ADDENDUM TO THE ENVIRONMENTAL STATEMENT RELATING TO THE PERMANENT WHARF IN RUPERT'S BAY, ST HELENA ISLAND

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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PERMANENT WHARF IN RUPERT'S BAY, ST HELENA

EXECUTIVE SUMMARY

The construction of a permanent wharf forms part of the strategic decision taken by SHG to build an airport to cater for future tourist access, rather than commission a new ship to replace the ageing RMS *St Helena*. This means that bulk cargo (excluding fuel) would not be shipped to the island on board the RMS on a near-monthly basis anymore. Furthermore, the current system of unloading freight onto lighters at sea is neither a safe nor efficient means of offloading cargo. The third key factor was the need for a ramp to launch a sea rescue boat, as part of the required airport safety management measures. Thus to address these issues, SHG decided to construct a new permanent wharf in Rupert's Bay.

The construction of a wharf and port facility in Rupert's Valley would move the hub of commercial maritime activity away from Jamestown (its historical home) to Rupert's, which is a designated industrial area in the Land Development Control Plan and currently accommodates the island's power station, a fish processing plant and a fuel offloading and storage facility.

The original Environmental Statement for the airport project was completed by Faber Maunsell (later known as AECOM) in 2008. This included a possible wharf located in the centre of Rupert's Bay – in the vicinity of the current refuelling boom (see cover photograph). However, the airport contractor's design engineers, in optimising the wharf design, decided to move it to the south-west point of Rupert's Bay (Figure 1.1 in Chapter 1). In view of this major change, the St Helena Planning Division requested the contractor (Basil Read) to compile an Addendum to the 2008 Environmental Statement (ES).

While it was acknowledged that much of the information contained in the ES remains valid, six additional surveys were carried out to inform this Addendum:

- Biodiversity assessment;
- Landscape and visual assessment;
- Cultural heritage and archaeology assessment (desk top);
- Water quality study;
- Cliff stability assessment;
- Sediment movement assessment;
- Traffic survey on Field Road.

The main impacts which may occur during construction, *after* mitigation is applied, are expected to be:

- Noise, dust, vibration and road safety issues related to the increase in heavy traffic, especially in Rupert's Valley, but also where the haul road passes close to the residential areas of Deadwood and Bottom Woods;
- Noise, dust and vibration from quarrying activities in mid- and upper Rupert's Valley, especially for the residents of Deadwood and Rupert's Valley;
- Loss of access to the beach and picnic area for a period of time;

- The economic impact of loss of access to Shears jetty for fish unloading activities for a period of time (Table A).

In terms of risk, the permanent wharf will increase the risk of:

- Oil spills from vessel grounding, shipping collisions and contacts and during fuel transfer operations and the impact that such an incident would have for the marine ecology;
- The introduction of alien invasive species into the marine environment via ship's ballast water;
- Introduction of communicable diseases and undesirable social behaviours (Table B).

No *major* negative impacts associated with wharf operation were identified, which could not be readily mitigated. There may be some job losses associated with the loss of the lighterage business and Rupert's beach may be closed for a few days each month but these can be mitigated to a certain extent and are considered to be of minor significance (Table B).

On the other hand, the wharf will realise a number of benefits, such as:

- Greater monetary savings and efficiencies from having a fixed wharf facility;
- Employment opportunities;
- Boost for small, micro and medium-sized businesses in Rupert's Valley;
- Alternative, safer landing for cruise ship passengers during rough sea conditions;
- More potential for the fishing industry – larger boats can be accommodated, boat ramp, provision of refuelling facilities, safer offloading conditions, etc;
- More attractive facilities for visiting yachts;
- Potential for new habitat to be created along the seaward face of the breakwater.

The visual impact could be viewed as being a major adverse or beneficial impact depending on the viewer's perception.

Many of the mitigation measures specified in the ES (which covered the Reference Design of the wharf) are relevant to the wharf in its new position. However, additional impacts were identified in this Addendum and some mitigation measures suggested in the ES are no longer appropriate (due to the changed position) or no longer apply. Table A sets out the impacts, the relevant mitigations[1] suggested in the 2008 ES (in italics) and additional new measures required to manage impacts arising from construction and Table B provides the same for the operational phase. Note that for the latter, responsibility for most of the actions will be various departments of SHG, whereas, most of the actions recommended for the construction phase will be the responsibility of the contractor, Basil Read.

