Vava’u Marine Services: Vaipua Boatyard Development

Environmental Impact Assessment

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1. Executive Summary

Vava'u Marine Services has proposed the development project outlined below in order to establish a boat haul out and storage facility, especially catering to the requirements of visiting yachts and locally based commercial boats in the Vaipua area on the outskirts of Neiafu, Vava'u.

This EIA is primarily concerned with development activities including the construction of a slipway (92m by 6m) and land clearance of surrounding vegetation as well as specific operational activities with potential negative environmental impacts. The construction of the boat ramp and slipway will require shallow dredging and excavations of patch coral reef on the near shore reef flats. Excavated materials will be used as filling material during construction of the land based part of the boat ramp. Vegetation clearing will be necessary around the seaward boundary of the property to allow boat ramp/slipway construction and access between the sea and boatyard storage area.

At the time of field surveys and report compilation, the permitting process was on-going; therefore the timescales of construction are not yet confirmed, however the contractors have been arranged and therefore design aspects of the project were supplied to the consultant. The proponent was able to supply construction schedules showing works completed within 4 months of permitting approval therefore this timeframe was taken into consideration to describe the environmental conditions inherent to the project site.

Alternative locations and equipment were considered and dismissed for economic and environmental reasons.

There are two main types of potential impacts arising from the development of this project: short term impacts during the construction phase and longer term impacts from irreversible modifications of the site and from boat works activities during the operational phase of the facility. Long term negative impacts due to proposed development are few and have been examined where they occur
No major impacts are predicted by the proposed development project. Several moderate to minor impacts associated with the project have been identified. These impacts range from permanent localised loss of coral habitat and destruction of live coral through to increased sedimentation from the construction phase of the project. Due to the scale of the proposed activities, the duration of the construction phase and the nature of the surrounding terrestrial and marine habitats that would be impacted, the majority of identified impacts are considered short term and/or localised.

All moderate impacts are discussed in detail and several feasible and cost effective mitigations are recommended to minimise the environmental impact of this proposed development. Mitigations recommended include (but are not limited to): the use of sediment curtains to protect significant coral heads and the marine environment as a whole; timing excavations to occur at low tide; using boundary markers for the in-water excavations; installing sand filter traps for the boat wash down area; managing land run off through the use of drainage channels; installing rain water catchment tanks; instigating a reforestation and coral transplantation program.

Impacts relating to hydrodynamics and coastal processes have been difficult to determine as the site may have already changed as a result of impacts associated with previous development works which are more significant and long-term than the proposed project. No information is available for the impacts associated with these historical works (to date, the construction of a bridge adjacent to the site and reclamation of land on the seaward boundary of the site have changed the coastal morphology of the area). Therefore, predicted coastal hydrodynamic impacts associated with this project would be comparatively minor and insignificant.

Appropriate monitoring of construction activities will be part of the development strategy to minimise the moderate and minor impacts that have been identified as well as those unforeseen impacts that have not been identified in the scope of this assessment. In additional to this an environmental management plan has been suggested along with an ongoing monitoring program for the operational phase of the development.

No negative socio economic impacts were identified as a consequence of the project since no local industry would be impacted and no access to fishing grounds would be restricted. Positive socio economic impacts have been identified through the increase in employment and training opportunities for the local population as well as opportunity to increase revenue for local businesses. Additionally, positive social economic impacts will be evident for the local fishing industry given the new opportunity to safely store their boats during storms and cyclones.

Following the assessment of the environmental and social economic impacts, as well as the potential impacts to the social uses of site, it has been determined that the proposed site for the project appears to be suitable for the development. This determination takes into account the environment, construction feasibility and economic values of the proposed development.

2. PURPOSE OF THE REPORT AND NEED FOR THE EIA

This document reports the findings of an Environmental Impact Assessment (EIA) for the construction of a hard stand boat haul out and storage facility (here on referred to as a boatyard) in the Vaipua area of the Vava'u island group in the Kingdom of Tonga. The boatyard operation will consist of a compacted haulage slipway, a graded and sealed land area and related terrestrial infrastructure covering an area of approximately 2.42 hectares. The boatyard will be a facility for the long or short term storage of a maximum of 150 vessels up to 55ft in length with a maximum weight of 30 tonnes.

Following the Environmental Impact Assessment (EIA) Act 2003, approval must be sought from the Tongan Government Ministry for Environment for any predefined major projects that are likely to have an impact on the elements described in the EIA Act. Under Schedule 1 (subsection j) of the EIA Act, this project comprises "of a dry storage area for more than 20 pleasure or recreation craft" rendering it a major project and therefore automatically requiring an EIA to be presented to the Minister of Environment.

Pacific Environmental & Ecotourism Consultancy Services (PEECS) (consultant) has been contracted by Vava'u Marine Services (proponent) to prepare the Environmental Impact Assessment (EIA). This EIA is prepared in accordance with the Tongan Environmental Impact Assessment Regulations 2010 and other relevant regulations and guidelines applicable to the proposed project.

3. Project Description

3.1 The Project

Vava'u Marine Services (VMS) have been operating in Tonga's northernmost major island group, Vava'u, since 2012 running a yacht repair and maintenance business to service the resident and visiting vessels within Tongan inshore waters. VMS have, in a short period of time, developed a successful business model for yacht repairs, however, a gap in the yacht service industry has become apparent and this project seeks to fill that gap. Tonga does not currently have any dedicated boatyard facilities for safe haulage and long or short term storage of yachts, however, VMS has secured land to be able to open such a facility as a development of their existing business. Planning is now focused on the adaptation of the project site by building a slipway to enable the haulage of keel hulled yachts and catamarans. The proposed site will have the capacity to store a maximum of 150 yachts year round. This Environmental Impact Assessment focuses on the proposed development of the existing site to enable boatyard activities and the impacts that this may have on the surrounding natural and social environments.

The equipment being proposed by VMS is based on over ten years experience in the boat yard industry and uses a marinised hydraulic trailer coupled with a heavy torque haulage unit to lift the boats and manoeuvre them into place. There are both environmental and economical advantages to this system including: minimised construction at the shore line, reduced construction footprint in the water, reduced cost of haulage equipment and reduced maintenance requirements.

Buildings left in situ by the previous tenants of the property will be utilised for administration, storage and bathroom facilities which has eliminated the need to construct new buildings at the property.

In order to lift the boats from the water and transport them to the storage area, an inclined driveway and in-water slipway will be constructed. The driveway is planned at 92m long, and 6m wide, extending a maximum of 30m into the water to enable the lifting of boats at all stages of the tidal cycle. The slipway will be constructed from a locally sourced rubble aggregate base, with preformed and reinforced concrete slabs. To achieve the recommended operational gradient of the slipway, clearing of coastal vegetation will be necessary along with dredging or reclamation works in the ocean.

3.2 Project Location

The proposed Vava'u Boatyard is situated 1.5km by road from the main town Neiafu in Vava'u, which in itself is 300km north of the main island of Tongatapu. Specifically, the proposed site is on the south-western end of the Vaipua Bridge, at the entrance of the Vaipua lagoon area. This site falls within an area already designated for commercial development (Pers. Comm. Vava'u Marine Services, September 2013) and is fringed by residential allotments. The coastal areas surrounding the project site are home to established stands of mangrove trees with scattered coral patches between the mangroves and the deep water drop off. Studies of mangroves in the nearby villages of Leiamatua and Tefisi have shown them to be well established, growing ecosystems supporting a variety of species (Vava'u Mangrove Survey, 2012). The area of shoreline directly associated with the proposed site has been previously cleared of mangroves and the land has been reclaimed creating a disruption in the natural mangrove system and allowing for secondary growth of terrestrial flora species.

The project site is directly accessible by road from the main town and is a 4.5km boat ride from the main harbour of Neiafu. A deep water anchor zone is marked off the shore of the proposed site and this is a popular area with larger vessels unable to enter the shallow channel of the main harbour.

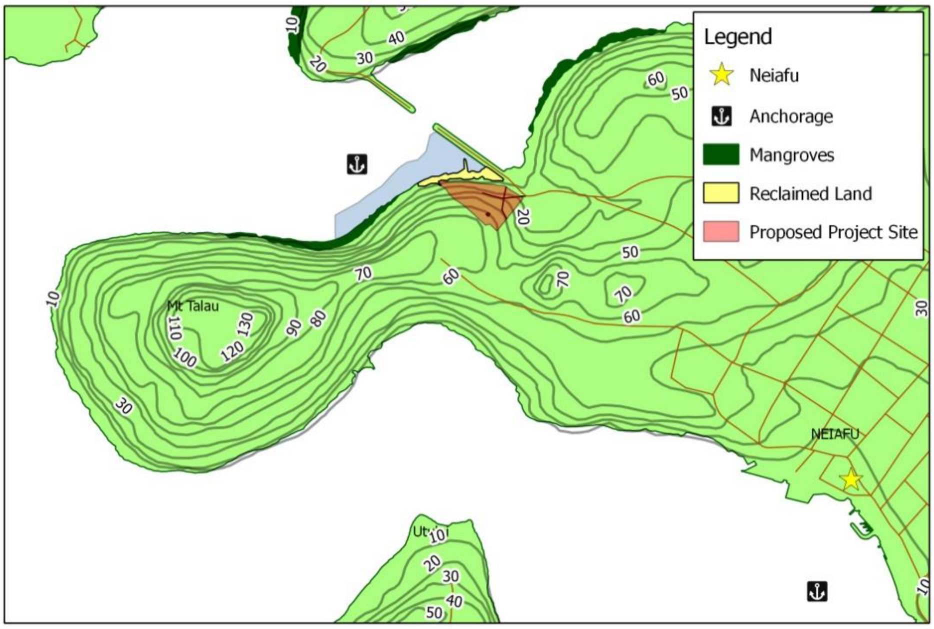


Figure 1: Setting of Proposed site in the contect of neiafu and main anchorage

3.3 NEED FOR THE PROJECT

Vava'u Marine Services is a yacht repair and maintenance business currently operating in Vava'u. Through their daily interaction with and knowledge of the yachting industry, they have identified a need for a hard stand boat haul out facility in Tonga to fill a gap in the South Pacific market and to encourage the yacht tourism industry to become year round. In addition to this, the Tongan government has stated their recognised need and long term desire to fill this gap in the yachting sector (Tonga Tourism Sector Roadmap, 2013)

Yachts arriving in Tonga are able (as of 2012) to get most of their repairs and maintenance needs addressed by Vava'u Marine Services and other businesses, however it has become apparent that there is a definite need for a haul out facility for private and commercial boats under 60ft. There are currently extremely limited facilities to lift boats out of the water and no facilities for hard stand yacht storage. Currently commercial fishing boats are hauled in the unconventional manner of using manpower to carry the boat onto hard ground and the other slipways used for temporary work on yachts are not designed for efficient or safe handling of keel boats. In addition to this there are no facilities available to transport boats onto hard stands for long term storage. A facility allowing for keel boats to be hauled and stored will greatly expand the range of services available to yachts and local boats in Tonga.

Traditionally the yachting season in Tonga runs from May to October to coincide with the calmer trade wind weather with yachts leaving for the security of boatyards and marinas in New Zealand and Fiji for the cyclone season (November to April). By providing the yachts with a secure haul out facility in Vava'u, boat owners will have peace of mind during the cyclone season encouraging more to stay year round. As a consequence there will be an increase in the number of yachts staying in Tonga year-round and a shift towards the yachting season being a year round input to the local economy.

3.4 Location and extent of the site boundaries

The proposed site is formed from a 2.4ha privately owned parcel of land (Fig 1). The land is naturally bounded on three compass points by a road, coastline and cliff face. To the east, the boundary is demarcated by a previously surveyed boundary fence. Beyond the original coastline boundary is now an area of reclaimed land measuring 2,500m² which will be subject to a beach permit allowing Vava'u Marine Services leased ownership of the waterfront and 50m out to sea.

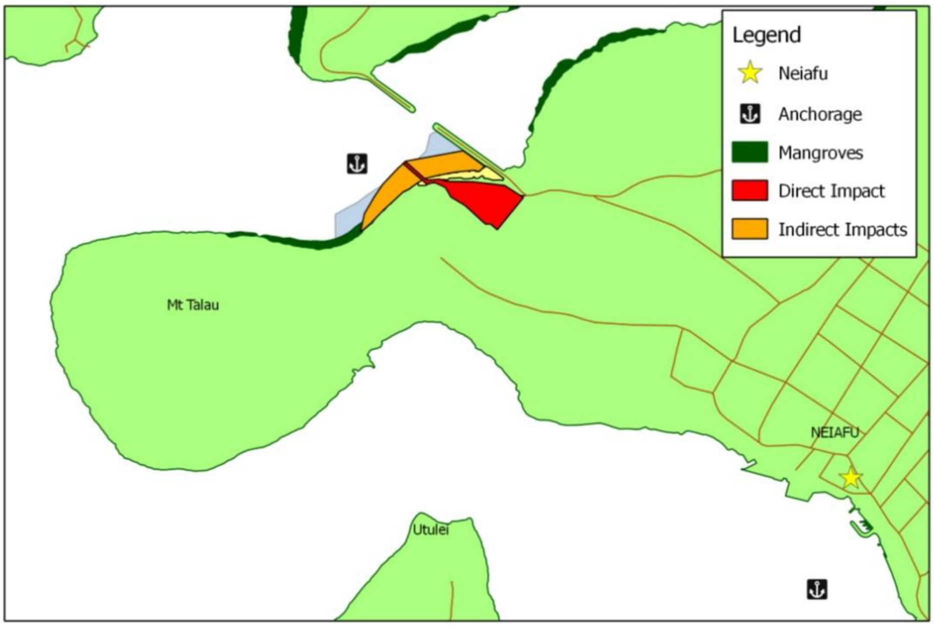


Figure 2: Direct and indirect impact area for proposed development

Direct impact area for the proposed project is the immediate project area, most notably the area proposed for the slipway. Indirect impacts can be expected to the east and west of the project site (Fig 2).

3.5 Construction phases and schedule for implementation

At the time of field surveys and report compilation, the permitting process was ongoing therefore the consultants were not informed of a confirmed time period for the development works. However, according to the contracted project manager, total works are expected to be completed within a maximum of 6 months with an estimated operational opening of October 2014. While this timeframe is not yet confirmed, it was the one taken into consideration to describe the environmental conditions inherent to the project site. All appropriate impacts were assessed for both summer and winter conditions to reflect the duration of the construction phase.

A work schedule for the development has been designed by the project engineer (Table 1). According to this schedule, construction work is estimated to take up to 5 months. The longest aspect of this will be the in-water construction of the slipway, taking up to 3 months. Once this is completed, works will start on adapting the existing land based infrastructure to accommodate hauled boats, machinery, workshops, administration blocks and bathroom facilities.

3.6 Major inputs - construction materials, methods and processes

The consultant engaged to design and project manage the site development has provided information to allow major inputs of the project to be detailed (Appendix 12.1).

Due to the relatively small volume of materials to be dredged and/or coral patch reef relocations in the direct footprint of the slipway, the most economical method of clearing would be with excavators. One excavator will be enough to complete the in-water works for the slipway footprint. For the laying of the driveway, 2-3 trucks, one bulldozer and a front end loader will be needed to move materials and place the preformed concrete slabs. No other in water works are anticipated.

There are no temporary facilities needed for construction workers and the site is connected to the national power grid as well as the local water supply. The existing buildings will be utilised as site office, break room and bathroom facilities.

Most of the input of the proposed project is the construction of the 6m wide, 92m long ($552m^2$) slipway. It is estimated that $1000m^3$ of aggregate will be used to construct the base for the slipway and this will be sourced from aggregate already existing on the site, created during its time as an operational quarry. At the moment, the coastal area of the site is reclaimed land created from quarry aggregate and leads out to a tidal sandy area with some coral patches.

The concrete surface of the driveway is expected to require $85m^3$ ready mix concrete which will be sourced locally and delivered to the site in a cement mixing truck to be poured into preformed and reinforced moulds.

Table 1: Draft 2014 construction schedule for boatyard development

Work Schedule for Boatyard Construction						
Description	March	April	May	June	July	August
Permitting						
Mobilisation						
Land clearing and preparation						
Excavation and dredging works						
Slipway in-fill						
Slipway paving						
Construction of bathroom and administration facilities						

It is anticipated that up to 10 labourers we be employed from the surrounding area for the duration of the construction phase of the project.

3.7 RISKS ASSOCIATED WITH THE PROJECT

The main environmental risks associated with the project are damage to the marine environment due to sedimentation during slipway excavations and construction. Chronic impacts such as this can be cumulative and long term. Coastal modification involved by this proposed project may also have some impacts on the littoral movement of the area, however, significant coastal modifications have already been carried out at the site by the previous land reclamation works and the construction of the Vaipua Bridge, therefore hydrodynamic and littoral impacts by this project is likely to be less significant than large scale modification already made at this site. It is anticipated that any additional impact from the construction of the slipway will be minor in comparison.

Damage to live coral is inevitable in development projects such as these. Significant damage is likely from direct impact during slipway construction. Sedimentation and smothering of live corals and other benthic organisms is also possible in the indirect impact zone to the left and right of the slipway excavations.

In terms of social impacts, noise pollution at the excavation and construction site will be noticeable and heavy vehicles operating in the area may also temporarily increase local traffic. Dust arising from construction work will also have an impact, previous uses of the site have left the site in a dusty state and frequent movement of aggregate and the use of heavy trucks will make this dust airborne during dry times. The operational phase of the project also has the potential to cause a visual impact with the masts of stored boats being visible above the vegetation line, this will be noticeable from directly opposite the proposed site, on the Vaipua Bridge, and from a section of the road leading to the site. The protection given by the cliff faces, surrounding hills and established vegetation will shield the site from view at most angles. Finally, the coastal area of the proposed site is currently used for shell fish gathering. The construction of the slipway will result in a 10m wide stretch of the coastline being unusable for gathering shellfish.

4. LEGAL AND ADMINISTRATIVE FRAMEWORK

This section outlines the relevant national environmental and any international conventions pertaining to the development under study for the construction of a boatyard in Vava'u.

4.1. ENVIRONMENTAL IMPACT ASSESSMENT ACT 2003

Under the regulations of this Act, any major project as defined in Schedule 1 is automatically subject to an environmental impact assessment. Article 4 of the Environmental Impact Regulations 2010 states that:
"The process of environmental impact assessment shall be applied to all major project so classified under Part III of the Act"

Part III of the Act lists the conditions under which an environmental impact assessment might be required of a development by order of the Minister, however the attached Schedule for the Act states that "any of the following shall be deemed major projects":

" ....
(j) marinas (comprising pontoons, jetties, piers, dry storage, moorings) for more than 20 vessels primarily for pleasure or recreation
...."

As the proposed facility involves dry storage for more than 20 recreational vessels and EIA is legally required and this assessment fulfills this obligation.

4.2. ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2010

These regulations describe the process involved in submitting an environmental impact assessment and the stipulations for its contents. These regulations will provide the basis for the scope of this EIA and all requirements have been met.

4.3. MARINE POLLUTION PREVENTION ACT 2002

The following articles of this Act are applicable to the proposed project and must be incorporated into this environmental impact assessment.

Article 7(1) "The scraping and cleaning of hulls and other external surfaces of vessels in a manner that may result in the introduction of non-indigenous harmful aquatic organisms or pathogens into Tongan waters is prohibited"
Article 8(1): "The use and application of anti-fouling paint or systems which contain organotin compounds on vessels less than 30m in length in Tongan waters is prohibited"

Article 9(1): "The discharge, disposal and escape of hull scrapings, paints and paint residues, abrasive blasting mediums and any other pollutants or harmful substance and any other effluent containing such pollutants or harmful substances into Tongan waters from ship repair facilities is prohibited"

Article 9(2): All ship repair facilities shall have in place systems for the effective containment and recovery of all hull scrapings, paints and paint residues, abrasive blasting mediums and any other pollutant or harmful substances and any other effluent containing such pollutants or harmful substances for proper reuse, recycling, treatment and/or disposal in Government approved waste management facilities on-shore"

5. ALTERNATIVES

5.1 NO ACTION

In considering the no action scenario, all significant direct marine impacts can be avoided, however, in the context of supplying Tonga with a hard stand haul out facility for boats, the no action option would not be of any benefit and would be in direct conflict with the Government of Tonga's stated need for such a facility. (Tonga Tourism Sector Roadmap, 2013)

5.2 DIFFERENT LOCATION

The natural topography and bathymetry of Vava'u limits the number of potential locations that a project such as this can be undertaken. The alternative locations considered by the project were at Ano Beach, (Pangaimotu Island) and an area of land used as a staging post for Military Island, near the 'Utanagke causeway on Pangaimotu Island (Fig 3).

