exceed acceptable levels.	Medium, Short Term & Limited	Low & Direct	Minor Negative	If proposed works are known to be noisy, they should be scheduled for times that can be reasonably considered working hours within the local communities.	Negligible

Project Activity	Environmental Receptor	Potential Impact: Construction Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
Construction and Maintenance	Fauna	**6-2** Noise generated through shipping activities may impact marine fauna, in particular the migrating humpback whale population during the months of July through October.	Low, Short Term & Regional	Medium & Direct	Moderate Negative	Commercial shipping is not believed to have significant negative impacts on cetacean behaviour, however during the sensitive humpback whale breeding season behaviours can become more critical and pronounced. It is recommended that an independent, trained observer be on board the cable laying vessel to observe whale behaviour and advise captain accordingly should any actions or stop-works be necessary.	Minor Negative
7. Subsistence and Livelihoods							
Construction	Human	**7-1** Potential impact on distribution of commercially targeted benthic fauna (sea cucumbers) in immediate areas of cable burial.	Moderate, Intermittent, Limited	High & Direct	Minor Negative	*Cable burial works in 2013 at the Sopu landing site has already resulted in the removal of benthic fauna and marine flora. August 2014 field surveys showed a limited recovery of these commercial species, therefore, burial works in the same location for this project will have a minor negative impact and mitigation is limited to ensuring that trenching works occur in the pre-existing impact zone. Field surveys of the Ha'apai landing site recorded a very low number of commercial benthic species at the landing site, possibly from historic over harvesting practices. No mitigations are necessary. The landing site at Vava'u is not in a location that is used for subsistence or commercial fishing.*	Minor Negative
Operational	Human	**7-2** There is the possibility for fishing vessel to land their anchors along the cable route, potentially entangling their anchors	Low, Short Term, Limited	Low & Indirect	Minor Negative	Moorings should be placed in the anchorage areas closest to the cable route in Ha'apai and Vava'u.	No Impact

Table 7: Impact table for operational and maintenance phase of project

Project Activity	Environmental Receptor	Potential Impact: Operation and Maintenance Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
8. Aesthetics							
Pre-Construction, Construction	Humans	**8-1** The construction of a trench at the beach face and clearance and removal of any vegetation from the landing site may result in a visually negative impact and loss of or damage to natural resources. The beach manholes to be constructed in Ha'apai and Vava'u will be in keeping with the surrounding areas and will not have any negative visual impact.	Low, Short Term, Limited	Medium & Direct	Minor Negative	Ensure than only essential excavations, trenching and construction occur in line with project activities.	Minor Negative
Pre-Construction, Construction, Operation	Humans	**8-2** The construction of a new office building in Vava'u will change a site that is currently a disused commercial plot into a functioning and modern one storey office building. Currently the site is unsecured and subject to littering activities. The construction of these new facilities will eliminate that problem.	Medium, Long Term, Local	High & Direct	Major Positive	N/A	Major Positive
9. Geological and Geotechnical							
Construction and Operational	Human and Flora	**9-1** Considerate restoration of the beach face and associated vegetation in the Ha'apai landing site could result in improved coastal stability at the vegetation line.	Low, Long Term and Limited	Medium & Indirect	Minor Positive	If an area of greater than 2m wide has been cleared at the vegetation line, take specimens of same species from along beachfront and transplant to disturbed zone.	Minor Positive
Pre Construction and Construction	Human and Flora	**9-2** The proposed cutting of a trench on the beach face in Ha'apai could result in increased erosion rates along the shoreline and at the vegetation line.	Medium, Short Term and Limited	Low & Direct	Minor Impact	Ensure that beach face and vegetation line trenching is kept to a minimum and ensures that works are carried out to minimising construction time on the beach. As much as possible, coordinate trenching activities to coincide with low tide. **No solid concrete structure should be constructed on the beach face. Solid structures block the longshore movements of sediments and lead to elevated erosion rates.**	Minor Negative

Project Activity	Environmental Receptor	Potential Impact: Operation and Maintenance Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
Operational	Human, Flora and Fauna	**9-3** Effects from storms and cyclones could lead to increased levels of erosion on the beach face, resulting in the exposure of the cable over time.	Medium, Long Term and Local	Medium and Indirect	Moderate Negative	Cable should be buried to a depth that takes into consideration a level of shoreline erosion over time. SOPACs PASAP report should be used in reference to shoreline erosion rates at this site. The report suggests that the proposed cable route lands on the border of an erosions transition zone. The southern side of the border has historically eroded at rate of approximately 1.2m/yr, while the northern side of the boundary erodes at an approximate rate of 0.4m/yr. It is recommended to lay the cable very slightly to the north of the current route, and at a depth that takes future erosion into consideration.	Minor Negative
10. Water Quality, Surface Water Hydrology & Groundwater							
Construction and Maintenance	Humans, Flora and Fauna	**10-1** The laying of the cable within the marine environment could result in the suspension of sediment that could impact marine flora and fauna.	Low, Short Term, Local	Low & Direct	Minor Negative	During the construction phase of the project, it is recommended that any intertidal trenching and refilling be carried out at low tide to minimise longshore transport of any suspended sediments.	Minor Negative
Operational	Flora, Fauna	**10-2** Shallow areas of the cable route could increase the chances of cable movement during storm or cyclone events, leaving the cable vulnerable to stresses and potentially causing an impact on marine flora and fauna.	Low, Long Term, Limited	High & Indirect	Moderate Negative	The cable should be pinned on the pavement area close to the landing point in Ha'apai (identified in the PASAP report). This pavement is shallow and often exposed at low tide, making it vulnerable to wave and surge actions from storms and cyclones.	Negligible
Construction & Operational	Humans, Flora and Fauna	**10-3** The proposed works on the site have the potential to impact the rain water drainage patterns, particularly during storm events.	Low, Long Term, Local	Medium & Indirect	Minor Negative	*Building plans provide sufficient drainage, through channelling and soak away pits to manage surface water runoff.*	No Impact

Project Activity	Environmental Receptor	Potential Impact: Operation and Maintenance Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
Construction	Human, Flora and Fauna	**10-4** Burial of the cable in the intertidal zone in Nuku'alofa will result in sediments becoming suspended in the near shore area.	Medium, Short Term, Limited	Medium & Direct	Minor Negative	Limit the duration of works to a minimum time scale.	Minor Negative
Construction and Maintenance	Human, Flora and Fauna	**10-5** The potential exists for equipment or vessels to release petroleum hydrocarbons or other hazardous materials into the environment.	Medium, Short Term, Regional	Low & Direct	Minor Negative	The implementation of standard Spill Prevention and Response Plan and other spill prevention measures will reduce the potential for such releases.	Minor Negative
11. Faunal Resources							
Construction and Maintenance	Fauna	**11-1** Cable laying activities in coral colonised near shore areas, particularly in Ha'apai, could cause damage to the live coral and result in unstable positioning of the cable.	Medium, Long Term and Limited	High & Direct	Major Negative	Use diver and/or marker buoy guided cable placement and post lay surveys to ensure that the cable comes to rest on the sea floor in the wide channels identified through field surveys. Diver should be a minimum of PADI Divemaster or above with documented experience in coral reef surveying in a professional capacity.	Minor Negative
Construction and Maintenance	Fauna, Human	**11-2** Cable laying activities during the months of July through October could result in minor changes in behaviour of humpback whale breeding populations in waters of <200m depth at all landing sites.	Moderate, Short Term and Regional	Medium & Direct	Moderate Negative	For cable laying activities during July through October, vessel operations should be conducted with a trained independent observer on board to spot whales, observe behaviours and advise vessel captain on any necessary actions.	Minor Negative
Construction	Fauna, Human	**11-3** Intertidal trench cutting for cable burial will result in the removal of benthic and sessile faunal resources in the direct impact area.	Low, Intermittent and Limited	High & Direct	Minor Negative	*No mitigations necessary, area of intertidal works has already been impacted by previous (2013) works and documented recovery is low.*	Minor Negative
Operational	Fauna	**11-4** The presence of the cable on the sea floor could result in changes in the benthic community due to the "reef effect"of species recruiting onto the cable.	Low, Intermittent and Limited	Low & Indirect	Negligible	*No mitigations possible.*	Minor Negative
Construction	Fauna	**11-5** The activities related to the construction phase of the project could impact the behaviour of land birds in the vicinity.	Low, Short Term and Local	Low and Direct	Minor Negative	*No mitigations necessary*.	Minor Negative

Project Activity	Environmental Receptor	Potential Impact: Operation and Maintenance Phase	Magnitude, Duration, Extent	Likelihood and Nature	Significance of Impact	Mitigations/Notes	Post-Mitigation Residual Impact
12. Floral Resources							
Pre Construction, Construction and Operation	Flora, Fauna	**12-1** The laying of the cable in the marine environment will result in the loss of some marine flora, specifically, seagrasses which provide habitat for juvenile fish species and benthic invertebrates. Near shore areas in Ha'apai and Nuku'alofa are particularly vulnerable to this impact.	Medium, Intermittent, Limited	Medium & Direct	*Minor Negative*	*No mitigations possible, loss of some seagrass areas are highly likely, however, the cable will either be buried during constructions or the cable will bury itself in soft sediments over time. Seagrass areas will regenerate over time.*	Minor Negative

7.3 Cumulative and Induced Impacts

Cumulative impacts are those that result from the successive, incremental and/or combined effects of an action, project of activity.

The Nuku'alofa landing site and inshore waters already accommodate one fibre optic cable, while Ha'apai and Vava'u have no such similar infrastructure. The Nuku'alofa landing site has not experienced any adverse impacts in the physical environment and only intermittent minor adverse impacts with regards to the disturbance of seagrass and benthic organism distribution in the direct impact area, these intermittent impacts are already showing signs of recovery.

The installed cable in Tongatapu has had a positive social impact on the local population through the introduction of high-speed telecommunications services. The Tonga Cable extension is expected to bring the same positive impact to the communities in Ha'apai and Vava'u.

It is not envisaged that the laying of the new cable will result in any long term adverse potential impacts to any of the environmental or social resources. No adverse cumulative or induced impacts are expected for all phases of this project.

There are no anticipated induced developments, and therefore adverse impacts, as a result of this project.

7.4 Impact Matrices

The following table is a summary of the potential impacts arising from this proposed project. The impacts are represented here in their pre-mitigation condition.