[1] Those mitigation measures included in the 2008 ES which are no longer appropriate or applicable to the new layout and design have not been listed here.

Table A: Summary of potential construction impacts and mitigation measures

Impact	Probability of occurrence and severity of consequences (before mitigation)	Recommended mitigation measures	Probability of occurrence and severity of consequences (after mitigation)
Large falling rocks may injure or kill people and damage equipment	Low Major adverse	• All measures assume that the hill and cliff faces are made safer by first loosening and removing potential dangerous rocks, boulders etc. Possible mitigation options include: ○ Cover lower slope with netting and provide catch fences above; ○ Cover hill and lower slope with netting or provide catch fences; ○ Selective use of 'Gunnite' on certain faces on all other areas over and above netting and catch fences – apply colouring to such surfaces to blend in. ○ Install 'New Jersey' barriers spaced slightly away from the rock face and fill with sand to absorb the impact of falling rocks.	Low Minor adverse
Loose small rocks and stones may injure people and cause minor damage	Possible Moderate adverse	• As above.	Low Minor adverse
Cliff stabilisation netting may affect terrestrial ecology	Possible Negligible adverse	• Commission an investigation into the existence of the psocid in the lava tube. If it is still present, avoid working in the immediate vicinity.	Possible Negligible adverse
Cliff stabilisation netting may affect heritage resources	Possible Minor adverse	• Avoid damage to all heritage features by placing catch fences away from old fortification walls and applying netting only to the lower slopes (below Munden's Path).	Low Negligible adverse
There could be reduced accessibility to footpaths e.g. Munden's during cliff stability works	Possible Minor adverse	• Place warning signs and barricades at both ends Munden's Path to prevent public access during stabilisation works. • Advertise path closure in media.	Possible Minor adverse
Suction and discharge of sediment along the wharf footprint may affect marine biodiversity	Probable Minor adverse	• Make sure no turtles or cetaceans are in the bay prior to work commencing. • Limit area of disturbance to wharf footprint. • Discharge sediment in an area determined in consultation with ENRD and Darwin project scientists.	Probable Minor adverse
The mobilisation of sediment laden runoff in Rupert's Valley which could enter local streams, drains and the marine environment.	Low Negligible adverse	• *Measures to prevent sediment laden runoff being discharged to local watercourses untreated will be put in place* (as per CEMP 1-6). • Install a litter and sediment trap at the end of Rupert's Run and clear out regularly.	Low Negligible adverse
Impact	**Probability of occurrence**	**Recommended mitigation measures**	**Probability of occurrence**

