Environmental & Social Impact Assessment

Tonga Climate Resilient Transport Project (TCRP)

Ports Infrastructure

FINAL

August 2018

EXECUTIVE SUMMARY

The Government of Tonga is seeking funding from the World Bank for the Climate Resilient Transport Project to facilitate the safe, efficient and sustainable movement of goods and people in the Kingdom of Tonga, whilst strengthening climate resilience of the transport sector. The overall Project addresses rehabilitation of key roading, maritime and airport infrastructure. The focus of this Report however, is the proposed maritime infrastructural Project which includes minor maintenance, dredging and safety repair works in 'Eua (Nafanua Port), Ha'apai (Taufa'ahau Port), Vava'u (Halaevalu Port) and Niuatoputapu (Pasivulangi Port) and channel entrances in Vava'u and Niuatoputapu.

An Environmental and Social Impact Assessment (ESIA) for the Project has been undertaken which assesses the environmental and socio-economic impacts arising from the Project and outlines measures to mitigate these impacts in accordance with Tongan legislation and World Bank safeguard policies.

Key stakeholders and Villages in 'Eua, Ha'apai, Vava'u and Niuatoputapu potentially impacted by the proposed Project were consulted and feedback has been incorporated into mitigation measures.

A number of key issues were identified that need to be resolved in the Project design phase including:

- The requirement to undertake a survey to confirm location and volume of materials to be removed at all sites and identify dredged material stockpile locations to ensure they are located in Government land.
- Undertake quantitative survey of adjacent coral reef communities and baseline water quality surveys for monitoring purposes adjacent to all Port and channel dredging sites particularly in relation to the 'Utulei SMA and the oyster farms in Neiafu harbour, Vava'u.

A range of potential impacts of the Project were identified including the following:

- Disturbance of undersea cable in entrance to Neiafu Harbour Vava'u
- Noise disturbance generated from dredging operations at Ports in 'Eua, Ha'apai, Vava'u.
- Potential impact on movement of subsistence fishers, recreational boating and commercial shipping due to dredging operations.
- Potential impact on coastal resource users where access is restricted to Port facilities during safety improvement works

Overall, all significant adverse impacts can be mitigated through adoption of the following measures:

- Strict adherence to working hours and regular maintenance of all machinery
- Confine activities to as short a period as possible
- Request Port Authorities / Fisheries Authority to advise local fishers of impending works and issue notice to all mariners.
- Implementation of a grievance redress mechanism to address any local community issues that may arise.

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1 Introduction

1.1 Background

The Government of Tonga is seeking funding from the World Bank for the Climate Resilient Transport Project (the Project), to facilitate the safe, efficient and sustainable movement of goods and people in the Kingdom of Tonga, whilst strengthening climate resilience of the transport sector.

The overall Project addresses rehabilitation of key roads, maritime and aviation sector infrastructure. This Report focuses on maritime sector infrastructure Project which includes minor maintenance, dredging and safety repair works in 'Eua (Nafanua Port), Ha'apai (Taufa'ahau Port), Vava'u (Halaevalu Port) and Niuatoputapu (Pasivulangi Port) and channel entrances in Vava'u and Niuatoputapu.

The Ministry of Infrastructure (MOI) are the agency responsible for Project implementation.

Argo Environmental Ltd in association with Landcare Solutions Limited have been commissioned to assess the potential environmental impacts of the Project (see TOR Appendix 1).

1.2 Project Rationale

The Tonga Climate Resilient Transport (TCRT) Project aims to support the transport sector in Tonga by:

- Addressing the infrastructure maintenance backlog in the road, aviation and, in this case, maritime sectors;
- Increasing the resilience of transport infrastructure to climate change and extreme weather events; and
- Ensuring safer and more reliable transport services.

In accordance with the TOR for the TCRT Project, an Environmental and Social Impact Assessment (ESIA) protocol has been adopted and an Environmental & Social Management Plan (ESMP) has been prepared to facilitate the various transport Projects proposed.

1.3 Project Categorisation

The World Bank requires the categorisation of Project under OP 4.01. Based on Project activities, the Project is considered to be Category B on the basis that the impacts will not be irreversible or unprecedented, and mitigation measures can be readily identified. The applicable safeguards policies which are triggered by the Project are OP 4.01 Environmental Assessment and OP 4.04 Natural Habitats.

OP4.12 Involuntary Resettlement is not triggered. There will be no land acquisition required for any project works. If any additional land is required, it will be subject to a negotiated lease arrangement with the land owner.

2 Project Description

2.1 Background

The key proposed maritime activities include minor maintenance, dredging and safety repair works at the following ports:

- 'Eua (Nafanua Port)
- Ha'apai (Taufa'ahau Port).
- Vava'u (Halaevalu Port)
- Niuatoputapu (Pasivulangi Port)

Safety improvement works include repairs to include activities such as sheet pile walls, breakwaters, pavements and concrete capping beams, as well as replacement of fenders and bollards.

Table 2A in Appendix 2 presents the volumes of dredged material for each Port identified by MOI. Figures 2A-2D in Appendix 2 presents excerpts from the marine charts showing proposed dredging locations supplied by MOI. Hydrographic surveys have not been completed and the dredging volume estimates provided by MOI are based on an evaluation of marine chart. This issue is addressed further by way of assessment of potential impacts and mitigation measures (Section 6).

Set out below is further detail relating to the proposed scope of works for each Port.

2.2 'Eua (Nafanua Port)

2.2.1 Port Safety Improvement Works

A series of immediate and future safety improvement works for Nafanua have been recommended[1]. In summary, key immediate works include:

- Installation of moveable traffic barriers.
- Investigate condition of tie-rods and anchor walls to determine whether the sheet pile wall can be repaired.
- Repairs to sheet pile wall on western face including a new concrete capping beam, and installation of Fenders and bollards and a new ladder on the western berth.

The total cost of the works is estimated to be USD$832,000.

2.2.2 Dredging Works

The Marine and Ports Department of MOI propose the following scope of maintenance dredging at Nafanua Port in 'Eua:

- Extraction of between 4,000 m^3 (at a dredging depth of up to 2m depth) and 16,512 m^3 (2-5m depth) of spoil material.
- The material to be dredged is located on the eastern side of Nafanua Harbour (see Figure 2.1) adjacent to the boat ramp and discharge from the adjacent stream.
- For dredging located within the wharf basin an excavator located on the wharf is to be used. For harbour channel excavation the excavator is to be located on a barge.
- Expected total duration of works including mobilization and dredging is expected to be 15 days approximately including 5 days of dredging works.

[1]Cooper D., 2017. Assessment of Maritime Safety Conditions of Ports and Wharves. MOI/AF-MPD/IC-B02.

Figure 2.1: Approximate location of proposed dredging works at Nafanua Port, 'Eua

2.3 Ha'apai (Taufa'ahau Port)

2.3.1 Port Safety Improvement Works

A series of immediate and future safety improvement works for Taufa'ahau Port have been recommended[1]. In summary, immediate works include:

- Repairs to concrete capping beam.
- Filling of void under concrete ramp.
- In-situ painting of existing bollards.
- Replacement of damaged fenders and repairs to ladders and repairs and installation of cap plates on piles on Naval Wharf
- Repair to erosion and extension of rock revetment at outer end of Pier Ramp and existing pavement.
- Repairs to toilets in the passenger area and provision of additional seating.

The total cost of the works is estimated to be USD$535,000.

2.3.2 Dredging Works

The Marine and Ports Department of MOI propose the following scope of maintenance dredging at Taufa'ahua Port in Ha'apai:

- The areas of proposed dredging are located adjacent to the wharf inside the habour and an area of shallows outside the Harbour (see Figure 2.3).
- Extraction of between 2,520 m^3 (to 2m depth) and 65,700 m^3 (to obtain between 2 and 5m depth) of spoil material. The rationale provided for the different volumes is that in order to accommodate deep draft vessels two areas in the entrance to the Harbour must be dredged to a depth of 5m so that the area adjacent to the wharf within the harbour can be dredged to a similar depth.
- Expected total duration of works including mobilization and dredging is expected to be 25 days approximately including 10 days of dredging works.

If the additional berthage option is pursued as part of future works (see Figure 2.2), an area to the north of the existing wharf would require dredging and the material could be disposed in the new reclamation.

Figure 2.2: Location of recommended additional berthage area and reclamation (from Cooper 2017[1]).

Figure 2.3: Approximate location of proposed dredging works at Taufa'ahau, Ha'apai

2.4 Vava'u (Halaevalu Port)

2.4.1 Port Safety Improvement Works

A range of immediate and future safety improvement works for Halaevalu Port have been recommended[1]. In summary, key immediate works include:

- Repairs to concrete capping beam and existing pavements;
- Fill and paint existing bollards and install a new bollard; replace fenders at the international and ferry wharves; and install a new ladder on the International wharf.

The total cost of the works is estimated to be USD$533,000.

2.4.2 Dredging Works

The Marine and Ports Department of MOI propose the following scope of maintenance dredging at Halaevalu Port in Vava'u:

- Extraction of between 9,600-68,950m3 of spoil material from adjacent to the domestic ferry wharf and Galloway Rock located to the West (see Figure 2.4). The rationale provided for the different volumes is that there will be a need to accommodate progressively larger vessels with a deeper draft.
- Expected total duration of works including mobilization and dredging is expected to be 25 days approximately including 10 days of dredging works.

Figure 2.4: Approximate location of proposed dredging works at Neiafu Port, Vava'u

2.5 Niuatoputapu (Pasivulangi Port)

2.5.1 Port Safety Improvement Works

A range of immediate and future safety improvement works for Pasivulangi Port have been recommended[1]. In summary, key immediate works include:

- Fill void at south-eastern corner of wharf;
- Replace existing bollards and install new fenders;
- Repair passenger shed and install light poles on wharf and causeway.

The total costs of the works are estimated to be USD$160,000.

2.5.2 Dredging Works

The Marine and Ports Department of MOI propose the following scope of maintenance dredging works at Pasivulangi in Niuatoputapu:

- Extraction of between 4,000-16,000m^3 of spoil material in the channel entrance (see Figure 2.5).
- Once equipment has been secured it is likely that works will commence late 2018.
- Expected total duration of works including mobilization and dredging is expected to be 40 days approximately including 10 days of dredging works.

Figure 2.5: Approximate location of proposed dredging works in the channel entrance to access Pasivulangi Port, Niuatoputapu

2.6 Nuiafo'ou (Futu Port)

2.6.1 Port Safety Improvement Works

A range of immediate and future safety improvement works for Pasivulangi Port have been recommended[1]. In summary, key immediate works include:

- Undertake repairs to the wharf embankment; and
- In-situ painting of existing bollard and install new ladders.

The total cost of the works are estimated to be USD$124,000.

2.7 Additional Port Works Methodology

Dredging and Port safety improvement works methodology that is consistent across all Ports includes:

- Excavated material is to be stockpiled on land adjacent to the Wharf for reuse in areas of the wharf requiring repair with excess material being made available for use by the general public. The exact location is unknown at this stage but MOI have indicated it will be on Government owned land.
- MOI will either hire all the required equipment for the dredging proposed work or purchase the equipment (except for vessel required to tow the barge and the truck required to transport excavated material).
- Small work force requirements due to the nature of the dredging works proposed with the majority travelling with the equipment and barge from Tongatapu.
- Possible need for local unskilled labour for Port safety improvement works. By providing paid employment, even for a short duration, would assist with alleviating local unemployment.

Any non-resident individuals required for the workforce would be housed in existing accommodation.

2.8 Timing / Expected Duration of Works

Timing and expected duration of works are unknown at this stage and are dependent on the requirements of MOIs contract with the Contractor. The Contractor will need to take into account seasonal issues such as cyclone season (detailed in Section 4.2.2.) particularly with any inter-island crossings of a barge that may be required.

Normal working hours are Monday to Friday, 7am to 6pm. Works outside of these hours will require permission from MOI and notice to affected parties and the public at least one week prior to work commencing.

Work on a Sunday (Sabbath Day) is not permitted (as protected in the Constitution of Tonga) and any requirements to work on a Sunday (e.g. emergency works) will require special approvals.

2.9 Alternative Methodologies

The Ports are existing infrastructure which requires improvements to ensure continued operation and to be more climate resilient.

The design approach and methodology for Port safety improvements are outlined in a Report undertaken to address these issues[1], and summarised in the previous Section, with a series of recommendations made. It is considered likely that this is the most cost effective and practical approach.

For dredging works, alternative methodologies are available (e.g., using a cutter suction dredge based in Fiji) but the current proposed method (excavator and barge) is considered the most cost effective and practical approach.

Overall, the preliminary designs and proposed construction methodology upon which this impact assessment is based, have been selected on the basis that they present the most effective use of natural resources and labour in order to minimise potential impacts on the local environment and community.

3 Environmental Policy, Legal & Administrative Framework

3.1 Environmental Regulatory Framework

Tonga has a well-established regulatory framework that provides measures to protect and preserve the environment from abuse, pollution and degradation, to manage the environment for sustainable development and to promote environmental awareness.

Legislation concerning the protection and preservation of the environment is found in a number of Acts and is the responsibility of a number of different Ministries according to their focus. Amongst these, are the following key legislations:

- Environmental Impact Assessment Act 2003 and Environmental Impact Assessment Regulations 2010
- Environmental Management Act 2010
- Marine Pollution Prevention Act 2002
- Parks and Reserves Act 1988
- Fisheries Management Act 2002
- Aquaculture Management Act 2003
- Birds and Fish Preservation Act 1988
- Public Health Act 1992

The Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) is the principal agency responsible for the management of the environment, and in administering environmental-related legislation in Tonga. It provides environmental assessments, reports and recommendations to the responsible Ministry, as well as being mandated under the Environmental Impact Assessment Act 2003 and the EIA Regulations 2010 to require environmental impact assessments and impose conditions for development projects within Tonga.

Accordingly, activities funded under the TSCP will follow the GOT's established procedures and associated guidelines established under the Environmental Assessment Act 2003, and environmental legislation of the relevant Ministry.

3.2 Environmental Approvals Framework

In broad terms, the environmental approval framework in Tonga involves:

- Land acquisition and lease approval (Ministry of Lands and Natural Resources "MLNR")
- Building Permit approval (Ministry of Infrastructure "MOI")
- Environmental approval ("MEIDECC").

The application process is summarised Figure 3.1.

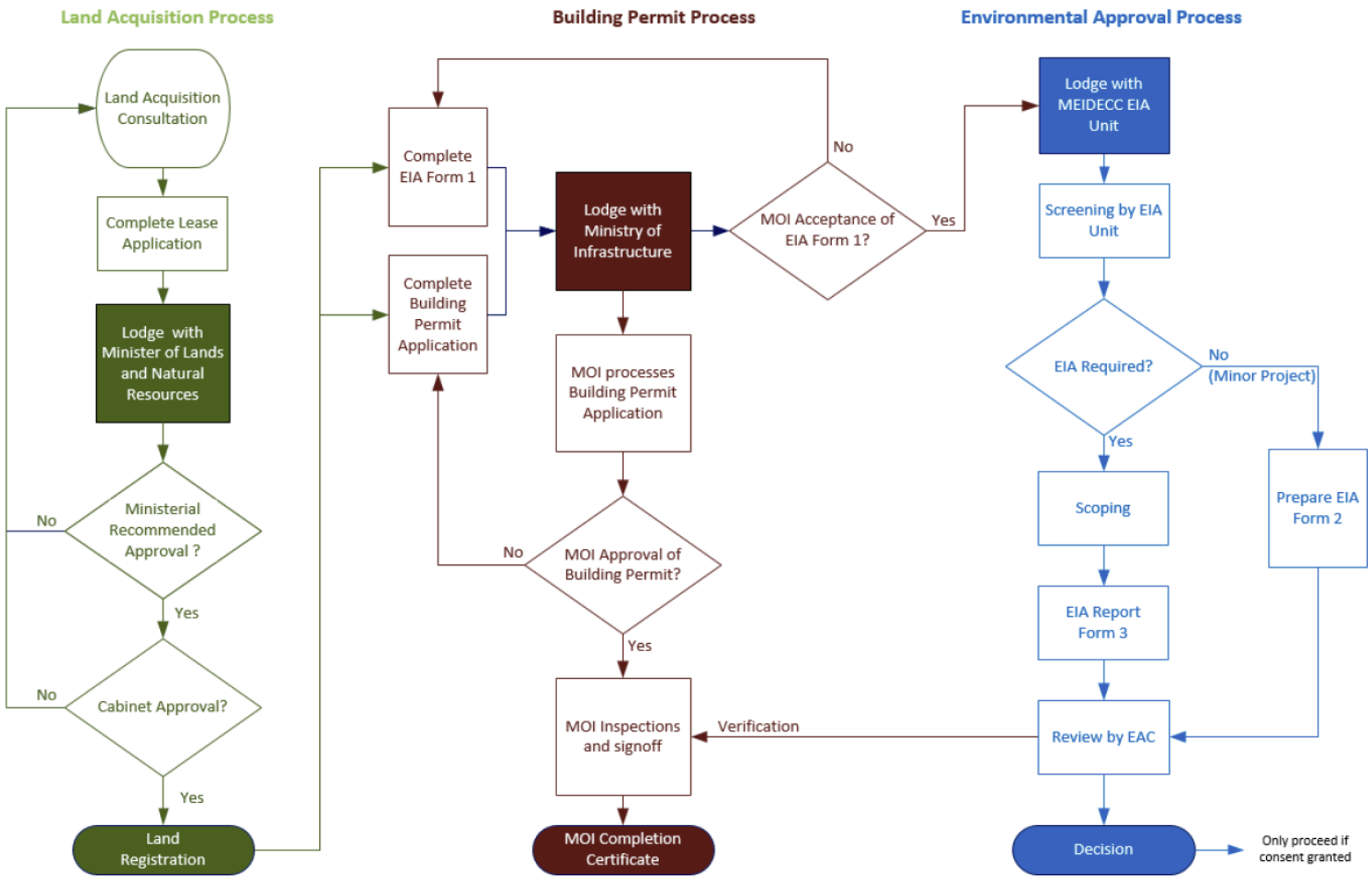

Figure 3.1: High level linkages between the three main environmental approval elements

3.3 Environmental Approvals Process

3.3.1 Introduction

Proposals for **all** development activities must be notified to the Minister of Environment, Information, Disaster Management, Energy and Climate Change for approval under the Environmental Impact Assessment Act 2003 and Environmental Impact Assessment Regulations 2010.