Table 8: Impact matrix

		PROJECT ACTIONS										
		Construction Phase								Operational Phase		
		Landing Site Preparation				Cable Laying				Land	Submarine	
		Construction: Offices	Solid Waste Management	Trench and Manhole Construction	Trenching Restoration	Cable Laying Marine	Cable Laying Terrestrial	Cable Burial intertidal	Beach Face Restoration	Office Operations	Cable Repair	Cable In Situ
Human & Built Environment	Employment and OHS											
	Recreation and Heritage											
	Traffic											
	Solid Waste											
	Air Quality											
	Noise and Vibration											
	Subsistence and Livelihoods											
Natural Environment	Aesthetics											
	Geological and Geotechnical											
	Water Resources and Management											
	Faunal Resources											
	Floral Resources											

Impact Matrix Key:

Positive Impact			Minor Adverse
Negligable Adverse			Moderate Adverse
			Major Adverse

7.5 Relevance of World Bank and ADB Safeguard Policies

Table 9: World Bank Operational Policies and ADB Safeguard Policies

WB Operational Policy	Application to Project	Potential Impacts	Mitigation Measures
OP4.01 Environmental Assessment	This OP is triggered by the commencement of the Tonga Cable Extension Project	N/A	N/A
OP4.04 Natural Habitats		A) Cable laying activities in coral colonised near shore areas, particularly in Ha'apai, could cause damage to the live coral and result in unstable positioning of the cable. B) The laying of the cable in the marine environment will result in the loss of some marine flora, specifically, seagrasses which provide habitat for juvenile fish species and benthic invertebrates. Near shore areas in Ha'apai and Nuku'alofa are particularly susceptible to this impact.	A) Use diver and/or marker buoy guided cable placement and post lay surveys to ensure that the cable comes to rest on the sea floor in the wide channels identified through field surveys. B) No mitigations possible, loss of some seagrass areas are highly likely, however, the cable will either be buried during constructions or the cable will bury itself in soft sediments over time. Seagrass areas will regenerate over time.
OP4.10 Indigenous People	This OP is not triggered as there are no Indigenous Peoples as defined in OP4.10 within the project impact area or who are impacted by the project activities.	N/A	N/A
OP 4.11 Physical and Cultural Resources	This OP is not triggered as there are no known physical or cultural resources within the project impact area. Chance find mitigations are recommended.		Any physical or cultural resources, as defined in WB OP4.11 that are discovered by chance during the course of the project development will trigger WBOP4.11
OP 4.12 Involuntary Resettlement	This OP is not triggered as there is no involuntary taking of land or involuntary restriction of access to parks or protected areas. There are no predicted adverse impacts on livelihoods in any of the project impact areas.	N/A	N/A
ADB Safeguard Policy	**Application to Project**		

Environmental Safeguards	This safeguard has been automatically triggered as there are likely to be potential environmental impacts and risks.
Involuntary Resettlement Safeguards	This safeguard has not been triggered as, following the screening process, it is not envisioned that there will be any physical displacement or economic displacement as a result of either (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. During the construction and operational phase of the project, access to the lands and waters around the landing points will remain open.
Indigenous Peoples Safeguard	This safeguard has not been triggered as, after screening, it has been determined that the project does not directly or indirectly affect the dignity, human rights, livelihood systems or culture of Indigenous Peoples as (defined in the SPS), neither does it affect the territories or natural or cultural resources that Indigenous Peoples use, own, occupy or claim as an ancestral domain or asset.

7.6 Uncertainties in Identifying Impacts

In spite of the measures that will be taken to mitigate against the foreseeable impacts, there is always the possibility of impacts that were not foreseen, or the extent of predicted impact can turn out to be greater than predicted, or the mitigating measures may not be as effective as expected. In order to ensure that such incremental impacts do not suddenly appear without warning, the project will monitor key parameters in the vicinity of the development that can serve as environmental indicators. The area (project area, direct impact area and indirect impact area) has been surveyed and a baseline has been established at the landing sites. As per the Environmental Management Plan, these areas should be monitored during all phases of the project, to provide an indication of impacts before they become too advanced for corrective action.

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8. Environmental Management and Monitoring Plans

8.1 Introduction

This section details the mitigation and then monitoring plan to be implemented during the pre-construction, construction, operational and maintenance phases of the project. The plan must be comprehensive and address relevant issues, with a reporting component that will be made available to the regulatory agencies on completion of cable laying activities.

8.2 Environmental Management Plan

8.2.1 Mitigation Plan

The following mitigations are recommended for the indicated phase of the project. All costs associated with mitigations have been incorporated into the overall development costs and are not detailed in the mitigation assessment.

Table 10: Mitigation Plan for Construction Phase of project

Mitigation Measure	Impact Reference	Responsible Agency	Notes
A. General Measures			
A-1 OHS signs should be displayed at sites of terrestrial construction.	1.3, 2.2, 3.2	TCL	
A-2 OHS policy should be implemented on construction site to Tongan standards.	1.3	TCL	Pre-Construction
A-3 OHS policy should be implemented on cable laying vessel to international standards.	1.3	CONTRACTED CABLE SUPPLIER	Pre-Construction
A-4 All measures should be taken to prevent marine pollution (including oils and spill) as per the Marine Pollution Prevention Act and all listed international conventions.	10.5	CONTRACTED CABLE SUPPLIER	Pre-Construction
A-5 Vessels will have Spill Prevention and Response Plans to prevent materials from entering the water and safety plans specific to the work area should be in place.	10.5	CONTRACTED CABLE SUPPLIER	
A-6 All heavy machinery used for terrestrial and intertidal construction works should be well maintained and recently serviced by a professional mechanic.	5.4	TCL	Pre-Construction
A-7 All intertidal excavations should be conducted during the mid-low-mid tide cycle to minimise the longshore drift of suspended sediments.	9.2, 9.3	TCL	
A-8 Chance findings of any heritage items or cultural resources during pre-construction or construction will result in the requirements of WB OP4.11 and ADB SPS being triggered.	2.1	TCL	
B. Communications Plan			
B-1 Communication plans should be developed for implementation in the pre-construction period. Communication plan should advise of the following: planned cable laying dates planned terrestrial construction dates minimum operating distances from cable laying vessels individual considerations for specific landing sites contact details for TCL team	2.2, 3.1, 3.2, 3.3, 6.1, 7.2	TCL	Pre-Construction

B-2 Communication plan should start one month before construction phase, and be repeated one week before construction phase. Communications should include (but not limited to): Ports Authority Nuku'alofa Marine Departments Nuku'alofa, Ha'apai and Vava'u Commercial Shipping Agents Nuku'alofa, Ha'apai and Vava'u Local communities in Ha'apai and Vava'u via local FM radio stations *Sports fisher clubs in Nuku'alofa and Vava'u *Tonga Whale Watch Operators Association in Vava'u for dissemination to Nuku'alofa and Ha'apai * for construction during July through October	2.2, 3.1, 3.2, 3.3, 6.1 , 7.2	TCL	Pre-Construction
C. Solid Waste Plan			
C-1 Refuse disposal facilities should be installed at the construction sites with a separate bin allocated for recyclable materials. Currently, in Tonga locally recyclable materials include: aluminium cans, aluminium foil and glass bottles, scrap metal. Recyclable or any other reusable materials should be disposed of as follows: Nuku'alofa: GioRecycling in Nuku'alofa Ha'apai: Transhipped to GioRecycling in Nuku'alofa* Vava'u: GioRecycling in Neiafu	4.1	TCL	
C-2 Separate all hazardous waste at the terrestrial construction sites. Hazardous waste includes: oil product, petroleum products, and chemicals. Hazardous waste should be disposed of as follows: Nuku'alofa: Tapuhia Landfill Ha'apai: Transhipped to Tapuhia Landfill in Nuku'alofa Vava'u: GioRecycling in Neiafu	4.1	TCL	
C-3 Construction waste should first be sorted for reusable waste, then disposed of after consultation with the Ministry of Infrastructure offices on Vava'u and Ha'apai.	4.1	TCL	

C-4 General garbage should be disposed of as follows: Nuku'alofa: Tapuhia Landfill Ha'apai: Non-toxic materials can be burned in situ and all non-burnable should be transhipped to Tapuhia Landfill* Vava'u: Kalaka site landfill * At the time of assessment plans were underway in Ha'apai to install a waste management scheme. Ministry of Infrastructure should be contacted before construction to verify methods of disposing of waste (construction, hazardous, recyclable and general).	4., 4.2	TCL	
C-5 Cable laying vessel will adhere to all regulations in the Marine Pollution Prevention Act in respect to the disposal of waste at sea.	1.3, 4.1	CONTRACTED CABLE SUPPLIER	
D. Air Quality			
D-1 Agreements with sub-contractors should include a clause to cover and secure any bulk transported construction material with tarpaulin, or similar, during transit.	5.2	TCL	Pre-Construction
D-2 All stockpiled and transported materials to be covered with secured tarpaulin (or similar) to protect air quality during dry periods and to prevent increases to sediment runoff during rain events.	5.1. 5.2	TCL	
D-3 (Only for implementation if drought conditions are not evident) Use of hose pipe and spray nozzles to dampen dusty areas of the Vava'u office and TS construction site at times of heavy machinery use during dry spells.	5.2	TCL	
E. Erosion: Ha'apai			
E-1 Vegetation Line (excavation) - damage to the vegetation line can cause erosion. During trenching, ensure only minimum width necessary for cable laying operations is excavated. Species growing along the vegetation line (*Ipomoea sp.*) is a common and hardy species of creeping vine, but care must be taken to ensure damage is minimal. No excavated materials should be stored on neighbouring sections of the vine to reduce extent of the impact.	9.2	TCL	

E-2 Vegetation Line (restoration) - after refilling of the excavated trench, vegetation will eventually recolonise damaged area. To increase the rate of regeneration and to ensure site is restored to pre-construction conditions, if disturbed area is greater than 2m wide at the vegetation line, specimens of the same species should be transplanted to the restoration site.	9.1	TCL	
E-3 Beachfront excavation - Excavation works should be conducted as close to low tide as possible. As with the vegetation line, excavations should only be as wide as the minimum operating width required. If the excavated area is likely to be exposed during the mid-high-mid tide cycle then excavated materials must be stored above the HWM. Loss of material through ocean wash will lead to changes in the beach profile and this can be avoided if this mitigation measure is followed.	9.2	TCL	
E-4 Trench should be a minimum of 1.5m deep along the length of the beach.	9.2, 9.3	TCL	
E-5 Trenches will be refilled with the same materials as excavated.	9.1, 9.2	TCL	
E-6 No solid concrete (or other material) should be constructed on the beach. Solid structures are known to change longshore drift patterns and cause changes in erosion patterns and rates.	9.2	TCL	
E-7 Consideration should be given to moving the Ha'apai LP 2-3m north. This would take the LP and cable into the zone with a historically lower rate of coastal erosion.	9.3	TCL	Pre-construction
F. Coral Colonies: Ha'apai			
F-1 Marine Department should be advised of planned activities to coordinate with shipping agencies.	11.1	TCL	Pre-Construction
F-2 Weighted marker buoys should be placed in the areas indicated in Figure 100 (GPS coordinated can be found in Table 12) to mark the sandy channel through live coral colonies.	11.1	CONTRACTED CABLE SUPPLIER	Pre-Construction
F-3 Small cable laying craft should be used to bring the cable to shore through the marked channel.	11.1	CONTRACTED CABLE SUPPLIER	