	and severity of consequences (before mitigation)		and severity of consequences (after mitigation)
Sediment could enter the marine environment during wharf construction.	Probable Minor adverse	• *Subject to the source and nature of material, quarried rock shall be washed prior to transport should it be deemed necessary by the Engineer.* • *Sediment traps and/or silt curtains shall be incorporated into the construction process of the jetty to prevent silt escaping from the working area* (however, from experience with the temporary wharf, silt curtains are unlikely to be effective in the marine conditions prevailing at Rupert's Bay (see s. 6.2.3)). • A detailed marine water quality monitoring protocol will be developed. If high levels of sediment are measured, the following mitigation measures will be considered: o Passing the material through a screen to remove the soil and fine material; o Washing the rock prior to transportation to the wharf. • Regular audits of the work area.	Probable Minor adverse
The potential risk of chemical and fuel (oil) spillages entering the marine environment	Probable Minor adverse	• *Measures to protect local watercourses and the marine environment from the potential risk of chemical/fuel spillages will be put in place, these shall include an emergency procedure to be followed in the event of a spillage or other pollution incident.* • The standard procedures to prevent oil spills set out in the EMP 2011 will be followed. • The CEMP will be updated to include a protocol to prevent and/or control spillages in the marine environment.	Possible Minor adverse
The risk of damage to Rupert's Lines during widening of the bridge over Rupert's Run	Possible Major adverse	• Erect protective hoarding or barricades to prevent damage to the historical wall during bridge widening work. • Impose 15mph speed limit. • Erect warning signs. • Re-face the landward wall with stone and re-point the arch over Rupert's Run. • Hold toolbox talks with drivers to raise awareness of the historical importance of the wall.	Low Minor adverse
Opportunity to repair the rough end of the stone-packed wall	Neutral	• Repair the rough end of the old historical retaining wall (part of Rupert's Lines) using sympathetic construction materials and techniques, in consultation with a heritage specialist.	Possible Minor beneficial
Noise from dump trucks delivering fill and rock armour.	Probable Major adverse	• *Seal the road surface to remove corrugations and repair potholes.* • No truck idling in residential area. • Ensure trucks are regularly maintained. • Impose speed limit of 15 mph. • Adhere to working hours stipulated in the EMP and CEMP. • Do not allow drivers to use engine retarders as brakes. • Ongoing monitoring of noise levels in Rupert's Valley, Deadwood and Bottom Woods.	Probable Moderate adverse
Noise from loading/unloading operations	Possible Minor adverse	• *Adhere to working hours stipulated in the EMP and CEMP.* • *Ensure trucks and equipment are regularly maintained*. • Ongoing monitoring of noise levels in Rupert's Valley and at Deadwood if necessary. • If noise monitoring shows excessive noise, consider lining the truck load beds.	Possible Minor adverse
Impact	**Probability of occurrence and severity**	**Recommended mitigation measures**	**Probability of occurrence and severity**

	of consequences (before mitigation)		of consequences (after mitigation)
Noise from concrete batch plant and pre-cast yard	Low Minor adverse	• Ongoing monitoring of noise levels in Rupert's Valley and at Deadwood if necessary.	Low Minor adverse
Vibration from dump trucks delivering fill and rock armour.	Probable Moderate adverse	• *Adhere to working hours stipulated in the EMP and CEMP.* • Seal the road surface to remove corrugations and repair potholes.	Probable Moderate adverse
Noise and vibration from blasting at the quarry	Probable Major adverse	• Conduct building condition surveys before and after the blasting period. • Provide residents of Rupert's Valley and Deadwood with 24 hours advance notice of blasts (as per current practice). • Adhere to noise limit of 125dB(A) at residential receptors. • Ongoing monitoring of noise and vibration.	Probable Moderate adverse
Dust impacts possible at the fish processing plant during wharf construction.	Probable Moderate adverse	• Discuss issue with Argos management e.g. routine closure of doors and windows. • Seal access road past Argos. • Impose the speed limit of 15mph. • Dust suppression on unsealed work areas next to Argos or cover with a layer of crusher run. • Ongoing monitoring of dust in Rupert's Valley.	Low Minor adverse
Dust from haul trucks and increased traffic	Probable Moderate adverse	• *Apply standard mitigation measures as set out in s. 2.6.3 of the EMP.* • Impose the speed limit of 15 mph. • Seal the road surface to remove corrugations and repair potholes. • Regular road sweeping. • Dust suppression on haul roads. • Install dust minimisation equipment at batch plant. • Ongoing monitoring of dust in Rupert's Valley. If monitoring shows that excessive dust is being generated, then: • Damp down the rockfill on the truck prior to transportation. If all the above measures still do not reduce dust levels to acceptable limits, then: • Use tarpaulin covers on the trucks. This will increase the turnaround time for each truck and will place additional burden on the time table for construction and should only be considered as a last resort.	Possible Minor adverse
Dust impacts from concrete batch plant and pre-cast yard	Low Minor adverse	• Apply standard mitigation measures for concrete batch plant as specified in CEMP. • Conduct ongoing monitoring.	Low Negligible adverse