The Secretariat and the Minister determine whether the proposed development is a "minor" or a "major" project, and this determination is to be advised to the proponent within 30 days. Proponents of major projects are required to submit a full Environmental Impact Assessment for review by the Secretariat. If the Project is deemed to be a minor project, approval is granted with or without conditions and the Project may proceed.

The broad environmental approval process is summarised in Table 3.1 and Figure 3.5.

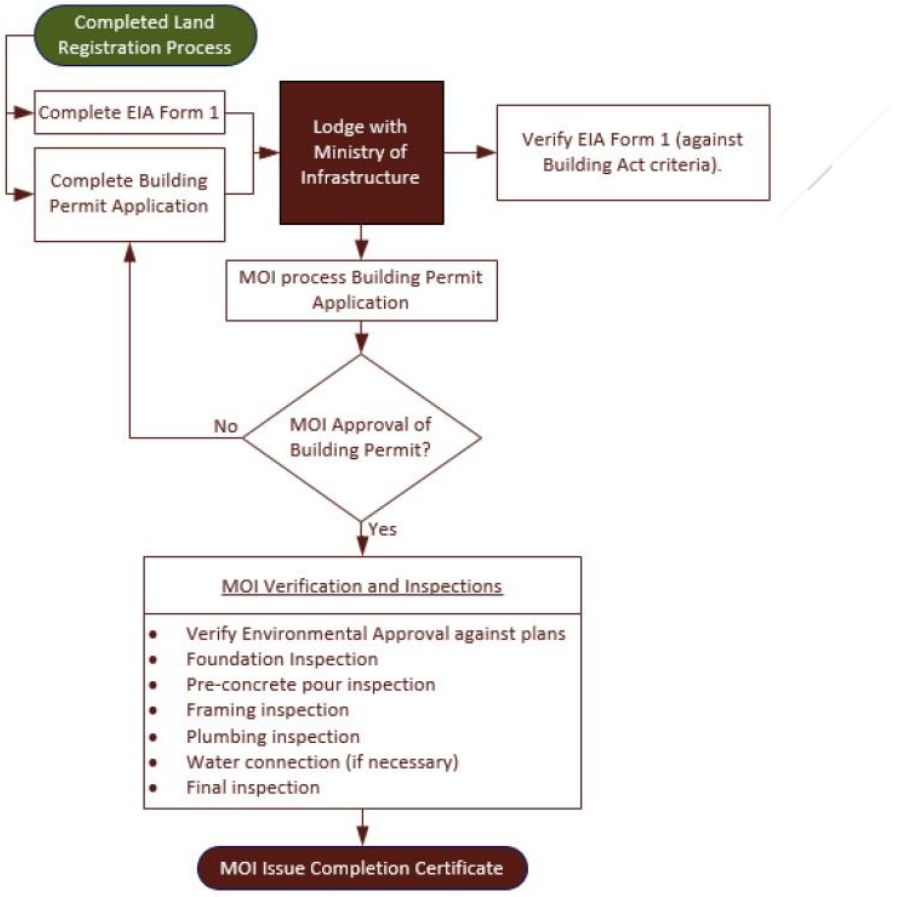

Figure 3.4: Ministry of Infrastructure overview of approval pathway

3.3.2 Application and Initial Evaluation Phase

Submission of Application to EIA Unit

Proposals for **all** development activities when notified to MEIDECC must include a completed "**Form 1**" as set out in Schedule 1 of the Regulations. The Secretariat and the Minister use Form 1 to determine whether the proposed development is a "minor" or a "major" project, and they are required to advise the proponent of this determination within 30 days.

If Proponents don't need any other permits the completed Form 1 may be delivered directly to the EIA Unit at the Environment Office of MEIDECC[2]. The EIA Unit will check that the correct form has been used.

However, most RE development activities would require a building permit from the Ministry

[2] Vuna Rd, Nuku'alofa, Tonga

of Infrastructure (MOI) in which case the Form 1 would also be lodged with MOI,

Delivering the application to the EIA Unit involves two steps.

1. Delivering the application to the EIA Unit at the Environment Office. The EIA Unit will check that a Form 1 is attached to the building permit application.
2. Paying the $10 registration fee to the EIA Unit at the Environment Office. They will issue a receipt, and keep a photocopy of the receipt for their records. MEIDECC will not process the application until the fee has been paid.

Initial Screening Phase – MEIDECC EIA Unit

An initial screening evaluation is undertaken during consideration of the completed Form 1 provided pursuant to Schedule 1 of the EIA Regulations 2010. The main purpose of Form 1 is to help the Minister determine whether a project should be dealt with as a Minor or Major Project.

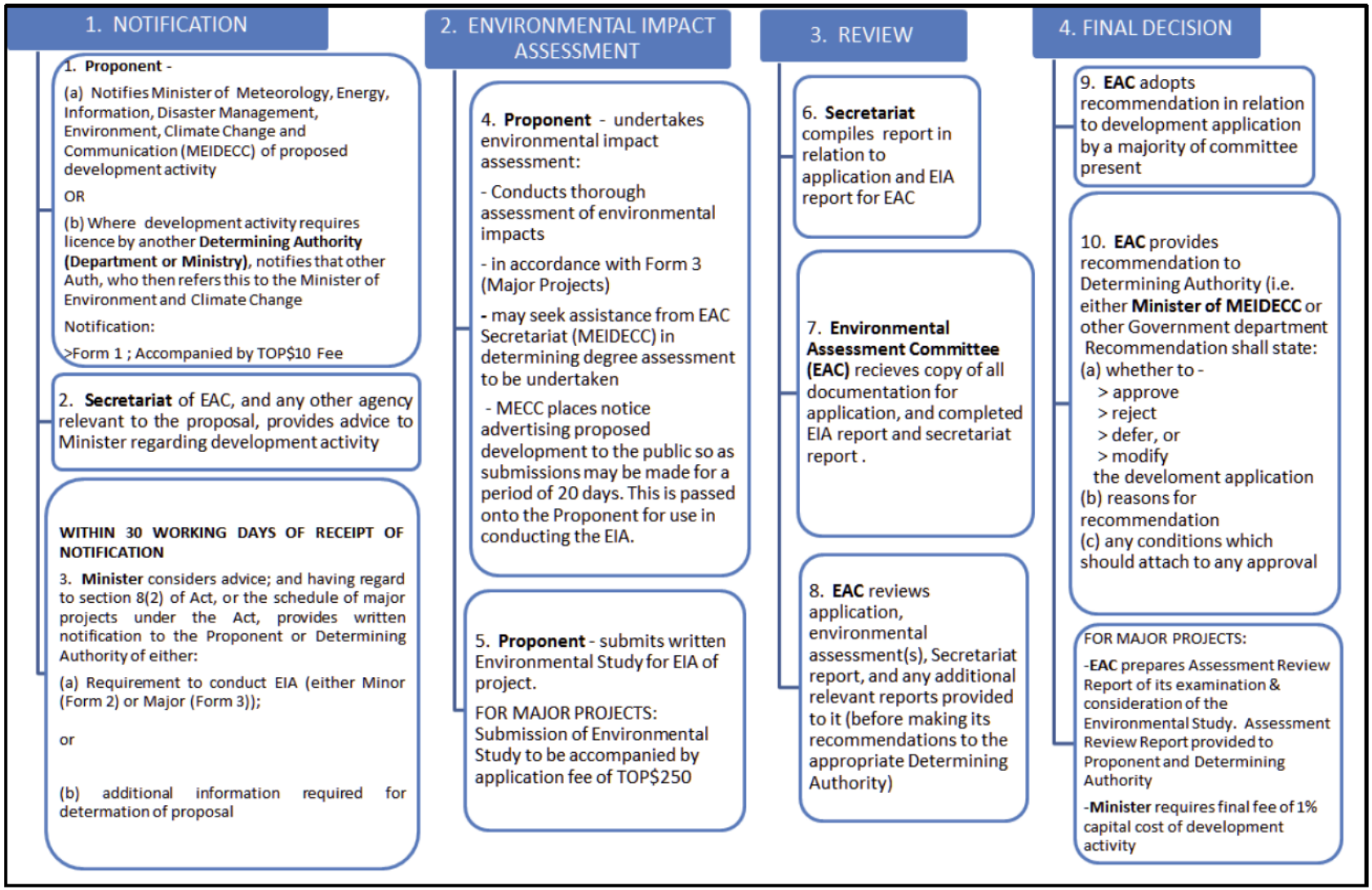

Table 3.1: Environmental Approval Process Detailed Overview

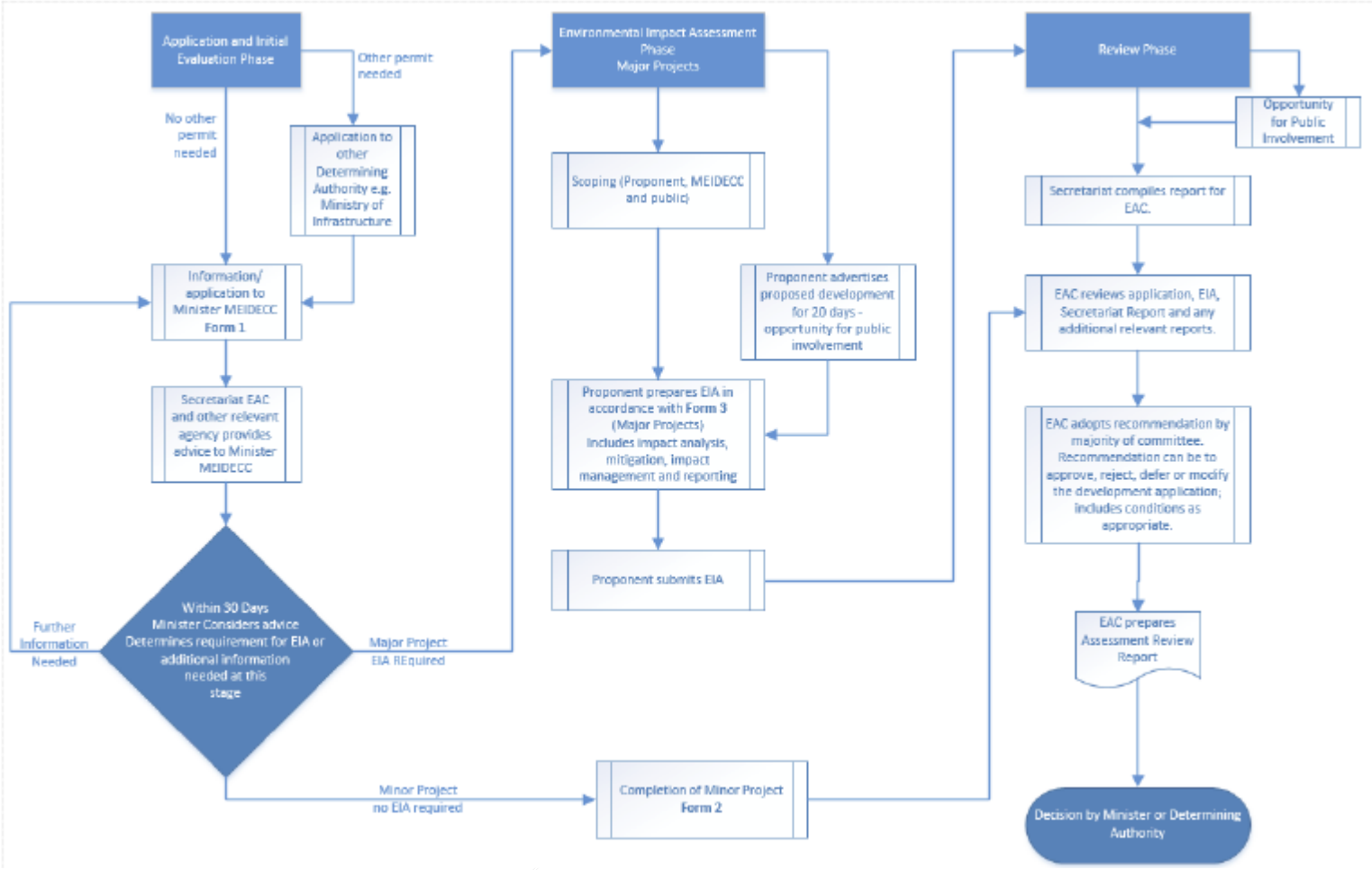

Figure 3.5: Environmental Approval Process Detailed Flowchart

3.3.3 Determination of Major or Minor Project Status

Once the EIA Unit has received the completed Form 1 it is assessed against the criteria in the EIA Act and EIA Regulations to determine whether the development activity is a minor or major project.

The Schedule in the EIA Act classifies a range of transport-related activities as Major Projects including:

(c) buildings, works, or land associated with the landing, take-off, parking or servicing of aircraft or helicopters;

(l) sand or gravel extraction from any beach within 50 metres of the high tide mark;

(r) construction of roads, wharfs, barrages, embankments or levees which affect the flow of tidal waters;

If the project is a Major Project, MEIDECC will issue a Form 3 and explain the next steps of the EIA process to the Proponent. If it is a minor project, the Minister will issue a Form 2.

For a major project, the proponent is required to submit a full Environmental Impact Assessment for review. The Minister subsequently issues an approval (with or without conditions), a request for further information, or a rejection.

For a minor project, approval is granted with or without conditions and the Project may proceed, usually under the provisions of an Environmental Management Plan ("**EMP**") which is binding on the Proponent. The EMP will address environmental management and protection measures and will be specific to the development under consideration.

3.3.4 EIA Preparation Phase - Major Projects

If the Project is defined as a Major Project or if the Minister otherwise so directs based on a risk assessment, the proponent will need to conduct an EIA in accordance with Form 3 (Major Projects) of the Regulations. The purpose of the EIA is to assess potential significant environmental issues associated with a project, and to develop appropriate methods to resolve those issues.

Preparation of the EIA is the responsibility of the Project Proponent.

The EIA element of the process involves a Scoping Phase and a Preparation phase both undertaken by the proponent in collaboration with regulators and other parties as necessary. The comprehensive initial screening undertaken during preparation of the Form 1 appraisal will inform this Scoping exercise and will greatly streamline this stage of the process.

Scoping identifies existing sources of data, key individual contacts and important areas of field study. It increases local, regional and national awareness of the project, its environmental concerns and facilitates rapid data collection and analysis.

The findings of the scoping exercise (i.e. information recorded in the scoping checklist) provide a list of potential environmental issues, which should be considered and assessed in detail in the subsequent EIA.

EIA Regulation 12 sets out factors to be taken into account by the Minister and the Secretariat when considering the likely impact of an activity upon the environment, including provision of an environmental management plan.

Minor Projects – Environmental Management Plan

Minor projects are not required to provide an EIA and are approved with or without conditions.

Major Projects – Environmental Management Plan

This ESIA incorporates an Environmental and Social Management Plan (ESMP) for each component in partial fulfilment of the requirements of the Act.