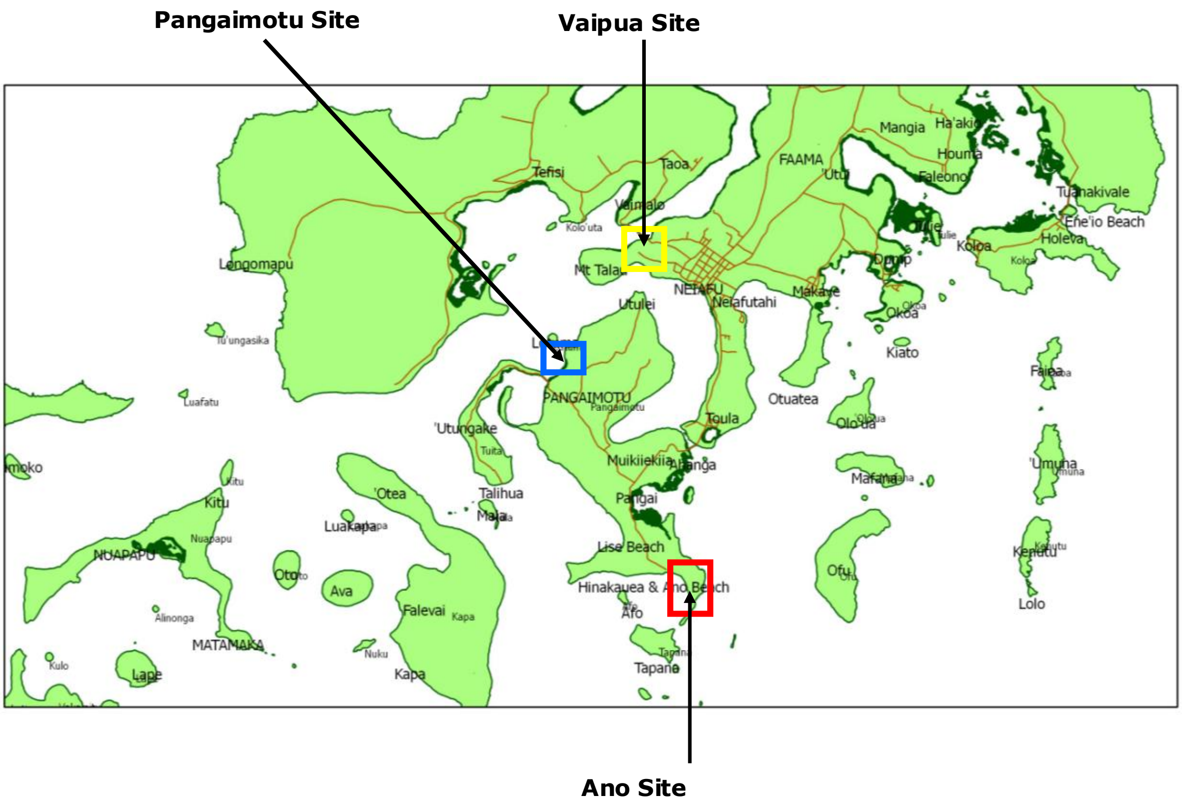


Figure 3: Map showing relative locations of sites considered for boatyard

5.2.1 ANO BEACH

With regard to the Ano Beach area, the potential plot of land is at the far eastern end of the bay, in an area currently used for recreation and local boat mooring. The plot has been approximately measured at 0.75 acres (3,000m^2) with as associated beach width of 12m at low tide. In addition to this, the shallow reef flat extends from the beach for approximately 100m before a suitable depth for a yacht can be achieved, which would require the excavation of approximately 1100m^3 over a 90m length into the ocean (Fig 4). To secure the shore line, significant coastal reinforcement works would be needed and concrete structures would be needed to ensure the stability of the slipway. In addition to this, the site lies at sea level and would be vulnerable to flooding during storms and heavy seas.

Figure 4: Ano beach location with potential construction and excavation zone in red

When considering the socio economic setting, the beach has a small homestead in the centre and a tourist bar/cafe at the western end. Directly opposite the Ano Beach site is also a popular restaurant, a floating art gallery and a mooring field. The area is not allotted for commercial developments of this nature and it is located a significant distance from the main yachting services in Neiafu, with no connection to the national power or water system.

5.2.2 Pangaimotu

This area of land is accessed by a dirt track which starts at the causeway and runs between the cliff face and the mangrove stand. The potential size of the entire plot is approximately 0.5 acres (2,000m²), although currently only approximately 600m² of this is compacted, dry and usable land. The remaining 1400m² is a narrow track and healthy mangrove stands that would need to be removed and the land reclaimed in its place. Additionally, the minimum dredging that would be required to construct the slipway would be an area approximately 55m long and 6m wide, excavating approximately 660m³ in the water (Fig 5).

This area is currently a favourite anchorage of visiting super yachts and is also home to one beach resort and two pearl farms. It is also important to note that the area immediately surrounding this potential site is being considered for the community led Special Management Area program supported by the Ministry of Fisheries (pers. Comm. Ministry of Fisheries, Vava'u, July 2013).

There is potential for connecting to the national power system, but not the ground water system.

Figure 5: Pangaimotu location with potential construction and excavation zone in red and mangrove clearing/land reclamation area in blue

5.3 Alternative Equipment

5.3.1 Mechanised Travel Lift

The alternative boat lifting machinery available for a boatyard is a mechanised travel lift which uses two heavy duty slings to lift the boats out of the water. Travel lifts require significant construction of excavated berths to stage the yacht. The travel lift is then driven on two piers either side of the berth and the yacht is lifted on the slings (Fig 6).

Figure 6: Mechanised travel lift on constructed piers

The travel lift cannot travel well up a gradient and would not be suitable for the proposed site. The economics of this alternative mechanical option with the additional significant dredging and excavations needed to construct the deep water berth make this an impractical option for the proposed site in Vava'u with its hard and shallow marine substrate.

5.3.2 Track Sled System

This system has been applied to a number of existing slipways in the Neiafu harbor (Fig 7) and while they are practical for lifting non-keel boats from the water for very short periods of time (several hours or days), they are not suitable to use in a boatyard environment due to the difficulties and dangers in trying to get a keel hull boat lifted off the sled and stored safety on the hard stand. There are no practical ways of doing this at present.

Figure 7: Example of current boat lifting facilities in Vava'u Harbour

5.4 Environmental Consequences and Mitigations of Alternative

There are significant environmental consequences for the two alternate locations given the amount of dredging that would be required to construct the slipway and/or reclaim land. There would be significant direct impact on the live corals and the mangrove stands in the areas, with indirect impacts reaching ecosystems in the surrounding areas. From a terrestrial perspective there would be significant environmental impact in the form of land clearing and deforestation of areas which are currently highly vegetated. Erosion and run off would have detrimental impacts to the immediate and surrounding marine environmental and coastal stability would be compromised. In addition to this, there would be a significant change of use for these otherwise recreational areas and would have a greater visual and socio economic impact because of this.

However, despite the obvious environmental impacts of the alternatives, the reason that the alternatives have been dismissed by Vava'u Marine Services were fundamentally economic, as the costs of construction would outweigh the feasibility of the business given the small area of both sites and the restricted number of boats that could be stored there compared to the proposed site.

5.5 Preferred Project Action

After evaluating the alternative available to the development of this proposed project, the preferred method that will be the subject of detailed impact assessment is the original proposition of a hydraulic trailer boat lifting systems at the original location in the Vaipua Bridge area. This location allows for the most cost effective method of lifting and storing boats and is the most logistically feasible in terms of its accessibility from public roads and no major alterations to natural environments.

5.5.1 Construction Phase

At the time of assessment, the design process was ongoing; therefore the consultants are not informed of a specific time period for the development of the works. However, according to the partners of Vava'u Marine Services, construction works have to be completed within 6 months; therefore this timeframe was taken into consideration to describe the environmental conditions inherent to the project site. Environmental parameters were assessed to reflect the duration of the construction phase.

Vegetation Clearance

To enable construction work to begin on the yard and slipway, the proposed area first must be cleared of grasses and vegetation (Fig 8). This will be the first stage of the construction process and is expected to take a maximum of two weeks. Vegetation along the boundaries of the property (with the exception of a 15m path for the slipway) will remain undisturbed. Vegetation from the flat storage area and the path of the slipway will be fully removed. The area to be cleared measures approximately 1km².

Figure 8: Vegetation to be cleared on the proposed development site

Slipway Construction

The slipway will have a surface area of approximately 552m², a third of which is underwater at high tide. The in-water element of the slipway will extend approximately 30m (from high tide) into the coastal zone to ensure that boats can be lifted during the both low and high tides. As per the trailer manufacturer's recommendations, the slipway will have a shallow gradient at a maximum of 8 degree incline. To ensure a constant incline between the elevation of the storage area (10m above mean sea level) and the lowest boat haulage depth, some light excavations or dredging will be needed. At the time of this assessment, slipway designs were not finalised and therefore accurate excavation volumes could not be calculated, however, several live corals will be directly impacted by the footprint and construction margin of the slipway (Fig 10). The slipway will be constructed using a mechanical excavator and a front end loader to deposit the required materials from the upper levels of the boatyard. Once this process is completed, the slipway will be compacted by heavy machinery before the surface is sealed with preformed concrete slabs. Unlike many of the slipways currently found on the shoreline of Neiafu, this design will not utilise an artificially constructed apron and will therefore resemble more of a ramp than the more familiar recessed slipway found on harbours or wharfs (Fig 9). It has been estimated that there is enough surplus quarry aggregate abandoned at the boatyard site to fulfil the construction requirements of the slipway construction. Should this prove insufficient in volume, additional aggregate will be sourced from the local quarries in Vava'u and transported by road to the project site.

Figure 9: Example of type of slipway being proposed and a deomstration of how the construction will proceed.

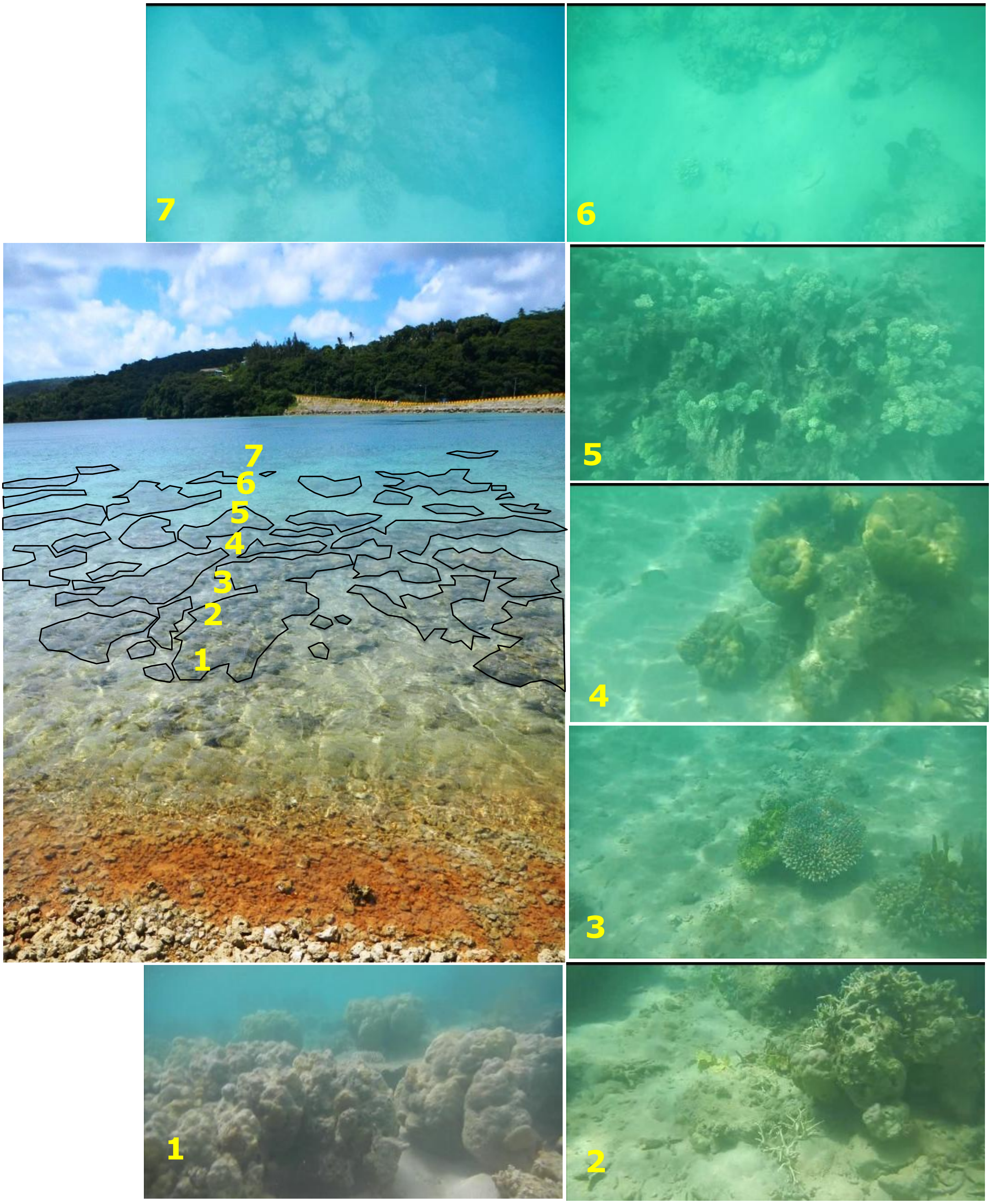


Figure 10: Path of excavation and paving for slipway. Corals to be directly impacted are represented along the slipway route.

5.5.2 Operational Phase

Once the boatyard is operational, it is expected that Vava'u Marine Services will be able to store a maximum of 150 yachts throughout the year. In addition to this there will eventually be an estimated maximum of 50 of short term maintenance haulages for boats throughout the year. Each boat hauled will have all of the bottom growth removed by hand scraping and then cleaned with a 4,000psi pressure washer rated at 3.5 gallons per minute before being moved onto boat stands (Fig 11).

Figure 11: Power washing of yacht hulls will be a frequent activity in the boatyard.

On average, each boat will take between 30 to 45 minutes to pressure wash resulting in the consumption of 105-158 gallons of water per hull, resulting in an estimated annual water consumption of 21,000 – 31,600 gallons on hull cleaning services. The boats will be scraped and washed at the top of the slipway, where it flattens out to become the storage part of the yard. The surface will be canted to direct all of the wash into gravel filter traps on either side of the slipway. All other maintenance works will be carried out in the main storage area of the yard at approximately 10m above mean sea level.

It is expected that most of the boats hauled will have some form of maintenance work carried out while they are stored. Much of the materials and equipment used for this work will be stored at the boatyard in secure areas. It is planned for containers to be acquired in the longer term for storage of materials, however in the shorter term it is likely that these materials will be housed in the pre-existing structures found at the site. The materials stored will include liquids such as anti foul paint, other marine paints, epoxy resin, polyester resin, paint thinner and removers, oil, acetone, caulking, acids, cleaning products and old diesel. At any one time the maximum amount of stores of these liquids is estimated to be enough for 3 to 4 months of operations, at the time of this report, the specific quantities had yet to be determined.

The actual process of hauling and re-launching a boat is estimated to be a maximum of one hour each time. The process will use the hydraulic trailer and the hauling unit which at the time of this report is expected to be a front end loader capable to hauling 50 tonnes up an incline of 8%. The trailer will be maneuvered into place below each boat, lift it off the stands, drive it into the water via the slipway until the boat is able to float off the trailers support pads, the supports are then lowered and the boat can drive, or be towed, into deeper water (Fig 12).

Figure 12: Marinised hydraulic boat trailer and haulage unit to be purchased for proposed project

6. Description of Environment

6.1 General Setting Tonga

The Kingdom of Tonga is comprised of over 170 islands, of which 36 are inhabited; spread over three main island groups (Tongatapu, Ha'apai and Vava'u) with several minor islands distributed over and area of the South Pacific Ocean approximately 800km long and 100km wide. Lying over 1,800km to the northeast of New Zealand and approximately 700km to the south east of Fiji, Tonga is stretches from latitude 15°50' and 23°50' S and longitudes 173°0' and 176°0' W encompassing approximately 400,000km² of territorial waters, running in a north-south line (Fig 13). A little over 100km to the east and running parallel to Tonga is the Tonga Trench running from American Samoa in the north to New Zealand in the south and measuring over 10km at its deepest point. The islands lie within the South Pacific equatorial drift and the dominant current runs southwest. The total land area has been estimated to approximately 700km² (Roy, P.S., 1990).

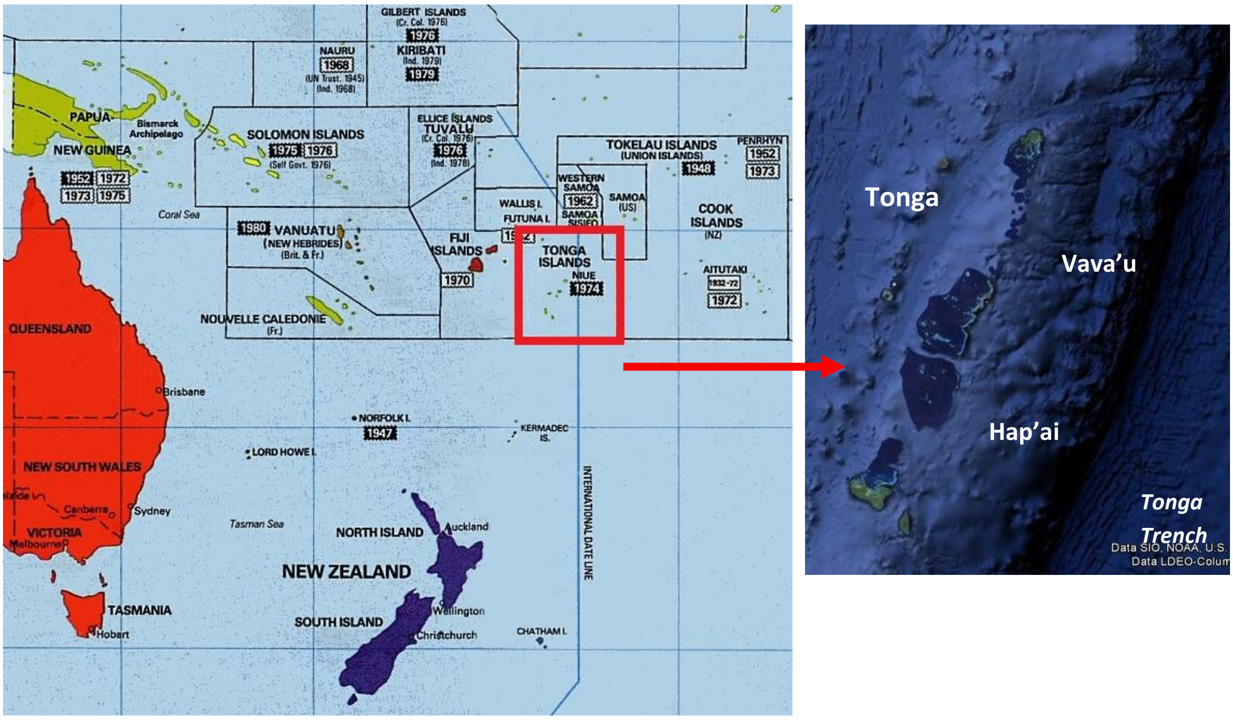


Figure 13: Tonga is located to the NE of New Zealand, on the edge of the Tongan trench

The islands are mainly elevated coral reefs which cap the peaks of two parallel submarine ridges, with some having volcanic origin. The region is geologically active, with earthquakes a common occurrence and volcanic eruptions known in recent times. The three main island groups of Tonga are coralline and limestone islands. Tongatapu (265km²) and Ha'apai (119km²) are both formed of low lying coral limestone islands, although Ha'apai does have some elevated volcanic islands to the west. Vava'u (143km²) is the northernmost of the three groups and is classified as raised coral limestone islands with some volcanic islands to the southwest. The minor island group of the Nieus (350km to the northwest of Vava'u) are volcanic in origin and cover an area of 71km² including lakes (Roy, P.S., 1990).

6.2 Geographic location and general setting of the project site

6.2.1 Island setting

The island group of Vava'u, specifically the main town of Neiafu, lies at coordinates 173°59'12"W and 18°38'56"S and is about 300km north east of the main city Nuku'aloafa in Tongatapu. Vava'u itself is comprised of one large main island measuring 90km² and 69 outer islands (Fig 15). Of these 70 islands, 17 are inhabited with a total population of 15,500 (Census 2011 Key Indicators, 2012), although 4,000 of these live in the main town of Neiafu. The Vava'u group measures 21km from east to west and 25km from north to south. Vava'u is a series of coral limestone islands, with impressive oblique cliffs along the northern most coastline up to 200m in height (Fig 14, 16).

Figure 15: Vava'u showing main island and southern scattered islands

Figure 14: Cliffs of the northern coast of Vava'u

The south of the island group is a collection of small, low lying coral reef islands and waterways. The main island is a raised platform of coral cliffs on the north coast and a low and irregular coastline to the south that opens in a complex network of channels, bays and islands forming one of the best natural protected harbours in the Pacific.

Figure 16: Flatter sandy coral island of the southern Vava'u islands

The specific site proposed for this project is an area on the main island of Vava'u known as Vaipua. Located towards the centre of the islands southern coastline, Vaipua sits at the entrance to the large Vaipua inland waterway. The centre of the site is located at 173°59'35"W and 18°38'39"S and originally had an elevation of 70m. Limestone quarrying activities have left this 2.42ha plot lying at 10m, approximately 20m inland from the shoreline. The site has a north northwest aspect and is sheltered at all points of the compass from the surrounding cliffs and islands. To the north of the site is the Vaipua bridge providing access to the western side of the main island and the main road providing direct access to Neiafu.

6.2.2 Current Use

Classified as rural seaside property the land was initially used commercially as a quarry for supplying graded aggregate to the building industry. Appropriated/leased by the Tongan Government in late 2011 the site was used as site base for the construction of the new causeway and bridge linking Neiafu with Muihoea (pers. obs. January 2012) (pers. comm. Vava'u Marine Services, September 2013).