Impact	**Probability of occurrence and severity of consequences (before mitigation)**	**Recommended mitigation measures**	**Probability of occurrence and severity of consequences (after mitigation)**
There will be an increase in construction traffic especially in Rupert's Valley, on Field Road and through Deadwood and Bottom Woods.	Probable Major adverse	• *Impose 15mph speed limit.* • *Provide footways for pedestrians in residential areas (if necessary).* • Try and limit non-essential trips. • May have to employ a stop-go system if necessary.	Probable Major adverse
Temporary diversions and possible temporary closures of roads	Probable Moderate adverse	• If access across Rupert's Run is not kept open during widening of the bridge, provide a temporary road access for Argos. • Try and keep one lane open during resurfacing of the road through Rupert's and employ a stop-go system. • Make sure that the community is aware of the system in place.	Possible Minor adverse
Influx of daily workers to Rupert's Valley could result in an increase in crime	Low Minor adverse	• Promote community awareness programmes. • Reinforcement of codes of behaviour and respect of privacy through tool box talks.	Low Minor adverse
Influx of daily workers to Rupert's Valley could result in increased economic activity for SMMEs	Probable Moderate beneficial	• Promote trading with local SMMEs.	Probable Moderate beneficial
Wharf construction will create some job opportunities and skills development	Probable Minor beneficial	• Employ local Saints. • Provide skills training e.g. in underwater construction.	Probable Moderate beneficial
The beach including the amenity area at Rupert's Bay will not be available at times for recreational use during the construction of the permanent wharf.	Probable Moderate adverse	• *Avoid land take and adverse impacts on Rupert's beach and amenity area as far as possible.* • *Implement measures to minimise the disturbance to businesses and users of the amenity area and beach at Rupert's Bay.* • *Temporary closures of the beach shall be kept to an absolute minimum.* • Advertise dates of closure well in advance. • Consider opening on Sundays, if no work being done and public safety will not be compromised. • Provide a parking area next to the public ablution block and erect signage to direct beach goers to the pedestrian access through the wall.	Probable Moderate adverse

Impact	**Probability of occurrence and severity of consequences (before mitigation)**	**Recommended mitigation measures**	**Probability of occurrence and severity of consequences (after mitigation)**
Access to recreational fishing spots on the south side of Rupert's Bay will be restricted	Probable Minor adverse	• Advertise dates of closure well in advance.	Probable Minor adverse
Possible shortages in water supply to Rupert's Valley due to increased construction water demand	Probable Moderate adverse	• Contractor must only use own borehole water for concrete mixing, dust suppression and other uses and not island supplies.	Low Negligible adverse
Pressure on sanitation facilities	Probable Moderate adverse	• Provide portable toilets at the wharf. • Prohibit use of public conveniences at the picnic area by workers.	Low Minor adverse
There could be disturbance and / or reduced accessibility to Shears jetty at Rupert's Bay for commercial fish unloading	Probable Major adverse	• *When it is not possible to keep the Shears open, an alternative arrangement will be agreed with the Engineer and relevant Departments of SHG.* Options could include: ○ Provide a temporary access track to the Shears; ○ Provide an alternative temporary jetty; ○ Pay compensation for costs incurred in having to transport fish landed in Jamestown to Argos.	Probable Moderate adverse
Disruption to navigation, commercial use, tourism and recreation in Rupert's Bay	Probable Moderate adverse	• Place notices in the media about the construction work, its duration and what restrictions will be imposed on access to the land or sea around the construction site.	Possible Minor adverse
There will be temporary land take in the upper sections of Rupert's Valley associated with the opening of a temporary quarry and the pre-cast yard	Probable Minor adverse	• None possible	Probable Minor adverse