3.4 Other Applicable Legislation

3.4.1 Aquaculture Management Act 2003

This Act allows for the designation of areas for aquaculture management and may also declare any associated development buffer zones.

The PIA for this Project is not proximal to any areas designation for aquaculture management.

3.4.2 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.

The Tongatapu Lagoon is the only defined protect area within the Act which does not fall within the PIA for this assessment. The listed protected species are not recorded as occurring within the PIA and therefore compliance is assured.

3.4.3 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, for processing and export of fisheries resources, for the conservation of fisheries resources and the designation of SMAs. The Project is anticipated to be in compliance with this Act.

3.4.4 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.

3.4.5 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.

3.4.6 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 the marine reserves or parks are within the PIA (see Section 4.1 for further detail).

3.4.7 International and Regional Policies

Convention on Biological Diversity (CBD) (1998)

The CBD is a multilateral treaty with three goals:

- Conservation of biodiversity
- Sustainable use of its components, and
- 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.

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.

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.

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.

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:

- 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.
- 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.
- 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.
- 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.
- 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 co-operation with other countries.

3.5 World Bank Safeguards Policies

3.5.1 Introduction

This ESIA is based on the following World Bank ["WB"] Operational Policies ["OPs"][3]. The

[3] https://policies.worldbank.org/sites/ppf3/Pages/Manuals/Operational%20Manual.aspx

WB Environmental and Social Framework 2017[4] has not been applied as it is not yet in force.

Environmental and Social Policies

OP 4.01 Environmental Assessment

OP 4.04 Natural Habitats

OP 4.10 Indigenous Peoples does not apply to this Project – indigenous peoples are broadly defined as "*distinct, vulnerable, social and cultural group attached to geographically distinct habitats or historical territories, with separate culture than the project area, and usually different language*". This definition does not apply to the Tongan situation.

OP 4.11 Physical Cultural Resources (PCR)* does not apply as the Project involves works to existing infrastructure

OP4.12 Involuntary Resettlement does not apply.

The relevant WB Policies OP 4.01 and OP 4.04. These policies are addressed further below.

3.5.2 Operational Policy 4.01 – *Environmental Assessment*

The WB requires an Environmental Assessment (EA) of Projects proposed for WB financing to ensure they are environmentally sound and sustainable, thereby improving decision-making.

OP 4.01 classifies the proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts:

Category	Status
A	Likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented.
B	Potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.
C	Likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.
FI	Involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

The Project, assessed as a Category B Project, with this ESIA presenting information on the following matters identified in OP 4.01:

- measures to prevent, minimise, mitigate or compensate adverse impacts (Section 6),
- public consultation and disclosure as part of the EA process (Section 5) and
- an Environmental and Social Management Plan (ESMP) (Section 7).

3.5.3 Operational Policy 4.04 – /

OP 4.04 Natural Habitats 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. No such significant habitat effects are identified in relation to the Project, but there remains the possibility of low to medium level adverse impacts on the marine environment and therefore consideration is given to the requirements of OP 4.04.

The policy requires the EA to identify impacts on biodiversity and species; to determine project

[4]http://documents.worldbank.org/curated/en/383011492423734099/pdf/114278-WP-REVISED-PUBLIC-Environmental-and-Social-Framework.pdf

impacts on these species; and to propose acceptable mitigation and monitoring measures. These matters are addressed in Section 6.2 of this ESIA.

4 Description of the Environment

4.1 Introduction

This section provides information on the physical, biological and socio-economic elements of the environment, which forms the baseline dataset that can be used as benchmarks for any potential future monitoring requirements. Where site-specific information is available, this has been presented, otherwise Tonga-wide data has been referred too.

The area considered for assessment of baseline conditions (the "Project Influence area" or "PIA") consists of the marine environment in and immediately adjacent to the proposed dredging works.

The PIA is defined through consideration of the project footprint including all ancillary project components and potential impacts on environmental, economic and social resources.

Table 4.1 outlines the guidelines that have been followed to determine the PIA for the Project which is based around a precautionary approach. All data was obtained by desktop study and a field survey conducted in May and June 2018.

Table 4.1: Project influence areas delineations and conditions

Environment	PIA
Important Species Habitat	Coastal reef/mangroves areas in close proximity to dredging areas
Inshore & Coastal Waters (<1nm from coastline)	Assuming a precautionary approach, a 250m corridor either side of the dredging areas has been adopted

4.2 General Environmental Description

Tonga is an archipelago located directly south of Samoa and about two-thirds of the way from Hawaii to New Zealand. Consisting of 169 islands, 36 of them inhabited, Tonga is divided into three main groups Tongatapu, Vava'u and Ha'apai which lie approximately 800 km north to south (see Figure 4.1).

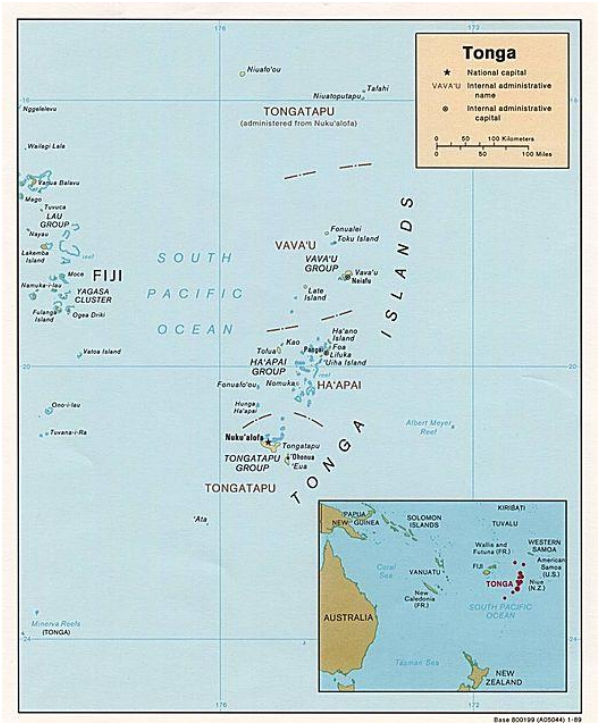

Figure 4.1: Location of Tonga and island groups in the Kingdom of Tonga.

Geologically the Tongan islands are of two types: most have a limestone base formed from

uplifted coral formations; others consist of limestone overlaying a volcanic base.

4.3 Physical Environment

4.3.1 Climate

The climate is tropical with a distinct warm period (December–April), during which the temperatures rise above 32°C and a cooler period (May–November), with temperatures rarely rising above 27 C. Between Tongatapu in the south and the more northerly islands closer to the Equator, temperatures increase from 23 to 27 C and the annual rainfall from 1,700 to 2,970 millimetres. The average wettest period is around March with on average 263 mm. Average daily humidity is 80%.

Cyclones

Cyclone season is from November to April. In the 25 year period between 1989 and 2014, 19 cyclones tracked through the Tonga group of islands with 13 of those making landfall: 10 in Ha'apai, two in Vava'u and one in Tongatapu. Typically, the paths of cyclones are from the northwest, moving in a south-easterly direction (Figure 4.2).

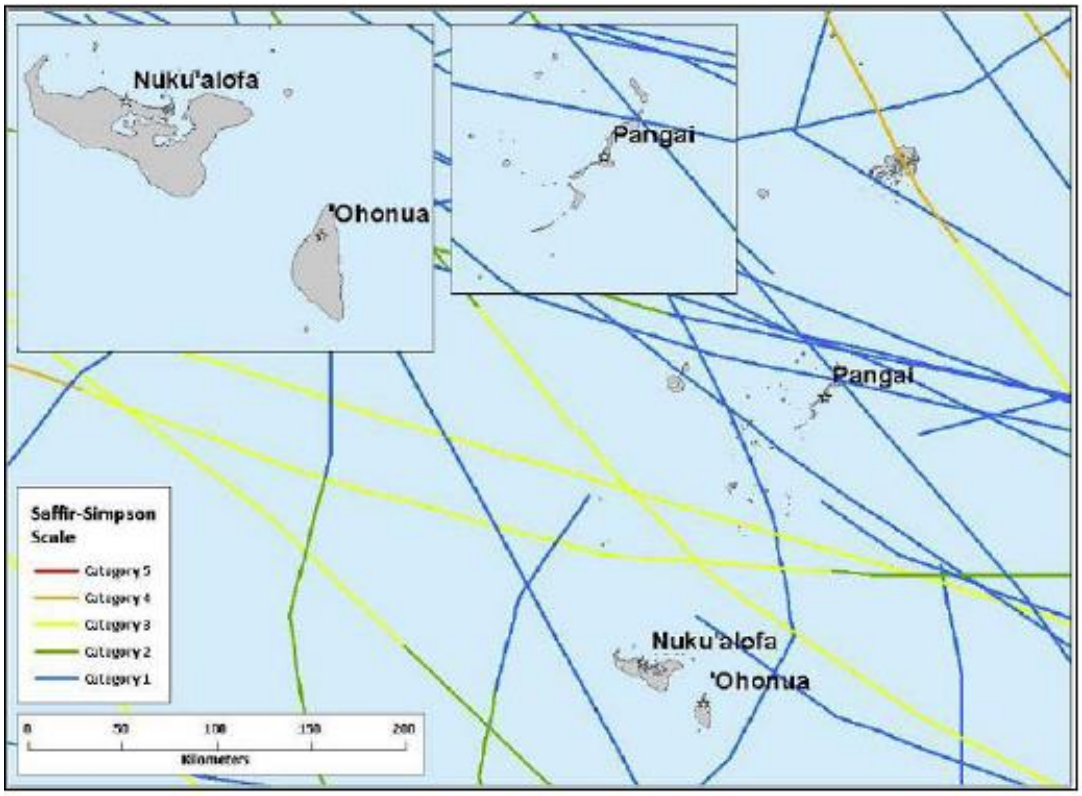

Figure 4.2: Category 3 and higher cyclone activity in Tonga 1945 – 2008[5]

Tides

The astronomical tide is a mixed, dominant semi-diurnal type with high water levels alternately higher and lower than the average (high water level). Mean spring tide range is around 1.1 m, maximum spring tide range approximately 1.5 m, and mean neap range around 0.6 m.

Tide ranges and high tide levels vary over different timeframes (e.g. daily, two weekly Spring-Neap tide, 7 month perigean-spring cycle). Longer-term cycles also influence tide range and magnitude of the highest tide. Of particular relevance is the 8.85 year complete cycle of the lunar perigee which influences high tides on a 4.4 year cycle.

Tide levels (and hence the level of the sea observed at any one time) can be also be elevated

[5]World Bank 2008. Pacific Catastrophe Risk Financing Initiative, Country Risk Profile: Tonga . Boston, MA: Air Worldwide on behalf of World Bank, SOPAC and GFDRR.

(or lowered) by other factors, the most significant in the Pacific is the ENSO cycle: During El Niño phases sea levels are pushed down (resulting in lower high tide levels), and conversely during La Niña phases sea levels are pushed up (resulting in higher high tide levels). However, the influence of ENSO on mean sea level variability is not as pronounced as in the Pacific Islands further west with variability in mean sea levels tending to be less than 0.15 m.

4.3.2 Climate Change

The IPCC Fifth Assessment Report[6] provides broad scale climate change projections for the Pacific region. A more detailed assessment of past and potential future climate change was carried out for the region[7]. The key points are as follows:

- Surface air temperature and sea surface temperature are projected to continue to increase (very high confidence). Annual mean surface temperatures are expected to be between 0.5° to 1°C higher by 2030 relative to 1990 and by 1°C to 2°C depending on emission scenario by 2055.
- The intensity and frequency of days of extreme heat are projected to increase (very high confidence).
- Annual and seasonal mean rainfall is projected to increase (high confidence). Increases in annual mean rainfall are projected to be most prominent near the SPCZ, with widespread increases in the number of heavy rain days (20-50 mm).

A number of projections however, suggest that islands located near the eastern edge of the SPCZ, such as Tonga, may become drier in the wet season as the trade winds in the south-east Pacific become stronger. There is also some suggestion of a shift towards the equator of the SPCZ in the dry season (May to October), which could increase mean rainfall during these months. In addition:

- The intensity and frequency of days of extreme rainfall are projected to increase (high confidence), for example rainfall events that occur on average once every 20 years are generally simulated to occur four times per year by 2055 (high emission scenario).
- Tropical cyclone numbers are projected to decline in the south Pacific sub-basin but with an increase in the proportion of more intense storms by the late 21st century. The occurrence of tropical cyclones affecting Niue will still be closely linked to the occurrence of periods of El Niño which will have a much more dominant influence on the cyclone occurrence than potential gradual changes in long-term average cyclone activity due to climate change.

Sea-level Rise

The rate of rise of sea levels across the globe is far from uniform. In some places, notably the western Pacific, sea levels have been rising rapidly (> 10 mm a year in some places), in others it has fallen. Since 1993 these regional differences have been measured by satellite (Figure 4.8). Tonga is on the edge of the area in the western Pacific that has experienced large rates of sea-level rise over the period of satellite recording period.

Over the longer term it is expected that sea-level rise over this last century around Tonga will have been close to the global average of about 0.19 m between 1901 and 2010.

Sea levels will continue to rise primarily because of thermal expansion within the oceans and loss of ice sheets and glaciers on land. Even if greenhouse gas emissions were stabilised today, sea levels would continue to rise. Sea levels to about 2050 are relatively insensitive to changes in emissions over this timeframe because of the time it takes the oceans to respond to changes in carbon dioxide and atmospheric temperatures, but future changes and trends in emissions become increasingly important in determining the magnitude of sea level rise beyond 2050.

[6] IPCC, 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.
[7] Australian Bureau of Meteorology & CSIRO, 2011. Climate change in the Pacific. Scientific assessment and new research. Volume 1: Regional overview.

The rate of global mean sea level rise during the 21st century is expected to exceed the rate observed during 1971–2010 due to increased ocean warming and loss of mass from glaciers and ice sheets[10]. For the period 2081–2100, compared to 1986–2005, global mean sea level is likely to be between 0.26–0.54 m for the lowest emission scenario considered (Representative Concentration Pathway scenario, RCP2.6) to between 0.45–0.81 m for the highest emission scenario (RCP8.5) (Figure 4.9).

High tides and extreme sea levels are likely to increase close to the same rate as mean sea-level rise in Niue. There is nothing obvious to suggest that storm surge has increased in magnitude or frequency or will do so within the next one to two generations (30 - 50 yrs).

Long-term sea-level rise will continue to push sea levels higher resulting in high tide levels increasingly exceeding what may be presently considered extreme or king- tide level.

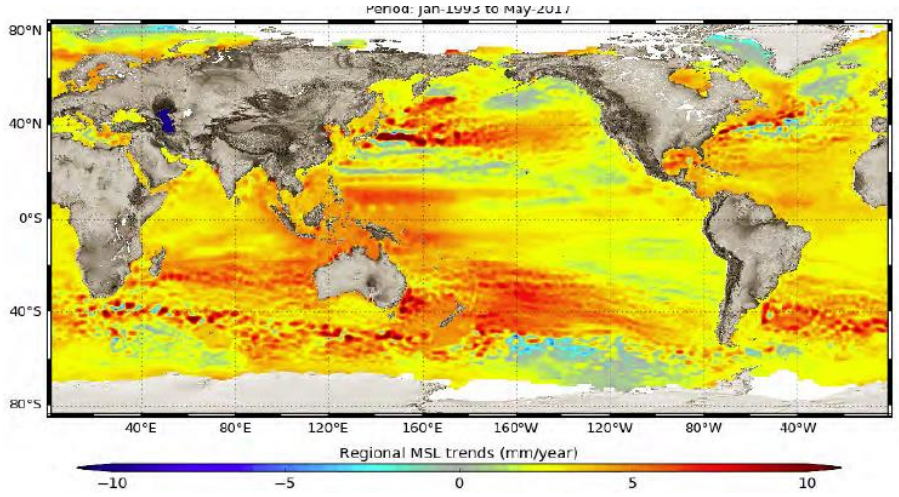

Figure 4.8: Global distribution of the rate of absolute sea-level rise between January 1993 and May2017 from satellite altimeter data. Source: https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html

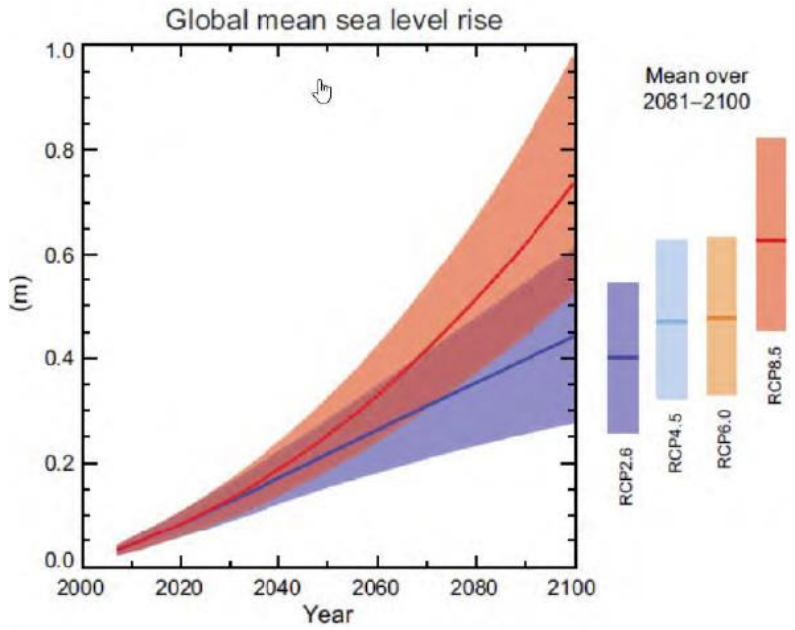

Figure 4.9: Projected global mean sea-level rise to 2100 relative to the average mean sea level between 1986 to 2005 for the four future scenarios presented in the Intergovernmental Panel for Climate Change Fifth Assessment Report (IPCC, 2013).