The site is located on the western outskirts of the Neiafu urban areas. The closest settled area is 0.35km east of the proposed site, although the urban area of Neiafu known as Mount Taulau is directly above the proposed site at an elevation of 70m, 60m above the proposed site. The population of the Neiafu district itself is a little over 5,500 (Tonga Tourism Sector Roadmap, 2013) in an area measuring approximately 6.5km² with a resulting population density 846 people per km². This would indicate that there are approximately 846 people living within 1km² of the proposed site. There is an uninhabited 250m wide buffer belt around the landward side of the proposed site.

The intertidal zone along the coast of the Vaipua area is an area of subsistence shell fishing, with several recent small middens found on the shore line and within the property itself. Regular observations of the shoreline at low tide has not resulted in any observations of shell fish harvesting so it is concluded that this is an occasional use site with minimal economical importance, but may have cultural and traditional use importance (pers. obs. November 2013).

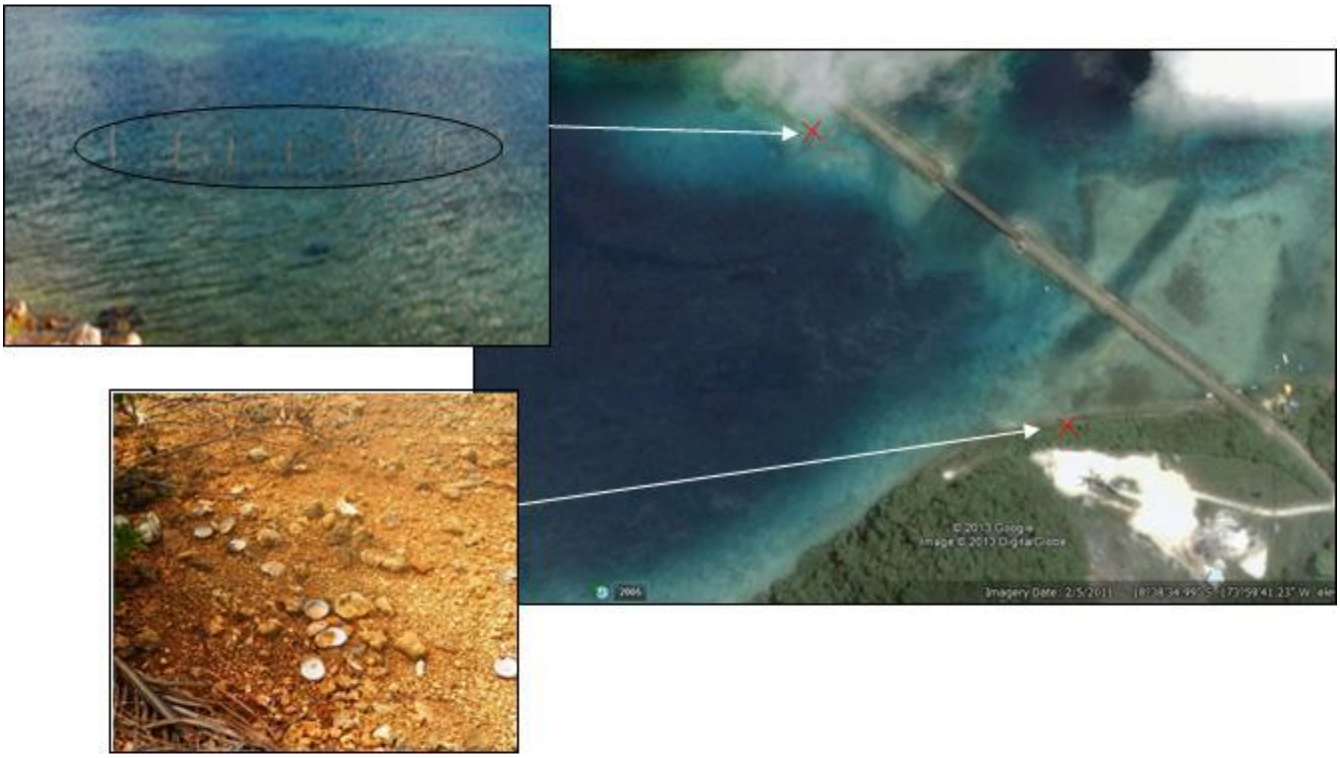


Figure 17: Small scale shellfish harvesting and pandanas soaking for weaving happen in area of the proposed project

Near shore, at the base of the bridge pilings approximately 120 – 200m away from the proposed slipway site, there is direct observation of the waterway at the base of the Vaipua Bridge being used as an area to soak the pandanas leaves which are used to weave the traditional mats. This is a culturally significant tradition and the source of much of the local handicraft based income (Fig 17).

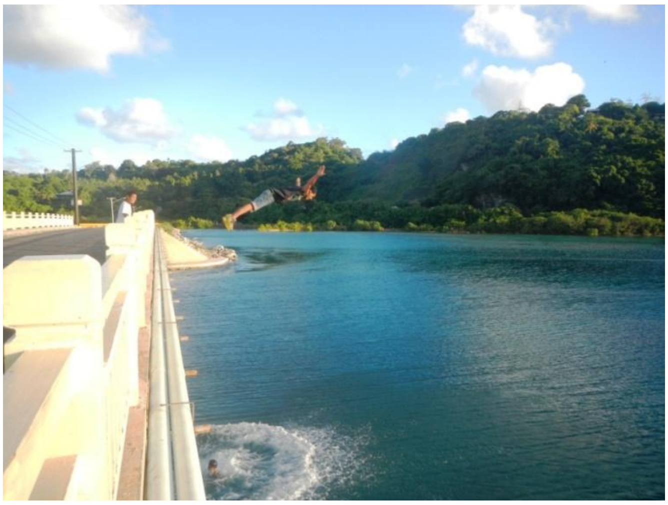


Figure 18: Swimming is also a favourite pastime in the vicinity of the project site

After completion of the bridge in early 2013 the site was vacated and returned to the owners. What remains is a flat, well graded and compacted sub surface excavated well back from the boundary markers and gently sloping to the water edge.

6.2.3 Accessibility

There is good existing accessibility to the proposed site from the main town of Neiafu which is a mapped, accessible road. In addition to this, the site is accessible from the water. Large vessels are able to anchor just off the shoreline, and currently small non-keel boats such as tenders and dingys are able to land on the shore directly at high tide.

Water and electricity is supplied by the applicable local authorities. A sewerage system in the form of septic tanks and soak-aways are in place and functional.

6.3 Climate Summary

The climate of Tonga is tropical throughout the year and is divided into two predominant seasons, a wet (Nov-Apr) and dry (May-Oct) season. The annual rainfall for Vava'u is approximately 2500mm per year, with 60-70% of that falling during the wet season (Table 2). The wettest month is March and the driest month varies between June and July which will be an important consideration for the development of this project. Tonga lies within the tropical cyclone corridor although instances of major cyclones are infrequent here with only four cyclones passing directly over Vava'u between 1945 and 2013 (URL 1).

Table 2: Climate data for Vava'u (1990-2003)

Month	Mean Temp °C		Mean Total Rainfall (mm)	Mean Number of Rain Days ('99-03) [>0.1mm]
	Daily Minimum	Daily Maximum		
Jan	23.4	30.3	254	19
Feb	23.5	30.5	268	20
Mar	23.5	30.5	283	21
Apr	22.9	29.5	209	18
May	21.6	28.1	107	15
Jun	21.0	27.5	115	15
Jul	20.0	26.6	107	16
Aug	20.1	26.7	100	14
Sep	20.7	27.1	133	13
Oct	21.5	28.0	138	14
Nov	22.4	29.1	135	14
Dec	23.1	29.7	234	19

The mean annual temperature for Tonga varies across latitude between the ranges of 23-28°C while the mean humidity persists at 75%. Higher latitudes show higher mean temperatures, resulting in an average annual temperature in Vava'u of 26.5°C. Daily highest temperatures are generally highest in February, with the coolest months being July and August (Table 2).

Winds over Tonga are dominated by the south east trades (Fig 19) which generally blow between 12-15 knots although, the wind speeds tends to be a little stronger from May to October (URL 1).

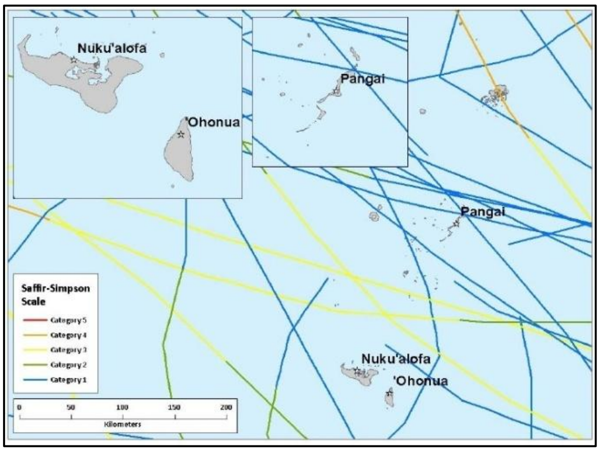


Figure 20: Selected historical tropical cyclone activity in Tonga 1945 - 2008

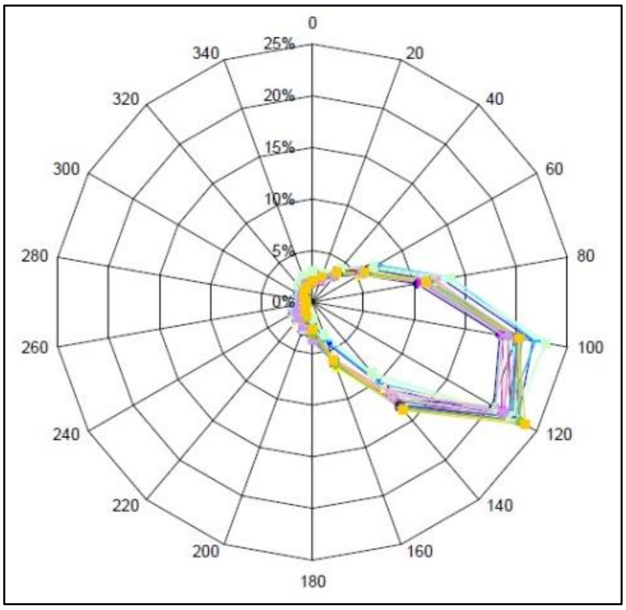


Figure 19: Tonga islands wind atlas, wind rose 1987 – 2001

Tropical storms and cyclones will also dramatically change both wind speed and direction as they pass during the November to April season. Cyclones and tropical depressions are at their most frequent in February, with an average of 1 or 2 cyclones affecting the 900km stretch of country each season (Fig 20). During El Nino years there is a noted increase in cyclonic activity with the 2002-2003 El Nino cyclone season bringing 5 cyclones through Tonga, with 3 of these causing severe damage to southern Tonga (Bouisset, S., & Hannaton, D, 2006).

6.4 Oceanography

Tonga is in an area of the South Pacific region known for having a semi diurnal tide type, characterized by two high and low tides in the course of 24 hours (URL 2). The tidal range in Tonga varies with the lunar cycle and ranges between 0.16 – 1.63m above chart datum (URL 1). Tidal cycles in Vava'u affect only the very near shore areas where the reef flat is a very gentle slope until the drop off is reached. At the Vaipua study site, the drop is approximately 70m from the shoreline, resulting in a 70m stretch of tidal influenced reef flat.

The construction of the Vaipua Bridge has greatly altered the hydrodynamic quality of the water immediately adjacent to the proposed site. The bridge is constructed in a manner that forces the tidal flow through two narrow culverts on both landing points, and also through the main length of the bridge which measure 15m of the total 400m long bridge. Figure 21 shows the flow of water experienced four times daily at peak tidal flow (2-4 hours before and after high and low tides) (pers. obs, November 2013). No baseline current data for the Vaipua area is available prior to the construction of the original causeway or the replacement bridge. Therefore, for the purposes of this assessment we can state that no original current system remains in the localised area. The artificial currents are rapid in their extremes as they flow under the bridge span. This rapid current has the effect of creating eddies near to the shore, with frequent spells of slack tide.

Figure 21: Unnatural current patterns and flow rate following the construction of the Vaipua bridge

Table 3 shows a set of physiochemical data for Vava'u. This 1996 data provides a baseline for comparison across the island group. The proposed development site is labeled at Lower Vaipua. These parameters were measured during the field survey for this assessment and the results for the Lower Vaipua area reflected those in table 3 giving us a stable baseline of data pre-construction (Tanaka, H. & Yamamoto, T., 1997).

There is little documentation on the benthic composition of Vava'u as a whole, however, direct observations at the proposed site and at several other similar locations in Vava'u confirms a typical composition of sandy/gravel reef flats with coral rubble and patch reef found to the drop off points. The composition of the substrate and patch reef is discussed in more detail in section 6.5 of this assessment.

Table 3: Baseline Physiochemical parameters of Vava'u waters 1996

Site No.	Water Temp. (°C)		Salinity (%)		pH		Diss. Oxygen (mg/l)		Conductivity (ms/cm)		Turbidity	
	0 m	10 m	0 m	10 m	0 m	10 m	0 m	10 m	0 m	10 m	0 m	10 m
Neiafu Bay	25.5	25.3	3.01	3.04	8.33	8.34	6.86	6.85	46.2	46.6	0	0
Muitatau	25.4	25	3.01	3.04	8.36	8.37	6.76	6.69	46.1	46.6	0	0
Lotuma	25.5	25.2	3	3.03	8.37	8.37	6.82	6.82	46	46.4	0	0
Falevai	25.3	25.1	2.95	3	8.18	8.18	6.78	6.87	45.4	46.1	0	0
Lape	25.1	25	3	3.02	8.18	8.17	6.96	6.88	44.8	46.3	0	0
Valetoa Bay	24.8	24.8	2.98	3.02	8.09	8.11	6.62	6.68	45.7	46.3	0	0
Pangaimotu	25.4	25	3	3.03	8.28	8.3	6.97	6.97	46.1	46.5	0	0
Tapana	25	24.9	3.02	3.05	8.31	8.32	6.81	6.8	46.4	46.7	0	0
Makave	25	24.8	3.03	3.05	8.36	8.37	6.96	7.02	46.5	46.8	0	0
Oloua	24.9	24.8	3.03	3.05	8.36	8.37	7.01	7.15	46.4	46.7	0	0
Kiato	24.9	24.7	3	3.04	8.38	8.38	7.18	7.1	46.1	46.6	0	0
Lower Vaipua	25.4	25.1	2.97	3.01	8.36	8.38	6.82	6.89	45.6	46.2	0	0
Middle Vaipua	25.2	25.1	2.99	3.03	8.35	8.37	6.72	6.8	45.9	46.4	0	0
Upper Vaipua	26.1	25.7	2.91	2.97	8.27	8.31	6.54	6.71	44.8	45.6	1	1

6.5 Terrestrial Environment

The terrestrial environment of the proposed site has been heavily altered over the course of the past 30 years. The site was originally a contoured area, in alignment with the cliffs on the southern boundary reaching a height of 70m above chart datum. The extreme alterations made while the site was a quarry have left it totally altered from its original state with no primary vegetation remaining and grasses along with the invasive Siale Mohemohe (*Leucaena leucocephala*) species of tree dominating the vegetation.

6.6 Coastal Environment

Significant alterations and modifications have been made to the proposed sites shoreline over the past 40 years. Among the modifications, the construction of a causeway and then the replacement of the this causeway with a bridge to the immediate north of the site, land reclamation at the site itself and the blocking of the tidal flow to the Vaipua inlet from 2010-2012 (pers. comm. VEPA, November 2013) due to the construction of the Vaipua Bridge have significantly impacted the coastal environment of the site. The shoreline is relatively stable in the area because; the extensive mangrove system to the south, the natural bay formed by the cliff and the reclaimed land to the north of the site act as terminal groynes, trapping the sediments and bringing little change to the shoreline during the seasons. The surrounding coastal area is thick with mangrove ecosystems with the proposed site, the only area which has long been cleared of any mangrove vegetation. This protecting habitat ensures coastal stability during storms and cyclones.

The vegetation found at the shoreline in the vicinity of the proposed site is comprised of two main zones. To the south of the site is the start of an extensive mangrove system which appears undisturbed and healthy, this also continues north of the Vaipua Bridge. The second zone is the land immediately bounding the property in which the vegetation is formed of secondary growth following the removal of mangrove areas and the reclamation of land. The vegetation there is dominated by three species, of which two are invasive and are reported as being of high risk (Flyn, T. & Space, J.C., 2001): Siale Mohemohe (*Leucaena leucocephala*) and Sita (*Melia azedorach*). The third dominant (and native) species is the Sea Hibiscus (*Hibiscus tiliaceus*). There are signs of some mangrove regeneration, with the northern end of this secondary zone becoming populated with a number of mangrove seedlings. It will be important to maintain the integrity of this area to ensure the successful regeneration of these mangroves.

6.7 Marine Environment

6.7.1 Introduction

It is necessary to describe the current status of the environment and also to establish a baseline for monitoring possible impacts elated to the project on major marine habitats. In order to assess the status in the vicinity of the proposed project location, a survey was undertaken. Documenting the status of the reef benthic community prior to the start of construction works of the project was considered a major component of the marine environment that could be used to monitor impacts to the marine environment especially due to the project construction and operation activities.

6.7.2 Methodology

The reef benthic community in the vicinity of the proposed site was studied using standard marine survey methodologies. These include photographic quadrate survey method for the assessment of the reef benthic community and the visual census methodology for the assessment of the fish community. One square meter frame was used along four 20m fixed transect lines parallel to the shore at 2m and 5m depths in the indirect-impact vicinity of the proposed project area, north and south of the planned slipway area. Photographs were taken every three meters along four 20m transect lines (English et al, 1997). The same transect lines were used as the basis for the fish survey to assess the abundance and diversity of reef fish at the time of the survey. The locations of the reef surveys are given in figure 22. To record the benthic community in the direct impact zone of the slipway, two 20m transects were placed within this excavation zone, perpendicular to the shore, and one meter square quadrate were recorded every three meters. These survey methods are widely practiced in coral reef ecological surveys in many coral reef areas of the world and the methodology is described in the survey manual for tropical marine studies.

Figure 22: 20m Transect locations for the marine environment survey. Direct slipway impact area is marked in blue and indirect impact zones are marked in orange.

The fish survey was performed as a roving snorkeler survey and all species within 1m belt of the transects were recorded. Surveys were performed for the duration of the reef benthos survey, which was performed simultaneously by a second surveyor.

6.5.3 Results and discussion

6.5.3.1 Reef Benthos

The reef comprising the foreshore area of the proposed development site is a patch reef and sand system commonly found on the shallow reef flats around the coastline of Vava'u. This reef leads into typical coral reef system as the water deepens and drops off at the edge.

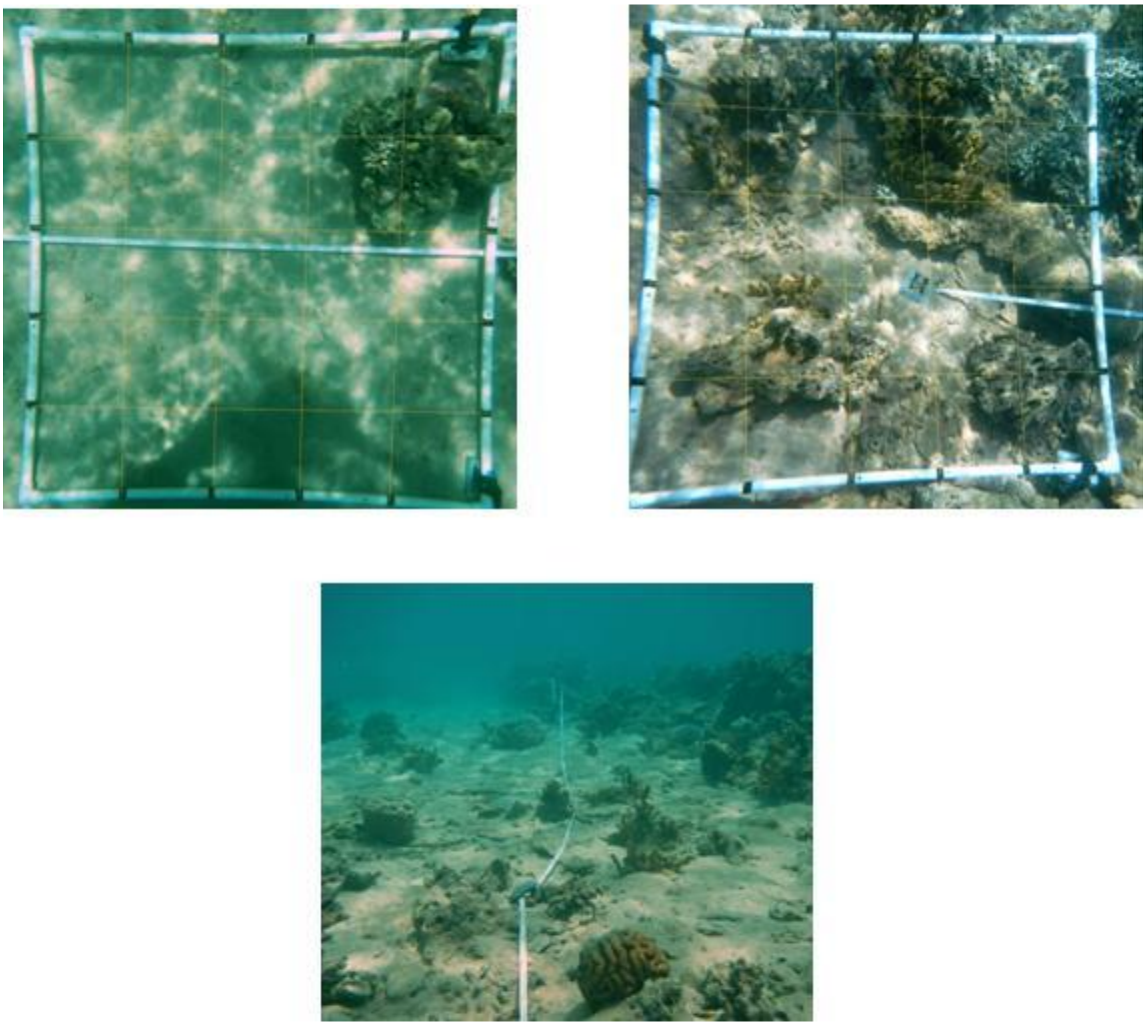


Figure 23: clockwise from top left: typical representation of benthos recorded on the transects in the excavation zone for the proposed slipway (T1 (l) and T2 (r)). The view looking back long the T1 transect within the excavation zone.