F-4 As the preferred measure, diver assistance should be considered during the cable laying process in the highlighted sections (Figure 100) to help guide the cable to a sandy substrate as it is cut from the surface buoys. A second option would be to use a post-lay diver survey along the cable route to identify and move sections of cable that may be in conflict with a live coral head. The second option would require more exertion underwater and may not be effective on trapped sections of cable, therefore, it is the least preferred method.	11.1	CONTRACTED CABLE SUPPLIER	
G. Natural Hazard			
G-1 The cable should be articulated and pinned to the Pangai reef pavement (Figure 25).	9.3	CONTRACTED CABLE SUPPLIER	
H. Endangered Species Plan			
H-1 Plan should be implemented during the protected and endangered humpback whale migration and breeding season of July through October.	6.2, 11.2	TCL, CONTRACTED CABLE SUPPLIER	
H-2 The NOAA approved Marine Protected Species Protocols shall be implemented by an onboard observer during installation to identify and take actions (if needed) to avoid disturbance of or contact with an animal (humpback whale or marine turtle). The protocols are provided in Appendix 4. Key elements of the protocol include: onboard observer with responsibility for maintaining a watch for animals and the authority to suspend operations to avoid direct contact, emergency contacts for mammal and turtle stranding, and reporting requirements for any incident that may occur.	6.2, 11.2	TCL, CONTRACTED CABLE SUPPLIER	
I. Subsistence & Livelihood			
I-1 A minimum of six moorings (three in Neiafu and three in Pangai) are to be installed in the locations shown in Figure 99.	7.2	TCL	Pre-Construction
I-2 The Marine Department of Tonga has issued minimum standards for the specifications of moorings to be laid in any harbour. Moorings must be “dead man” design with two cement blocks chained together, one of which has the actual mooring chain and line attached.	7.2	TCL	Pre-Construction

8.2.1 Operational and Maintenance Mitigation Plan

Table 11: Mitigation Plan for Operational and Maintenance Phase of the Project

Mitigation Measure	Impact Reference	Implementing Agency	Notes
J. General Measures			
J-1 OHS policy for the workplace should be implemented in the new TCL offices in Neiafu. Training should be given as part of the induction process for all staff.	1.3	TCL	
J-2 All measures should be taken to prevent marine pollution (including oils and spill) as per the Marine Pollution Prevention Act and all listed international conventions.	10.5	TCL, CONTRACTED CABLE SUPPLIER	Maintenance
J-3 Maintenance vessels will have Spill Prevention and Response Plans to prevent materials from entering the water and safety plans specific to the work area should be in place.	10.5	CONTRACTED CABLE SUPPLIER	Maintenance
J-4 Chance findings of any heritage items or cultural resources during maintenance works will result in the requirements of WB OP4.11 and ADB SPS being triggered.	2.1	TCL	Maintenance
K. Communications			
K-1 For any required maintenance works a communications plan should be developed to include the following information: maintenance works dates nature of works minimum operating distances from vessels contact details for TCL team	2.2, 3.1, 3.2, 3.3, 6.1,7.2	TCL	Maintenance
K-2 Communications should include (but not limited to): Ports Authority Nuku'alofa Marine Departments Nuku'alofa, Ha'apai and Vava'u Commercial Shipping Agents Nuku'alofa, Ha'apai and Vava'u *Local communities in Ha'apai and Vava'u via local FM radio stations **Sports fisher clubs in Nuku'alofa and Vava'u **Tonga Whale Watch Operators Association in Vava'u for dissemination to Nuku'alofa and Ha'apai * for maintenance works within 5nm (9km) of shore only ** for maintenance works within 5nm (9km) of shore between the months of July through October	2.2, 3.1, 3.2, 3.3, 6.1,7.2	TCL	Maintenance
L. Solid Waste			

L-1 All operational refuse should be separated for recyclable materials. Suitable refuse bins should be provided to facilitate this and should be disposed of with the GioRecycling facility in Neiafu and in Ha'apai, transhipped to GioRecycling in Nuku'alofa*.	4.1	TCL	
L-2 General garbage should be disposed of at the Kalaka landfill in Vava'u and in Ha'apai, transhipped to Tapuhia Landfill in Nuku'alofa*. * At the time of assessment plans were underway in Ha'apai to install a waste management scheme. Ministry of Infrastructure should be contacted to verify methods of disposing of waste and recyclables in Ha'apai.	4.1	TCL	
L-3 Cable maintenance vessels will adhere to all regulations in the Marine Pollution Prevention Act in respect to the disposal of waste at sea.	4.1	CONTRACTED CABLE SUPPLIER	Maintenance
M. Endangered and Protected Species			
M-1 For maintenance works during the humpback whale migration season of July through October and for maintenance works in less than 15km from shore, the Marine Protected Species Protocol should be implemented.	6.2, 11.2	CONTRACTED CABLE SUPPLIER	Maintenance
N. Coral Colonies			
N-1 For maintenance within the area indicated on Figure 100, surface marker buoys and post maintenance diver surveys should be used to ensure that the cable is returned to the its pre-maintenance placement.	11.1	TCL, CONTRACTED CABLE SUPPLIER	Maintenance

Figure 99: Minimum recommended approximate mooring installation locations in relation to cable route in (t) Vava'u and (b) Pangai

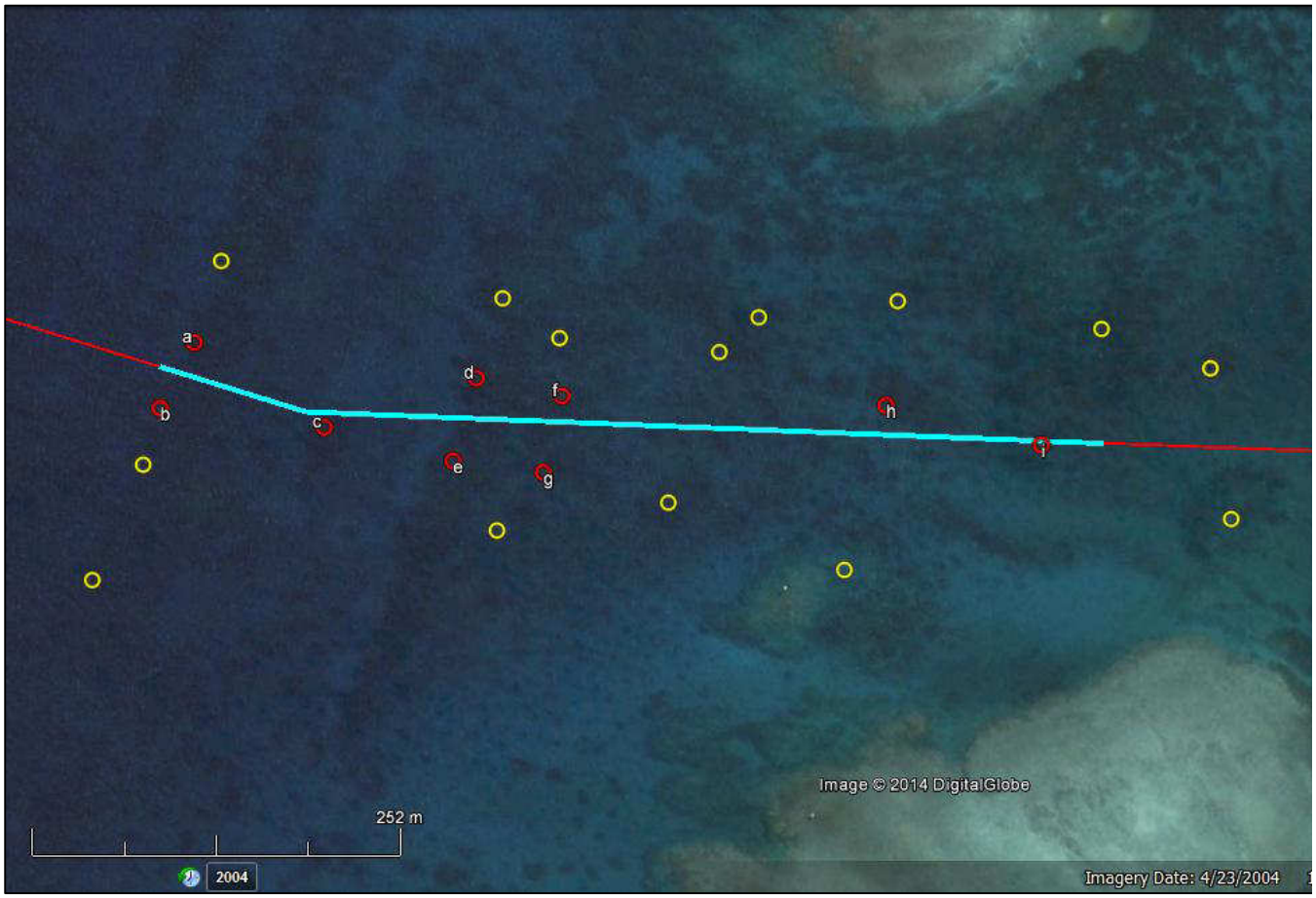

Figure 100: Detailed view of diver assisted cable placement area in Pangai (blue section). Surface markers buoys should be used on the red markers (see Table 12 for locations)

Table 12: GPS coordinates of all coral patches to be marked using surface marker buoys on approach to Pangai

Marker Letter	Coordinates	Approximate Depth	Diver Assistance?
a	19° 43.352'S, 174° 22.559'W	20m	Y
b	19° 48.406'S, 174° 22.572'W	20m	Y
c	19° 48.413'S, 174° 22.508'W	16m	Y
d	19° 48.395'S, 174° 22.448'W	11m	Y
e	19° 48.425'S, 174° 22.457'W	11m	Y
f	19° 48.401'S, 174° 22.414'W	13m	Y
g	19° 48.429'S, 174° 22.422'W	13m	Y
h	19° 48.405'S, 174° 22.287'W	8m	Y
i	19° 42.419'S, 174° 22.226'W	8m	Y
j	19° 48.432'S, 174° 22.026'W	5m	N
k	19° 48.414'S, 174° 22.003'W	5m	N
l	19° 48.433'S, 174° 21.996'W	5m	N
m	19° 48.450'S, 174° 21.547'W	<5	N

8.3 Monitoring Plan

It should be noted that the cable laying process is of very short duration, anticipated to be no more than six days. Land activities are expected to be completed within the same time frame. TCL will record and monitor data covering the environmental, socioeconomic and cultural aspects. This section presents an outline of the monitoring programs proposed for the construction and operational phases.