4.3.3 Coastal Hazards

Tides

The astronomical tide is a mixed, dominant semi-diurnal type with high water levels alternately higher and lower than the average (high water level). Mean spring tide range is around 1.1 m, maximum spring tide range approximately 1.5 m, and mean neap range around 0.6 m.

Tide ranges and high tide levels vary over different timeframes (e.g. daily, two weekly Spring-Neap tide, 7 month perigean-spring cycle). Longer-term cycles also influence tide range and magnitude of the highest tide. Of particular relevance is the 8.85 year complete cycle of the lunar perigee which influences high tides on a 4.4 year cycle.

Tide levels (and hence the level of the sea observed at any one time) can be also be elevated (or lowered) by other factors, the most significant in the Pacific is the ENSO cycle: During El Niño phases sea levels are pushed down (resulting in lower high tide levels), and conversely during La Niña phases sea levels are pushed up (resulting in higher high tide levels). However, the influence of ENSO on mean sea level variability is not as pronounced as in the Pacific Islands further west with variability in mean sea levels tending to be less than 0.15 m.

Any changes in tide levels as the results of changing climate could potentially affect the Port facilities as a result of an increase in tidal inundation.

Sea Level Rise & Erosion

The impacts of sea level rise and erosion has been investigated previously[8] for Lifuka in Ha'api. It is likely that similar issues will be experienced for the other islands.

An analysis of satellite images for the last four decades has shown that the Pangai shoreline has receded at an average rate of 0.7 m/year, with localised rates as high as 1.4 m/year. Erosion intensified after 1982, when a jetty in the current Port area consisting of concrete piles and timber decking was replaced by a stone causeway and ramp. Coral heads in the area were also blasted to provide a swing basin. The present Pangai Harbour and breakwater were completed in 1996 which has interrupted the natural longshore sediment drift and appears to have contributed to the erosion south of the harbour.

In terms of the effects of sea-level rise on the Taufa'ahau Port facilities at Pangai by 2111 it is possible that the sea level will approach the level of the wharf's surface at high tide with a mean sea level that is 1.2 m higher than it is today. At present, under extreme tropical cyclone conditions, Pangai wharf can be flooded (Figure 10).

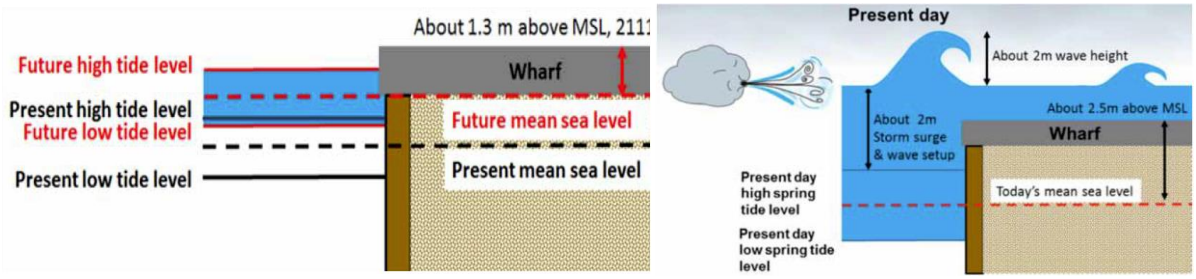

Figure 4.10: Envelope of tidal levels by 2111 (left) and present day effects of an extreme tropical cyclone storm seas (right)

Tsunami

A tsunami is a series of 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.

A tsunami in 2009, the most recent to affect the Tongan archipelago, was generated by an 8.1 magnitude earthquake located within the Samoan Islands which sent three 6m high waves towards Tonga (Figure 4.11). The majority of the damage in Tonga was experienced in Niuatoputapu.

[8]Kruger and Damlamian 2014. Coastal hazards. Section B: Mapping the resources. SOPAC.

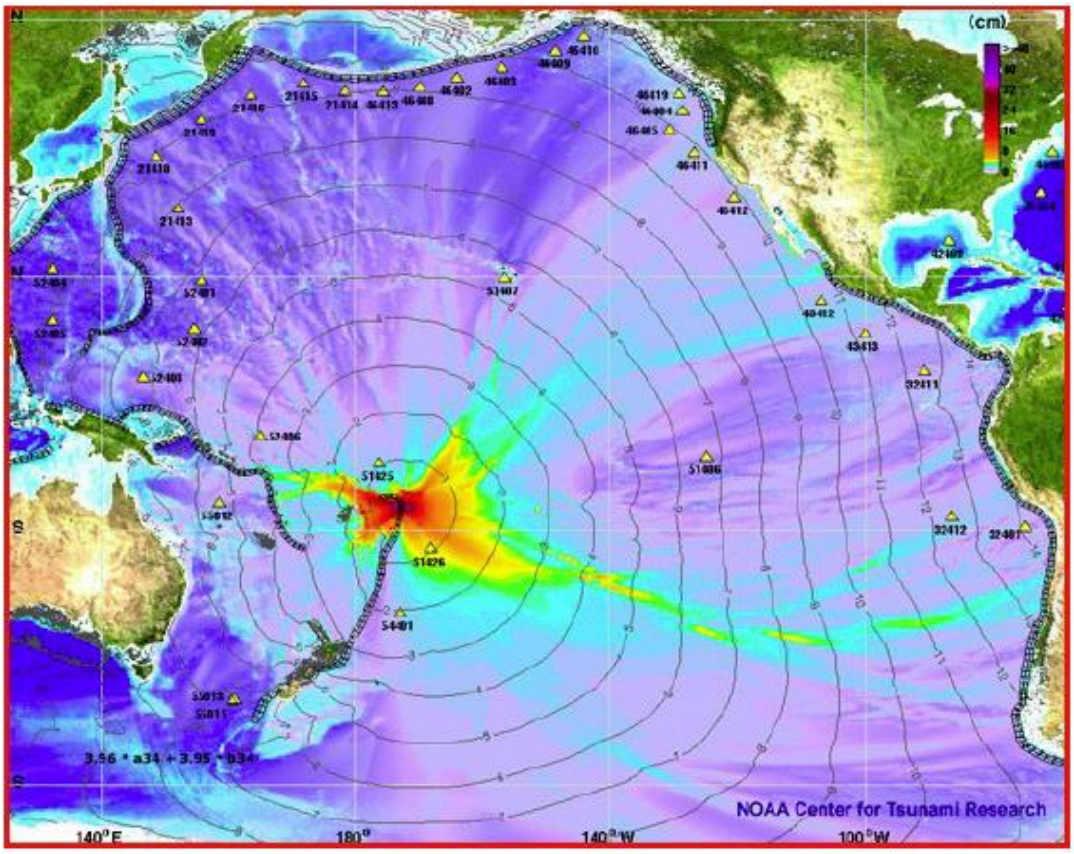

Figure 4.11: 2009 tsunami wave height and travel time[9].

4.4 Marine Ecology

4.4.1 Intertidal & Subtidal Ecology

A qualitative assessment of the marine ecological resources adjacent to the TCRP Port sites in Tonga has been undertaken and is provided in Appendix 3. This assessment is based on site investigations undertaken in June 2018. In summary, the key points to note are as follows:

- Habitat in and immediately adjacent of the Ports of 'Eua, Ha'apai, Vava'u and channel in Niuatoputapu typically consists of: coral aggregate and sands in the deep water directly adjacent to the wharfs; intertidal and subtidal reef flats with robust coral communities; and the reef slope and sands of the deeper sea floor. The Port in 'Eua has a build-up of deposited sediment in the western part of the harbour. Galloway Rocks in Vava'u consists of coral outcrops across the sandy bottom.
- Generally, the habitat encountered is populated with a range of species that are adapted to the less than ideal conditions (i.e., high suspended solids or wave energy) that prevail in these locations.
- Apart from the Utulei SMA in Vava'u which is located directly adjacent to the proposed dredging location at Galloway Rocks and within the PIA, and the oyster farm in Neiafu Harbour no areas particular significance were identified.
- Water quality conditions at the time of the site visits are typically within ANZECC (2000) default trigger values for inshore marine waters.

4.4.2 Marine Mammals

[9] NOAA Centre for Tsunami Research.

A total of 16 species of marine mammal have been recorded within the Tongan EEZ[10] (see Table 4.1) the majority of which have been confirmed in field (or specimen) records.

The majority of research effort to date to determine the abundance and distribution of cetaceans in Tonga has been conducted in Eu'a (located approximately 20km south east of Tongatapu) and Vava'u (located approximately 280km north east of Tongatapu) reflecting the fact that the larger cetaceans are migratory animals are primarily located typically between mid-August to mid-September.

Table 4.1: Tongan cetacean species records and IUCN conservation status

Common Name	Scientific Name	Class	Status
Minke whale	*Balaenoptera acutorostrata*	1	LC (Pop trend: stable)
Humpback whale	*Megaptera novaeangliae*	1	LC (Pop trend: increasing)
Melon-headed whale	*Peponocephala electra*	1	LC (Pop trend: unknown)
Pygmy killer whale	*Feresa attenuata*	1	LC (Pop trend: unknown)
Short-finned pilot whale	*Globicephala macrorhynchus*	1	DD (Pop trend: unknown)
Risso's dolphin	*Grampus griseus*	1	LC (Pop trend: unknown)
Orca	*Orcinus orca*	1	DD (Pop trend: unknown)
False killer whale	*Pseudorca crassidens*	1	DD (Pop trend: unknown)
Pantropical spotted dolphin	*Stenella attenuat*	1	LC (Pop trend: stable)
Spinner dolphin	*Stenella longirostris*	1	DD (Pop. trend: unknown)
Bottlenose dolphin	*Tursiops aduncu*	1	DD (Pop trend: unknown)
Blainville's Beaked Whale	*Mesoplodon densirostris*	-	DD (Pop trend: unknown)
Ginkgo Toothed Beaked Whale	*Mesoplodon ginkgodens*	-	DD (Pop trend: unknown)
Hector's Beaked Whale	*Mesoplodon hectori*	-	DD (Pop trend: unknown)
Fraser's Dolphin	*Lagenodelphis hosei*	-	LC (Pop trend: unknown)
Sperm whale	*Physeter macrocephalus*	2	V (Pop trend: unknown)

Notes: LC = least concern. DD = Data Deficient. V = Vulnerable. 1 = Class 1 relatively recent field (or specimen record) confirmation of a given species within EEZ. 2 = Class 2 potentially Class 1 record that is either dated or may be marginally outside of a given EEZ. – = species presence reported by IUCN only.

Tongan waters are known for their yearly humpback migration[11]. Tongan humpbacks are thought to represent a specific isolated breeding stock of humpback whales in the South Pacific[12]. Whales migrate are known to migrate past various islands in the Tonga group.

It is considered unlikely that there will be any significant impacts on migrating whales as all works are confined to Ports or channel entrances with migration pathways located outside the PIA.

4.4.3 Seabirds

There are 15 species of seabirds with a known presence in Tonga according to the IUCN and Birdlife International.[13] A recent checklist reported as many as 41 species[14], including the wandering albatross, one giant petrel, several additional petrel and storm-petrel species, four shearwater species, three species of skuas, and many more tern species (Table 4.2). As many as twenty three of these species, such as black noddies, brown noddies and white terns, may also breed in Tonga. A number of the islands in the Tongan group (such as Maninita, 'Ata, Late Hunga Ha'apai, and Fonualei Islands) provide nesting or breeding habitat for these bird species.

[10] SPREP 2007. Secretariat of the Pacific Regional Environment Programme Pacific Islands Regional Marine Species Programme 2008 – 2012. Apia Samoa, SPREP:48.
[11] Orams, M. 2001. "From Whale Hunting to Whale Watching in Tonga: A Sustainable Future?" Journal of Sustainable Tourism 9(2): 128-146. Olavarría, C *et al.* 2005. Population structure of humpback whales throughout the South Pacific with reference to the origins of the eastern Polynesian breeding grounds. SC/57/For Information 8 Report to the Scientific Committee of the International Whaling Commission. Garrigue, C., C. Olavarria, et al. 2006. Demographic and genetic isolation of New Caledonia (E2) and Tonga (E3) breeding stocks. Inter-sessional Workshop for the Comprehensive Assessment of Southerm Hemisphere Humpback Whales. Hobart.
[12] Olivarria *et al.* 2007. Population structure of South Pacific humpback whales and the origin of the eastern Polynesian breeding grounds. Mar. Ecol. Prog. Ser. 330: 257-268
[13] www.birdlife.org
[14] Environment Consultants Fiji 2001. Summary list of the Birds of Tonga. Pacific Birds. Suva Fiji Islands.

It is considered unlikely that there will be any significant impact on seabird nesting or breeding habitat on the basis of the PIA.

Table 4.2: Seabird species in Tonga and their IUCN conservation status

Common Name	Scientific Name	Status
Herald Petrel	*Pterodroma heraldic*	LC
Wedge tailed Shearwater	*Puffinus pacificus*	LC
White-tailed Tropicbird	*Phaethon lepturus*	LC
Lesser Frigatebird	*Fregata ariel*	LC
Masked Booby	*Sula daactylatra*	LC
Red-footed Booby	*Sula sula*	LC
Brown Booby	*Sula leucogaster*	LC
Great Crested Tern	*Sterna bergii*	LC
Black-naped Tern	*Sterna sumatrana*	LC
Sooty Tern	*Sterna fuscata*	LC
Brown Noddy	*Anous stolidus*	LC
Black Noddy	*Anous minutus*	LC
Blue Noddy	*Procelsterna cerulea*	LC
Common White Tern	*Gygis alba*	LC
Phoenix Petrel	*Pterodroma alba*	EN

Notes: LC = least concern. EN = Endangered.

4.4.4 Turtles

Four species of sea turtle have been reported from within Tongan waters; the leatherback, green, olive ridley and hawksbill (Table 4.3). The green and hawksbill turtle are the most common[15]. There is limited information on migrations or connectivity to South Pacific populations or on nesting beaches in Tonga. Two species (Olive Ridley Turtle *Lepidochelys olivacea* and Green Turtle *Chelonia mydas*) are considered critically endangered reduction in population size of 80% over the last 10 years or three generations.

Table 4.3: Sea Turtle species in Tonga and their IUCN conservation status

Common Name	Scientific Name	Status
Hawksbill Turtle	*Eretmochelys imbricata*	CR
Leatherback Turtle	*Dermochelys coriacea*	CR
Olive Ridley Turtle	*Lepidochelys olivacea*	EN
Green Turtle	*Chelonia mydas*	EN

Notes: CR = Critically endangered. EN = Endangered.

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 and hawksbill turtles are known to nest in Vava'u (Figure 4.12) and Ha'apai although occurrences of nesting activity is very low and distributed over scattered outer islands (SPREP). The peak nesting season is from December to January.

Although the proposed dredging operations do not appear to conflict with any turtle nesting locations in Vava'u, or known foraging grounds, monitoring for presence of turtles is recommended during dredging operations.

[15] Prescott, N. 2004. Tonga Biodiversity Stocktaking. Technical Report 1: For the Development of a National Biodiversity Strategic Action Plan. Tonga Department of Environment. Tongatapu, Tonga. 275.