Live coral cover was moderate over the extent of this survey. Live coral cover averaged 19% (range 6 – 32%) coverage over the direct and indirect impact areas. Sand was the most abundant substrate type, averaging 63% coverage with dead coral, rock, algae and sponges making up the remaining 18%. When looking at the actual excavation zone, live coral coverage accounts for 16.5% coverage and sand, again is the dominant substrate with 63% coverage (Fig 24). There were no recorded occurrences of coral disease or damage caused by the Crown of Thorns starfish, and no recorded evidence of coral bleaching. Algae was more prevalent in the shallower transects, indicating a lack of herbivorous fish species, however this was not wide spread and does not indicate an unhealthy patch reef system. Very few coral recruits were observed on the transects indicating that this area may be unsuitable for the juvenile coral survival possible due to the increased turbidity that the area suffered during the 2009-2012 Vaipua bridge construction. During this time water flow into the Vaipua lagoon was blocked and the seaward side of the causeway became stagnant and highly turbid (pers comm., K. Cass, November 2013).

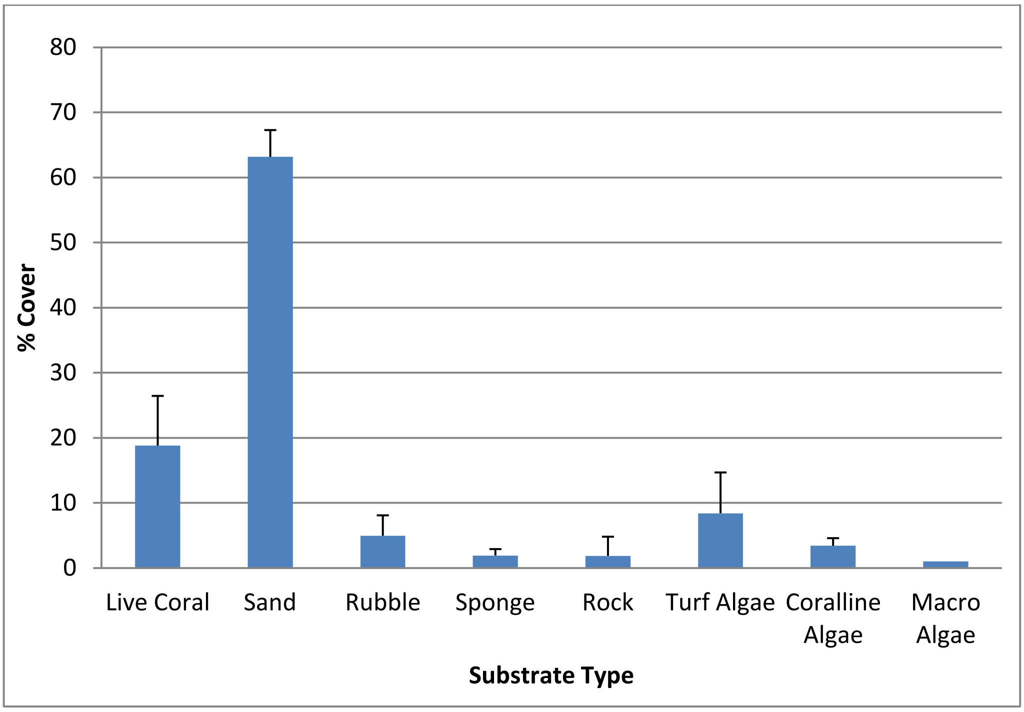


Figure 24: Reef substrate category for the vicinity of the proposed development site. Upper 95% confidence interval for each category is shown. N=6.

Coral communities were dominated by *Porites* species, with the shallower areas being dominated by *Porites sp* micro atolls. *Acropora sp* were the second most abundant corals (Fig 25). Four massive *Porites sp* coral heads were found outside the survey area in deeper waters, but were considered to be in close enough proximity to warrant including in this discussion as important coral reproducers and specimens of significant age. Coral diversity was low on all surveyed transects with 12 species being identified to at least genus level (Fig 25).

A previous study in the same vicinity (Holthus, P., 1996) reported similar results on reef benthos. Direct comparison can be made on live coral cover reported at the same site for a marine survey of the Vava'u group by Holthus on behalf of the Ministry of Environment in 1996. Live coral cover in this study for the outer Neiafu harbor area, which included the Vaipua site, was between 10-30% live coral cover. This is in agreement with the coral cover estimated in this survey.

Coral diversity was higher and corals were larger and in more established patches on the deeper transects (T4 & T5) in the indirect impact zone. The path for the slipway chosen by VMS has been done in such a way to minimize the number of larger coral patches in the excavation zone (Fig 26).

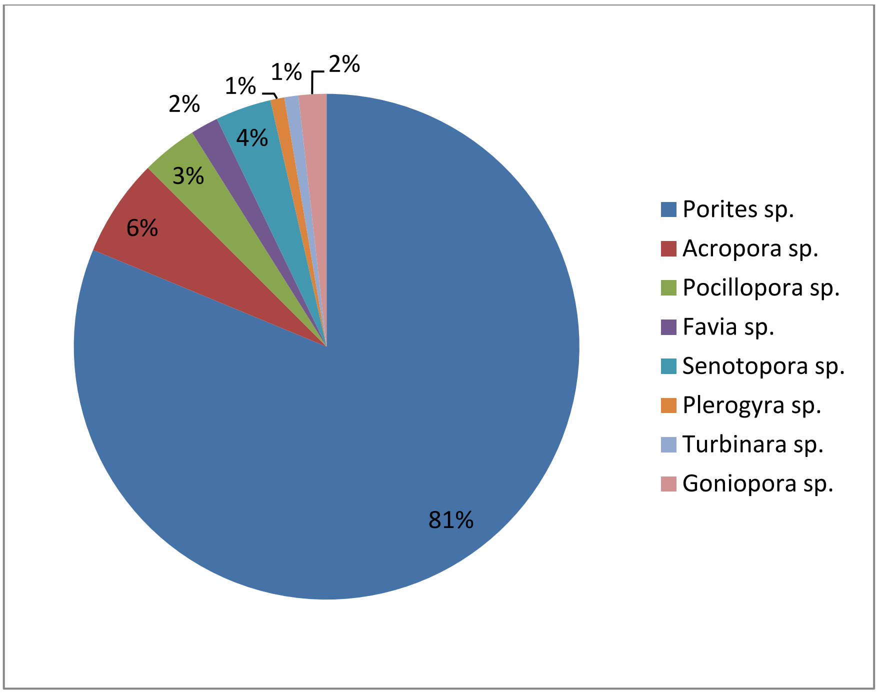
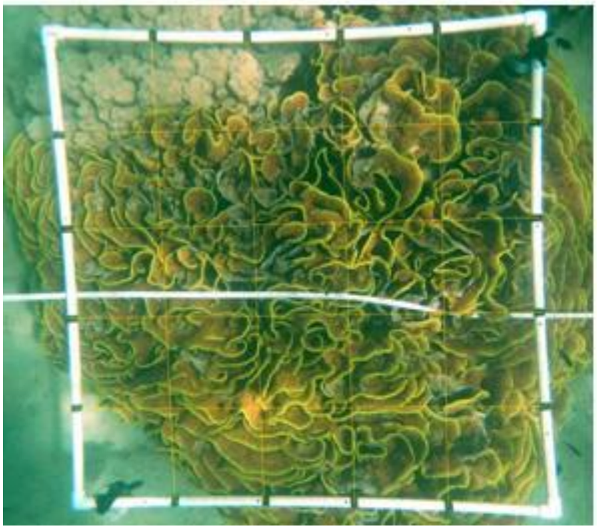


Figure 25: Relative abundance of coral species grouped by genus for the survey site



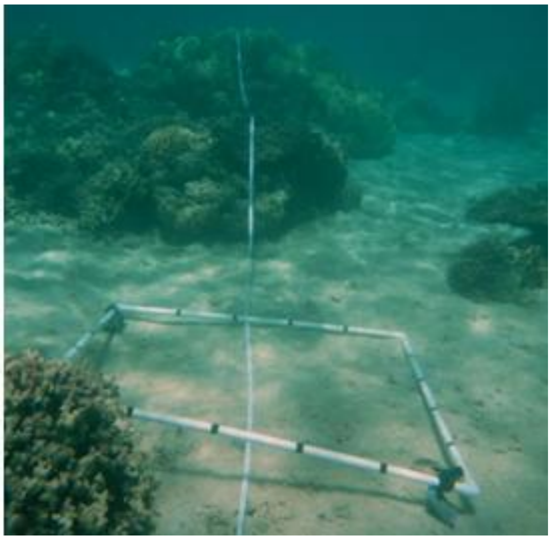


Figure 26: Examples of larger coral patches found outside the excavation zone. A large Cabbage Coral (*Turbinaria reformism*) (l) and a more developed patch reef system (r) dominate the deeper waters of the indirect impact zone.

The 1996 survey coincided with the construction of the Vaipua causeway and the unchanged state of the marine environment between the two surveys (1996 and 2014) demonstrates that the patch reef system in the shallow reef flats is resilient to the affects of occasional in-water construction works such as those proposed by Vava'u Marine Services. While this proposed development will have irreversible impacts on the coral community within the 300m² excavation zone, it is probable that with correct mitigation measures, the long term health of the surrounding reef can be maintained.

6.5.3.2 Reef Fish Community

The reef fish survey produced results that would be expected from this type of marine environment. The results produced 45 species of fish (32 identified to species level, 13 to genus level) belonging to 19 families. Schools of anchovy species were observed forming within the shallower waters of the survey site. The relative abundance of the reef fish in the survey site were grouped according to single, few (2-10), many (11-100) and abundant (101+) and these values are group as families and displayed in Table 4. Damselfishes are found in high numbers across the survey site and this could be the reason for the apparent health of the reef and few areas of algal dominance. Butterflyfishes are also found in high numbers and diversity which reflects the healthy and diverse nature of the coral patch reefs. Commercially valuable fish species such as snappers and parrotfish are found at this site but in few numbers, with the exception of the anchovy which are a popular bait fish species.

Table 4: Fish census survey results showing number of species grouped by family and the relative abundance of each family using REEF standardised methodology. Relative abundance categories are: Abundant (A) n=101+, Many (M) n=11-100, Few (F) n=2-10 and Single (S) n=1.

Name		Number of Species	Relative Abundance
POMACENTRIDAE	*Damselfishes*	8	A
CHAETODONTIDAE	*Butterflyfishes*	4	M
LABRIDAE	*Wrasses*	4	F
SCARIDAE	*Parrotfish*	4	F
ACANTHURIDAE	*Surgeonfishes*	4	M
ENGRAULIDAE	*Anchovies*	2	A
MULLIDAE	*Goatfish*	2	F
BLENNIIDAE	*Blennies*	2	F
GOBIDAE	*Gobies*	2	F
SIGANIDAE	*Rabbitfishes*	2	F
TETRAODONTIDAE	*Puffers*	1	F
HOLOCENTRIDAE	*Soldierfish*	1	S
AULOSTOMIDAE	*Trumpetfish*	1	S
FISTULARIIDAE	*Cornetfish*	1	S
LUTJANIDAE	*Snappers*	1	F
POMACANTHIDAE	*Angelfishes*	1	F
ZANCLIDAE	*Moorish Idol Fish*	1	F
BALISTIDAE	*Triggerfishes*	1	F
OPOTOGNATHIDAE	*Jawfish*	1	S
SYNODONTIDAE	*Lizardfishes*	1	S

6.5.3.3 Invertebrates

Very few invertebrate species were seen during the field surveys, since most are cryptic in nature and nocturnal species hiding under rocks and crevices. Two species of sea cucumber were observed at the survey sites, Lollyfish (*Holothuria atra*) and Snakefish (*Holothuria coluber*) both of which are commercially important species and both of which are found in low numbers at this site. Two species (*Linckia laevigata* and *Choriaster granulates)* of star fish were also observed. The Long Spined sea urchin *Diadema setosum* was also present but in low numbers and dispersed over the survey site. Several clam species were also observed in low numbers and identification of these species was not possible.

6.5.3.4 Protected Marine Species

No protected marine species were observed.

6.8 Social Environment

The Vaipua village, located within the Neiafu district is a residential area on the outskirts of the main Vava'u town of Neiafu. Population estimates of Neiafu (which includes Vaipua) in the 2011 census show over 4,000 people which is also reflected in the 1986, 1996 and 2006 (Census 2001 Key Indicators, 2012) census reflecting a stable population in the area and perhaps reflects the migration of people to the capital island of Tongatapu and abroad to New Zealand and, to a lesser extent, Australia.

Since Vaipua is so closely located to Neiafu, all the basic infrastructures such as schools, health services, electricity and town water are installed and available. The majority of the working population of Vaipua are employed in Neiafu which is a short walk away; no public transportation exists for the village. There are several small shops selling basic provisions and a new petrol station which is helping to encourage economic development in the area.

The majority of the area is zoned for residential use with smaller plots being made available for commercial and agricultural use.

7. Environmental Consequences

7.1 Introduction

7.1.1 Areas of Potential Impact

Impacts on the environment from various activities of the development works (constructional impacts) and operation of the boatyard (operational impacts) have been identified through interviews with the directors of Vava'u Marine Services, interviews with the civil engineer, field data collection and surveys and based on past experience in similar development projects. Possible impacts arising from the construction and operation works are categorized into reversible and permanent (irreversible) impacts. The impacts identified are also described according to their location, extent (magnitude) and characteristics. Reversible and irreversible impacts are further categorized by intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken.

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

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

- Fishing activity
- Commercial and recreational navigation
- Archaeology and heritage
- Recreation and leisure
- Noise and vibration
- Air quality
- Infrastructure, land drainage and coastal protection

Potential impacts on the 'natural' environment are considered to comprise those impacts on the following aspects:

- Sediment quality
- Water quality
- Marine and coastal ecology
- Marine and coastal ornithology
- Fish and shellfish resources
- Geology, landscape and visual setting

7.1.2 Measures of Significance

Significance of impacts is measured in terms of extent, magnitude and duration. For each potential impact revealed, the extent was assessed in terms of its spatial scale, the magnitude of each potential impact was assessed in terms of its effect on the natural processes it impacts on and the duration was also assessed in years. Following the assessment of these criteria and the related categories, the potential impacts have been given significance ratings described in Table 5:

Table 5: Significant ratings for potential Environmental impacts

Significance Rating	Description
Major	Impact is long term, large scale environmental risk
Moderate	Impacts give rise to some concern, may cause long term environmental problems but are likely short term and acceptable
Minor	The impact is short term and cause negligible impact on the environment
Negligible	The impact has no significant risk to environment either short term or long term

The process involved with the construction and operation of the proposed development were measured against the environmental characteristics in a Leopold Matrix to evaluate all of the potential impacts and their scale (Leopold et al 1971). The full Leopold Matrix scoring and risk significance can be found in Appendix 12.3, however, for the purpose of this EIA report we are going to discuss the positive and negative impacts rated as ‘minor’ to ‘major’

Table 6 has been extracted from the Leopold Matrix and shows the ‘minor’ to ‘moderate’ environmental and social impacts associated with this proposed development. No impacts were identified as having a ‘major’ significance. The impacts are discussed in the context of the development processes that will potentially generate them.

Table 6: Extract of the Leopold risk matrix for environmental impacts. All moderate (red) and minor (orange) negative environmental impacts are shown below

		Project Processes										
		Modification of habitat	Alteration of ground cover	Surface or paving	Noise and Vibration	Channel dredging including straightening	Cut and fill	Surface excavation	Trucking	Spills and leaks	High pressure hull cleaning runoff	Anti-foul hull painting
Environmental Characteristics	Water Quality (Ocean)					orange				orange	red	
	Air Quality								orange			orange
	Deposition (sedimentation, precipitation)		orange			orange	red	orange				
	Trees (including mangroves)							orange				
	Birds				orange			orange				
	Fish & shellfish	orange		orange		orange						
	Benthic organisms	red		red		red						
	Fishing					orange						
	Transportation network (movement, access)						orange		orange			
	Utility networks										red	

7.2 Impacts During Construction

Several processes during the construction phase of development will have impacts on the social and natural environment. Table 6 above highlights that the process of clearing the path of the slipway (terrestrial and marine), backfilling the land side of the slipway and paving the slipway will have the greatest impact during the operational phase, which is to be expected as this is the most intrusive part of the yard development. Each impact is discussed in relation to the processes in the following sections.

7.2.1 Clearing the vegetation for construction of the slipway

In above table, this process is represented by alteration of ground cover and surface excavation. There are two minor impacts associated with this process:

- the potential increase in sedimentation on the near shore reef from clearing the vegetation
- the loss of shoreline trees that are growing in this area.

The level of rainfall experienced during this phase of construction will greatly influence the level of sedimentation experienced on the near shore reed area. It is estimated that construction of the slipway will start with the clearing of the vegetation in second quarter of 2014, which falls within the dry months as described in section 6.3 of this report. Vegetation clearing during the drier months of

June and July would minimise the likelihood of rain, however construction and budget scheduled do not allow for this.

In regards to the trees that will be removed during the clearing process, field based surveys have shown that these are made of secondary, or possibly tertiary growth following site disturbance and land reclamation. The vegetation zone earmarked for clearing is dominated by the two invasive species *Leucaena laucocephale* and *Melia azedorach*. The loss of these species is not considered to be of any significance in a biological perspective due to the high invasive rating that both species have be given in the Report to the Kingdom of Tonga on Invasive Plant Species of Environmental Concern (2001). Field studies also show that there will be no direct impact on the mangrove species found in the clearing area. There is a potential indirect impact on the mangrove stands to the south of the area from the increased sediment load that is expected in the near area in the short term during construction.

7.2.2 CLEARING AND EXCAVATING THE TIDAL AND SUB-AQUATIC PART OF THE SLIPWAY

In the above table, this is represented by channel dredging and modification of habitat. There are 5 minor impacts and 2 moderate impacts associated with this process which can be summarised as:

- Direct and indirect impact on the fish and shellfish resources
- Direct and indirect impact on the benthic community, which includes corals
- Short term and localised decrease in the water quality specifically relating to turbidity
- Increase in sedimentation in the immediate area
- Short term disturbance to recreational fishing activities, specifically relating to shellfish

This process will have the greatest negative impact of the whole development. The clearing of the slipway footprint will directly impact on the coral and shellfish community and will lead to the loss of live specimens. The direct impact will be very localised to the slipway footprint itself, however increased sediment load from the excavation process will lead to a wider indirect impact in the area immediately surrounding the footprint.

The marine survey aspect of this assessment showed that there are at least four significant *Porites lobata* coral heads measuring over 2 meters tall lying a few meters outside the proposed footprint of the slipway. These coral heads are very significant due to their apparent health (no signs of disease or algal growth) and their approximate age which can be measured in the hundreds of years. Great care will be needed during the construction phase of this development, specifically the slipway excavations, to ensure that these coral heads are not damaged. As they do not lie in the direct path of the excavations, the use of sediment curtains and excavation boundary marker buoys should be considered to minimize damage. The significant works that have already been undertaken in the area over the past years has appeared to leave these ancient corals undamaged which has reduced the overall impact rating on the Leopold matrix due to the small scale of this proposed development compared to the past bridge building and land reclamation works.

Although, the direct and indirect impact to the corals themselves will be potenially significant, the very localised magnitude of the impact reduces the overall risk of the process. Interviews with the directors of Vava'u Marine Services has also revealed their plans to relocate as many of the corals as feasible that are scheduled to be impacted by the excavation work using a method that has proven successful elsewhere in Vava'u. This mitigation action also reduced the significance of the impact when applying it to the Leopold Matrix.

7.2.3 Cutting, backfilling, laying and compacting the base for the slipway

In the above table, this is represented by cut and fill and trucking. There are 3 minor and 1 moderate impact associated with this process and can be summarised as following:

- Increase in particulates suspended in the air leading to a reduction in air quality in the immediate area caused by cutting, filling and increased trucking traffic
- Increase in sedimentation in the near shore areas from construction work and rain water run off
- Increase pressure on the local transportation network as heavy plant is used to build the base for the slipway

Of these above impacts, the increase sedimentation is regarded as the highest risk, again due to the risk of smothering live corals in the near shore area. As this work is being done during the dry season, the risk of heavier rainfalls and therefore greater sediment is reduced, however, mitigations are needed to ensure that while there is bare earth and earth moving works being undertaken, the risk to the health of the benthic community is reduced and short term. Conversely, the drier months mean that the impact on air quality in the surrounding area will be increased due to the predicted dusty conditions and the high level of heavy plant traffic. This process is estimated to take 4 weeks to complete and is therefore short term and low in magnitude, making this a minor rather than a moderate impact.