Receptors	Monitoring Task	Monitoring Parameter	Timing
Surface and Ground Water			
	Effectiveness of surface water management system in Neiafu site	Identification of erosion events	Continuous
	Functioning of soak away and septic tank in Neiafu site	Record keeping of systems maintenance	Continuous
Cultural Heritage			
	Review and audit of mitigation activities to ensure satisfactory implementation of mitigation measures	100% recording of any archaeological chance finds	Construction and Maintenance
		Triggering of appropriate policies	
Economy and Employment			
	Record economic indicators for local content and social issues	Reduction in cost (TOP) of broadband internet access	Operational and Ongoing
		Number of part-time employees (PTE) and full-time employees (FTE) during project phases	
Infrastructure			
	Traffic Monitoring	Duration of any terrestrial traffic control measures	When construction occurs close to developed areas
		Duration of any disruption to regular marine traffic	When cable vessel operated in the near shore environment
	Tourism	Number of grievances responded to and addressed	Annually
Working Conditions			
	OHS audits	Total recorded incidents, lost time incidents and other OHS indicators	Monthly audit
	OHS evaluation for subcontractors	Records verifying the condition of personal protective equipment	Post Construction

Noise (terrestrial)			
	Monitor noise attenuation during terrestrial construction works	Noise	Continuous during mentioned operations
Marine Environment			
	Monitor marine water quality during near shore construction	Turbidity Suspended solids Oil and grease Dissolved metals	Once pre construction and one post construction
	Monitor of foreshore seabed and substrate characteristics for recovery	Percentage cover seagrass	One year after construction
		Relative abundance and distribution of benthic invertebrates in comparison to neighbouring areas	Further annual monitoring depending on results of first year.
	Monitor presence of humpback whale	100% implementation of mitigation measures	Continuous during cable laying activities planned for July through October
	Monitor impact of cable on live corals: Ha'apai	Post lay survey for correct placement of cable	Once immediately after cable placement
Terrestrial Environment			
	Monitor recovery of vegetation line at Pangai LP	Percentage of plant cover	Immediately after construction and every three months for first year of operations
	Retaining wall vegetative litter removal	Height of exposed retaining wall at rear of property	Ongoing during operational phase

8.4 Institutional Capacity Assessment

The successful implementation of this project depends on the management of the environmental and social impacts, in addition to the effective management of construction and operational processes. These roles and responsibilities fall under four central agencies within Tonga:

- Tonga Cable Ltd
- Ministry of Environment, Energy, Climate Change Disaster Management, Meteorology, Information and Communications (MEECCDMMIC)
- Ports Authority, Nuku'alofa
- Marine and Ports Department

This section examines each of these agencies, assesses their capacity to manage the issues that have been identified within this report and makes recommendations on how to best address any identified capacity gaps.

Tonga Cable Ltd – This is the implementing agency for this project and has already overseen the successful installation and commissioning of the international leg (Fiji to Tonga) of the Tonga Cable Project. TCL is a fully operational and well-equipped corporation with a team of staff who are now directly experienced with the installation, implantation and operations of a fibre optic cable telecommunications system in Tonga. With the construction of a new operational facility in Vava'u and with capacity development already well underway in the two outer island groups, no capacity gaps have been identified in the course of this assessment.

MEECCDMMIC – With the responsibility for enforcing the EIA Act, an Environmental Assessment Committee has been established (2013). This committee has the responsibility of ensuring that all regulations are adhered to and is also responsible for managing the EIA application and reporting processes. The forming of the EAC shows a level of commitment from the MEECCDMMIC to ensuring that development in Tonga is done in consideration to the environment and while there are budgetary constraints to consider, the EAC team has already been active in enforcing regulations in the island groups. The EAC is still very much dependent on developers self regulation in adhering to the EIA regulations and processes. TCL has already committed itself to the correct EIA processes as outlined in Section 4 of this assessment and the EAC is aware of the project. The onus will be on TCL to ensure that they are following correct processes to obtain their environmental permit. The EAC will use this EIA report to inform TCL of their conditions of permit and any monitoring requirements, it will then be the responsibility of TCL, as the proponent, to facilitate the EAC in their stipulated monitoring requirements which usually include an on-site inspection and monitoring parameters as per the EIA recommendations. It may be necessary for TCL to engage the services of an external environmental organisation (either governmental or private) to complete some of the monitoring requirements.

With TCLs commitment to the Tongan EIA process, this will act as a capacity development tool for the new EAC and the MEECCDMMIC. No "hands on" involvement is required from the Ministry as the project develops, so no additional capacity building is required.

Ports Authority, Nuku'alofa – This department has responsibility for all shipping within the Tongatapu area. It operates the port of Nuku'alofa from its offices in the port complex. The Ports Authority is already experienced in managing their operations and working with with TCL during the installation of a fibre optic cable as they were fully involved in the same process in 2013.

The Ports Authority staff are fully equipped to manage their areas of responsibility in this project and view these operations as "business as usual." No areas have been identified that would benefit from specific capacity building activities

Marine and Ports Departments – This department is a division of the Ministry of Transport and has the responsibility for operating the ports in Pangai and Vava'u. The outer island offices are each managed by an Officer In Charge, however, all decision making and planning comes out of the Nuku'alofa offices. The capacity in the outer island offices is limited to overseeing specific shipping activities within their respective ports. Permission for most activities in these ports is granted by the CEO in Nuku'alofa.

Communications for all cable laying activities should be directed to the Nuku'alofa office however the Officers In Charge in Pangai and Vava'u should also be included to avoid any communication difficulties. It is advisable for TCL to arrange a meeting with the CEO of the Marine and Ports Department in Nuku'alofa prior to commencement of the operational phase of the project to discuss the specific needs in each of the island groups and to develop a communications and operations plan to provide the outer island groups with a cohesive strategy for coordinating shipping and local communications.

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10. Appendices

10.1 Terms of References

Tonga Cable Limited

Terms of Reference
for the Environmental Impact Assessment
for
Extension of Tonga Cable

A. BACKGROUND

The Government of Tonga has asked the World Bank and the Asian Development Bank to part finance the Tonga Domestic Cable Project. The Project entails construction of a submarine fibre-optic cable from Nuku'alofa to Vava'u with a Branching Unit and connection to Ha'apai group and construction of a new submarine cable landing station in Neiafu (Vava'u).

The proposed extension of Tonga Cable would be commissioned and operated as a wholesale telecommunications business by Tonga Cable Ltd (TCL). TCL is currently majority-owned by the Government of Tonga (83%) and Tonga Communications Corporation (TCC) (17%). The Government has committed to ensuring, through appropriate regulation, that the cable will be available to all potential service providers on an "open access" basis, with fair and transparent pricing.

Steps undertaken so far to progress the extension of Tonga Cable include the following:

- Approval of Cabinet to extend the cable
- Establishment of the managing facilities/resources within Tonga Cable Ltd.
- Preparation of detailed technical specifications and economic/financial model, and draft bidding documents
- Preparation of the design of landing station for Neiafu
- Conducting Marine Survey and selecting the actual route for the cable

The key issues to be addressed at this stage include.

(a) *Validation of technical, social and economic analysis and business model*: ongoing.

(b) Environmental impact assessment and mitigation plan: this is the subject of these terms of reference.

B. SCOPE OF SERVICES

TCL will be the counterpart for this assignment. TCL seeks the services of a suitably qualified and experienced Consultant (firm) to provide the services outlined in these Terms of Reference which are to:

1) Undertake a full and detailed, qualitative and quantitative environmental analysis of the Project.
2) Prepare corresponding Environmental Management Plans for the Design, Construction/laying, Operations and Maintenance Phases of Project.

3) Submit a final and acceptable Environmental Assessment Report and Environmental Management Plan.

These TORs are to be read in conjunction with the projects detailed technical specifications and all other relevant project documents.

C. PROJECT DETAILS

C1. Project Development Objective

The immediate objectives of the Project are to improve the enabling environment for telecommunications and ICT in Tonga and promote increased access to infrastructure and services by reducing the costs of international connectivity. Expected sector-specific outcomes are: (i) increased volume of international, regional and national traffic and, (ii) decreases in average price of international, regional and national communications.

C2. Project Description

Submarine Cable System linking Nuku'alofa and Vava'u with Branching Unit to Ha'apai- The cable system comprises of approximately 320 km unrepeatered cable to Vava'u plus 50km of unrepeatered cable to Ha'apai and a landing station in Neiafu. The cost includes cable materials and laying costs, and cable equipment. [Detailed technical specifications are available]. The design capacity for the cable system would be 1x40Gb/s on Nuku'alofa-Vava'u, 24x40Gb/s on Nuku'alofa-Ha'apai, 26x40Gb/s on Ha'apai-Vava'u with an initial lit capacity of 40Gb. A new cable landing station will be constructed in Neiafu. In Nuku'alofa, the cable will be connected to the existing Tonga Cable Network landing station in Sopu. The Tonga Cable connects Tonga with Southern Cross Cable in Fiji. This new cable is expected to provide substantially higher capacity than through existing satellite links, and reduce international bandwidth costs from their present level of about US$3,500 per megabit per month by 75% by 2016, based on current bandwidth prices.

D. Detailed Tasks for the Consultant

Task A: Determine the Project's Influence Area – The consultant is to determine, define and map out the project's marine and land based influence areas based on the proposed corridor of the marine cable, location of marine and land based infrastructure and construction methods. The consultant will clearly delineate these areas into two – (i) marine and coastal based and (ii) in-land based.

Task B: Marine Protected Areas – The consultant will undertake a detailed and extensive review and catalogue all relevant Marine Protected Areas and describe all other Natural Habitats as defined by the World Bank's Operational Policy OP4.04, that overlap and are adjacent to the project's marine area of influence and illustrate these on maps and will describe the legal status, significance and developmental restrictions and compliance requirements for these MPAs.

Task C: Baseline Data in the Project Influence Area and/or Marine Protected Areas - The Consultant will undertake a comprehensive gathering, collection and review of the required baseline data from existing credible sources within these areas. Where the required data is missing, inadequate or unreliable, the consultant will undertake the necessary surveys and/or collection in

the bio-physical and/or social environment to obtain this data. The consultants shall present the obtained baseline data pertaining to,

(i) the physical marine environment, (i.e. ocean floor topography, etc), and land based environment such as geology, climate and meteorology, surface and ground water hydrology, land use, land acquisition needs, etc.,

- (ii) biological environment, (i.e. flora and fauna and habitat and ecosystems values, rare and endangered species, migratory species, within or adjacent to the project's influence area /MPA's etc.),
- (iii) socio-economic and cultural environment, including screening for the presence of Indigenous Peoples in these areas and Physical Cultural Resources as defined by respectively World Bank policies on Indigenous Peoples (OP4.10) and Physical Cultural Resources OP4.11, where applicable. The consultant will also investigate, determine and confirm the presence or absence of critical natural habitats, as defined by the World Bank's Natural Habitats Policy (OP4.04) in the areas, and
- (iv) information on existing or planned infrastructure/projects in these areas that may have direct, induced and/or cumulative impacts on this projects activities.