Table B: Summary of operational impacts and mitigation measures

Impact	Probability of occurrence and severity of consequences (before mitigation)	Recommended mitigation measures	Probability of occurrence and severity of consequences (after mitigation)
Large falling rocks may injure or kill people and damage equipment	Low Major adverse	• See Table A above.	Low Minor adverse
Loose small rocks and stones may injure people and cause minor damage	Possible Moderate adverse	• See Table A above.	Low Minor adverse
Impact of wharf on sediment movement in Rupert's Bay	Probable Minor adverse	• None required.	Probable Minor adverse
Risk of oil spills during product transfers	Possible Minor adverse	• Ongoing personnel training. • Develop and regularly update an oil spill control and pollution response plan. • Adherence to port and safety regulations/procedures. • Restrict tanker manoeuvring and product transfers to daylight hours • Provide marine breakaway couplings and emergency shut-down systems. • Ensure ready availability of oil spill equipment during each fuel transfer.	Low Minor adverse
Risk of oil spills due to vessel grounding	Low Major adverse	• Ongoing personnel training. • Develop and regularly update an oil spill and pollution response plan. • Ship vetting systems in place. • Provide advisories to ships' captains. • Update all relevant marine charts. • Aids to navigation marks demarcating navigation limit (these have been included in the wharf designs in accordance with the most recent guidelines of the International Association of Marine Aids to Navigation and Lighthouse Authorities). • Adherence to operational limiting conditions and port safety regulations.	Negligible Major adverse
Risk of oil spills due to vessel contact with wharf	Low Major adverse	• Ongoing personnel training. • Develop and regularly update an oil spill and pollution response plan. • Aids to navigation demarcating reference marks • Adherence to operational limiting conditions and port and safety regulations.	Low Minor adverse
Increased risk of ship collisions with other sea craft	Low Moderate adverse	• Ongoing personnel training • Adopt a single shipping practice in the bay i.e. only allow one vessel to be manoeuvring at one time. • Pollution response plan • Impose a 250m wide exclusion zone around bulk fuel moorings. • Adherence to port and safety regulations.	Low Minor adverse
Impact	**Probability of occurrence**	**Recommended mitigation measures**	**Probability of occurrence**

	and severity of consequences (before mitigation)		**and severity of consequences (after mitigation)**
Potential for pollution from ships and wharf area (litter, waste water, spills, leaks, food waste)	Probable Minor adverse	• Provide litter bins on the wharf and empty on a scheduled (at least weekly) basis. • Erect appropriate signage. • Enforce the MARPOL regulations regarding the disposal of waste within 25 nautical miles of the coast. • Penalise offenders for littering and waste dumping.	Possible Minor adverse
Impacts on human health due to decreased water circulation in the bay causing an increase in pollution concentrations from sewer and stormwater outfalls	Possible Minor beneficial	• Install a soakaway at Argos and remove effluent discharge pipe. • Install a litter trap at the seaward end of Rupert's Run and clean out on a regular basis (at least every 3 months). • Provide larger litter bins at the picnic area and empty on a weekly basis (preferably immediately after a weekend). • Erect appropriate signage. • Erect information boards detailing the negative impacts of litter on marine ecology (it could form part of the island-wide waste management strategy).	Probable Moderate beneficial
Increased risk of ship collisions with cetaceans	Low Minor adverse	• Impose a 14 knot speed limit within the shelf area of the island for ships. • All ships to report any collisions.	Low Minor adverse
Possible increase in habitat for benthic fauna around breakwater	Probable Minor beneficial	• None required.	Probable Minor beneficial
Impacts on biodiversity due to decreased water circulation in the bay causing an increase in pollution concentrations from sewer and stormwater outfalls	Possible Minor adverse	• Install a soakaway at Argos and remove effluent discharge pipe. • Install a litter trap at the seaward end of Rupert's Run and clean out on a regular basis (at least every 3 months). • Provide larger litter bins at the picnic area and empty on a weekly basis (preferably immediately after a weekend). • Erect appropriate signage. • Erect information boards detailing the negative impacts of litter on marine ecology (it could form part of the island-wide waste management strategy).	Low Negligible adverse
Risk of introduction of invasive marine species through discharge of ballast water	Low Major adverse	• Ships not allowed to discharge ballast water within shelf area of the island.	Low Major adverse
Impact of wharf lighting at night on seabirds and marine life	Possible Minor adverse	• There are several different lighting products on the market which limit the impact of lights at night on birds and marine fauna. These will be considered during the final design of the wharf.	Low Minor adverse
Increased noise levels from ship offloading/loading activities	Low Minor adverse	• Ongoing training of wharf operations staff. • Regular maintenance of equipment. • Minimise use of reverse beepers.	Low Minor adverse
Impact	**Probability of occurrence and severity**	**Recommended mitigation measures**	**Probability of occurrence and severity**