7.2.4 Paving and sealing the entire slipway

This is represented in the above matrix by surface or paving. There is one minor and one moderate impact associated with this process. The previous process in the slipway construction were identified has having a great environmental impact than this final stage. The negative impacts relating to this process are to the coral and shellfish species that live in the direct area of the slipway and will have their habitat permanently removed. This will be destructive for specimens in the direct area, however, as this will be a very localised impact, the impacts have been rated as minor (shellfish) and moderate (corals). This will be an irreversible process, however the previously mentioned proposal of Vava'u Marine Services to relocate the feasible corals will go some-way to mitigate against this impact and therefore reduces the significance of the impact.

Risk associated with increased rain water run off over a concrete surface is well documented and this can often lead to increased sedimentation in the near shore waters. This risk was assessed as part of the Leopold Matrix with the drainage system design included in the final slipway taken into consideration. The steps being taken to manage rain water run-off, and therefore sedimentation, reduced the magnitude of this potential impact and resulted in this being a low risk impact. The full details can be seen in Appendix 12.1.

7.3 Impacts during the Operational Phase

Environmental impacts associated from the operational phase of the current proposed development project are limited to a relatively few activities. These activities can cause short term to long term impacts on the immediate environment. Below are some of the possible impacts:

- Possible impacts due to accidental spillage of oil and other wastes (by vessels using the slipway) and of other products from vessels undertaking maintenance work in the boatyard.
- Introduction of pollutants and alien organisms to the reef environment from the high pressure cleaning of hulls
- Air quality and health concerns for individuals engaged in the sanding, preparation and painting of hulls during the anti-fouling process.

Of the above possible impacts, the introduction of pollutants from hull cleaning and the health risks associated with anti foul treatment for hulls were assessed as having the highest impact. These are two very specific activities associated with the operational phase of the boatyard and are examined in more detail in the following sections.

7.3.1 Hull Pressure Washing

Every boat that is hauled for storage and the vast majority of boat that are hauled for maintenance works will have their hulls pressure washed at the land side staging point for the boatyard slipway.

Contaminated water from the power washing of boat hulls can contain traces of oils, copper oxide, paint pigments, biocides, and other harmful substances, as well as non-native species, which can be harmful to marine life if allowed to enter the water untreated (Liebl, D., 2002).

The treatment of this washdown water is vital in minimizing the impact that this activity will have on the coastal water quality, the site soil quality and the ground water quality. There are two main options available for the management of washdown water run-off and these are discussed below. A third option for the management of run-off water is to divert it to the local sewerage drainage system. This is a generally acceptable method of management, however it is not applicable in this setting as there are no sewerage management systems in place for the island.

Closed Loop Treatment System

A closed looped system (Fig 27) is one that reuses the wash water once it is in the system. The water storage tank would be filled with rain water, used for washdown, filtered and/or treated and then it goes back into the storage tank for reuse. The main benefit of this type of system is that no washdown water is discharged in the natural ecosystem. Within a closed loop system, the water does not need to be as clean or as thoroughly treated as it would be in a system that releases the water back into the ground or water ways.

The system works by first channeling the water into a settlement tank as the first stage of filtration. Water will sit in this tank for a time to allow the suspended sediments time to settle out of the water column. The filtered water is then pumped through a series of filters and treatments before it is pumped back in to the main storage tank for reuse.

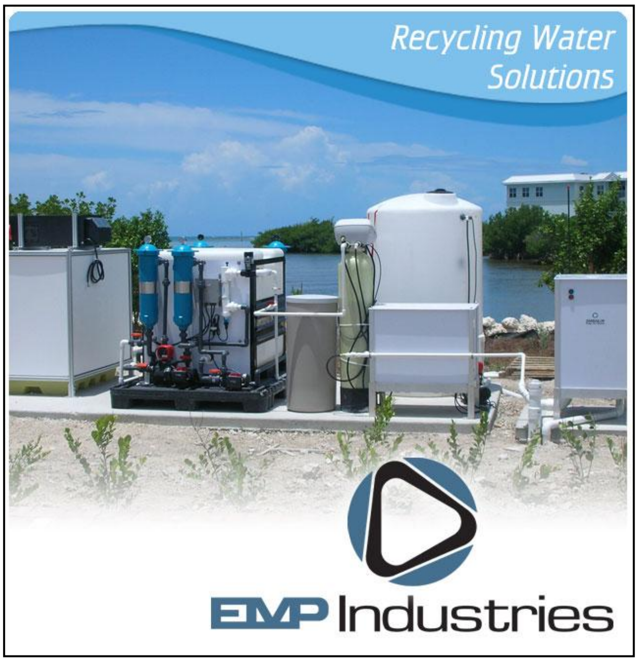


Figure 27: An example of a closed loop water filtration system

While this system will avoid any contamination to the natural environment from pressure washing activities, it is an expensive option and this will be the limiting factor in installing a closed loop system into this development. It is estimated that the cost for a facility of this proposed size will be approximately US$33,000 with an annual running cost of approximately US$3,500 before any shipping or import duties have been considered (Liebl, D., 2002).

STORM WATER FILTERS FOR COMMERCIAL SITES

Storm water filters are most applicable a small scale developments sites (max 6 acres) and can generally provide reliable rates of pollutant removal if design improvements are made and regular maintenance is performed (Claytor, R. & Schueler, T., 1996). Storm water filters seems to have particular utility in treating run off from contaminate 'hot spot' areas such as commercial parking areas, industrial areas, vehicle service centers and marinas. There are a number of different storm water filtration designs, however, as per the recommendations from The Center for Watershed Protection in the US, the most applicable design for dealing with the washdown run off from this proposed project is an online (all water must flow through this system) surface sand filter design. In this system, the first stage is a sedimentation tank which allows for settling of suspended particulates, much like in the closed loop system. The water is then distributed into the second chamber, which consists of an 18-24" deep sand filter bed. Pollutants are trapped or strained out at the surface of the filter bed which may have sand or grass cover. The water is then collected through a pipe at the bottom of the filter bed and channeled to a third tank with a permeable floor to allow the filtered water to leech into the ground therefore allowing a final stage of exfiltration using the natural limestone substrate (Fig 28).

Monitoring of surface sand filters in the United States have shown a removal rate of suspended sediments as greater than 80% and a hydrocarbon removal rates of 65-90% (Claytor, R. & Schuele, T., 1966). Table 7 gives percentage removal of monitored pollutants using this filtration technique. It is also worth noting that filters of this type are not very efficient in removing total nitrogen however sand filters are able to remove dissolved metals.

Table 7: Pollutants removal capacity of surface sand filtration of storm water run off

Pollutant	Removal Capacity
Total Suspended Solids	85%
Total Phosphorous	55%
Total Nitrogen	35%
NO3	Neg
Bacteria	40-80%
Metals	35-90%

In this situation one main benefit of this system is its relative low cost using locally sourced materials. Recommendations are made for the improvement of the designed by introducing barrier filters such as geotextile screens to avoid clogging of sand or aggregate and this is available at relatively low cost to the developers.

If the proposed surface sand filter design (Appendix 12.1) is implemented then the risk of contamination is greatly reduced, however, regular monitoring and maintenance is essential to ensure this system remains effective.

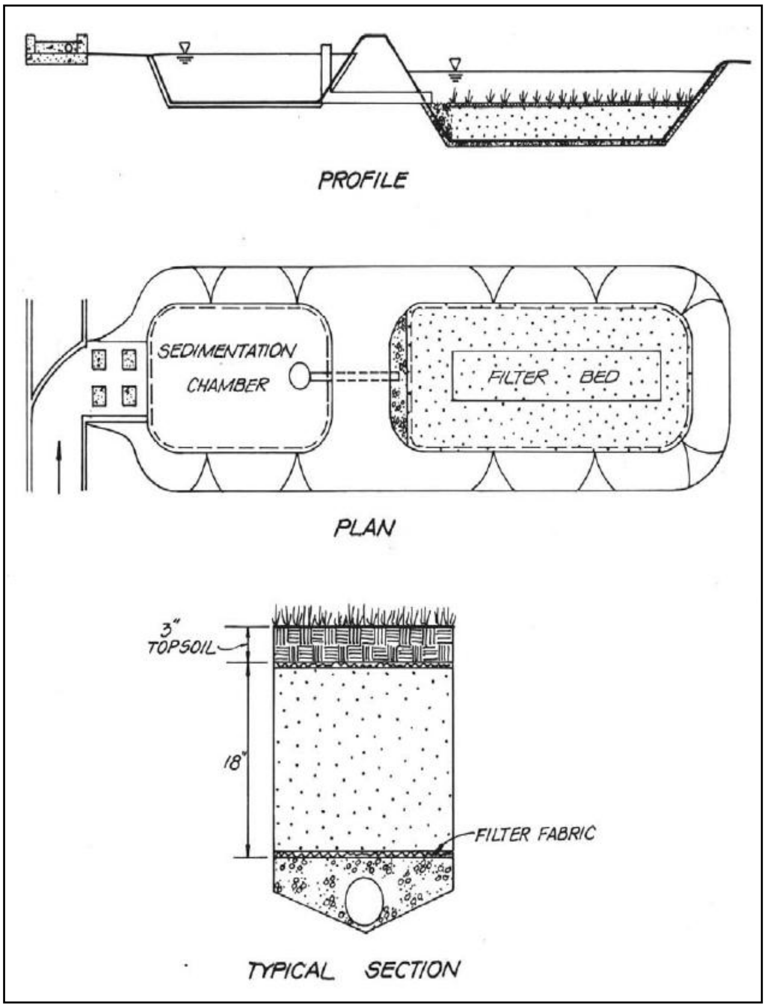


Figure 28: Typical design for a surface sand filter system

7.3.2 Air quality and health impacts of hull sanding and painting.

The bottom paints used on boat hulls may contain metal compounds that are toxic to marine life and the removal of these paints produces waste materials that can be harmful to the environment. The first stage of removal of some of this paint through pressure washing has been discussed in the previous section. To remove the remainder of the paint, it is necessary to use a power sander which will then produce a fine dust containing potentially hazardous metals (principally copper). Protective clothing, high quality face masks and vacuum sanding systems to contain the released dust are all recommended to minimize the impact that this activity may have on the natural and human environment (Liebl, D., 2002).

7.4 Visual Impacts

Although only minor visual impacts have been identified, consultation during the scoping of this assessment has identified concerns over the visual impact of this development. It is an understandable concern given the nature of the facility and its proximity to a village. It is also understandable given that the Vaipua bridge area is visible from beauty spot lookouts on Mount Taulau and from the anchorage usually used by the visiting cruise ships. It is important that the facility have a minimal visual impact on these important tourist facets.

Vava'u Marine Services are sensitive to the need to blend their facility into the local aesthetic environment and as such are planning their construction phase to minimize the clearing of the boundary vegetation. They have also planned to replant as much of the cleared land as possible both for aesthetic and for erosion control. Basic representations of the proposed boatyard are represented in the following images.

Figure 29: View from Mount Taulau. Location of facility is indicated by arrow. Facility is blocked from view by the southern headland

Figure 30: View of the facility from the Vaipua Bridge. Boundary vegetation will shield most of the yard from view, leaving the top two thirds of masts visible. The slipway location, bearing and size are represented.

7.5 Social Impacts

Only positive social impacts have been identified in the operational phase in terms of increased employment opportunities and capacity building. Having a new type of facility in Tonga, specifically designed to attract a higher number of visitors and increase the duration of their stay, will increase employment opportunities in for the local population. No adverse social impacts are envisaged during the construction and operation of the facility.

7.6 Mitigation Plan

There are a number of actions that can be taken to minimize the identified impacts. Those that are explored in table 8 emerged out of the discussions and consultations during this EIA and from the past experience of the consultant. Mitigation measures are selected to reduce or eliminate the severity of any predicted adverse environmental effects and improve the overall environmental performance and acceptability of the project.

In considering the mitigation measures it has to be noted that the proposed development site is significantly impacted due industrial activities carried out over the years. In summary the key mitigation measures are:

- Sediment curtain around slipway excavation area
- Excavations to be undertaken at low tide
- Boundary markers for slipway excavations
- Filter traps for washdown area
- Drainage channels for land area
- Minimise boundary vegetation clearance
- Install water tank for washdown activities
- Vacuum sander and air filter face mask for hull works
- Reforestation program
- Coral transplantation program

The following table outlines in detail the recommended mitigations for the construction and operational phase of the Vava'u boatyard project.

Table 8: Mitigations for environmental impacts of construction and operation phase of proposed Vava'u Marine Services Boatyard

Possible Impacts	Impact Intensity	Mitigation Measures	Location	Time frame (Phase)	Institutional Responsibility	Cost (TOP)
Sedimentation and siltation on the reef due to construction works	**Moderate:** impact is intense in the near shore area, however impact is localised and of short term duration	Sediment curtain.	Near shore reef	3 months (Construction)	VMS, Contractor	N/A – should be included in the initial costs
		Tidal areas excavated during low tide	Inter tidal zone	2 weeks (construction)	VMS, Contractor	N/A – should be built into construction schedule
Loss of habitat, damage or death of coral at the site of the slipway	**Moderate to minor:** destruction of habitat is highly localised but permanent.	Coral transplanting program under guidance from local NGO (if entire coral is too big to move then remove fragments to cultivate)	Near shore reef	2 months (during construction)	VMS, VEPA	Approx $500 for coral frame materials although could be used from existing materials on site
		Stake pathway for excavator to identify perimeter of excavation area	Inter tidal zone and near shore reef	2 months (during construction)	Contractor	N/A
		Choose slipway path to, as far as possible, minimise corals impacted	Inter tidal zone and near shore reef	2 weeks (during construction)	VMS, Contractor	N/A

Possible Impacts	Impact Intensity	Mitigation Measures	Location	Time frame (Phase)	Institutional Responsibility	Cost (TOP)
Pollution of marine environment from hull cleaning activities	**Moderate:** Ongoing operational impact with localised impact to near shore reef	Install two stage sand and gravel traps to filter all organic and non-organic matter out ensuring all water is captured in the filtration system	Land, top of slipway ramp	Ongoing (operational phase)	VMS	N/A – should be in initial costs
Loss of barrier vegetation in coastal zone	**Minor:** Short term and very localised impact May have positive elements as replanting will focus on native rather than invasive species	Only clear necessary vegetation during construction of slipway	Land, coastal barrier area	1 month (during construction)	VMS, Contractor	N/A
		Ensure reforestation program is implemented after the construction phase to minimise gaps in the vegetation barrier	Land, coastal barrier area	1 month (operational phase)	VMS	N/A – can be undertaken in house using local plants
Air pollution	**Minor:** Short term impact limited to construction phase	Ensure construction works run to schedule to minimise heavy plant use	Air	3 months (construction phase)	Contractor	N/A
		Dampen dusty area after long periods without rain during heavy plant use	Air	3 months (construction phase)	Contractor	Approx $100 additional water costs

Possible Impacts	Impact Intensity	Mitigation Measures	Location	Time frame (Phase)	Institutional Responsibility	Cost (TOP)
Alteration to the local hydrodynamic currents	**Minor:** significant alterations have already occurred in immediate area due to bridge construction	None (any direct impact from the proposed slipway is insignificant compared to larger modifications already made to the proposed site)	Coastal and inter tidal zone	Near shore reef and inter tidal zone	n/a	N/A
Air quality for anti fouling works on yachts	**Minor:** localised, limited exposure impact	Provide workers with air filtration masks and protective clothing	Boatyard	Ongoing (Operational phase)	VMS	N/A – should already be included in initial costs
Increase in pressure of local transport network due to construction works	**Minor:** short term impact	Ensure construction phase runs to schedule to minimise impact	Land	3 months (construction phase)	Contractor	N/A
Increase in pressure on the local water utilities during the operational phase	**Moderate:** Long term impact on local natural resources	Construct and install water tanks to maximise use of rain water and reduce reliance on local town water supply	Land	Operational phase	VMS, Contractor	N/A – should be in initial costs

Possible Impacts	Impact Intensity	Mitigation Measures	Location	Time frame (Phase)	Institutional Responsibility	Cost (TOP)
Increased opportunities for run-off over concrete slipway	**Minor to moderate:** Long term and localised impact	Design vegetation channel drainage system to deliver all yard run off for exfiltration	Land, coastal area and near shore reef	During construction phase	VMS, Contractor	N/A
Accidental spillage	**Minor:** long term	Put up sign boards advising good practices	Land and near shore reef	Operational phase	VMS	Approx $200 for sign production by local company

8. ENVIRONMENTAL MANAGEMENT PLANNING

There exist several guides for environmental management of boat yards and marinas with many of these plans including a self assessment form to gauge the effectiveness of the operational environmental management plan in place. Each of the developed plans are based on the environmental legislation of the countries concerned and are comprehensive approaches to ensuring minimisation of negative environmental impacts. Using these guides for the operation phase of the boatyard as well as the mitigations recommended in the previous section, the directors can effectively manage their impact on the local environment.

The “Environmental Best Management Practices for Marinas and Boatyards” developed by the University of Wisconsin has been attached in Appendix 12.5 of this assessment as a guide for Vava’u Marine Services environmental planning and management. The self assessment forms included should be completed annually to ensure that best practices are maintained and consistent (Liebl, D., 2002).

The self assessments should be coupled with the monitoring plan as recommended in this assessment for the entirety of the operational phase of the boatyard.

9. UNCERTAINTIES INVOLVED IN IDENTIFYING IMPACTS

In spite of the measures that will be taken to mitigate against the foreseeable impacts, there is always the possibility of impacts that were not foreseen, or the extent of predicted impact can turn out to be greater than predicted, or the mitigating measures may not be as effective as expected. In order to ensure that such incremental impacts do not suddenly appear without warning, the project will monitor key parameters in the vicinity of the development which can serve as environmental indicators. The area (project area, direct impact area and indirect impact area) has been surveyed and a baseline and reference plots have been established at key locations on the reef flat. These areas will be monitored (using the monitoring program) regularly to provide an indication of impacts before they become too advanced for corrective action.

10. MONITORING PROGRAM

Monitoring of the environment is essential to ensure that potential impacts are minimized and to mitigate unanticipated impacts. Table 9 provides the methods and indicators that will be used and the frequency of sampling of the marine environment. Indicators used will be percentage of live coral cover and fish diversity and abundance. Data from the photo quadrates will be used as baseline data to carry out monitoring to assess whether previous levels of indicators had increased or decreased.