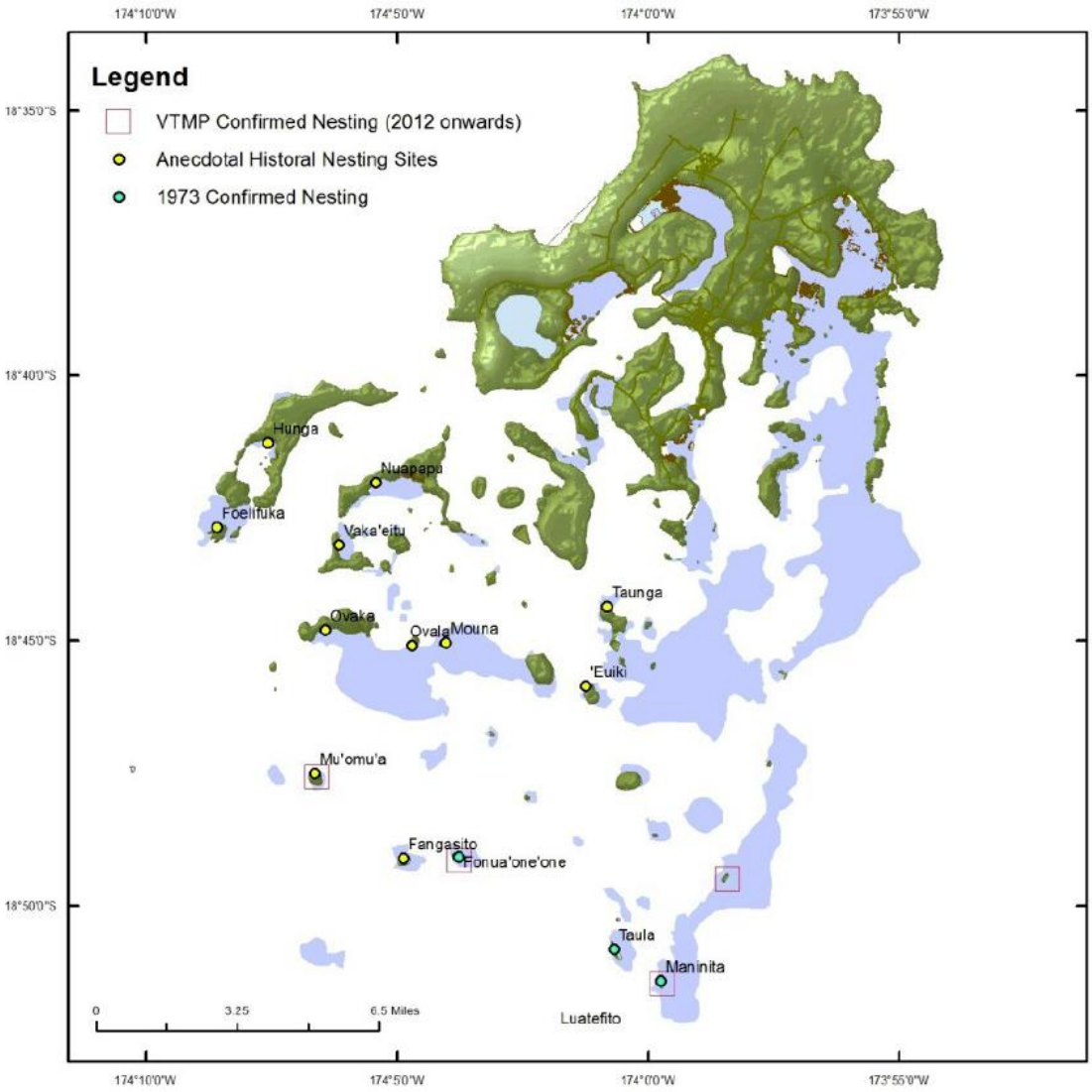

Figure 4.12: Marine turtle nesting map for Vava'u[14]

4.5 Social Environment

4.5.1 Demographic Data

Population

Population data is provided in the 2016 census[16]. The following key points can be made:

- the Kingdom of Tonga has a total population of 100,651 (50,312 males and 50,433 females) compared with 103,252 in 2011.
- The largest Island, Tongatapu, has 74% of the population (74,611) and with a land area of 257 km^2, this equates to a population density of 290.6 persons per km^2.
- Vava'u, Ha'apai, 'Eua and Niuatoputapu have populations of 13,740, 6,144, 4,950 and 1,232 respectively and with land areas of 138, 109.3 87.4 and 71.7 km^2 respectively, equating to population densities of 99.5, 56.2 56.6 and 17.2 persons respectively per km^2.

[16]Tonga 2016. Census of population and housing. Volume 1: basic tables and administration Report. Tonga Statistics Department.

Since the 2011 census there has been an overall population decline in Tonga of 2.5% with islands ranging from 1.1 % (Tongatapu) to 7.9% (Vava'u). The issues associated with population decline in outer islands are likely to be many and varied but it is possible that the ongoing investment in infrastructural Projects such as the Port upgrade and dredging projects may in a small part assist with retaining population in these locations.

Employment

The key points relating to economic activity in the Islands identified in the 2016 census[14] are as follows:

- In Vava'u, 5,715 (41.5%) of the total population of 13,738 are economically active with 1,850 (13.5%) subsistence workers. 14% of the population are unemployed.
- In Ha'apai, 2,828 (46%) of the total population of 6,125 are economically active with 918 (15%) subsistence workers. 9.7% of the population are unemployed.
- In 'Eua, 2,143 (43.4%) of the total population of 4,945 are economically active with 717 (14.4%) subsistence workers. 12.4% of the population are unemployed.
- In Niuatoputapu, 588 (47.7%) of the total population of 1,232 are economically active with 107 (9%) subsistence workers. 5% of the population are unemployed.

Possible short-term employment opportunities associated with the Project will assist with providing paid employment to local villagers in the islands.

4.5.2 Fisheries

Commercial and subsistence fishing

Both commercial and subsistence fishing is undertaken in Tonga. The commercial fishery targets tuna, snapper, commercial sport, seaweed and the aquarium trade[17]. Subsistence fisheries common throughout the Tonga target mostly reef fish by a variety of methods such as night spearfishing, gillnetting, hand-line fishing and the use of fish fences[18]. Small boats of various types are used including canoes, outboard-powered dinghies and inboard-motor vessels.

According to the FAO, Tonga's fisheries and their proportional associated production are estimated as: Coastal Commercial 54%; Coastal Subsistence 30%; Offshore: Locally Based 15%; Offshore: Foreign Based 0%; and Freshwater & Aquaculture <1%.

In the past mullet, beche-de-mer (sea cucumber), lobster and giant clam have had commercial value but severe population declines has resulted in these species being mostly absent from both commercial and subsistence fishing. Fishery exports are dominated by tuna and deep-water snappers (red snapper (*Etelis coruscans*) and pink snapper (*Pristopomoides filamentosus*)) which are air-freighted fresh mainly to Hawaii[19].

The inshore fishery is dominated by four main methods: diving/spear fishing, gill netting, bottom fishing and reef gleaning. Spear fishing targets reef fish while the 19 registered bottom fishing vessels in Tonga 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[20].

[17] CFC 2007. Tonga Commercial Fisheries Conference. Tongatapu, Tonga.
[18] Malm, T. 2001 The tragedy of hte commoners: the decline of the customary marine tenure system of Tonga. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 13: 3-13.
Kronen, M. 2004. Fishing for fortunes? A socio-economic assessment of Tonga's artisanal fisheries. Fisheries Research 70: 121-134.
Gillett, R. 1994. Tonga Fisheries Bibliography. FAO. Suva, Fiji Islands, FAO: 93.
[19] Chapman, Lindsey. 2000. Development Options and Constraints Including Training Needs Within the Tuna Fishing Industry and Support Services in the Kingdom of Tonga. Secretariat of the Pacific Community. Noumea, New Caledonia. 53pp.
Hamilton, A. & M. Batty 2007. Constraints to Tuna Fisheries Development in the Pacific. Tonga National Commercial Fisheries Conference. Tonga, FFA.
[20]Pacific Environmental Consulting 2016. Environmental Assessment. Tonga Cable Extension Project: Nuku'alofa, Ha'api & Vava'u. Prepared for Tonga Cable Ltd, Nuku'alofa, Tonga. April 2016.

In a recently referenced[14] World Bank study, residents of six coastal communities were asked to identify the three subsistence fishery resources most important to them. Seven types were most commonly cited: finfish, octopus, lobster, bêche-de-mer, giant clams, seaweed and Anadara (shellfish).

In Vava'u directly adjacent to the area proposed for dredging at Galloway Rocks there is a local Special Marine Area (SMA) which is overseen by the local community (see Appendix 3 for further detail) to manage fisheries resources that they rely on for food and income. SMAs are legislated under the Fisheries Management Act 2002 for the purposes of community-based fisheries management in their adjacent coastal areas.

Aquaculture

The Ministry of Fisheries has developed an aquaculture program in 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 and the cultivation of other edible species such as urchins (*Tripneustes sp*.) and seaweed ('Limufuofua').

The most relevant activity to this project is the oyster farming that occurs in Vava'u. 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 two farm areas in Vava'u (Figure 4.13) which are located over 2 kms from the proposed dredging locations and outside the PIA.

Figure 4.13: Location of Oyster farms in Vava'u (and existing submarine fibre optic cable – red line)

4.5.3 Marine Traffic

Commercial Shipping

All of the Ports where works are proposed receive commercial vessel traffic of varying frequencies. Figure 4.14 presents the marine charts showing harbour limits for Ha'apai and Vava'u. Typically vessel traffic is light with 10-12 visits per month in Ha'apai and between 13-15 visits per month to Vava'u, and lower visits to 'Eua and Niua[21]. No anchoring areas are

[21]Tonga Ports Authority Annual report. 2016.

defined for Vava'u only.

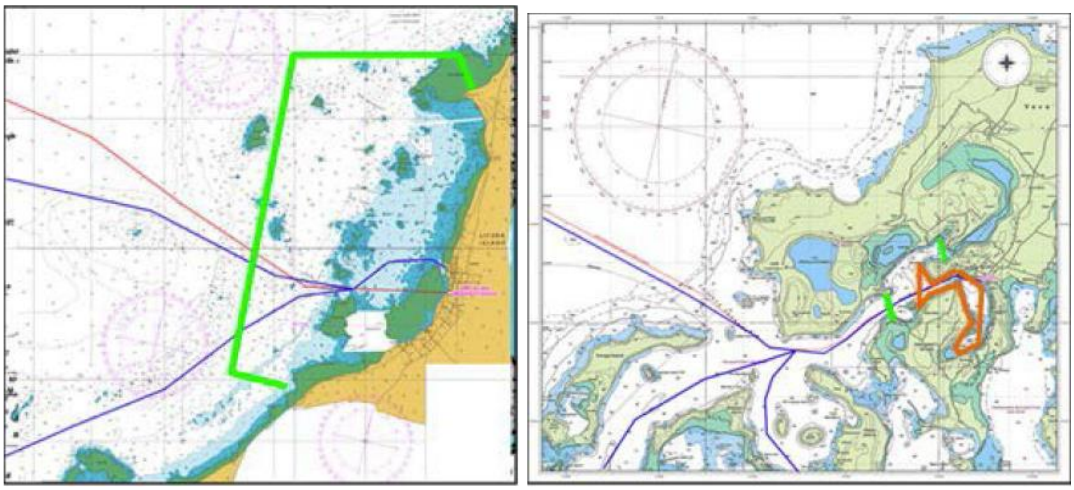

Figure 4.14: Ha'apai harbour chart with harbour boundaries marked in green (left) and Vava'u chart with harbour limits (green) and no anchoring zone (orange) (right)

Recreational Vessels

There are several tourism industries that operate the most notable of which are the commercial game fishing vessels and licensed whale watching/swimming vessels.

Game fishing activities also take place in Vava'u with seven licensed game fishing vessels in Vava'u. The Vava'u Sports Fishing Club has installed three fish aggregating devices (FADs) along the western edge of the Vava'u island group and consisted of a collection of surface buoys moored in deep (>200m) water. These are located will beyond the PIA.

The majority of the game fishing boats 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 operate all year with the most intense activity occurring during the winter months of June to November.

Whale watch vessels operate in all the island groups except Niua. There are currently more than 25 licensed vessels in Tonga with the majority based in Vava'u. These vessels operate in inshore waters of their respective island groups for six days a week from July to October.

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. It is considered unlikely that should dredging activities be scheduled during the whale watching season, operations are not expected to have any significant impact on daily movements. To mitigate any potential affects advance notification of dates and duration should be provided 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. This represents 33,500 people nights per year and whilst 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.

Small numbers of cruise vessels also visit Tonga and Vava'u in particular. These visits are also important to the local economy as they provide support for local businesses including restaurants and tourism operations.

Whilst dredging operations are not expected to impact significantly on the recreational yachting and cruise liner industry, to mitigate any potential impacts a notice to mariners should be provided in advance of works being undertaken.

4.5.4 Other Infrastructure

A fibre optic cable installed in 2016 currently sits on the seabed along the channel approach to Neiafu harbour, and into Neiafu Harbour itself. In addition, the same fibre optic cable comes ashore at Pangai in Ha'apai just south of the main Port. Figure 4.11 shows the approximate orientation of the cable in Neiafu and Figure 4.15 in Pangai, Ha'apai.

As built drawings will be required to establish where the cable is located particularly in Neiafu prior to dredging works being undertaken.

Figure 4.15: Location of submarine fibre optic cable in Pangai, Ha'apai

A fish trap in Pangai, Ha'apai is located south of the Taufa'ahau Port and Harbour and outside the PIA.

4.5.5 Issues associated with existing infrastructure

Information to allow an evaluation of the importance of functioning Port facilities (including access to these facilities) for local island communities is limited. However, anecdotal evidence and community consultation outcomes (see Appendix 4 for detail), although limited in terms of specific feedback relating to the Ports Projects, indicates local communities on all islands depend on functioning Ports for their survival for a number of reasons as follows:

- Income from tourism activities from tourists arriving in larger cruise liners and recreational yachts particularly in Vava'u (as outlined in Section 4.5).
- General access for all vessels including those that undertake subsistence, commercial and recreational fishing (see Section 4.3.5). In Niuatoputapu for example, the vessel which ships essential supplies to the island can often be delayed due to unfavourable weather conditions that restrict access to the Port facility through the shallow channel entrance.
- Public travel to and from Tongatapu and the other Tonga Islands. In 'Eua for example, ferry travel is often curtailed due to the restricted access to the Port during unfavourable weather conditions.
- Public safety. In 'Eua for example, use of the boat ramp in the eastern part of the harbour is restricted to high tide and relatively calm seas due to dangerous nature of launching smaller vessels at any other tide and sea state. This in turn impacts on local fishing industry and tourism operators.
- Export of crops and fish to wider markets which provides income to islanders.

In terms of potential gender-specific impacts, reef gleaning is traditionally undertaken by the women of the community, but it is of limited relevance given the nature and scope of the

proposed Port works.

5 Consultation & Stakeholder Engagement

5.1 Background and Approach

As required by WB Safeguard Policies consultation and disclosure of Category B projects must be undertaken with project affected groups (stakeholders) and non-government organisations (NGO).

The potential environmental and social impacts of the project require the opportunity for discussion and review during the environmental assessment/ESMP process to inform detailed design and mitigation measures.

The ESMP remains a draft until public disclosure and consultation has been completed. This will allow for the ESMP to be updated with details of consultation and disclosure as and when this is completed. Disclosure and consultation will be the responsibility of MOI.

5.2 Outcome of Consultation

Appendix 3 details the outcome of the public consultation process. Table 5.1 summarise the public consultation undertaken. The key points to note are as follows:

- In ‘Eua, a total of 5 public consultation meetings were held in Houma, ‘Ohonua, Mu’a, Angaha and Kolomaile Villages.
- In Vava’u, a total of 11 public consultation meetings were held in Pangaimotu, Leimatu’a, Mataika, Tu’anekivale, Tu’anuku, Longomapu, Tefisi and Houma Villages. A total of 136 people attended the meetings including both men (97) and women (39).
- In Ha’apai, a total of 7 public consultation meetings were held with villages located across the main Island of Lifuka including Ha’ateihosi’I, Faleloa, Faleloa, Koulo Pangai and Vahe Foa Villages. A total of 79 people attended the meetings including both men (46) and women (33).
- In Niuatoputapu, one public consultation meeting was held with villagers at the wharf when they were gathered for the arrival of the ferry. A total of 28 people attended the meetings including both men (17) and women (11).