Task D: Review of Applicable Law – The consultant will review all relevant and applicable environmental laws of Tonga and all international laws protecting marine life, fisheries, etc, marine protected areas, and adequately identify the compliance requirements of these laws.

Task E: Review of applicable World Bank, and Asian Development Bank requirements- The consultant will review all World Bank and Asian Development Bank safeguards policies and their respective requirements to ensure project compliance.

Applicable World Bank Policies:

- Environmental Assessment (EA) (OP4.01) – inter alia, requires (i) detailed qualitative and quantitative analysis to determine project impacts,(ii) determination of tangible measures to prevent, minimize, mitigate or compensate for these adverse impacts, (iii) public consultation and disclosure as part of the EA process and (iv) requires an Environmental Management Plan (EMP) to address set of mitigation, monitoring and institutional measures to be taken during design, implementation, operation of maintenance phases of the project.
- Natural Habitats (OP4.04) – This policy requires the conservation of natural habitats and specifically prohibits the support of projects that involve significant conversion or degradation of critical natural habitats, as defined by the policy. The policy further requires the EA to indentify impacts on biodiversity and species and to determine endemism, endangered species and to determine project impacts on these species and to propose acceptable mitigation and monitoring measures.
- Physical Cultural Resources (PCR) (OP4.11) – This policy seeks to avoid the disturbance and or destruction of PCR as defined by the policy by the projects activities. PCR includes places of worship, buried artifacts, cemeteries and archeological assets, etc. The policy further requires, (i) EA to undertake an exhaustive desk review and/or site investigation to pre-identify and locate PCR's in the project influence area, (ii) EA/EMP to propose management measures and (ii) to include chance find clauses in civil works contracts during construction and maintenance stages.
- Indigenous Peoples (IPs) (OP.4.10) – requires the Governments of Tonga to engage in a process of free, prior and informed consultations with Indigenous peoples, as described by

the policy in situations where IP's are present in, or have collective attachment to, the project area and for the preparation of an Indigenous Peoples Plan (IPP) and/or Indigenous Peoples Planning Framework (IPPF).

- Involuntary Resettlement (OP4.12) – this policy addresses direct economic and social impacts from the projects activities that will cause (a) involuntary taking of land resulting in (i) relocation or loss of shelter, (ii) loss of assets or access to assets or (iii) loss of income sources or livelihoods and (b) involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons. The policy requires siting of project infrastructure to be so chosen so as to avoid these impacts altogether or to minimize them to the extent possible. Where these cannot be avoided, the policy requires the preparation of either or both of these instruments (i) resettlement policy Framework, (ii) Resettlement Action Plan, and for meaningful consultations with potentially affected people. The policy prohibits Community donations of lands for location-specific infrastructure.

Applicable Asian Development Bank policies are contained in ADB's *Safeguard Policy Statement* (2009)[2] which covers three key safeguard areas of (i) Environment, (ii) Involuntary Resettlement, and (iii) Indigenous Peoples. Chapter V. Safeguard Policy Statement and Appendixes 1 to 6 will be closely reviewed for implications of the Project.

Task F: Analysis of Direct, Induced and Cumulative Environmental Impacts - The consultant will undertake a detailed analysis to determine the positive and negative environmental and social impacts associated with each phase of the project, i.e. Phase 1 - Cable Laying and construction of land based infrastructure, (ii) Phase 2- Operations & Maintenance Phase. For each phase in the project influence area and/or marine protected areas identified above, based on the technical specifications the consultant will undertake an in depth and detailed quantitative and qualitative analysis for likely timeline scenarios using appropriate methodologies and hydro-graphic modeling if required, to predict and/or determine the intensity, scale, and scope of the direct, induced and cumulative positive and negative environmental impacts associated with this project. These impacts are to be determined as a change in the baselines identified above.

Task G: Analysis of Alternatives- The consultants will provide an evaluation of reasonable alternatives [i.e. alternative routings, sites for landing station] by assessing the extent to which these alternatives may be more appropriate from an environmental (and socio –economic and cultural) requirement than the proposed measures, technical specifications, corridor and plans project. Propose alternative feasible changes in the proposed marine cable alignment, and other associated sub marine and land based infrastructure to reduce or otherwise to more sustainably manage these impacts. This work will be done in consultation with technical specialists on submarine cable infrastructure, including consultants retained by the Bank and consultants retained by TCL.

Task H: Meaningful Consultations – The consultant will identify and hold meaningful consultations with the project's national and local potentially affected peoples and other stakeholders and including international environmental NGOs (IUCN, WWF, and Greenpeace), in only one central location (either in Fiji, New Zealand or Australia) , to present and discuss the findings and proposed measures in the EA, and to seek their respective views and inputs before

finalizing the EA process. The consultant will maintain adequate records of this process and will present a detailed summary in the EA reports. The consultants will use suitable participatory methods to consult potential PAPs. In its inception report, the consultant will include a consultation plan to be agreed with the projects steering committee.

Task J: Institutional Assessment - Having determined the environmental and social issues that would be associated with this project, the consultant is to undertake a detailed qualitative review of the relevant Government of Tonga own national ministries and other institutions, and Tonga Cable Ltd (TCL), with responsibility and/or jurisdiction for management of the project and its environment and social impacts, with the purpose of (i) determining their capacity to manage these issues and (ii) making recommendations to the Government of Tonga and to TCL on how best to effectively address any identified capacity gaps these issues during project implementation.

Task K: Environmental Management Plan (EMP) – the consultant will prepare the Environmental Management Plan for each phase of the project, which are the Design, Construction (including laying of submarine cable), Operations and Maintenance phases, in accordance with the World Bank's OP 4.01 and ADB's Safeguard Policy Statement (2009) which will include (a) details of environmental mitigation and monitoring program to be implemented, (b) clear definition of institutional arrangements and responsibilities for EMP implementation, (c) assessment of current institutional capacity to implement the EMP and proposed capacity building/institutional strengthening activities; and (d) scope, budget, schedule, frequency, location and responsibilities for implementation of environmental mitigation, monitoring, and capacity building and institutional strengthening activities.

The consultants will be required to visit Tonga for initial assessments, and to conduct stakeholder workshops to discuss and disseminate findings and recommendations.

E. Required Skills of the Consultants

TCL is seeking the services of one national consultant (if possible) and one international consultant to support the national consultant. Both consultants must be highly competent and have relevant academic qualifications and experience to deliver the services that are being sought in this TOR. Significant knowledge of, and relevant professional experience conducting Environmental Assessments for projects with substantial submarine works are desired. The successful completion of these services will require the team of consultants to have the following competencies and skills in the following areas; oceanography, marine biology/biodiversity, international environmental marine law, environmental assessments with particular focus on cumulative impacts on marine resources and ecosystems, natural resource management (for fisheries), and social scientist. Please note that this is a list of skills required, rather than a list of individual consultants.

F. Deliverables of the Consultant subject to the Guidance and approval of TCL

- Detailed, modern and accurate maps, charts and other visual presentations of data and analysis in electronic and print form.
- Workshop to present interim and final draft reports. These workshops will be held in Tonga

- Reports – EA Inception report, draft and final draft EA reports.

G. Indicative Timeline

T – Date of Contract Signature
T + 0.5 months – mobilization of Team to Tonga.
T + 0.75 months – submission of EA Inception Report.
T + 1.5 months – hold meaningful consultations with stakeholders.
T+ 2.0months – submission and Presentation of First Interim Draft Final EA Report.
T + 3.0 months – submission of Final Draft EA Report.

10.2 EIA Regulations 2010: Form 3

FORM 3: MAJOR ENVIRONMENTAL IMPACT ASSESSMENT

Project ID No.:

Name of Project:

Contact Person:

Contact Number:

The written environmental study shall include the following:

1. Title, abstract and executive summary.
2. Description of the purpose and scope of the proposed development activity:
    a) Purpose: What goals and objectives of society are served? Why is the project needed?
    b) Direct benefits expected: products, services, jobs, return on investment
    c) Location and extent of site boundaries and associated facilities at preferred site and other feasible sites (please provide map of area)
    d) Technology to be used.
    e) Local infrastructure required: roads, utilities, etc.
    f) Inputs of capital, labour, natural resources.
    g) Duration of construction period and operating life.
3. Present a justification of the proposed development activity in terms of environmental, economic, cultural and social considerations.
4. Identify, describe and analyse the potential direct and indirect physical, biological, social, cultural and economic impacts of the development activity for both construction and operational phases of the development.
5. Detail any measures to be taken to protect the environment and to avoid,

reduce or otherwise mitigate any potential adverse effects of the development.

6. Evaluate and describe any feasible alternative activities, including locations, for achieving the objectives of the development.
7. Evaluate and describe the implications and consequences of not undertaking the proposed development.
8. Identify, describe and analyse the possible cumulative effects upon components of the environment with other existing or likely future development activities.
9. Public involvement.
10. Assess the way in which the project accords with the current Government of Tonga Development Plan, declared Government of Tonga environmental policy, and/or any international environmental policies, agreements, conventions or treaties to which the Government of Tonga is, or is considering becoming, a signatory.

This is to confirm that all required information has been lodged in accordance to the requirements of the Act.

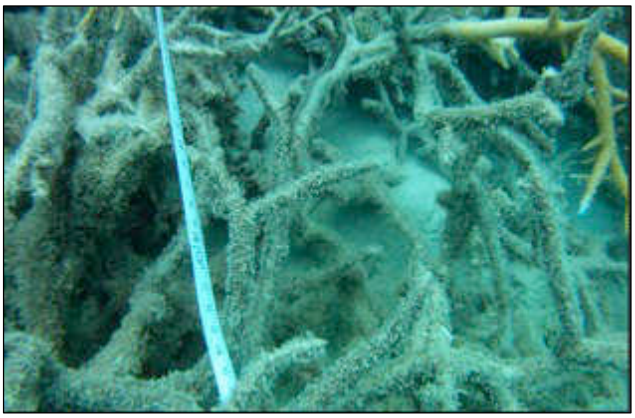
Signature:

Print Name:

Determining Authority:

10.3 Ha'apai Field Survey Transect Plates

Transect 1

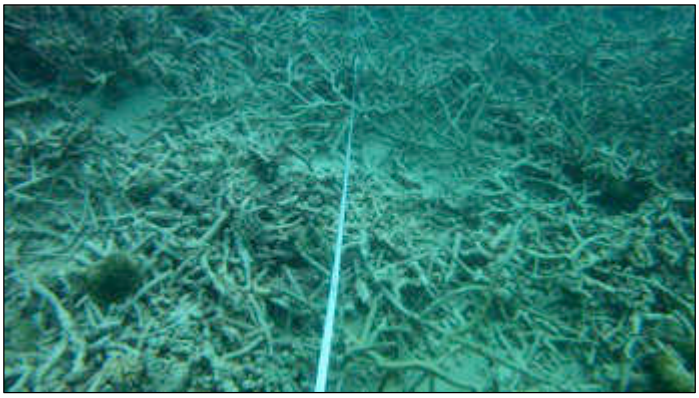
	
A coral ridge runs parallel to the shoreline of the landing site with small sand breaks in between.	Dominant coral species *Acropora sp*. in healthy condition.
	