Table 9: Monitoring Program with methodology and indicators for proposed development

Reef Community	Methodology	Indicators	Sampling Frequency	Estimated Cost for Monitoring
Coral and other benthic cover	LIT	Percentage cover	Twice (during and after completion of project)	Rate per field survey TOP500
Reef fish community, diversity and abundance	Fish visual census	Number of Fish and diversity index	Twice (during and after completion of project)	Rate per field survey TOP500
Coral recruitment, growth rates and mortality on coral transplanted structure and natural reef	Quadrat (including photo) methodology	Length, health and % cover	Every six months from the start of project	Rate per field survey TOP 500
Sedimentation rates	Quantative assessments of sediment loadings on the reef benthos sediment traps deployed at pre-determined locations	Turbidity	Every two months	Rate per field survey TOP150
Sea water quality	Water testing to be done on site by local agency.	salinity, pH, electrical conductivity, DO, Nitrate, phosphate, sulphates, total and faecal coliforms	Twice annually (during and after completion of project and then ongoing)	Rate per test set TOP100

11. REFERENCES

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URL References:

URL1: Tonga Meteorological Service Vava'u Climate Summary www.met.gov.to/index_files/Page642.htm

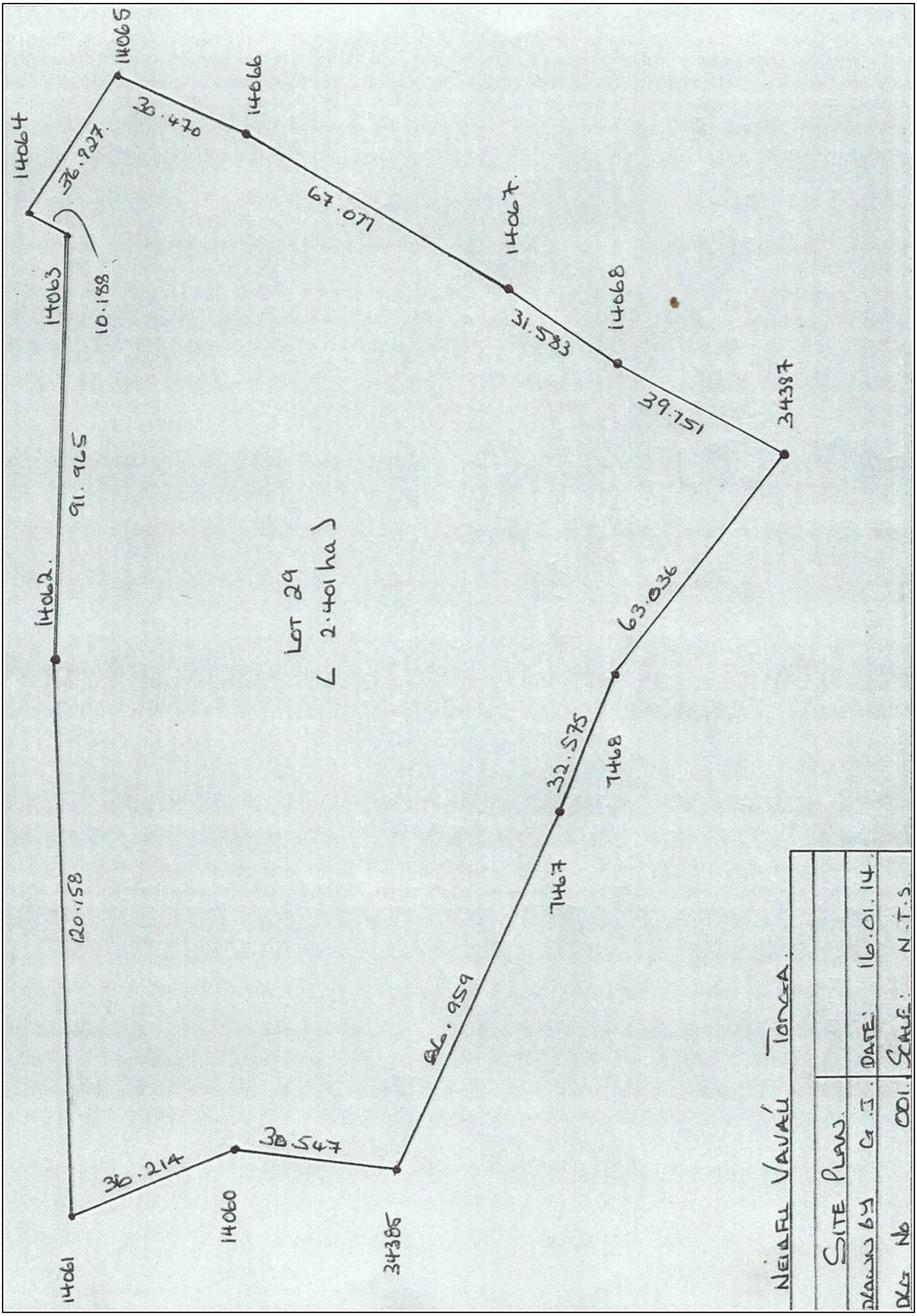
URL 2: Tide Times for Nuku'alofa, Tonga www.tide-forecast.com/location/Nukualofa-Tonga/tides/latest

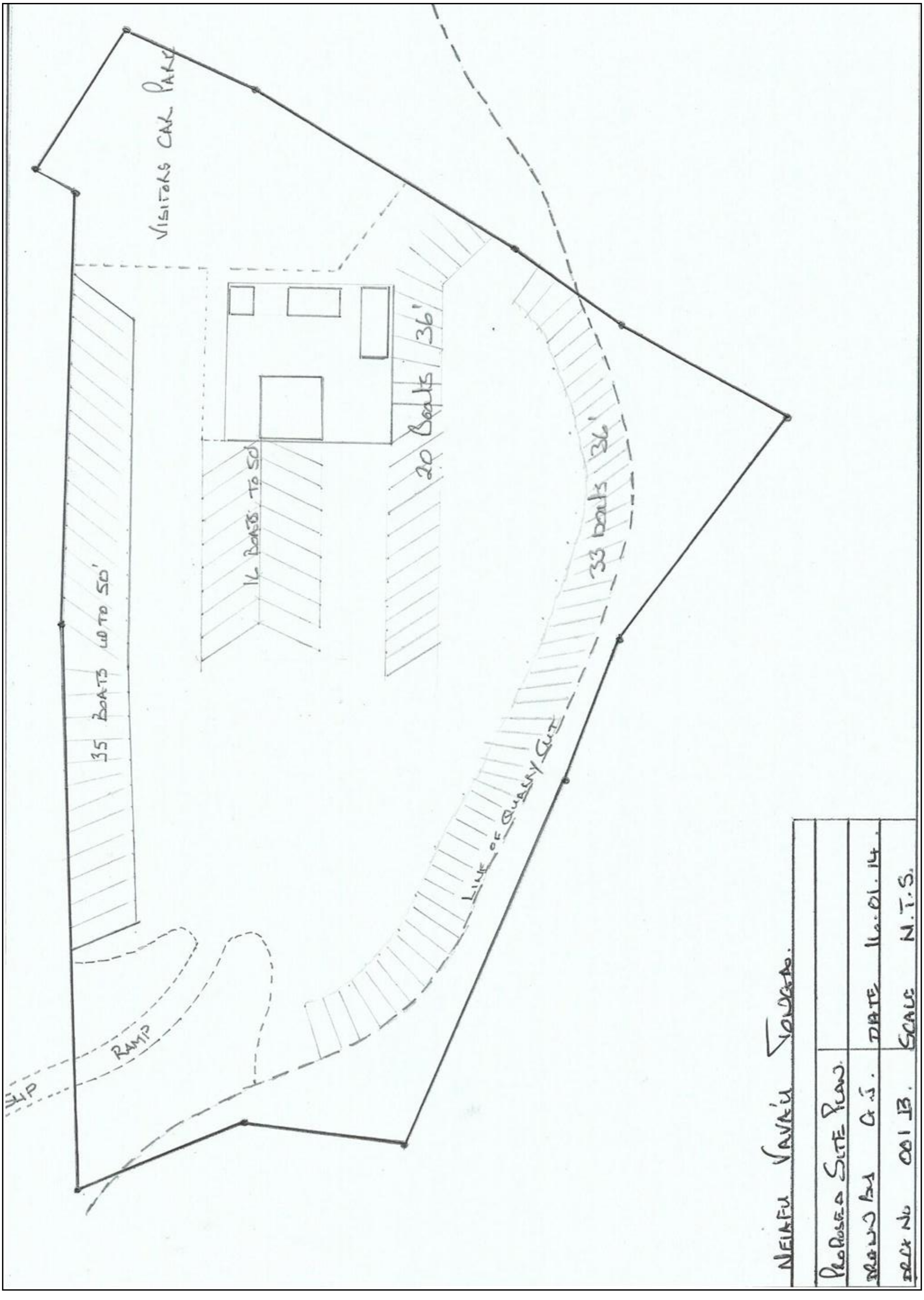
12. APPENDIX

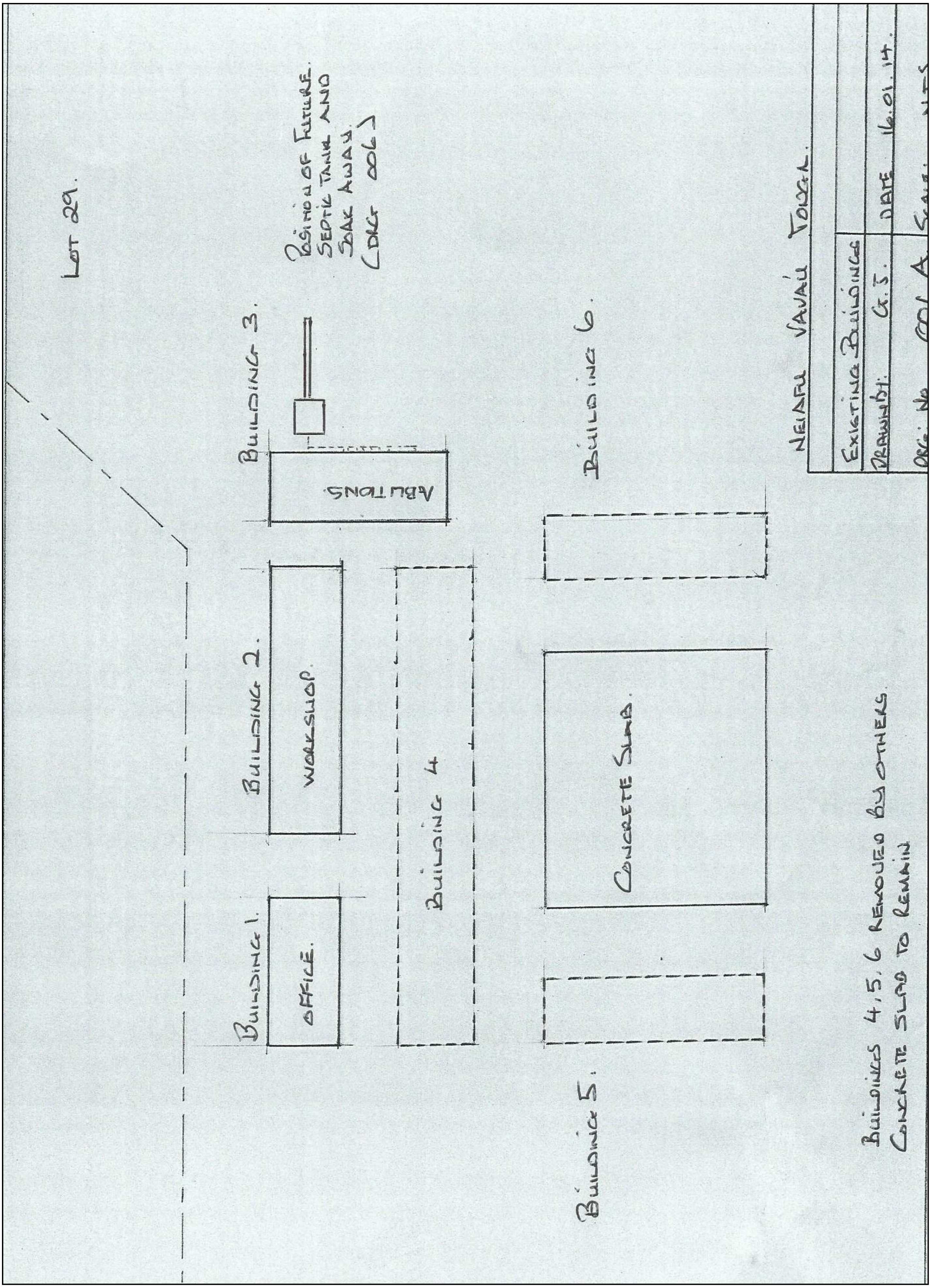
12.1 ENGINEERING DESIGN PLANS

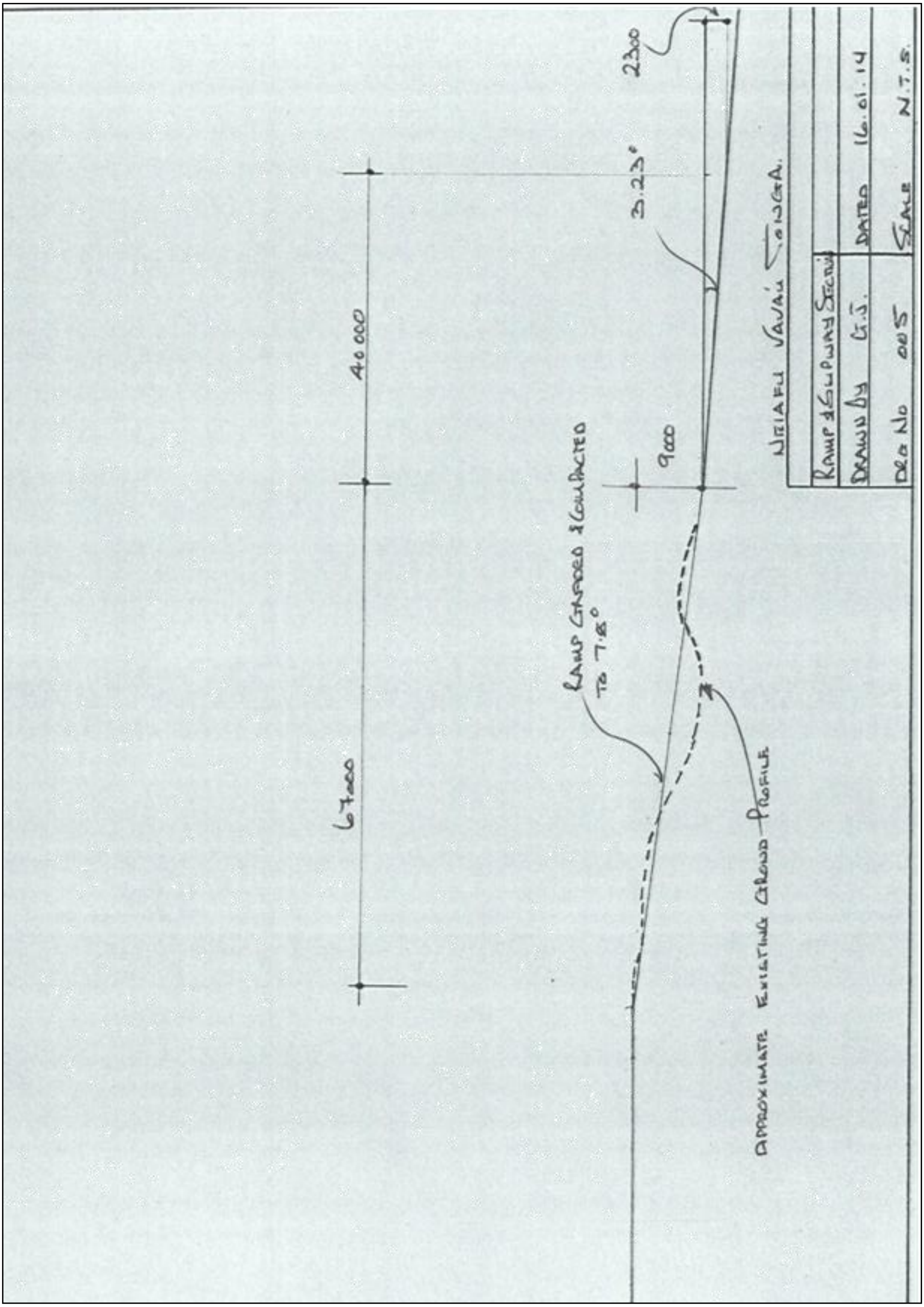
Diagrams supplied by G. Jennings and included in this EIA are as follows:

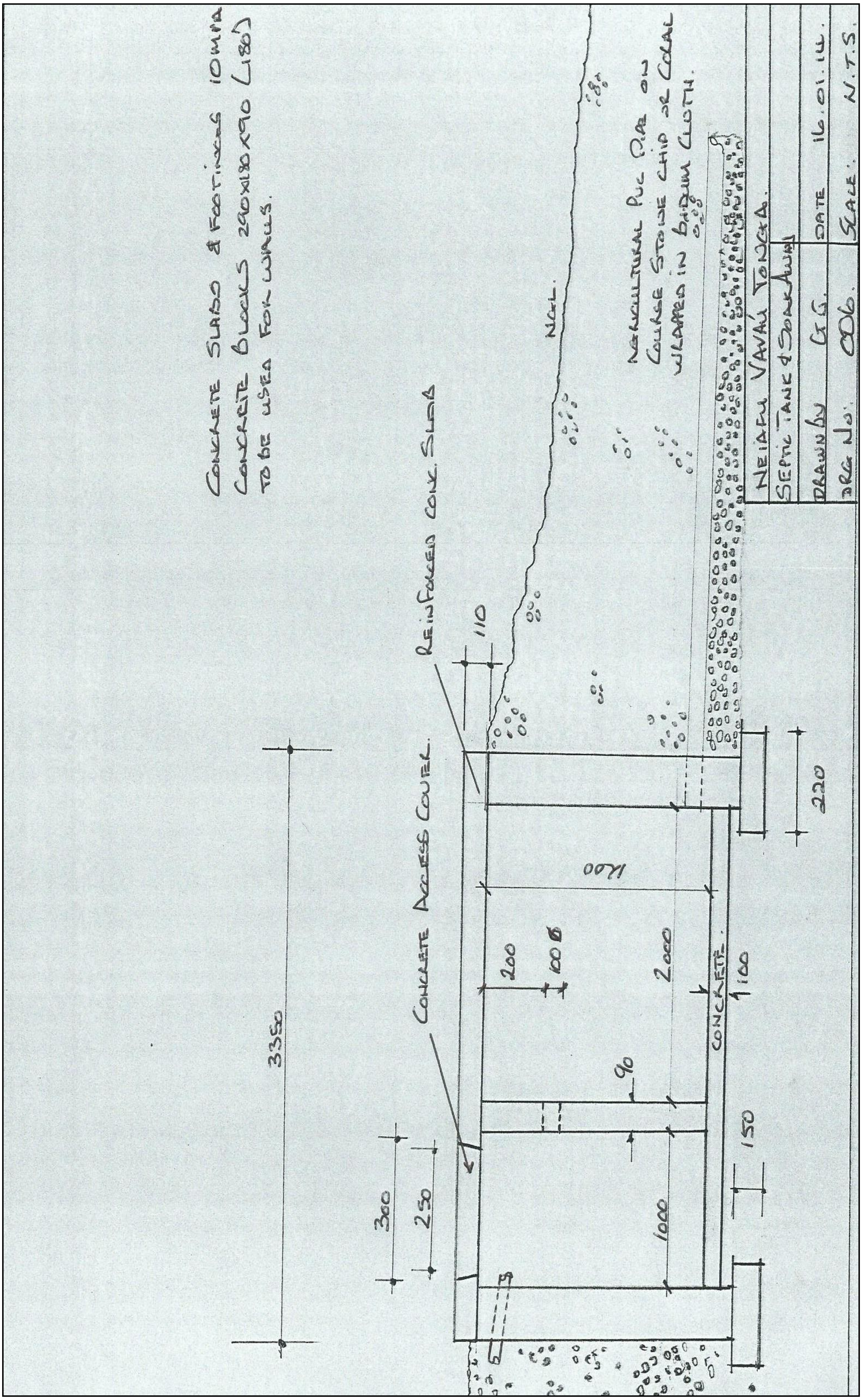
Plan Number	Description
001	Site Boundaries as defined in the Land Registry record
001A	Building plan showing existing buildings and indicating which are to remain. Ablutions block with soak away septic tank shown.
001B	Design plan for operational boatyard with boat storage slips and yard buildings shown.
005	Terrestrial and in-water boat ramp and slip design showing approximate profile of exiting land surface and approximate excavation areas.
006	Design of wash down gravel filtration trap to be installed at the top of the boat ramp. All wash down water to be contained and filtered.


NEIAFU VAVA'U TONGA.
SITE PLAN.
DRAWN BY G.I.
DATE: 16.01.14.
DWG No 001.
SCALE: N.T.S.
LOT 29
(2.401 ha)
14061
14060
34385
7467
7468
34387
14068
14067
14066
14065
14064
14063
14062
36.214
30.547
86.959
32.575
63.036
39.751
31.583
67.077
30.470
36.927
10.188
91.965
120.158


VISITORS CAR PARK
35 BOATS UP TO 50'
16 BOATS TO 50'
20 BOATS 36'
33 BOATS 36'
LINE OF QUARRY CUT
RAMP
SLIP
NEIAFU VAVA'U TONGA.
PROPOSED SITE PLAN.
DRAWN BY G.J.
DATE 16.01.14.
DRG NO 001 B.
SCALE N.T.S.

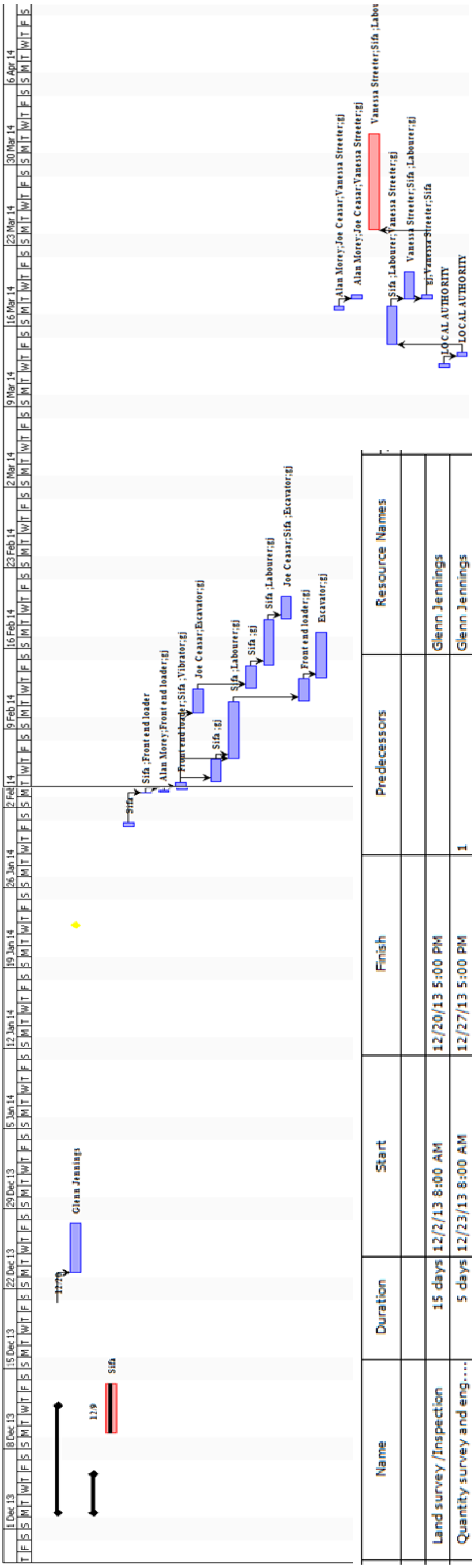

LOT 29.
POSITION OF FUTURE SEPTIC TANK AND SOAK AWAY. (DRG 006)
BUILDING 3.
ABLUTIONS.
BUILDING 6.
NEIAFU VAVA'U TONGA.
EXISTING BUILDINGS
DRAWN BY: G.J.
DATE 16.01.14.
DRG. NO 001 A
BUILDING 2.
WORKSHOP.
BUILDING 4
CONCRETE SLAB.
BUILDING 1.
OFFICE.
BUILDING 5.
BUILDINGS 4, 5, 6 REMOVED BY OTHERS.
CONCRETE SLAB TO REMAIN


2300
3.23°
40 000
67000
9000
RAMP GRADED & COMPACTED TO 7.8°
APPROXIMATE EXISTING GROUND PROFILE
NEIAFU VAVA'U TONGA.
RAMP & SLIPWAY SECTION
DRAWN BY G.J.
DATED 16.01.14
DRG NO 005
SCALE N.T.S.