Overall, a total of over 140 people attended the public consultation meetings or were met with to discuss the Project and garner feedback. Table 5.2 summarises the feedback received. No specific comments were provided regarding the Ports Project in meetings held in Vava’u Ha’apai and ‘Eua apart from indicating support with most people’s attention focussed on the roading upgrade Project. In Niuatoputapu, a number of comments were made regarding the proposed Port Project summarised as follows:

- Villagers rely on the shipping service for supplies and sending cargo.
- The Project will help to improve wharf to make sure ferry will dock anytime.
- Deeper wharf may allow bigger ships to dock.

No issues relating to gender, age or vulnerable groups were raised.

5.3 Disclosure

Disclosure is about transparency and accountability through release of information about the project and does not equate to consultation (and vice versa). This ESIA / ESMP document will be made available on the WB Infoshop website and in hard copy at Government offices and community centres on Tonga (most applicable and accessible).

Table 5.1: Summary of public consultation

Location	Date	Village/Ministry	Gender	
			Male	Female
'Eua	19.06.18	'Eua Governor + Town Officers	1+	
		Houma		
		'Ohonua		
		Mu'a		
		Angaha		
		Kolomaile		
Ha'apai	06.06.18	Ha'apai Governor & Town Officers	6	-
		Weaving Women's Group	-	3
		Ha'ateihosi'i	4	9
		Faleloa	6	9
		Koulo	9	4
		Pangai	8	3
	07.06.18	Vahe Foa	12	5
		TAL	1	
Vava'u	13.06.18	Neiafu	13	5
	14.06.18	Governor	1	-
		Weaving Women's Group	-	2
		Pangaimotu	3	4
		Leimatu'a	11	6
		Mataika	16	
	15.06.18	Tu'anekivale (incl. Mangia)	13	7
		Tu'anuku	7	
		Longomapu	15	4
		Tefisi	7	4
	16.06.18	Houma	11	7
Niuatoputapu	13.06.18	Niua Toputapu	17	11

Table 5.1: Summary of comments made during public consultation

Communities	Communities Comments
Vava'u	
Tefisi, Longomapu	- Support wharf upgrade
Neiafu	- No comment
Tu'anekivale, Mangia	- Wharf dredging welcomed.
Tu'anuku, Longomapu	- No comment
Pangaimotu	- Concur for need for wharf dredging
Mangia, Houma, Mataika	- No comment
Neiafu	- No comment
Tefisi, Vaihoi, Leimatu'a	- No comment
Ha'api	
Koula	- Wharf dredging is needed
Pangai, Holopeka, Hihifo,	- No comment
Loto Foa, Fotua, Fangale'ounga	- Welcome wharf dredging
'Eua	
Mu'a, Angaha, Kolomaile*	- No comment
Houma	- Approve of wharf dredging
Ohonua	- Wharf dredging is good
Niuatoputapu	
Hihifo, Vaipoa, Falehau	- Welcomed and support the proposed dredging - Rely on the shipping service for supplies and also sending cargo to Tongatapu - Help to improve wharf to make sure ferry will dock anytime - Deeper wharf may allow bigger ships to dock, which is a bonus for the island

6 Assessment of Potential Impacts, Risk & Mitigation Measures

6.1 Introduction

The TCRT Project has the potential to create a variety of impacts. These potential impacts are either positive or negative depending on the receptors involved. The impact of this project on the social, ecological and physical 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.

This ESIA document defines an impact 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*".

This section provides an assessment of the potential construction and operational impacts of the proposed TCRT Project on the physical and ecological and socio-economic resources on and adjacent to the site. Potential impacts have been identified and evaluated as to whether they are adverse, positive, or have a negligible or neutral impact. These issues are discussed in the following sections in relation to the proposed Project activities.

6.2 Construction Impacts

6.2.1 Biophysical Impacts

Potential biophysical impacts associated with the proposed Port safety improvements to the wharfs are not considered significant and are not considered further.

Potential biophysical impacts arising as a result of proposed dredging activities are as follows:

- Loss or change in benthic habitat, ecology and physical characteristics
- Generation of suspended solids and offsite deposition.
- Changes in water quality.
- Water column and sediment toxicity.

In addition, potential impacts may arise as a result of disposal of dredged material to land such as silt runoff and salt leaching affecting adjacent marine or terrestrial environment. Due to the lack of significant vegetation in and adjacent to the Port facilities the potential impact of salt leaching is not expected to be significant relation to proposed dredging activities.

6.2.2 Impact of sediment removal

The removal of sediment by dredging at the Port facilities in 'Eua, Ha'apai, Vava'u and the channel areas in Vava'u and Niuatoputapu will result in the disturbance to and loss of benthic habitat. The benthic communities of these areas are summarised in Section 4.4.1 and in detail in Appendix 3. However, this potential impact is not expected to be significant due to the following:

- No species or ecological communities of particular ecological or social concern, or conservation value are likely to be present in proposed dredging footprint. In this regard, removal of existing bottom habitat is considered to be of little or no significance.
- Over time, the dredged area will be recolonised by invertebrate species typical of the area.

A. SEDIMENT RESUSPENSION

Sediment Sources

All dredging operations resuspend some sediment during the extraction process. The mechanism by which sediment is resuspended depends on:

- The dredging method – In this case the proposed method (excavator) has the advantage in that the amount of sediment disturbance and resuspension is minimised compared with many other dredging techniques.
- The characteristics of the sediment – With the exception of 'Eua, the sediments in the areas to be dredged have a large sand component minimising silt resuspension.
- The depth of dredging and water at the site – the maximum depths of dredging at sites is approximately 3-5m.
- Tidal currents and turbulence at the site – given the limited range tidally driven current speed is likely to be low.
- Operational considerations such as equipment type, method of operation and skill of the operator.

Issues

Resupension and transport of sediment may result in the following impacts:

- Physical effects of sedimentation on benthic communities.
- Reduction in water clarity due to increases in water-borne suspended solids concentrations.

In addition, potential impacts relating to the release of sediment-associated contaminants to the water column and potential toxic effects of contaminants in redeposited sediment on benthic communities can arise.

The various Port facilities were visited in June 2018 and a preliminary assessment of the risk of potential contaminated sediments being present adjacent to these wharfs undertaken. Given the lack of high risk activities undertaken the port facilities the risk of contaminated sediments being present is low.

The other potential issues identified above are discussed in detail below.

Extent of Sediment Resuspension

Sediment resuspension and downstream transport have been assessed in a number of New Zealand harbours and estuaries.

Dredging using less precise dredging methods such as clamshell dredging (similar in effect to an excavator) of the Auckland naval base, Port of Onehunga, Half Moon Bay marina, Pine Harbour marina[22] have also not resulted in any identifiable downstream increases in suspended solids concentrations. Typical release rates of 2,250 kg/hr (or 1.5 m^3/hr) have been measured.

Sediment Dispersion

Suspended solids generated on an ebb or flood tide could potentially travel offsite. Estimating the cumulative dispersed increase in suspended solids depends on an accurate knowledge of the rate of release of sediment to the water column. Based on the release rate identified in the previous Section and the development of a typical 'triangular' plume, it is predicted that

[22]Kingett Mitchell 1995. Effects on the marine environment associated with the expansion of the Fergusson container terminal. Prepared for BCHF Ltd. November 1995.

the release of 2,250 kg of sediment per hour from the dredging operation would result in a downstream net addition of suspended solids of 25 - 42 g/m^3 based upon:

Concentration	=	*mass release / width x depth x tidal velocity*
Where: 0.15 m s^{-1}	=	*mean tidal velocity*
50m	=	*plume width at 200m from the dredged area*
3-5m	=	*average water depth*

This concentration is within the likely range of suspended solids concentrations observed in these Ports where a range of 2.2 – 37 g/m^3 is reported (see Appendix 3). Concentrations are likely to be significantly higher during extreme events such as cyclones when nearshore sediments are resuspended and runoff from the adjacent land area carries considerable volumes of suspended material.

As a result, the possible suspended solids output due to dredging activity is not considered to have a significant impact on local water quality. In addition, the proposed dredging durations for all ports are very limited, and any turbidity impacts will be short-lived as a result.

B. WATER QUALITY

Introduction

In this section, matters relating to potential effects of contaminants associated with the sediment are examined. Such issues include:

- Changes in water quality resulting from the release of interstitial water during dredging and desorption of constituents on particulate surfaces.
- The potential for deposited sediment to exert toxic effects on benthic biota off site.
- The potential for bioaccumulation in organisms exposed to sediment released by the dredging operation.

Issues

The key water quality issues typically identified as being associated with dredging operations include: dissolved oxygen; and dissolved chemical release.

As previously indicated due to the likely low level of contaminants present in the seabed sediments dissolved chemical release is not expected to be significant.

In addition, past research has indicated changes in dissolved oxygen concentrations adjacent to and downstream of dredging operations are typically undetectable. Reductions in DO concentrations due to clam shell dredging are typically 5% of ambient concentration or less[23].

Work undertaken on oxygen consumption in the Waitemata Harbour in Auckland has shown that consumption as a result of anaerobic sediment suspension is unlikely. The potential impacts, should they occur, are unlikely as marine animals are typically unaffected by small fluctuations in concentrations and fish are able to detect and avoid such situations. As a result it is generally considered that there is little cause for concern in relation to the effects of reduced dissolved oxygen concentrations that could result from dredging operations[24].

The ‘Utulei SMA located directly adjacent to the dredging site in Vava’u is unlikely to be affected by changes in water quality due to the reasons outlined above.

[23]Palermo et al. 1990. Evaluation of clamshell dredging and barge overflow. Technical Report D-90-6. US Army Engineer Waterways Experiment Station. March 1990

[24]Hayes, D., and P.-Y. Wu. 2001. Simple approach to TSS source strength estimates. In Proceedings of the WEDA XXI Conference, Houston, TX, June 25-27, 2001.

C. IMPACT OF SEDIMENT DEPOSITION

Due to the likely low level of contaminants present in the seabed sediments the potential impacts due to toxicity related to sediment deposition is not expected to be significant. The potential impacts of sediment deposition are dependent on:

- Tolerance of biota to smothering should it occur;
- The volume of sediment transported out of the dredged area;
- How the materials is dispersed; and
- The overall loading on the benthic community.

Overall, the potential impacts associated with offsite sediment deposition are not expected to be significant due to the following:

- The short duration of dredging activity which ranges from 10-15 days depending on location.
- The soft bottom benthic communities where present at each Port locations are already adapted to natural fluctuations in sediment loads currently experienced, and the ability of these communities to quickly recover following a depositional event minimises any potential impact.
- The reef communities adjacent to the harbours in Eua, Ha'apai and Vava'u and the channel entrance in Niuatoputapu are considered to be dominated by robust species that are already to sediment deposition or, in the case of Niuatoputapu, the high energy environment in which they prevail.

The 'Utulei SMA in Vava'u is located in the PIA directly adjacent to the proposed dredging activity and could be potentially adversely effected by sediment deposition. However, significant adverse effects are not anticipated due to: a high proportion of sediments would be expected to deposit downstream of dredging activity (the SMA is located parallel to the dredging location); and the degraded nature of the ecological community present in the SMA.

In addition, the Neiafu Harbour oyster farms are located considerable distance from the proposed dredging activity and are likely to be unaffected.

6.2.3 Socio-Economic Impacts

Potential negative socio-economic impacts resulting from the Port safety improvement works and dredging projects include the following:

- Disturbance of the subsea cable in the channel leading to Neiafu Harbour and adjacent to the Port facility as a result of dredging activities.
- Potential hazards to other vessel movements during dredging activities adjacent to Port facilities (in 'Eua (Nafanua Port), Ha'apai (Taufa'ahau Port) and Vava'u (Halaevalu Port)) and in channel entrances (Vava'u & Niuatoputapu).
- Conflict with all vessels accessing facility during Port safety works.
- Potential impact on fish communities and harvested benthic invertebrates within 'Utulei SMA affecting subsistence harvesting for local villagers and oyster farmers in Neiafu Harbour both in Vava'u.
- Potential employment opportunities due to the possible need for local labour for Port safety works.
- Noise generated from dredging activities in Nafanua Port ('Eua), Taufa'ahau Port

(Ha'apai), Halaevalu Port (Vava'u) and in channel entrances (Vava'u). Overall, noise impacts are not expected to be significant on account of the following: the proposed dredging activity with an excavator on a barge is not inherently a noise process; Ports undertake a range of other activities that generate noise; and channel dredging locations are remote from settlements where disturbance could potentially arise.

6.3 Operational Impacts

Potential biophysical impacts following completion of the proposed works are limited and are not considered further. A range of potential positive socio-economic impacts can be identified as follows:

- Potential for increased income in Vava'u from tourism activities as a result of improved access for larger cruise liners
- Unrestricted access for all vessels including those that undertake subsistence, commercial and recreational fishing. For example dredging of the channel entrance in Niua will allow the vessel which ships essential supplies to the island as scheduled.
- Unrestricted public travel to and from Tongatapu and the other Tonga Islands. In 'Eua the ferry will be allowed to access the Port as scheduled so disruption to travellers will not occur.
- Improved public safety. In 'Eua small vessels will have all tide access reducing potential impact on the local fishing boats and tourism operators that rely on the ramp for access.
- Certainty of continued export of crops and fish to wider markets which provides income to island.
- Improved climate resilience as a result of the Port safety improvement works particularly where repairs are planned to existing wharf structures in 'Eua, Ha'api, Niuatoputapu and Niuafo'ou making them potentially less susceptible to the effects of changing climatic conditions.

6.4 Risk Assessment & Impact Identification Methodology

Risk Assessment is routinely undertaken as part of the ESIA process. In assessing a projects environmental risk, impacts are rated to determine the appropriate response or management actions that should be implemented to minimise potential impacts. The risk assessment methodology for the TCRT Project is described in this Section.

An EMP[25] has been prepared for the Transport Sector Consolidation Project which outlines an approach to assessment of risk that has been previously agreed with MEIDECC. To ensure consistency the same approach to risk management has been adopted for the assessment of risk for this Project whereby the level of risk posed by the activities associated with the Project is assessed and is based on the following: the likelihood or probability of an event; and the consequences of the impacts of that event occurring (see Table 6.1).

Table 6.1: Qualitative risk analysis matrix

	Consequence				
	1	2	3	4	5
Likelihood	Severe	Major	Moderate	Minor	Negligible
A - Almost Certain	E	E	H	M	M
B – Likely	E	H	H	M	L
C- Possible	H	H	M	M	L
D – Unlikely	H	M	M	L	L

Risk Map Colour Code
E = Extreme
H = High
M = Moderate
L = Low

[25]MOI 2018. Environmental Management Plan. Transport Sector Consolidation Project, Additional Financing. Revised Version. Ministry of Infrastructure, Kingdom of Tonga. 18 January 2018.

E - Rare	M	M	L	L	L

This is a conventional risk management framework and is considered applicable in the context of this assessment which has a focus on high level identification of biodiversity and ecosystem services risks. The ESIA process will provide detail on these risk areas as appropriate.

There are four main levels of risk after combining the 'likelihood' and 'consequences' factors (see Tables 6.2 & 6.3).

Table 6.2: Qualitative measures of likelihood

Level	Descriptor	Example	Frequency
A	Almost certain	Is expected to occur in most circumstances	> Once per year
B	Likely	Will probably occur in most circumstances	Once per year
C	Possible	Could occur	Once every 5 years
D	Unlikely	Could occur but not expected	May happen within Project life
E	Rare	Occurs in only exceptional circumstances	Not likely to happen within Project life

Source: Modified from *Environmental Risk Management – Principles and Process. HB 203:2006* (Standards Australia/Standards New Zealand, 2006).

Each level has a response or management control action. The four 'Risk Levels' are:

- Extreme (E) Risk - those impacts that require immediate action at the highest level of management.
- High (H) Risk - those impacts requiring action at senior management level.
- Moderate (M) Risk - those that require policies in place to address impacts and monitoring programs.
- Low (L) Risk - those impacts that do not require any specific management actions but may be part of routine management and monitoring plans.

In cases of "E", "H" and "M" Risks, mitigation measures are identified to reduce the level of residual Project risk as shown in Table 6.3.

6.5 Outcome of Risk Assessment & Impact Identification

Tables 6.4 present the results of the risks associated with the proposed TRCT Project. Key points in relation to identified 'Extreme' and 'High' Risk Project activities are outlined in the following Sections of this Report.