Coral is of varying health with patches of old dead coral (greater than 1 year).	View of the coral ridge extending North to South parallel to the shoreline.
	
View of the coral ridge extending North to South parallel to the shoreline	View of the coral ridge extending North to South parallel to the shoreline.

Transect 2

Coral ridge extending north to south parallel to shore.

Sand patches with old dead coral of greater than one year.

Sand patches in 6m depth between coral ridge.

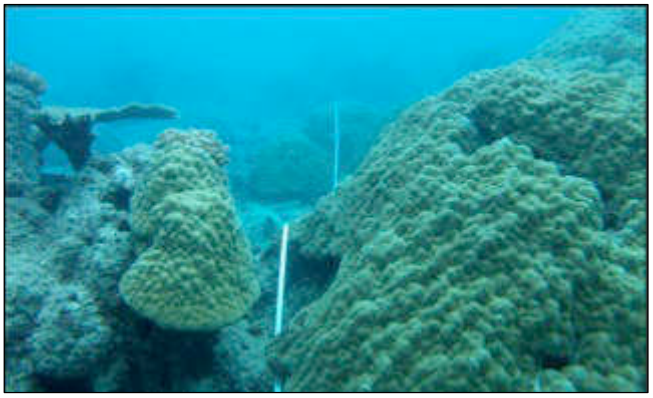
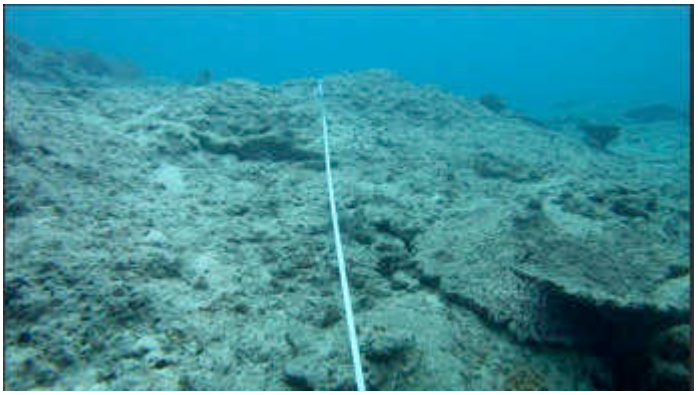
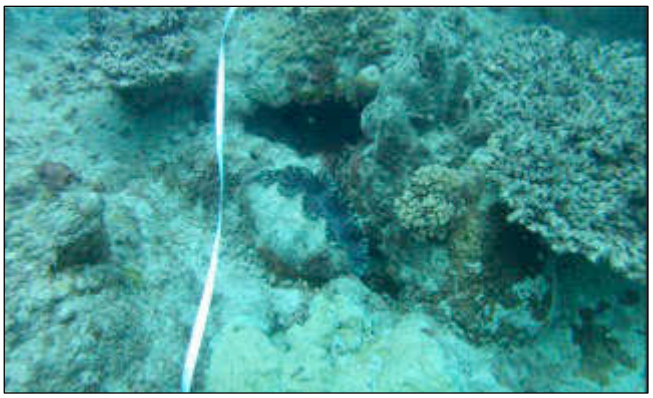
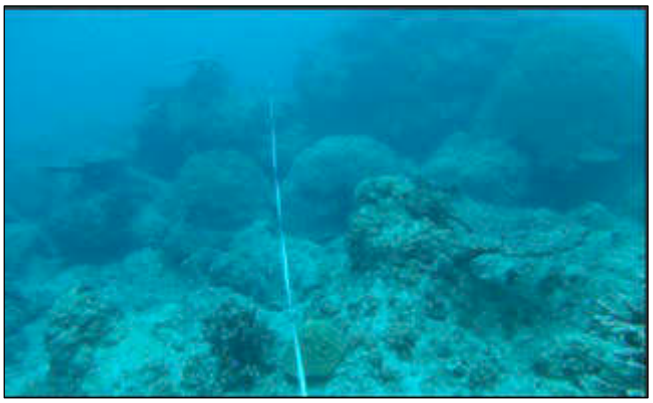


Large areas of old dead coral may cause friction to cable and not suitable substrate.

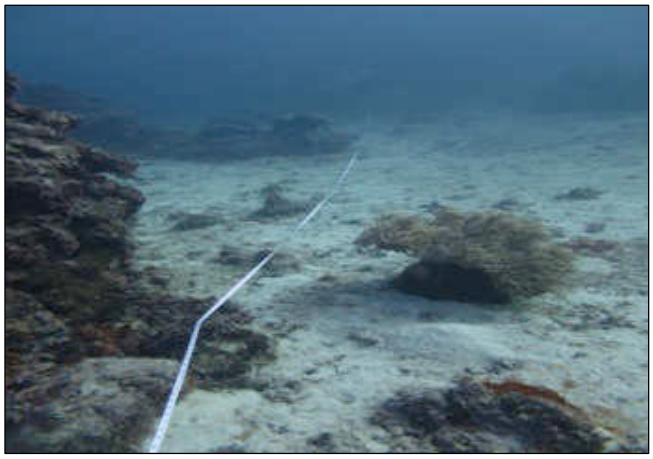
Acropora formosa, branching coral, some of the corals are lose due to wave interaction.

Healthy *Acropora sp.* branching and plate species on coral ridge amongst old dead coral and algae.

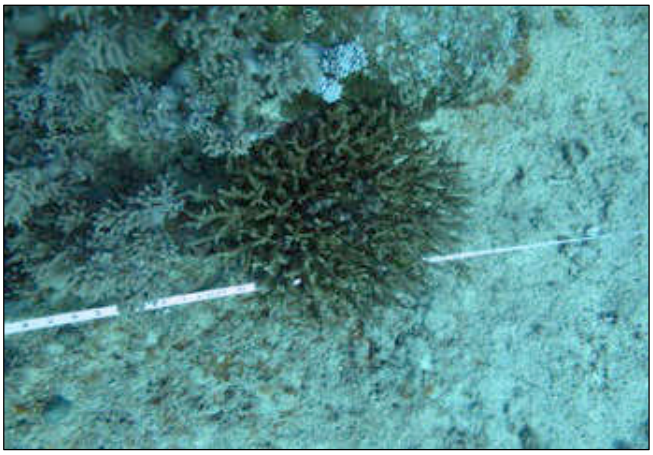
Transect 3

	
Porites sp found around starboard channel marker in the commercial channel entrance.	Ridge of exposed substrate in 4m depth by channel marker on starboard side of channel entrance.
	
Ridge of exposed substrate in 4m depth by channel marker on starboard side of channel entrance.	Porites massive colonies inside the commercial channel to the starboard side (approx. 75m from the proposed route).
	
Scattered *Porites sp*. massive colonies on starboard.	Sand gaps between *Porites sp* increasing as depth contour changes to 20m.

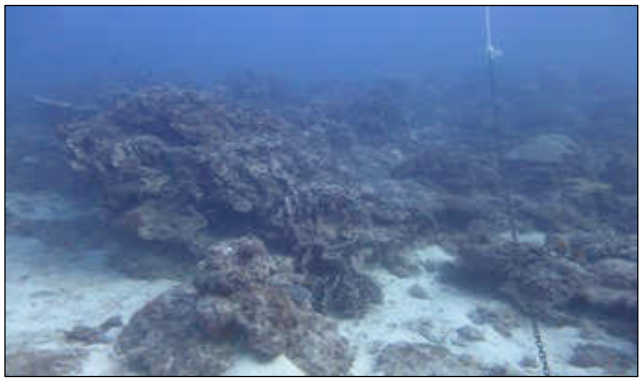
Transect 4



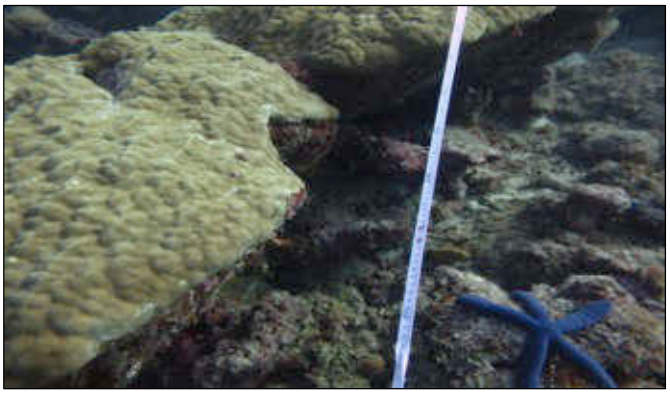
Sand channels extending approx. 20m from the southern side of the cable route.



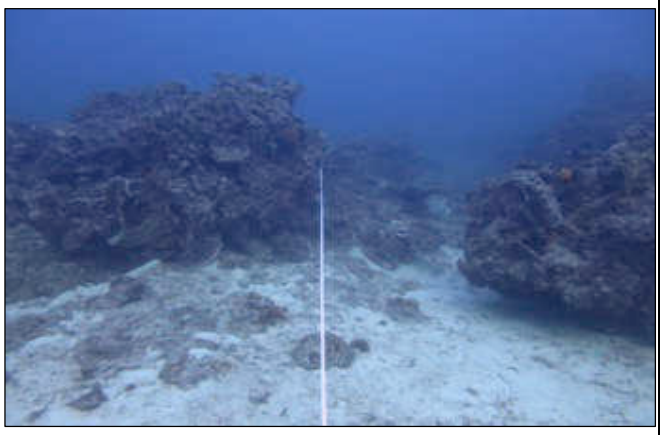
Small Acropora plate corals attached to substrate towards the cable route.



Coral ridge as seen to the entrance to the channel and located along the cable route. Sand channels to the south are shown above.