CONCRETE SLABS & FOOTINGS 10MPA
CONCRETE BLOCKS 290x180x90 (180)
TO BE USED FOR WALLS.
NGL.
AGRICULTURAL PVC PIPE ON
COURSE STONE CHIP OR CORAL
WRAPPED IN BIDUM CLOTH.
REINFORCED CONC SLAB
CONCRETE ACCESS COVER.
CONCRETE.
110
1400
200
100Ø
2000
100
90
150
3350
300
250
1000
220
NEIAFU VAVA'U TONGA.
SEPTIC TANK & SOAKAWAY
DRAWN BY G.S.
DATE 16.01.14.
DRG NO: 006.
SCALE: N.T.S.

12.2 Works Schedule

Estimated construction works schedule. Source: Site Survey, G. Jennings, January 2014



Name	Duration	Start	Finish	Predecessors	Resource Names
Land survey /Inspection	15 days	12/2/13 8:00 AM	12/20/13 5:00 PM		Glenn Jennings
Quantity survey and eng.…	5 days	12/23/13 8:00 AM	12/27/13 5:00 PM	1	Glenn Jennings
Enviromental survey and r..	6 days	12/1/13 8:00 AM	12/9/13 5:00 PM		
Manual clearing of vegatat..	5 days	12/9/13 8:00 AM	12/13/13 5:00 PM		Sifa
Burning of vegatation	1 day	1/31/14 8:00 AM	1/31/14 5:00 PM		Sifa
Removal of metal from site	0.25 days	2/3/14 8:00 AM	2/3/14 10:00 AM	5	Sifa ;Front end loader
Final levelling of storage a…	0.5 days	2/3/14 10:00 AM	2/3/14 3:00 PM	6	Alan Morey;Front end loade…
Grading of ramp to 8 Degr…	0.5 days	2/3/14 3:00 PM	2/4/14 10:00 AM	7	Front end loader;Sifa ;Vibra…
Excavating of slipway	2.5 days	2/10/14 8:00 AM	2/12/14 1:00 PM	8	Joe Ceasar;Escavator;gj
Formwork for ramp conc.	2 days	2/4/14 10:00 AM	2/6/14 10:00 AM	8	Sifa ;gj
Cast ramp concrete	3 days	2/6/14 10:00 AM	2/11/14 10:00 AM	8;10	Sifa ;Labourer;gj
Formwork for slipway	2 days	2/12/14 1:00 PM	2/14/14 1:00 PM	9	Sifa ;gj
Cast slipway slabs	2 days	2/14/14 1:00 PM	2/18/14 1:00 PM	12	Sifa ;Labourer;gj
Place slipway slabs	2 days	2/18/14 1:00 PM	2/20/14 1:00 PM	13	Joe Ceasar;Sifa ;Escavator;gj
Retaining sides to ramp	2 days	2/11/14 10:00 AM	2/13/14 10:00 AM	11	Front end loader;gj
Stormwater drains and gut..	2 days	2/13/14 10:00 AM	2/17/14 10:00 AM	15	Escavator;gj
Revamp office block	1 day	3/17/14 7:00 AM	3/17/14 5:00 PM		Alan Morey;Joe Ceasar;Van…
revamp workshop	1 day	3/18/14 8:00 AM	3/18/14 5:00 PM	17	Alan Morey;Joe Ceasar;Van…
Revamp toilet block	7 days	3/24/14 7:00 AM	4/1/14 5:00 PM	22	Vanessa Streeter;Sifa ;Labo..
Water and elcctrical stations	2 days	3/14/14 8:00 AM	3/17/14 5:00 PM	24	Sifa ;Labourer;Vanessa Stre..
Electrical reticulation	3 days	3/18/14 8:00 AM	3/20/14 5:00 PM	20	Vanessa Streeter;Sifa ;Labo..
Water reticulation	1 day	3/18/14 8:00 AM	3/18/14 5:00 PM	20	gj;Vanessa Streeter;Sifa
ELECTRICAL SUPPLY BY A…	1 day?	3/12/14 7:00 AM	3/12/14 5:00 PM		LOCAL AUTHORITY
WATER SUPPLY BY AUTH	1 day?	3/13/14 8:00 AM	3/13/14 5:00 PM	23	LOCAL AUTHORITY

12.3 Leopold Matrix

Table 10: The Leopold Matrix shows a full list of project processes and environmental characteristics with all associated impacts. Negative impacts are indicated as Negligible (Yellow), Minor (Orange) and Moderate (Red). Postive impacts are indicated as Minor (blue) and Moderate (green)

			Construction Phase												Operational Phase							
			Modification of habitat	Alteration of ground cover	Alteration of drainage	Surface or paving	Noise and vibration	Barriers, including fencing	Channel dredging including straightening	Cut and fill	Surface excavation	Erosion control and terracing	Trucking	Septic tanks, commercial & domestic	Noise and vibration	Product Storage	Reforestation	Automobile	Recreational pleasure craft	Spills and leaks	High pressure hull cleaning runoff	Anti-foul hull painting
Physical and Chemical Characteristics	Earth	Soils																				
	Water	Water Quality (Ocean)																				
	Atmosphere	Air Quality																				
	Processes	Erosion																				
		Deposition (sedimentation, precipitation)																				
		Compaction and settling																				
Biological Characteristics	Flora	Trees (including mangroves)																				
		Grass																				
		Barriers																				
	Fauna	birds																				
		Fish & shellfish																				
		Benthic organisms																				
Cultural Factors	Recreation	Fishing																				
		Swimming																				
	Aesthetics	Scenic views and vistas																				
	Manmade facilities	Transportation network (movement, access)																				
		Utility networks																				
Other		Traditional handicraft use																				

12.4 Photo Plates

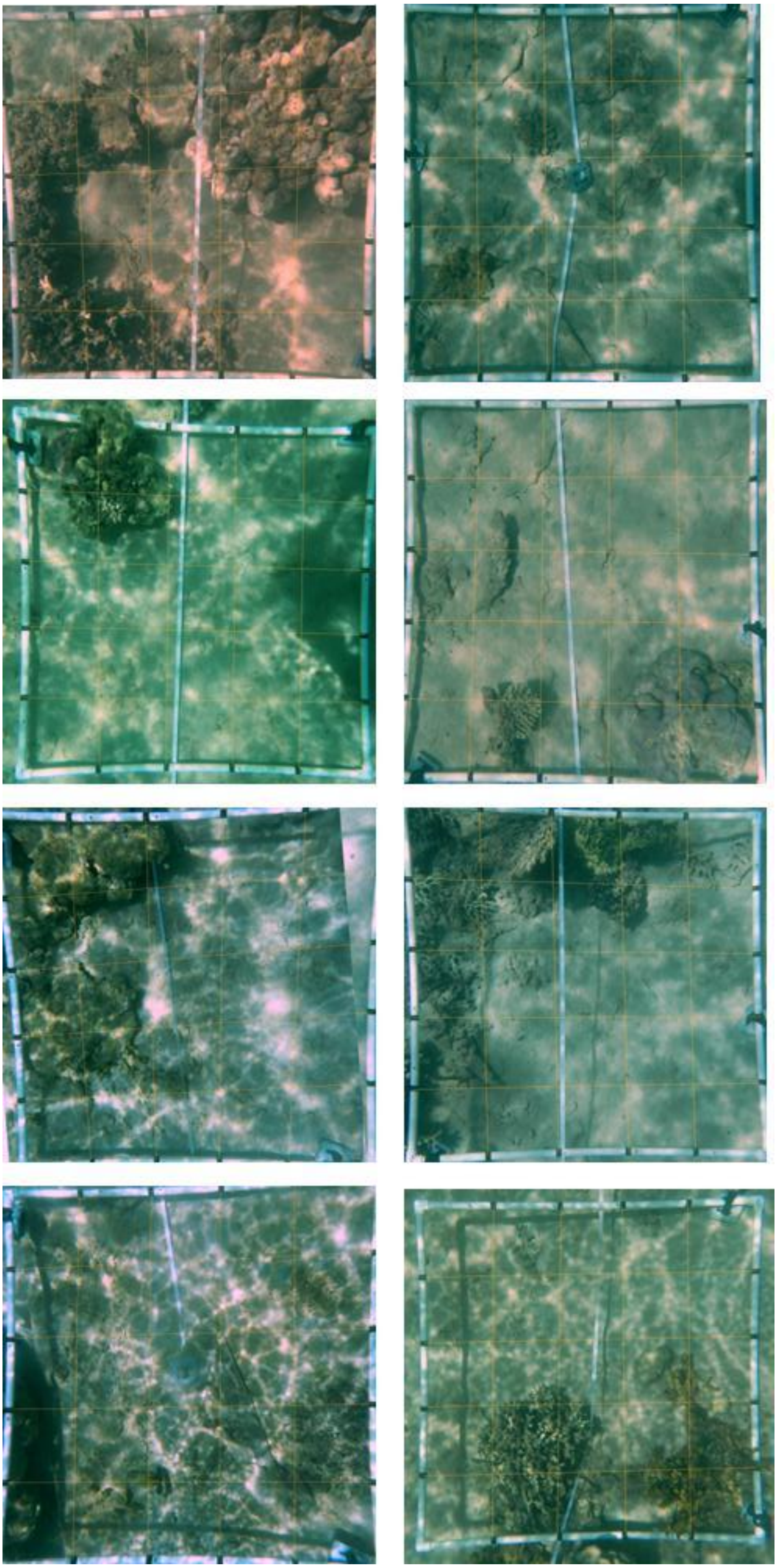


Figure 31: Transect 1 photo quadrats from within excavation zone

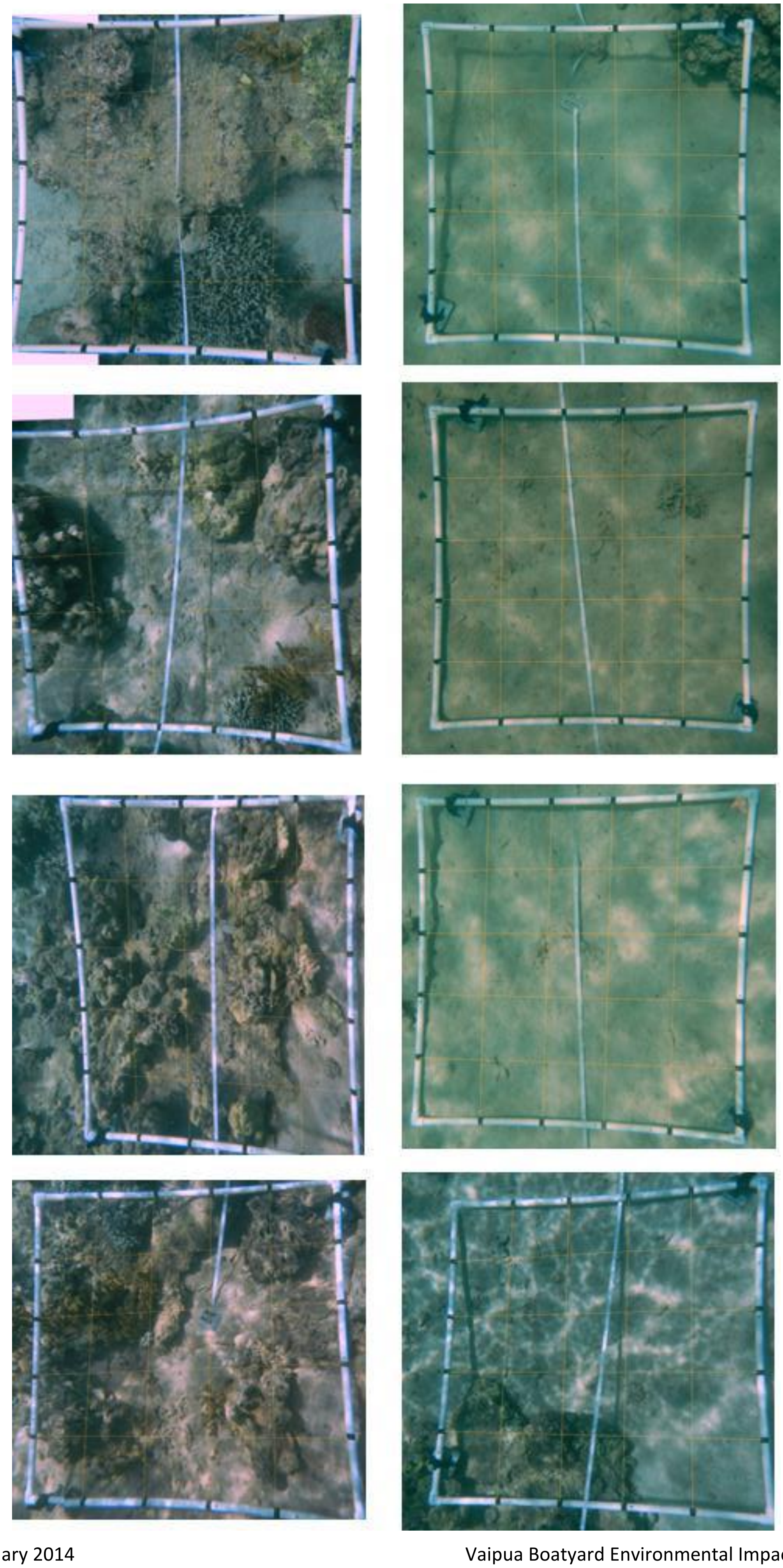
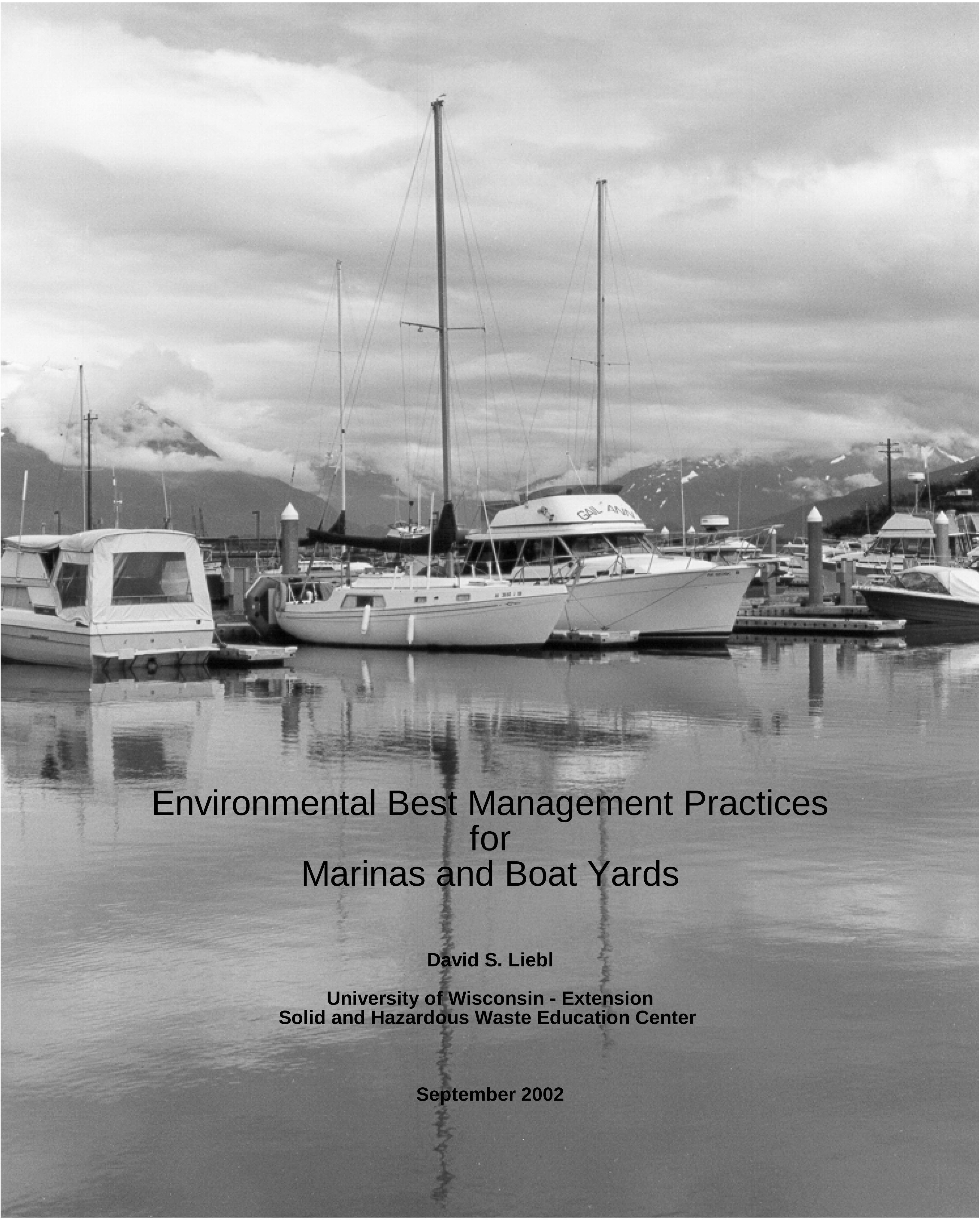


Figure 32: Transect 2 photo quadrats from within excavation zone

12.5 Environmental Best Practices – Boatyards and Marinas



Environmental Best Management Practices for Marinas and Boat Yards

David S. Liebl

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Solid and Hazardous Waste Education Center

September 2002

Introduction

Like all other businesses, marina and boat yard operators must comply with environmental regulations. Unlike other businesses, marinas and boat yards have a special relationship with our most precious natural resources: lakes, rivers and the sea. The use of these waters by marina users and operators carries with it a special responsibility to meet the highest environmental standards. This manual provides guidance and best management practices for the marina and boat yard industry to meet and exceed the requirements of good environmental stewardship.

Contents

The manual is organized into the following sections:

Best Management Practices for Operations

The following environmental best management practices for marinas and boat yards are described for common boat yard activities. The types of marina and boat yard operations that they apply to include:

Recreational boat docking facilities
Commercial boat docking facilities
Boat storage facilities
Boat building and maintenance facilities

These best management practices are meant to guide the marina or boat yard operator in meeting or exceeding their regulatory responsibilities, but are not a substitute for existing regulations. Any questions about specific regulations and compliance responsibilities should be directed to your local environmental regulatory agency.

Storm Water Runoff - State and federal storm water discharge programs control pollutant discharges to lakes and streams caused by run-off from businesses.

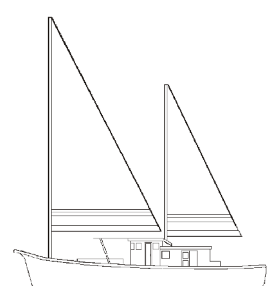
- Marina and boat yard operators that have maintenance or boat washing operations are required to submit a storm water permit, and develop a storm water pollution prevention plan.
- Storm water from roofs, surface lots, and other impervious surfaces, should be directed to areas were water can infiltrate into the soil. Direct flows of run off into surface waters should be avoided.

Waste Water Discharge - Most non-domestic waste water generated by marina and boat yard operators are considered industrial waste water.

- Non-domestic waste water, industrial waste water, or other waste water should not be discharged into any sewer designated to carry storm water or allowed to flow directly into surface waters.
- Any industrial waste water, or other liquids that are discharged to sanitary sewers require prior approval from the sewerage treatment plant operator.

Material Storage and Handling - Many chemicals that are commonly used by boat yards can pollute the environment. Care should be taken in handling these products to avoid spills.

- Any underground storage tanks should be removed. All aboveground tanks should have adequate spill containment dikes, and shed roofs to prevent contamination of rainwater.
- Liquid wastes should not be discharged into a storm sewer, sanitary sewer or onto the open ground or surface waters.
- All facilities should maintain a supply of petroleum absorbent material and "spill-dry" in a readily accessible location. In addition, all facilities should have a written spill prevention and contingency plan to deal with petroleum product spills.



Fueling Operations - It is the responsibility of the facility operator to properly supervise the fueling operations, and in most cases it is preferable that a facility employee actually perform the fueling operation.

- Fuel nozzles should have automatic back pressure shut-offs and should not have a holding clip to keep the nozzle open (i.e., the nozzle should only be held open by hand).
- There should be petroleum absorbent pads in the immediate vicinity of the dispenser, readily accessible in the event of a small spill. If fuel spills into the water or onto the ground, the person fueling the boat should use the absorbent pads to remove the fuel from the water surface or from the ground.
- Mobile fueling operations at any facility should be the joint responsibility of the marine facility, the tank truck operator, and the vessel owner. Extreme caution should be taken to prevent spills from occurring.

Spills - Material spills are inevitable, and any spills should be cleaned up promptly when they are detected.

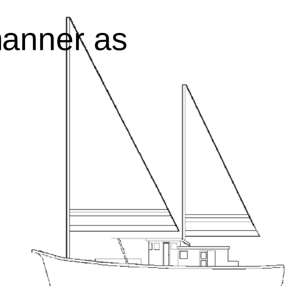
- Avoid using detergents to clean-up after spills, as byproducts can pollute surface waters. The use of absorbents and other mechanical approaches are preferred.
- Grease, oil, diesel fuel and gasoline spilled on land should be collected and put into the appropriate waste container. Uncollectible residues may be absorbed with "spill-dry" or a similar product and should be disposed of by a waste transporter permitted to handle such wastes.
- For spills on water a floating containment boom large enough to enclose the area of surface water where a spill may reasonably occur should be kept at hand.
- Staff at fueling facilities should have proper training in the deployment of fuel spill equipment and materials. Each facility must have a spill contingency plan that describes what action to take in the event of a spill.