Table 6.3: Qualitative measures of consequence

Rating	Project Objectives	Financial	Safety	Environment	Compliance	Reputation
Severe	Failure to meet all three objectives with termination of project.	Cost over-run by 25% or financial loss greater than TOP1M.	Fatality or permanent significant disability, long term impairment or illness significantly affecting the quality of life for an employee, contractor or member of the public.	Permanent impacts to populations of significant flora or fauna (e.g. threatened), highly significant heritage items, complete removal of habitat or significant impairment of ecosystem function.	Claim or action could be brought in the Courts; and	Court, regulator or Government/ Cabinet inquiry concludes improper, corrupt or grossly negligent conduct.
					Regulators could bring prosecution and penalties (and potential imprisonment for individuals); and	Other action by MOI results in termination of Minister or CEO.
Major	Project substantially fails to meet one objective of the project	Cost over-run between 15-25% or financial loss between TOP500 and TOP1M.	Long term or permanent disability, impairment or illness not significantly affecting the quality of life for an employee, contractor or member of the public.	Medium-long term (>10 years) physical impacts likely to cause impacts to flora/fauna populations, or direct impacts to flora / fauna populations. Adverse impacts to significant heritage items.	Claim or action could be brought in the Courts; and	Action by MOI results in one or more Executives or senior managers being terminated.
	Project requires restructuring to meet revised project objectives				Regulator could bring prosecution for which the penalty (and potential imprisonment for individuals).	Government or Cabinet inquiry into our actions or operations.
						Prolonged and negative national media attention.
Moderate	Project does not meet the target(s) of at least one indicator for the project objectives	Cost over-run between 5% - 15% or financial loss between TOP100,000 - TOP500,000.	Hospitalisation with medical intervention of an employee, contractor or member of the public.	Medium term (3-10 years) impacts on populations of native flora / fauna including loss of individuals of threatened species, Significant impacts on physical environment.	Claim or action could be brought in the Courts; &	Short term negative national media attention.
	Project requires time extension to meet project objectives				Regulator could bring prosecution for which a penalty or fine for an individual.	Regulator conducts formal inquiry.
						Prolonged and negative media attention.
Minor	Project fails to meet intermediate results, but could with intervention, meet the project objectives	Cost over-run less than 5% or financial loss between TOP10,000 and TOP100,000.	Injury or illness requiring medical treatment of an employee, contractor or member of the public.	Short term (1-3 years) direct impacts on physical environment (water, soil, air) that may impact on flora or fauna. Loss of individuals of common native flora or fauna. May extend outside of work area.	Claim or action could be brought in the Court; and	Formal complaint made to a Regulator.
					Regulator could issue an enforcement or penalty notice.	Short term negative media attention.
Negligible	Intervention required to meet targets and results to achieve project objectives	Financial loss less than TOP10,000K.	Nil to first aid injury, low level short term inconvenience or symptoms for an employee, contractor or	Low-level direct impacts on physical environment (water, soil, air) within work area.	Offence is merely reportable; and/or	Negative comment about MOI at Cabinet level.
				Impacts easily remedied.	Regulator could issue a warning notice.	Formal complaint made to MOI.

Rating	Project Objectives	Financial	Safety	Environment	Compliance	Reputation
			member of the public.	No identifiable impact on flora or fauna.		

Table 6.4: Issues & risk assessment

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation	Post-Mitigation Residual Impact
			C	L	Rating		
A. Design							
1. Confirmation of Dredged Material volumes							
Dredging Project design	All Ports & channels	Unnecessary mobilization of machinery for dredging activities	1	B	E	MOI to undertake survey to confirm location and volume of materials to be removed	M
	All Ports & channels	Stockpiling of dredged material on private land	2	A	E	MOI to confirm where on Government land stockpiles are to be located	M
	Internet cable, Vava'u	Disturbance of undersea cable in entrance to Neiafu Harbour resulting in loss of internet access	1	B	E	Contractor to confirm location of subsea cable to ensure no disturbance occurs	M
2. Climate Resilience							
Proposed safety improvement works	Wharf structures	Failure of existing wharf structures given the current state of repair (in some cases)	2	A	E	Provision of more robust structures to withstand the rigors of climate change.	M

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation	Post-Mitigation Residual Impact
			C	L	Rating		
B. Construction							
B1 DREDGING PROJECT							
1. Dredging Operations							
Proposed dredging operations	All vessel operators that use Port facilities	Potential conflict of dredging operation with other vessels	3	A	H	Contractor to issue notice to Mariners, Port Operations, ferry operators, tourism operators, commercial fishing fleets, etc, advising of timing of works	M
2. Mobilisation							
Movement of barge to site	Other mariners / barge	Potential collision risk with other boat users. Potential loss of barge in poor weather conditions	1	C	H	Travel during daylight hours, notice to mariners Ensure suitable weather conditions for inter-island crossings	L
3. Dredging Activity							

Activity	Source of Risk	Description of Potential Impact	Assessment of Risk			Mitigation	Post-Mitigation Residual Impact
			C	L	Rating		
B. Construction							
B1 DREDGING PROJECT							
Removal of seabed materials	Adjacent ecological communities	Deposition of resuspended materials on adjacent marine ecological communities	3	B	H	Develop Monitoring Plan including undertaking baseline survey of fish / benthic communities and water quality to ensure no significant impact. Important for 'Utulei SMA and Neiafu oyster farmers	L
	Loss of benthic community in area of dredging	Habitat loss in dredging areas in Vava'u, Ha'api and Niuatoputapu	2	A	E	Undertake survey to determine extent and health of colonies present to determine potential requirement for relocation.	M
Excavator removal of sediments	Contractors staff	Injury to personnel	1	B	E	Site-specific training to workers. PPE to be provided.	M
Stockpiling of dredged material on land	Adjacent marine environment	Runoff of silt	3	A	H	Contractor to ensure any silt runoff is contained.	M
Fuel management	Marine environment	Spillage of fuel into marine environment	3	A	H	Refueling of excavator to be undertaken in contained area Spill kit available for use.	L
B2 PORT SAFETY IMPROVEMENT PROJECT							
1. Port Improvement Activities							
Proposed safety improvement works	All vessel operators that use Port facilities	Potential conflict of works with vessels using Port facilities	2	A	E	Contractor to issue notice to Mariners, Port Operations, ferry operators, tourism operators, commercial fishing fleets, etc, advising of timing and extent of works. Contractor to ensure works are undertaken at times when that don't conflict with commercial shipping activity.	M
Fuel management	Marine environment	Spillage of fuel into marine environment	3	A	H	Refueling of all equipment to be undertaken at wharf in contained area. Spill kit available for use.	L
Undertaking Port safety works	Contractors staff	Injury to personnel	1	B	E	Site-specific training to workers. PPE to be provided.	M
	Local community	Assist with alleviating unemployment	3	B	H	Contractor to use local labour where possible	M

6.6 Residual Risk Matters

All of the “Extreme“, “High“ and “Medium“ Risk matters identified in Section 6.5 of this ESIA are resolved to a “Low“ Risk category by application of mitigation measures (which will be included in the ESMP set out in Section 7). As a result, all key Project risks are able to be mitigated.

6.7 Cumulative & Induced Impacts

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

It is envisaged that the TCRT Project will not result in any long term adverse impacts to any identified environmental or social resources.

No adverse cumulative or induced impacts are expected for any phases of the various Projects.

7 Environmental & Social Management Plan

7.1 Introduction

The ESMP is outlined in Tables 7.1 which identifies the mitigation measures and monitoring actions that the Executing Agency (MOI) has committed to implement for the design construction and operational period of the project.

This approach makes for an ESMP that is practical and can be easily be used during project implementation. This ESMP will inform the Contractor's ESMP to be prepared following detailed design.

7.2 Performance Indicators

Given that nearly all of the potential negative impacts would occur during the construction period, and that robust environmental contract clauses will be able to avoid all impacts, key performance indicators will be as follows:

i) Confirmation that the ESMP tasks are defined as specific individual or grouped environmental and social clauses in contract bid documents.

ii) Confirmation that environmental management criteria are included as part of the contractor selection process, including their experience preparing and implementing ESMPs, etc;

iii) Safeguards advisors retained by the Contractor and by the PMU to provide assistance with ESMP implementation, contractor briefing on habitat protection, contractor ESMP supervision (including observations during construction), and participation in community consultation;

iv) A written record of the briefing on safeguards according to tasks defined in the ESMP and contract specification as soon as contractors have been selected.

v) Compliance monitoring checklists prepared and being used by the contractor and safeguards consultant and due diligence notes, completed as defined in the ESMP, and making the notes available in an easily accessible file for the contractor, Technical Coordinator, PMU Project Manager and others to use.

vi) Preparation of a completion report, identifying mitigation measures defined in the ESMP, their implementation timing and any follow up actions; and,

vii) A written record of all interviews and consultations.

The safeguards advisor will be responsible for preparing a performance indicator report on behalf of the PMU, by listing the seven items above and provide a short text to indicate how these items were implemented and their success as of the start of the operating period of the project.

7.3 Implementation Arrangements

The Ministry of Finance and National Planning is the Executing Agency and the MOI is the Implementing Agency. The MOI is responsible for the management of all activities, including procurement, financial management, and reporting.

7.4 Institutional Capacity

The successful implementation of this project will depend on the management of the environmental and social impacts, in addition to the effective management of construction and operational processes. These roles and responsibilities will fall under MOI and MEIDECC.

MOI will require environmental awareness training for monitoring the Contractors' implementation of the ESMP. Project management staff will have overall responsibility to ensure safeguard compliance in the preparatory and construction phase and will work in collaboration with the Government staff with regard to safeguard requirements.

An Environmental Assessment Committee (EAC) has been established in 2013 with the responsibility for enforcing the EIA Act. 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 MEDE 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 self-regulation in adhering to the EIA regulations and processes. MOI 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 MOI to ensure that they are following correct processes to obtain their environmental permit. The EAC will use this ESIA report to inform MOI of their conditions of permit and any monitoring requirements. It will then be the responsibility of MOI, as the proponent, to facilitate the EAC in their stipulated monitoring requirements which usually includes on-site inspections and monitoring parameters as per the EIA recommendations.

As MOI is committed to the EIA process, this will act as a capacity development tool for the new EAC and the MEECCDMMIC. No direct involvement is required from the Ministry as the project develops, so no additional capacity building is required.

A safeguards consultant will fill the gap in institutional safeguards capacity. The safeguards specialists will also assist to build capacity for implementation of safeguards instruments during supervision missions.

7.5 Mitigation Costs

The cost of a part time safeguards advisor, with marine ecology experience, to implement the ESMP and monitor the Contractor's CESMP is budgeted at $NZ75,000. This work would include all reporting and contractor briefing. Mitigation measures, where required to be implemented, are detailed in the ESMP.

Table 7.1: Environmental and Social Management Plan

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING	IMPLEMENTATION	SUPERVISION
1.0 Pre-Construction Period (Planning and design actions to prevent future impacts)						
1.1 Ecological Environment						
Project Design	Unnecessary mobilization of machinery for dredging activities	MOI to undertake survey to confirm location and volume of materials to be removed	All port dredging locations	Before works begin	MOI	MOI
	Stockpiling of dredged material on private land	MOI to confirm stockpile locations on government land	All port dredging locations	Before works begin	MOI	MOI
Reef Communities	Disturbance of coral reef communities	Undertake quantitative survey of adjacent coral reef communities and baseline water quality surveys to determine sensitivities to sediment impacts for monitoring purposes.	Vava'u, Ha'api & Niua	Before works begin	Contractor/MOI	Safeguards advisor
Species potentially at risk (turtles, etc)	Disturbance to foraging turtles	Contract specifications to include best practice for operating vessel in proximity to turtles.	All port dredging locations	For contract document preparation	Contractor/MOI	Safeguards advisor
1.2 Socio-Economic Environment						
Subsea internet cable	Disturbance of undersea cable in entrance to Neiafu Harbour resulting in loss of internet access	Contractor to confirm location of subsea cable to ensure no disturbance occurs	Vava'u	For contract document preparation	Contractor	MOI
Wharf structures	Climate impacts	Mitigation by design of safety improvement works	All port dredging locations	Before works begin	MOI	MOI
Stakeholder engagement (SEP)	Information sharing throughout the life of the project Prepare stakeholder engagement plan to ensure information on the project is shared with all stakeholders.	Implement stakeholder engagement plan to ensure information on the project is shared with all stakeholders.	All project locations	Throughout project life	MOI Construction Contractor	Safeguards Advisor
Community Grievances	Minor concerns/issues developing community resentment due to unaddressed project related concerns	Establish grievance redress mechanism prior to start of works and making this known to villages during follow up meetings before work begins.	All port dredging locations	Before civil works begin	Contractor	Safeguards advisor
2.0 Construction Period (Impacts associated with the work)						
2.1 Ecological Environment						

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING	IMPLEMENTATION	SUPERVISION
Reef Communities	Disturbance to benthic communities including 'Utulei SMA and Oyster farms (Vava'u)	Contractor(s) to adhere to best practice dredging techniques to minimize sediment suspension during dredging activities. Undertake monitoring survey of fish / benthic communities and water quality to determine whether any changes due to dredging activity	Sites adjacent to dredging locations	When dredging work work is being undertaken.	Contractor	Safeguards advisor
Marine environment	Runoff of silt from stockpiled dredged material on land to marine environment	Contractor to ensure runoff from dredged material stockpile is contained and treated prior to any discharge.	All port dredging locations	When work is undertaken.	Contractor	Safeguards advisor
	Spillage of fuel into marine environment	Refueling of excavator to be undertaken in contained area Spill kit available for use.	All port dredging locations	When work is undertaken.	Contractor	Safeguards advisor
Species of special Interest – turtles, etc	Disturbance to migrating turtles	Contractor to adhere to guidelines on minimally intrusiveness wrt turtles.	All port dredging locations	When work is under taken.	Contractor	Safeguards advisor
2.2 Socio-Economic Environment						
Workers	Injury to personnel during dredging and safety improvement works activities	Site-specific training to workers. PPE to be provided.	All port locations	When work is under taken.	Contractor	Safeguards advisor
Local land owners	Stockpiling of dredged material on private land	Ensure stockpile locations are located on Government land	All port dredging locations	When work is under taken.	Contractor	Safeguards advisor
Coastal Resource Users - subsistence	Potential impact on movements of existing subsistence fishers	As per the contract specifications, contractor is to confine activities to as short a period as possible Request Fisheries Authority to advise local fishers of dredging activities, dates, and avoidance measures.	All port locations	When work is under taken.	Contractor	Safeguards advisor
Coastal shipping – recreational boating and commercial shipping	Disruption to shipping during mobilisation and dredging activities	Ensure shipping notice is issued, advising of dredging activities, dates, and safe clearance for other activities. Request Port Authorities to advise local shipping of activities and avoidance measures. Contractors to provide written statement that marine navigation lights and other national maritime measures are closely followed by contractors' vessel at all times.	Port dredging locations	When work is under taken.	Contractor	Safeguards advisor

PARAMETERS	POTENTIAL IMPACT	MITIGATION MEASURES	LOCATION	TIMING	IMPLEMENTATION	SUPERVISION
Coastal Resource Users - all	Restricted access to Port facilities during safety improvement works	Contractor to issue notice to Mariners, Port Operations, ferry operators, tourism operators, commercial fishing fleets, etc, advising of timing and extent of works. Contractor to prepare work plan that enables Port access to be maintained.	Port safety works locations	When work is under taken.	Contractor	Safeguards advisor

8 Grievance Redress Mechanism

A grievance redress mechanism (GRM) is presented below to ensure the Project's social and environmental safeguards performance. The purpose of the GRM is to record and address any complaints that may arise during the implementation phase of the project. The GRM is designed to address concerns and complaints promptly and transparently with no impacts (cost, discrimination) on project affected people (APs). The GRM works within existing legal and cultural frameworks, providing an additional opportunity to resolve grievances at the local, project level.

The key objectives of the GRM are:

- Record, categorize and prioritize the grievances;
- Settle the grievances via consultation with all stakeholders (and inform those stakeholders of the solutions)
- Forward any unresolved cases to the relevant authority.

As the GRM works within existing legal and cultural frameworks, the GRM will have community, project and RMI judiciary level redress mechanisms. Details of these components are described as follows.

8.1 Grievance Redress Mechanism

Many project related grievances are minor and site-specific. Often they revolve around nuisances generated during construction such as noise, dust, vibration, workers disputes etc. These grievances may be community-specific or may relate to other users of the marine areas where dredging and part safety improvement works are proposed.

For all sites the Project Contact Person (PCP) within the MOI PMU will receive, review, record and address project related complaints.

In practice not many complaints are expected with potential some complaints likely to be associated with construction impacts. Most will be received directly on site by the Contractor's Site Supervisor (CSS) who will endeavour to resolve them satisfactorily on site.

The CSS will inform the MOI Contact Person who will relay to the PCP at MOI/PMU the complaints and outcomes, and of others not satisfactorily resolved. At this point the PCP should take over.