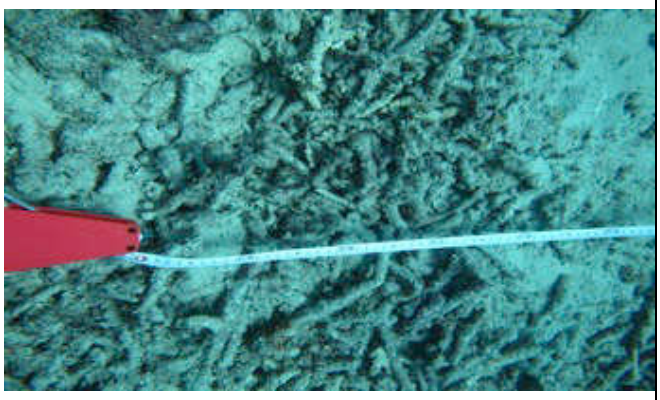
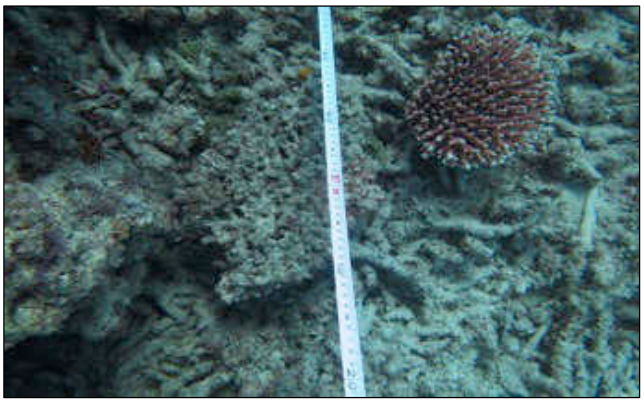
Coral ridge located in the centre of the channel supports Porites coral structures.



Transect showing sand channel approx. 35m to the north of the proposed cable placement.

Acropora plate corals on coral ridge located in the center of the channel on T4.

Transect 5

	
Old dead Acropora rubble lying on sand channel to the southern side of the channel.	Scattered Acropora branching and algae on rubble approximately 4m from the cable route.
	
Large sand channel area extending to the south side of the channel from the cable line.	Large coral areas of varying health are scattered through the channel. These are easy to identify from the surface.
	
Old dead rubble with single live Acropora plate approx. 27m to the south of the cable line.	Large sand area extending to the north of the cable route.

10.4 Marine Protected Species Protection Protocols

Marine Protected Species Protection Protocols

Tonga Cable Extension Project

The following guidelines are to be followed by the crew of the cable ship and support boat(s) during the 2016 installation of the Tonga Cable Extension in Vava'u and Ha'apai. These guidelines are intended to establish awareness of the potential for contact with marine protected species (marine mammals and turtles), and actions for avoiding contact during the installation. In addition, procedures for reporting incidents involving marine mammals are described below.

These guidelines are based on protocols used by observers during cable installations and inspection surveys conducted in California.[1]

These guidelines are to be carried out to the extent feasible by the ship's personnel and onboard representative, giving first priority to the safety of the vessel and crew.

- A look-out for marine mammals and turtles shall be included with the normal lookout duties of the vessel's bridge personnel, provided this does not interfere with the safe operation of the vessel.
- Maintain a log of sightings, noting date, time, coordinates, and approximate distance of the animal from the ship. The log shall be turned in daily.
- If contact with a marine mammal appears likely, the vessel speed should be reduced as soon as possible.
- If a mammal approaches the cable lay operation, slack should be taken out of the cable to reduce the amount of cable in the water column. If it is safe to do so, the ship should be allowed to drift.
- In the unlikely event of contact between a marine mammal and the vessel, the following actions should be taken (if it is safe to do so):
    - Contact the onboard representative immediately;
    - Log all information related to the incident (see attached log) and prepare to report the incident to the Marine Mammal Response Network, and NOAA Marine Mammal Response Network Coordinator, Protected Resources Division. Contact with marine mammals **MUST BE REPORTED** in any circumstance.
    - Await instructions from either the Marine Mammal Response Network or the contracted representative.
- Record all information related to the incident, with photographs if applicable, and submit with the daily report to the onboard representative.

IN CASE OF MARINE MAMMAL CONTACT WITH A PROJECT VESSEL CONTACT:
KAREN STONE, VEPA MARINE MAMMAL RESPONSE TEAM
+676 8446897

[1] The protocols were originally developed by the Marine Mammal Consulting Group in Santa Barbara, California, and approved by US state and federal agencies with authority for overseeing the activity.

MARINE PROTECTED SPECIES DAILY REPORTING LOG

DATE	TIME	LOCATION	OBSERVATION

Contact Information:
Karen Stone
Marine Mammal Response Network Coordinator
Vava'u Environmental Protection Association
PHONE: +676 8446897
EMAIL: info@vavauenvironment.org

10.5 Consultation Meetings Minutes

Ministry of Environment and Environmental Assessment Committee Meeting, Nuku'alofa 30 July 2014
Lupe Matoto, Deputy CEO of Environment
Lesieli Tu'ivai, Environment Officer
Ms Dorothy, Environment Officer

- Introduced cable route and landing areas.
- Standards of WB EIA are sufficient for this EIA.
- Timeframe of operations and the sensitivity of the whale season.
- Plan for local bilingual consultations.
- No known works in plan for Lifuka. PASAP project was discussed but the department is still waiting to receive the report back from the ministry where it has gone for review.
- Lotuma in Vava'u has been approved for SMA status, but it is not known how far along that process is. KW informed that we have lots of good survey data from the area and will develop mitigations for this sensitive area.
- Recommended to meet with 'Asipeli Palaki CEO of Lands to get permission for LiDAR data from the GIS department. LiDar project has identified vulnerable areas in Lifuka, it is high resolution altitude and bathymetric data at 50cm intervals.
- Forms 1 and 3 were given for submission to the EIA team. Form 1 ''Determination of Category of Assessment' has a TOP$10 fee and Form 3 'Major Environmental Impact Assessment' has a submission fee of TOP$250.
- Have advised that as World Bank require an EIA then we will be submitting under Form 3.
- Lupe advised of the 1% fee that is now being levied under the EIA Regulations 2010.
- Four hardcopies and one soft copy of the final assessment have been requested for the EAC review.

Ministry of Lands and Natural Resources, GIS Department, Nuku'alofa 30 July 2014
Asipeli Palaki, CEO Lands
Kate Walker, PEECS

- Permission was given to obtain LiDar data from Ministry of Lands
- Stated approval of format of Landcare Research EIA
- GIS department uses the 2m contour to indicate high risk areas that are vulnerable to inundation with climate change impacts.
- Fine detail is available for bathymetry and contours for the whole of Tonga through the LiDar project. 0.5m interval contours
- Aerial photograph obtained of Ha'a'pai landing site – marine and terrestrial

Ports Authority, Nuku'alofa, 31 July 2014
Mosese Lavemai, CEO of Ports Authority, Nuku'alofa
Captain Motu Hakau, Harbourmaster Nuku'alofa
Kate Walker PEECS

- Coordinates of all harbours are listed in the Ports Authority Act Proclamation 1998
- Ha'apai Discussion:
    - Container ships sometimes anchor in deep water south of Hakau Island
    - Main shipping channel into Ha'apai harbour is through Ava Limu Moto passage. It's a narrow and shallow channel. It is the main shipping route into Ha'apai
    - An alternative approach route for the cable was suggested by Captain Hakau but quickly dismissed by him as it would pass through fishing grounds on the south of Lifkua
    - Within the harbour, the shipping approach to the main wharf (north of the coral reef) is very shallow and the ferry often touches bottom.
    - Ha'apai is visited by the Sitka, Pulupaki and Niuvakai. Approximately three visits per week in total but the Marine Department in Ha'apai can confirm can coordinate with TCL.

  - Marine Department run the harbour in Ha'apai and can provide more detail for operations.
  - The main channel into Ha'apai will need to be widened at some point in the future. The shallow rise on the northern side of the entrance (opposite end to the cable route) will be removed and the whole channel deepened. Laying the cable on the southern end of the channel is preferred.
  - There is a long standing conversation of cruise ships calling into Sand Island but any designated anchorage will be well north of the cable.
- Vava'u Discussion:
  - Cruise ship anchorage is designated at the base of Mount Talau, well north of the proposed cable route.
  - Super yachts and other large yachts anchor within the sheltered waters of Lotuma Island.
  - Long held plans are there to dredge and widen the entrance to Neiafu harbour but there is no time frame on this and it is not included in the Governments 2013-2023 Infrastructure Investment Plan
  - There are not any legally designated anchor zones within the Neiafu harbour, only local management no anchor zoning
  - Commercial shipping rule for the entrance of vessels into the Neiafu harbour entrance channel is 'one at a time'
  - Vava'u is visited by Friendly Island Shipping, Sitka, gas ship, Matsons and GPS. Marine department and shipping agents can coordinate for operations
  - Three shipping routes into Vava'u and the larger ships tend to take the outside route, which is the same as the cable route
  - Cruise ship schedule for 2015 will be known by their agent and advised in advance
  - Initial talk of laying cable on the western edge of the channel but dismissed as the gradient of the slope would not provide secure platform for cable so ruled out by Captain Hakau.
  - June - November are busy times of year for recreational and commercial shipping so careful coordination with all marine departments will be necessary. Communication should be given to all parties to advise in advance (one month) of planned works.
- Nuku'alofa Discussion:
  - Existing cable is now on the marine chart
  - Cable will be laid along the same path as the existing cable
  - 8-9 container ships per month visit Nuku'alofa harbour, although this is starting to increase: 14 ships visited in June. Average of two per week but twelve months from now, shipping could be busier again.
  - Need one months notice of cable laying so to inform local and international mariners
  - Anchorage for ships awaiting piloting has been moved due to previous channel and is now divided into two areas, one to the east and one to the west of the cable.
  - Tidal station is set at berth #4 of domestic wharf
  - ML requested a notice be sent to Ports Authority ref the existing cable so that the domestic fishing fleet can be aware.
  - Concerns were raised over potential disturbance of the cable on the reef flat in Nuku'alofa by visiting local fishermen who may not be aware that the cable is buried. Suggested a sign on the waterfront to inform, however cable depth of 1.5m below the surface provides sufficient protection.
- Question was raised by ML over liability of damage to cable – who is liable for anchor damage?
- Notification of cable is requested by ML to advise local and international mariners
- Recognition of this being an important development for Vava'u and Ha'apai

Whale Watch Operators, Ha'apai, 13 August 2014
Craig Avery, Ha'apai Whale and Sail
Darren Rice, Matafonua
Matt Haling, Fins'n'Fluks
Kate Walker, PEECS
Karen Stone, PEECS

- CA mostly stays south of Pangai so he doesn't envision any negative impacts
- Pleased that Ha'apai is getting the cable too: CA, MH, DR
- MH tends to spend his time whale watching in front of Lifuka Island but doesn't anticipate any adverse impacts
- DR mostly operates north of the planned route so he's not too concerned
- DR did the diver survey for the CRS so was very familiar with project