Engine Maintenance and Repair - These operations can be a cause of easily preventable spills.

- When ever possible conduct maintenance and repair operations over land, avoid repairs conducted over water.
- Use suction-style oil pumps to drain crankcase oil, and use absorbent pads to remove oil from bilges.
- Engine test tanks should never be drained to surface waters or septic systems.

Engine Parts Washing - Washing engine parts with solvent may not be done over open ground.

- Parts washing should be done in a container or parts washer with a lid to prevent evaporation. The parts should be rinsed or air dried over the parts cleaning container.
- Dirty parts washing fluid should be recycled or disposed of by a licensed waste hauler.
- Water soluble engine washing fluids should be treated in the same manner as other industrial waste waters.



Engine and Parts Storage - Engines and engine parts should be stored on an impervious surface such as sealed asphalt or cement, and covered to avoid contact with storm water. Care should be taken to prevent oil and grease from leaking onto the open ground.

Bottom Paint Removal - Bottom paints may contain metal compounds that are toxic to marine life and the removal of these paints from the bottom of a boat produces a waste product which can harm the environment.

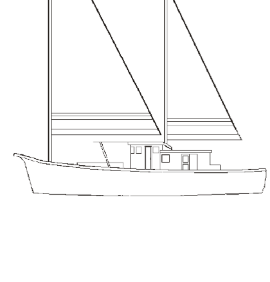
- Discharges of bottom paint residues to surface waters or land is prohibited.
- Bottom paint removal should be conducted over an impermeable surface such as sealed asphalt or cement (not over open ground) with a retaining berm so that the waste water can be contained.
- Removing bottom paint by high pressure water or with a low pressure hose and a scrubber or scraper produces an "industrial waste water". This waste water may be recycled or disposed of, but it may not be discharged to surface waters or storm sewers, and paint solids should be separated from the waste water and disposed of properly.

Removing bottom paint by wet or dry sanding (either by hand or with power tools) produces a sanding dust containing potentially hazardous metals (principally copper).

- Sanding should be done over an impervious surface such as asphalt, cement, or a material such as canvas, plastic, etc. (not over open ground) and there should be a berm or retaining wall surrounding the area so that the sanding dust can be swept or vacuumed and disposed of properly.
- Whenever possible vacuum sanding systems should be used to collect sanding dust as it is created.
- Dust should not be allowed to become wind-borne or otherwise leave the containment area.

Sanding Hulls or Topsides - The sanding dust generated by this activity should be collected and disposed of properly and may not be intentionally discharged into a storm sewer or onto surface waters.

- Where sanding is conducted on land, reasonable precautions should include laying drop cloths beneath the area being sanded and collecting the debris for proper disposal.
- Where sanding is conducted in the water, reasonable precautions should include covering the water near the boat with floating traps or surrounding the immediate area with floating booms and removing the debris with a skimmer.
- Whenever possible vacuum sanding systems should be used to collect sanding dust as it is created.



Spray Painting - Wastes related to spray painting are often a major source of environmental pollution. Several steps can be taken to reduce waste and emissions from painting operations.

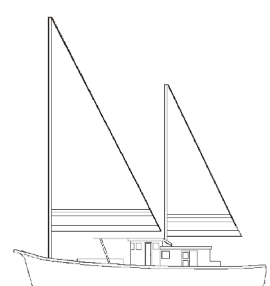
- Carefully control inventory so that waste paint and solvents are kept to a minimum; store waste paint, solvents, and rags in covered containers to prevent evaporation to the atmosphere.
- Direct solvent from cleaning spray equipment into containers to prevent evaporation to the atmosphere.
- Whenever possible use solvents with low volatility and coatings with low VOC content; use high transfer efficiency coating techniques such as brushing and rolling to reduce overspray and solvent emissions.
- Spray painting on land should occur over an impermeable surface and in such a manner that overspray does not fall on open ground or surface waters.

Pressure & Steam Cleaning - The use of pressure cleaning equipment for the initial rinse-off of a vessel hauled from the water can generate industrial waste water.

- Pressure cleaning should be restricted to an area with an impermeable surface (such as sealed asphalt or sealed concrete) and with a berm or pitch which allows the waste water to be contained and collected.
- Waste water from pressure cleaning may not be discharged to septic tank or surface waters. Waste water may be disposed by sanitary sewer disposal.
- Tanks used to collect waste water and remove solids are considered process tanks and paint solids classified as hazardous must be separated and removed by a licensed hauler.

Steam cleaning should be done on an impervious area designed to collect and contain the cleaning effluent, discharges to surface waters are prohibited.

- If detergents or solvents are not used, a properly sized grease trap/oil and water separator connected to a sanitary sewer and properly maintained, should provide adequate treatment to allow the effluent to meet sewer standards.
- If detergents or solvents are used, the oil and grease are emulsified and a grease trap will not function properly. In these cases, treatment or recycling systems should be used. This water should be considered industrial waste water and discharge to septic systems or storm sewers is prohibited. If sanitary sewers are not available, waste water should be hauled by licensed hauler.



Best Management Practices for Materials

Anti-Freeze

Anti-freeze, when drained from an engine, should be stored in a clearly marked container on an impervious surface and under cover. Reuse and recycling of antifreeze should be done whenever possible (e.g. as freeze protection for bilges or plumbing). Antifreeze cannot be disposed of down a storm sewer or in a septic system. Disposal to a sanitary sewer must be allowed by the treatment plant, otherwise it should be removed from the site by a waste transporter permitted to handle this waste.

Used Lead-Acid Batteries

Store on an impervious surface, under cover, protected from freezing, to be collected by an approved recycler.

New Oil

Including new engine oil, transmission fluid, hydraulic oil, and gear oil. These petroleum products should be kept in non-leaking containers on an impermeable surface, away from floor drains. Cover in a manner that will prevent storm water from contacting the container. Leaking containers should be emptied promptly upon detection, either by transferring the product to a non-leaking container or by disposing of it in the "waste oil" container.

Waste Oil

Waste engine oil, transmission fluid, hydraulic oil, and gear oil should be stored in a clearly marked non-leaking container on an impermeable surface, and covered in a manner that will prevent storm water from contacting the container. Oil spills should be prevented from leaving the area by means of a berm or retaining structure. Waste oil should be removed from the site by a permitted waste oil transporter, or used in a waste oil heater on-site.

Oil Filters

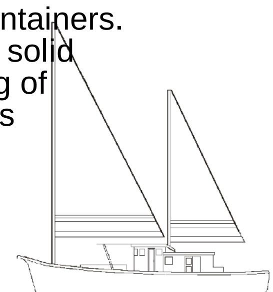
Oil filters should be crushed or punctured and hot-drained by placing the filter in a funnel over an appropriate waste collection container to allow the excess petroleum product to drain into the container. Drained filters should be collected and recycled when possible. Only filters that have been crushed or hot-drained to remove all excess oil may be disposed of as solid waste.

Mercury Lamps and Switches

Spent fluorescent bulbs, other mercury lamps and mercury switches are hazardous waste. Spent lamps should be collected and stored safe from breakage until a sufficient quantity has accumulated for recycling, or disposal as hazardous waste.

Fiber Reinforced Plastic

Use of epoxy and polyester resins for repair or construction of boat hulls can generate significant amounts of waste. Common solvents such as acetone or methylene chloride evaporate easily and should be kept in covered containers. Small amounts of unused resins may be catalyzed prior to disposal as solid waste. However, catalyzation is not an acceptable method of disposing of outdated or unneeded resin stores. These materials must be treated as hazardous waste and disposed of by a licensed waste hauler.



Glue and Adhesives

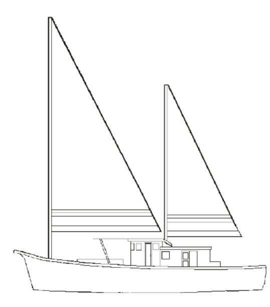
Residual amounts of glues and adhesives remaining in empty caulking tubes may be disposed of as solid waste. All other glue and adhesive related wastes must undergo a determination for hazardous waste characteristics. Non-hazardous glues and adhesives in liquid form cannot be disposed of as solid waste, and should be used for their originally intended purpose.

Paints, Waste Diesel, Kerosene and Mineral Spirits

These products should be stored in non-leaking containers on an impermeable surface, and covered to prevent storm water from contacting the container. Each container should be clearly labeled with its contents. Storage locations should conform to local Fire Codes. The disposal of any waste products from these materials should be by performed by a licensed waste transporter. These waste products should not be allowed to evaporate; poured on the ground; disposed of in storm sewers, septic systems or POTW's; or discharged to surface waters.

Waste Gasoline

Waste gasoline should be stored in a non-leaking container, on an impermeable surface and covered to prevent storm water from contacting the container. The container should be clearly labeled "waste gasoline" and the storage location should conform to local Fire Codes. Whenever possible, waste gasoline should be filtered and used as a fuel. Waste gasoline should not be allowed to evaporate; poured on the ground; disposed of in storm sewers, septic systems or sanitary sewers; or discharged to surface waters. Waste gasoline should be removed from the site by a licensed waste transporter.



Environmental Best Management Practices
Self Assessment

In this section a series of short questions are provided as a guide to marinas and boat yards. Their purpose is to help determine if there is a need to improve facility environmental management. The questions are not intended to be comprehensive with respect to the full range of regulated activity, but provides a good starting point for self-evaluation. Any responses that match the answers marked with an asterisk (*) are candidates for seeking additional assistance or information.

Tanks

Are there any unused bulk storage tanks such as for fuels or chemicals, either above ground or below ground, and

Yes _____* No _____ Don't Know _____*

If yes, have they been properly cleaned, filled, or removed?

Yes _____ No _____*

Are fuel storage tanks in use been properly registered?

Yes _____ No _____* Don't Know _____*

Wastewater

If there are wastewater discharges to the municipal wastewater treatment facility, are the discharges in compliance with all pre-treatment requirements or discharge limits?

Yes _____ No _____ * Don't Know _____ *

If there is any direct discharge of wastewater into groundwater or to the surface such as a stream, lake or drainage ditch, does your business have a permit to do so?

Yes _____ No _____ *

Does your business have floor drains that go directly to the sewer?

Yes _____ * No _____ Don't Know _____ *

Solid Waste

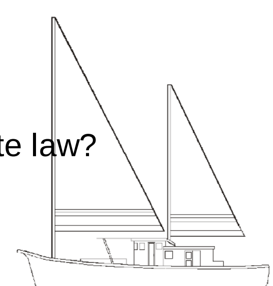
Does your business dispose of any materials on the property?

Yes _____* No _____

Are wastes generally separated for recycling and disposal?

Yes _____ No _____ * Don't Know _____ *

Does your business recycle materials as required by local ordinance and state law?



Yes _____ No _____ * Don't Know _____ *

Does your business burn solid waste at its site or facility?

Yes _____ * No _____

Hazardous Waste

Has your business conducted hazardous determinations for all potentially hazardous waste streams?

Yes _____ No _____ * Don't Know _____ *

Has an inventory been conducted and maintained for all hazardous materials in use or produced on site?

Yes _____ No _____ *

Are regulated hazardous wastes generated from your business properly hauled and disposed, or treated by certified operators who meet state and federal requirements?

Yes _____ No _____ * Don't Know _____ *

Are hazardous wastes properly segregated from other wastes, including other hazardous wastes and solid waste or non-hazardous liquid waste?

Yes _____ No _____ * Don't Know _____ *

Are hazardous wastes properly stored, including appropriate fire and explosion isolation and ventilation for volatile materials?

Yes _____ No _____ * Don't Know _____ *

Are all wastes properly dated and labeled?

Yes _____ No _____ * Don't Know _____ *

Does your business have clearly defined procedures for preventing spills and leaks, and for dealing with any spill or leak that does occur?

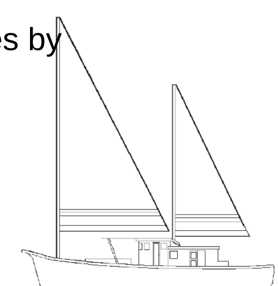
Yes _____ No _____ * Don't Know _____ *

Does your business generate oil and other vehicle wastes that may not be considered hazardous waste?

Yes _____ * No _____

Does your business know how much hazardous waste it generates and stores by month and by year?

Yes _____ No _____ *



Does that business know its generator status, and does your business know whether it has any reporting obligations to the Wisconsin Department of Natural Resources?

Yes _____ No _____ *

Does your business know whether it needs an EPA identification number?

Yes _____ No _____ *

Does your business maintain a complete file of Material Safety Data Sheets (MSDS) for all hazardous materials on site, and are the MSDS sheets available at a convenient location for employees?

Yes _____ No _____ * Don't Know _____ *

Does your business maintain effective education and training programs on safety and chemicals hazards, including adequate follow up on enforcement of rules?

Yes _____ No _____ *

Do employees know proper procedures for handling and managing hazardous materials, including procedures for spill response and emergency cleanup ?

Yes _____ No _____ *

Are containers with hazardous materials labeled with proper warnings, and are containers kept closed or secured in proper storage facilities?

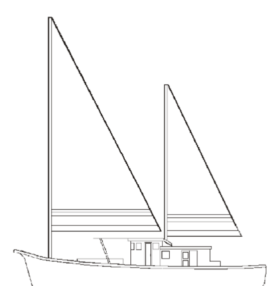
Yes _____ No _____ *

Does the storage of hazardous chemicals in your business comply with National Fire Protection and local ordinances?

Yes _____ No _____ * Don't Know _____ *

Are hazardous materials ordered on an as needed basis rather than stockpiling larger quantities?

Yes _____ No _____ *



Hazardous Waste Regulatory Primer

Types of Wastes Which May Be Regulated
As a small business you must be aware of your responsibilities for proper disposal of your waste materials. This section provides background information to help you determine if disposal of your waste materials is regulated by state and/or federal agencies. Understanding and correctly interpreting waste regulations can be difficult and confusing. The following list specifies the types of waste which may be subject to federal and/or state regulations. Note that for regulatory purposes, these definitions may vary from state to state.

Solid Waste: Solid waste generally refers to any garbage, refuse, sludge, and other discarded or salvageable material, including solid, liquid, semisolid or contained gaseous material resulting from industrial, commercial, mining and agricultural operations, and from community activities. This does not include solids or dissolved materials in domestic sewage, dissolved or suspended solids in industrial waste water effluent, or other common water pollutants.

> Note: Wastes that are "solid" in their physical state are not always considered "solid wastes" from a regulatory standpoint. If a waste conforms to the above definition and is not considered to be hazardous (i.e. is not listed by the EPA as hazardous or doesn't have hazardous characteristics, as detailed below), then it can be categorized as a solid waste.

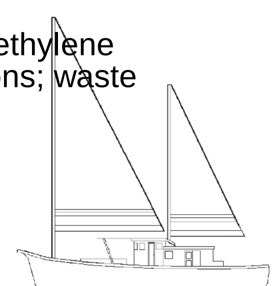
Typical solid wastes include: paper; wood; yard debris; food wastes; plastics; leather; rubber and other combustibles; and noncombustible materials such as glass and rock.

Hazardous Waste: Hazardous waste is any solid waste (see above) which is defined as hazardous. A solid waste is defined as hazardous if it is either 1) listed as hazardous by the EPA or a state's regulatory agency; or 2) has hazardous characteristics.

1)The EPA-issued hazardous wastes lists include: wastes generated by non-specific sources (e.g. spent halogenated solvents); wastes generated by specific sources (e.g., distillation bottoms from recycling paint solvents); acutely hazardous commercial chemical products and manufacturing chemical intermediates which may be hazardous under certain conditions; and toxic commercial chemical and manufacturing chemical intermediates which may be hazardous in certain circumstances.

2)The criteria for determining whether a solid waste has hazardous characteristics include: ignitability (e.g. flash point less than 140° F); corrosivity (e.g. pH less than 2 or greater than 12.5); reactivity (e.g., reacts violently with water, normally unstable, generates toxic fumes, etc.); and toxicity (e.g. as determined by the "TCLP" laboratory test).

Typical hazardous wastes include: 1,1,1-Trichloroethane; toluene; xylene; methylene chloride; perchloroethylene; spent cyanide plating, cleaning and bath solutions; waste water treatment sludges.



Mixed/Contaminated Waste: Mixed/contaminated waste refers to (non-hazardous) solid waste which has been mixed with, or contaminated by, a hazardous waste or substance.

> Note: If a solid waste is mixed with (or contaminated by) a "characteristic" hazardous waste it is considered hazardous only if the resulting mixture retains the hazardous characteristic. A mixture of a "listed" hazardous waste with a non-hazardous solid waste is generally considered hazardous unless certain specific criteria can be met.

Typical mixed/contaminated wastes include: used motor oil and chlorinated solvent, used engine coolant and gasoline, paint booth filters.

Air Emissions: Air emissions refer to the release or discharge of a pollutant into the ambient air either 1) by means of a stack, or 2) as a fugitive dust, mist or vapor as a result inherent to the manufacturing or formulating process.

Typical air emissions include: overspray and drying from painting or coating operations; evaporating solvents from parts cleaning/degreasing operations; perchloroethylene from dry cleaning operations.

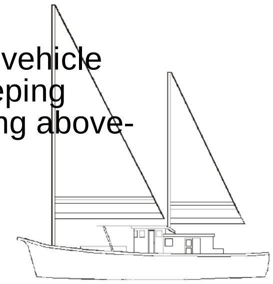
Wastewater Discharge: Wastewater discharge refers to any direct discharge of a pollutant from a "point source" (i.e. an identifiable source such as a pipe, ditch, or outfall) to surface waters, ground waters, such as through septic systems, or to a publicly owned treatment plant (POTW).

> Note: The term "pollutant" is very broadly defined and even includes heat from non-contact cooling water. Pollutants are generally characterized as either 1) "conventional," which includes such things as total suspended solids (TSS), biochemical oxygen demand (BOD), phosphorus, oil and grease, or 2) "toxic," which consists of various chemicals or chemical compounds which have toxic effects on human health, wildlife, fish or aquatic life.

Typical wastewater discharges include: wastewater from vehicle washing operations; wastewater from food processing; spent aqueous cleaning solutions; industrial process waste waters; and boat sewage discharge.

Storm Water Discharge: Storm water runoff refers to water from rainfall and snow melt that runs off buildings, sidewalks, etc., and flows over the ground surface returning to a water body, potentially collecting pollutants from air and/or land along the way. As the runoff "leaves" a particular site it is considered (for regulatory purposes) "Storm water discharge." Storm water discharge is usually considered a "point source" pollution as it actually originates from a particular site, or a discreet point source. Storm water discharges are sometimes referred to collectively as "urban runoff" which is generally considered "nonpoint" source pollution.

Typical Storm water runoff /discharge pollutants include: oil and grease from vehicle maintenance; sediments from construction sites; pesticides from grounds keeping activities; detergents from vehicle washing; and hazardous liquids from leaking above-ground storage tanks.



Underground Storage Tanks (USTs): An underground tank is generally defined as a tank and any associated pipes having 10 percent of its volume or more beneath the surface of the ground. USTs containing petroleum products or hazardous substances are generally subject to regulation.

Determining Your Generator Status

Hazardous waste is a by-product of many large and small businesses. From a public perspective, it is most often associated with medium- to large-size manufacturers, but in reality many small, non-manufacturing businesses produce some hazardous waste. From a regulatory view, the business is responsible for determining if it is generating any hazardous waste. Generators fall into one of three categories: very small quantity generator, small quantity generator, and large quantity generator (or VSQG, SQG, and LQG, respectively). The generator status is determined by three factors:

1. amount of hazardous waste generated per calendar month
2. amount of hazardous waste accumulated on site at any one time
3. whether the waste is hazardous or acute hazardous

Very Small Quantity Generator - A VSQG (also know Conditionally Exempt Small Quantity Generator or CESQG) has a monthly generation limit of 100 kg (220 pounds) or less of hazardous waste, and 1 kg (2.2 pounds) or less of acute hazardous waste (consisting of EPA listed pesticides). A VSQG cannot accumulate more than 1,000 kg (2,205 pounds) of hazardous waste, or 1 kg (2.2 pounds) of acute hazardous waste.

A VSQG must determine if its waste is hazardous and comply with generation and storage limits. It must properly manage or dispose of hazardous waste at an approved hazardous waste facility. When the wastes are transported, they must be properly marked and labeled according to U.S. Department of Transportation rules, and a licensed transporter is to be used. If the transporter requires a manifest, then the VSQG must get an EPA identification number.

Small Quantity Generator - A SQG has monthly generation limits of less than a 1,000 kg (2,205 pounds), and an accumulation limit of 6,000 kg, or 13,230 pounds. The maximum accumulation cannot be stored more than 180 days.

The regulatory burden is greater for a SQG. In this case an EPA identification number is required, proper storage regulations apply, record keeping and reporting requirements apply, an annual report must be given to the regulating agency, and emergency procedures must be established for leaks, spills, or fires involving hazardous waste.

Large Quantity Generator - A LQG generates over 1,000 kg (2.205 pounds) per month and may not store hazardous waste more than 90 days. With acute hazardous waste, any generator exceeding the VSQG limit of 1 kg (or 100 kg spill) becomes a LQG.