The PCPs will, on receipt of each complaint, note date, time, name and contact details of the complainant, and the nature of the complaint in the Complaints Register. The PCP will inform the complainant of when to expect a response. They will then address the complaint to the best of their abilities, as quickly as possible. Should the PCP not be able to resolve the complaint to the satisfaction of the affected persons, they will then refer the complaint directly to the MOI Project Manager (PM).

Complaints referred to the MOI PM will require immediate action to reach a resolution. The aggrieved party will be informed of the course of action being taken, and when a result may be expected. Reporting back to the complainant will be undertaken within a period of two weeks from the date that the complaint was received.

If the complaint is not resolved to the satisfaction of the aggrieved party, the complaint will then be referred by the MOI Secretary to the National Steering Committee (NSC). The NSC will be required to address the concern within 1 month.

Should measures taken by the National Steering Committee fail to satisfy the complainant, the aggrieved party is free to take his/her grievance to the Ombudsman's Office, and the Ombudsman's decision will be final.

It is rare for a complaint to be unresolved after the Ombudsman's decision. However, the very last resort will be redress in the Courts.

Appropriate signage will be erected at works sites providing the public with updated project information, summarising the GRM process and including contact details of the PCP. In

addition, a comments box should be placed in the Airport facility as an additional avenue to receive complaints. Anyone is able to lodge a complaint and the methods (forms, in person, telephone, forms written in Tongan) should not inhibit the lodgement of any complaint.

The Complaints Register will be maintained by the PCP, who will log:

i) details and nature of the complaint;

ii) the complainant name and their contact details;

iii) date;

iv) corrective actions taken in response to the complaint.

This information will be included in MOI's progress reports to the Bank.

Table 8.1 and Figure 8.1 outline the Project level grievance redress process.

8.2 Judiciary Level Grievance Redress Mechanism

The project level process will not impede affected persons access to the legal system. At any time, the complainant may take the matter to the appropriate legal or judicial authority as per the laws of Tonga.

Table 8.1: Grievance Redress Process – Project level

Stage	Process	Duration
1	The Aggrieved Party (AP) will take his/her grievance to Construction Site Supervisor (CSS) who will endeavor to resolve it immediately. Where AP is not satisfied, the CSS will refer the AP to the Project's Contact Person (PCP). For complaints that were satisfactorily resolved by the CSS, he/she will inform the PCP and the PCP will log the grievance and the actions that were taken.	Any time.
2	On receipt of the complaint, the Project PCP will endeavor to resolve it immediately. If unsuccessful, he/she then notify PMU Project Manager	Immediately after logging of grievance.
3	The PMU Project Manager will endeavor to address and resolve the complaint and inform the aggrieved party. The Project Manager will also refer to the MOI Project Manager other unresolved grievances for his/her action.	2 weeks.
If the matter remains unresolved, or complainant is not satisfied with the outcome at the project level		
4	The MOI Project Manager, will then refer matter to the National Steering Committee (NSC) for a resolution.	1 month.
5	If it remains unresolved or the complainant is dissatisfied with the outcome proposed by the NSC, he/she is free to refer the matter to the Ombudsman's Office.	Anytime.
7	If the issue remains unresolved through the Ombudsman's decision then the ultimate step will be for the Courts or Land Court respectively to deliberate. All decisions are final at this point.	

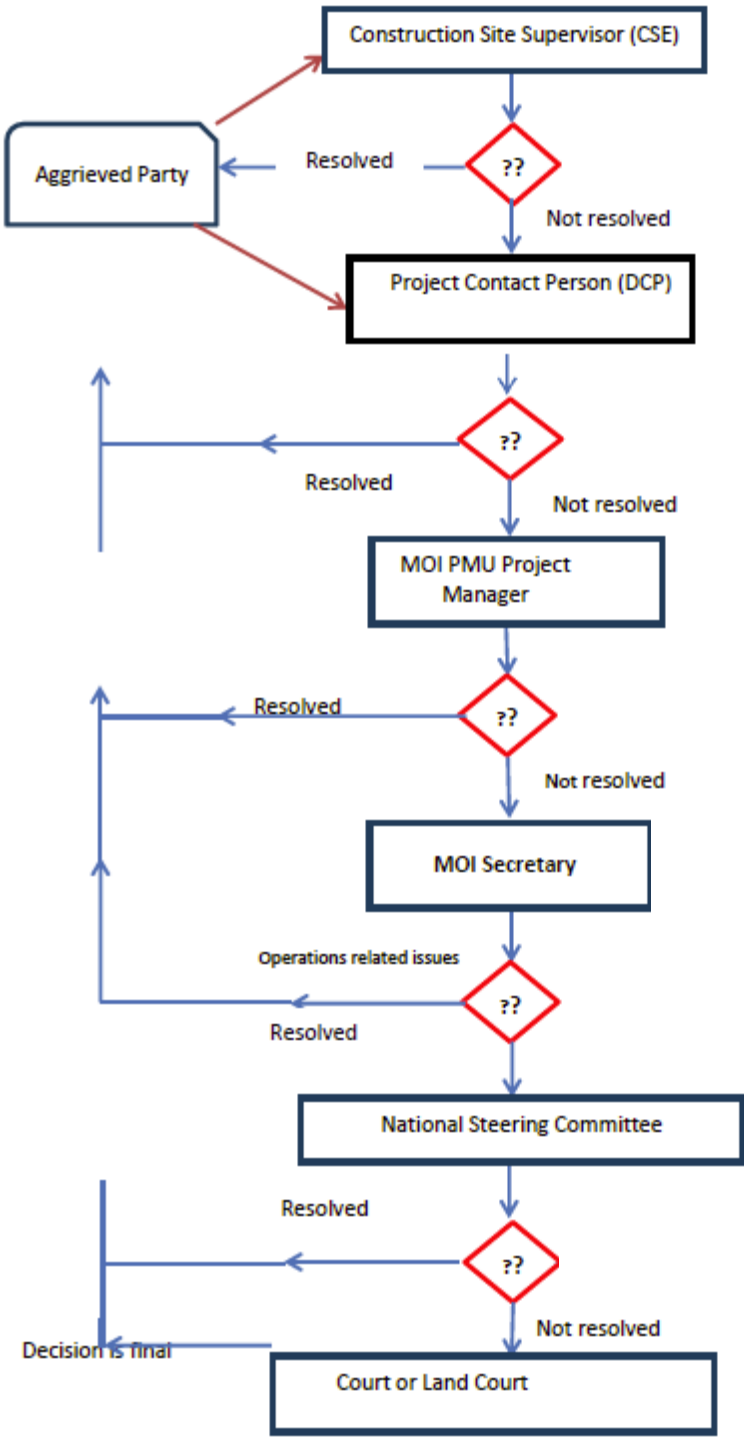

Figure 8.1: Flow Diagram showing Project level Grievance Redress Mechanism

9 Appendices

Appendix 2: Dredged Material Volumes & Locations

Table 2A: Proposed dredging volumes and locations

Place	Depth (m)	Area (m2)									Total Volume (m3)	Remark
		A1	A2	A3	A4	A5	A6	A7	A8	A9		
Niuatoputatu	0 to 2	0	0	1,760	714	1,430	0	0	0	0	3,904	These dredge areas are mainly at channel toward the leading light, 27 meters to the starboard and 20 meters to port when approaching
	2 to 5	3,848	1,163	2,640	3,570	2,145	180	1,425	43	1,081	16,094	
Vava'u	0 to 2	9,600	0	0	0	0	0	0	0	0	9,600	Area A1 are mainly for small local boats in Vava'u but it will be dredge down to the same depth as area A2 to cater for other deeper draft vessel. Area A2 will then dredge with area A3 to same depth for the use of foreign vessel with deeper draft
	2 to 5	0	38,400	0	0	0	0	0	0	0	38,400	
	5 to 10	0	0	64,000	4,950	0	0	0	0	0	68,950	
Ha'apai	0 to 2	0	0	2,520	0	0	0	0	0	0	2,520	Area A1 & A2 outside the harbour must be dredge down to 5m so that dredging within the harbour could go down to match A1 & A2 for deep draft vessel
	2 to 5	41,400	13,500	10,800	0	0	0	0	0	0	65,700	
Eua	0 to 2	4,000	0	0	0	0	0	0	0	0	4,000	The estimation of the volume to dredge at 'Eua harbour would come with the most error since the accuracy of the source of information were it was collected is very low
	2 to 5	6,000	10,512	0	0	0	0	0	0	0	16,512	

Legend

		Total Volume (m3)	
	0 to 2	20,024	These are priority area which may be of interest to local boat in the area as well as to Domestic ferries
	2 to 5	136,706	These area basically intended for the Domestic ferries or other vessels with deeper draft
	5 to 10	68,950	This area in Vava'u Harbour only are intended for Internation vesse with deeper draft than 5m. The draft restriction in Vava'u is 6m and if it require to dredge the wharf for deeper draft vessel, Galloway Rock at 'Utulei will have to go as deep as required for the wharf

Figure 2A: Nuiatoputapu channel entrance

Figure 2B: Taufa'ahau Port and channel entrance at Ha'apai

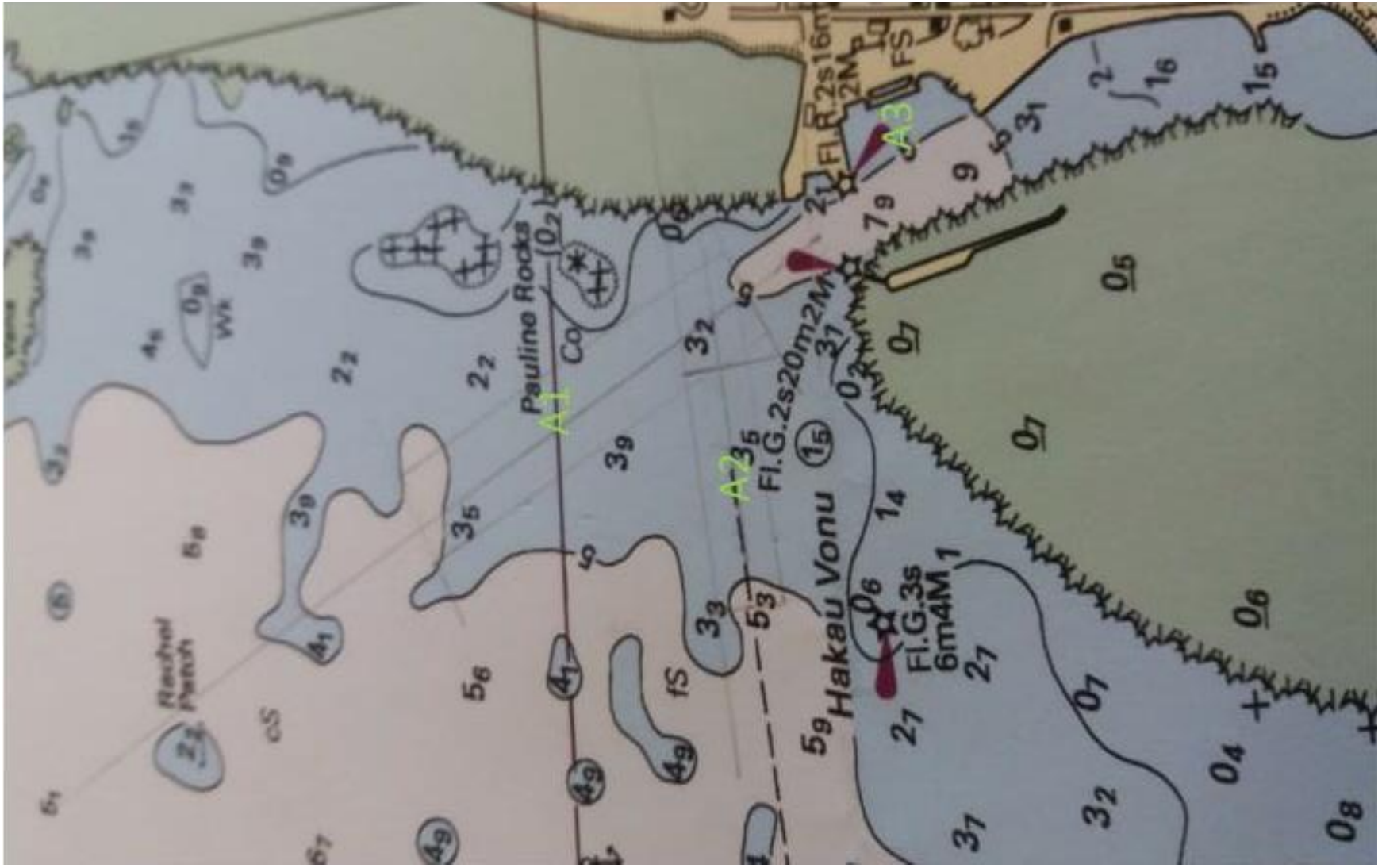

Figure 2C: Halaevalu Port and channel entrance at Vava'u

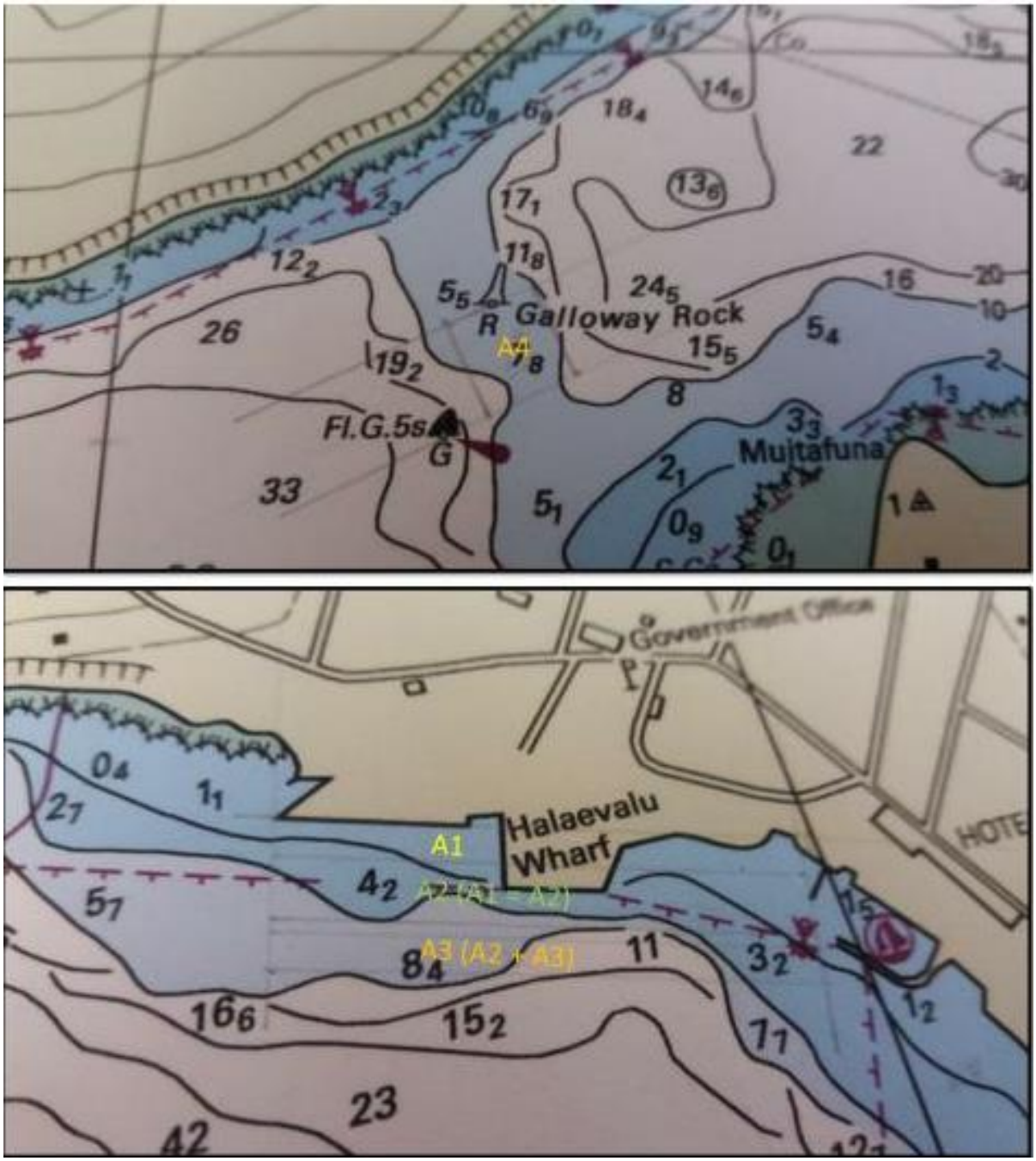

Figure 2D: Nafanua Port at ‘Eua

Appendix 3: Marine Ecological Resource Assessment