SOPAC/SPC, Fiji 18 August 2014
Jens Kruger, Oceanography Team Leader, SOPAC
Kate Walker, PEECS
Karen Stone, PEECS

- Variability in shoreline in the Pangai stretch of coastline in Ha'apai
- Questioning if TCL had made any engineering stabilisation considerations (Ha'apai)
- Sediment transport is important to consider. Concrete structures must not be constructed on the beach at the LP (Ha'apai)
- Two studies have been done on sediment transport in Lifuka Island, one is PASAP survey – results given to PEECS during meeting
- Coastal Hazard Map of Lifuka (given to PEECS) shows set back area and recommendations for future constructions
- LiDar is 2m or less contour line for vulnerable terrestrial areas (see GIS Department consultation notes) but SOPAC uses distance from shore as their vulnerability boundary which needs to be considered for the building of the BMH. SOPAC advises 140m
- 1.5m trench on the beach needs to carefully analysed by engineer. Questions over whether it is deep enough to account for future erosion
- Marine habitat mapping has been undertaken by SOPAC (provided to PEECS)
- The full PASAP report has yet to be released by the Government of Tonga so JK was unable to furnish consultants with a copy but has advised to email EAC in Ministry of Environment and request permission to receive draft copy (as of writing this assessment, approval has been granted from EAC and PEECS is still awaiting copy of report)
- In the shallow waters (Ha'apai) storm action will be a factor if the cable isn't secured
- Vava'u and Nuku'alofa are straight forward from a geology point of view

WWF South Pacific, Fiji, 18 August 2014
Sally Bailey, Conservation Director
Seremia Turiqi, Fisheries Policy Officer
Kate Walker, PEECS
Karen Stone, PEECS

- Coastal Fisheries: will there be any impact on livelihoods from this project?
- Will the near shore excavations have any lasting impact on the fisheries of Nuku'alofa and Ha'apai – an important thing to address in this assessment
- Questioning if the project will have any impact (direct or indirect) on mangroves
- Levels of EMF need to be assessed for impacts on migratory fish such as tuna
- Whales are an important part of the economy and ecology of Tonga, care needs to be taken to avoid impacts on these species. WDCS will be able to provide expert knowledge

- Would like to see the monitoring and substrate survey data being released for public use
- Assured that no known turtle nesting or foraging grounds will be impacted by project Local knowledge (VEPA) is being sought for this

Whale and Dolphin Conservation Society, Fiji, 19 August 2014
Cara Miller, South Pacific Representative, WDCS
Kate Walker, PEECS
Karen Stone, PEECS

- 200m or shallower is the key water depth for female humpback whales and their calves to be
- National Marine Sanctuary in Hawaii has recently undertaken a similar EIA
- The stop-works requirement referred to in the EIA for phase 1 of the Tonga Cable Project (Fiji to Tonga) is more related to seismic and sonar activities. This phase of the project will not have those elements so it is not considered to be as big an impact
- Beaked whales are more sensitive to noise than HBW and their seasonality seems to match HBW but in significantly lower numbers
- Any planned works in the Tongan Trench would be more of a concern but is not relevant to this project

Marine and Ports, Vava'u, 27 August 2014
Mr F Paha , Officer in Charge of Marine and Port, Vava'u
Kate Walker, PEECS

- Local no-anchoring coordinates were provided for Neiafu harbour
- Moorings would be a good idea for the area just off the LP. Permission needs to be given by Marine and Ports in Nuku'alofa but it shouldn't be a problem.
- Commercial shipping is at the frequency of once per week for the 'Otuanga'ofa, once per fortnight for the Sitka and approximately once per month for the gas ship, Matsons and GPS.
- Coordinate with marine department and shipping agents closer to the time.
- No current plans that he is aware of for upgrades or dredging of the harbour.

Vava'u Environmental Protection Association, Vava'u, 27 August 2014
Karen Varndell, Project Coordinator VEPA
Don Blanks, Chairman VEPA
Kate Walker, PEECS

- Vava'u Environmental Protection Association (VEPA) is a Vava'u based non-governmental association in The Kingdom of Tonga, dedicated to the conservation and sustainable use of Vava'u's natural resources through biodiversity and conservation programs, awareness and outreach and community initiatives.
- Happy that all areas the cable would be placed in Vava'u were areas not identified as biodiversity hotspots and that the cable placement was enough of a distance away from Lotuma Island to not have any adverse impacts.
- VEPA also commented that the landing site at Neiafu, will not have any impact on benthic marine life and the area for the landing site is not an important fishing ground for communities.
- Raised questions about the timeframe for the cable laying and was happy that mitigation and observation methods are included if the cable is to be laid during the prominent humpback whale migratory season of July through October.
- Raised questions about the development on land and increasing potential soil erosion and run off issues that increase sediment into the harbour.
- VEPA was happy that mitigation of soil erosion and run off are included in the EIA.
- Very happy that high speed internet is coming to the islands for socio economic development.

Ministry of Fisheries, Vava'u 28, August 2014
Salika Nguae, Officer in Charge of Fisheries, Vava'u
Kate Walker, PEECS

- SMAs currently exist for Ovaka and Taunga.
- SMAs have been approved for funding from the ADB in Vava'u: Falevai, Hunga, Lape and 'Utungake. None of them are marked yet but it is thought that this will start in early 2015
- The Ministry of Fisheries (in Nuku'alofa) will need to contacted regarding terrestrial trenching works at the Halaevalu Wharf as they are in charge of that area.
- The Vava'u Fishermen Council have been given the management of the eastern end of the wharf and the Ministry has plans to hand the eastern side (including the landing site) to the Council but there is no timeframe on this and it shouldn't impact the project
- Lots of the larger fishing vessels use the slipway at the wharf to store their boats as there are no proper fenders installed along the dock face of the main part of the wharf. If fenders can be installed then the boats won't use the slipway area.
- BMH will not be secured from the public as there is no budget to repair the fencing at the wharf within the Vava'u office Budget. If TCL want to limit access to their BMH, they could consider repairing some of the fencing.
- There is no fishing in the vicinity of the LP
- Wanted to ensure that the cable is laid at sufficient depth and far enough north as not to interfere with slipway access.

Town Officer and PIA Residents, Mount Talau, Vava'u, 28 August 2014
Mr 'Otohalakolo, Town Officer Mount Talau
Salia Falekakala, PEECS
Kate Walker, PEECS

- The residents of all houses surrounding the project site in the Mount Talau area of Neiafu were personally invited and then followed up with by Ms Falekakala, however, none attended the meeting.
- Mr 'Otohalakolo apologized for the invited residents not attending the meeting and offered to speak to them all on our behalf at the next town meeting
- Gratitude was expressed that this project was going to be coming to Mount Talau.
- No problems were anticipated with the construction of a new building at the former Vava'u Club site.
- Mr 'Otohalakolo expressed concern over conversations in the kava circle about whether the new cable would mean that the teenagers would be exposed to lots of inappropriate things on the internet as they thought that access would free for all the children. We were able to reassure Mr 'Otohalakolo that the methods of accessing the internet would remain the same as they are now and that the teenagers would still have to pay for any internet access. He was reassured by this.
- SF followed up with Mr 'Otohalakolo after his meeting with the residents of Mount Talau and was advised that there were no comments or questions and that everyone was fine with the proposed development.

Tonga Whale Watch Operators Association, Vava'u, 1 September 2014
Pat McKee, Secretary TWWOA
Alan Bowe, President TWWOA
Kate Walker, PEECS

- The area along the cable route, to the south east of where the cable enters the main island group is used a lot for whale watching and swimming.
- Whale watch operators are not allowed to conduct operations from the Tu'anuku point and inwards to the harbour, the main shipping channel
- Asking for communications for operations and to advise what the operating distance from the cable laying vessel should be.
- Advance notice will be used to advise their clients (if cable laying is during the season) so they can better plan their days' activities. Especially important for specialist group bookings. People are understanding as long as they are informed
- Duration of operations inshore are very short and it is not anticipated that there will be any problems but communication and advance notice are vital.
- If letter of support from TWWOA is needed then they are happy to provide.

Ministry of Fisheries & Fishing Community, Ha'apai, 3 September 2014
Sosefina Vili, Officer In Charge of Fisheries, Ha'apai
Sailosi'Afoli, Fisheries Officer, Ha'apai
Sateki Launoa, Pangai Fisherman
Palu Siakumi, Pangai Fisherman
Tu'uta Talanoa, Pangai Fisherman
Kate Walker, PEECS

- Sometimes there is pandanus soaking to the north and south of the cable route on the beach but this activity is intermittent and the project won't impact the use of the beach for this (construction or operation)
- The suggestion of putting buoys for the local boats at the beach was met with much enthusiasm. Ms Vili believes that using buoys will make the local mariners understand that this is an important area – it is similar to the way they use buoys for the SMAs and there is already an understanding within the fishing community about this
- Needs to be advance notice communications to advise the local population: communicate through the marine department, the fisheries department and the local FM radio station. Include times and dates of works.
- Sea cucumber fishing happens on the shore in Lifuka but not in the landing site beach due to over harvesting in their area. Closed season for sea cucumber fishing is October to March.
- Diving fishermen tend to fish much further offshore and away from the planned route.
- Most fishermen tend to fish off the seamounts, which the cable route avoids by design.
- The fishermen saw no obvious impact to their industry either in the construction or operation phase of the project
- All respondents spoke in favour of the project coming to Ha'apai.
- Questions asked by the fishermen:
    - Would the cable damage the reefs, as this is important habitat for fish?
    - Will electric shocks be a danger from the cable?

Marine and Ports, Ha'apai, 3rd and 4th of September

Meeting was prearranged for the 3rd but on arrival, the Officer in Charge was unavailable. Rearranged for the 4th, but on arrival the Office in Charge was not available.

Ministry of Environment, Ha'apai
This position does not currently exist in Ha'apai. The office was relocated to Nuku'alofa following Cyclone Ian.

Ministry of Environment, Vava'u, 5 September 2014
Feauini Vaikoso, Officer In Charge of Environment, Vava'u
Kate Walker, PEECS

- FV did not foresee any impacts on the whale population or industry as the project duration within Vava'u waters is very short
- As Lotuma island is potentially going to be part of an SMA in 2015, question whether it was possible to move the cable slightly further away from the reef. Does it have to be that close?
- There are potential for dredging works in the future for the Neiafu harbour entrance as sediments build up on both sides of the channel making it narrower. No known plans or timeframe for this possible work.
- FV trusts that TCL and their architects have looked carefully at the site design for water drainage and landscaping in the new offices. This is a risky area due to the slope and the potential for erosion through rain runoff is high.
- FV recommends good soil retaining plants should be planted on the slope or consider the use of soil retaining engineering like examples in Fiji or Japan.
- Looking forward to the arrival of faster internet and recognises the importance of the project for Vava'u but does not want it to be at the expense of the environment.