	of consequences (before mitigation)		of consequences (after mitigation)
Increased concentrations of greenhouse gas (GHG) emissions from ships in port	Possible Minor adverse	• Vet shipping charter companies to ensure that they have new generation ships (which comply with MARPOL regulations) or systems in place to minimise GHGs.	Low Negligible adverse
Direct ship offloading avoiding need for lighterage	Probable Moderate beneficial	• None required.	Probable Moderate beneficial
Job losses due to termination of lighterage	Probable Moderate adverse	• Employ staff from lighterage companies as wharf operational staff (stevedores).	Probable Minor adverse
Employment at new port	Probable Moderate beneficial	• Employ local Saints as far as possible. • Provide relevant training.	Probable Moderate beneficial
Economic activity in Rupert's Valley will increase	Probable Moderate beneficial	• None required.	Probable Moderate beneficial
Economic development of island	Probable Moderate beneficial	• None required.	Probable Moderate beneficial
Potential alternative landing place for cruise ship passengers	Probable Minor beneficial	• Ensure that steps or other passenger landing facilities are provided at the wharf. • Notify cruise ship companies.	Probable Moderate beneficial
Larger fishing vessels can be accommodated	Probable Moderate beneficial	• None required.	Probable Moderate beneficial
More/safer services for visiting yachts	Probable Minor beneficial	• Advertise new facilities in yachting magazines and websites.	Probable Minor beneficial
Increased potential for fishing from new wharf	Possible Minor beneficial	• None required.	Possible Minor beneficial
Temporary closure of Rupert's beach during ship calls	Probable Minor adverse	• Minimise duration of temporary closures. • Notify public of beach closures one week in advance of a ship call.	Probable Minor adverse
Impact of visiting mariners on community health (risk of STDs, teenage pregnancy, communicable diseases etc)	Probable Major adverse	• Provide suitable accommodation for visiting seamen. • Promote sex education in schools particularly regarding HIV, STDs and teenage pregnancy. • Make free condoms available at bars and other social venues. • Ensure adequate facilities and staff available to conduct health screening. • Strict controls on the importation of drugs.	Probable Moderate adverse

Impact	Probability of occurrence and severity of consequences (before mitigation)	Recommended mitigation measures	Probability of occurrence and severity of consequences (after mitigation)
The scale, design and characteristics of the proposals within the context of the local character area and adjoining seascape.	Probable Moderate adverse	• None possible.	Probable Moderate adverse
Views from residential properties in Rupert's Valley.	Possible Minor adverse	• *Plant indigenous trees along road.*	Possible Minor adverse
Views from various footpaths, including post box walks, fisherman's routes with immediate views of the wharf.	Probable Major adverse	• None possible.	Probable Major adverse

LIST OF ACRONYMS AND ABBREVIATIONS

ADA	Airport Development Area
ADCP	Acoustic Doppler Current Profiler
ADOA	Airport Development Order Area
ANRD	Agriculture and Natural Resources Directorate
BFI	Bulk Fuel Installation
BR	Basil Read
CD	Chart Datum
CEMP	contractor's environmental management plan
CO_2	carbon dioxide
dB(A)	decibel
DBO	design, build, operate
DfID	Department for International Development
dwt	dead weight tonne
EAAD	Environmental Assessment and Advocacy Division
EC	European Community
EIA	environmental impact assessment
EMP	environmental management plan
ENRD	Environmental and Natural Resources Directorate
ES	environmental statement
GDP	gross domestic product
GHG	green house gas
HFO	heavy fuel oil
HER	Historic Environment Record
LPDCO	Land Planning and Development Control Ordinance
mamsl	metres above mean sea level
MARPOL	Convention on Marine Pollution
MDO	marine diesel oil
MHWS	mean high water spring (tide)
NEMP	National Environmental Management Plan
PM10	particulates smaller than 10 micron
PMU	Project Management Unit (Halcrow)
PRDW	Prestedge Retief Dresner Wijnberg
PSU	practical salinity unit
RIB	rigid inflatable boat
RMS	Royal Mail Ship
Ro-Ro	roll on - roll off
SAIEA	Southern African Institute for Environmental Assessment
SANS	South African National Standards
SHG	St Helena Government
SMMEs	small, micro, medium sized enterprises
SO_2	sulphur dioxide
TEU	twenty foot equivalent unit
TSP	total suspended particulates
$\mu g/m^3$	microgram per cubic metre (of air)
UNCLOS	United Nations Convention on the Law of the Sea
VDV	vibration dose value
WHO	World Health Organisation

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1 INTRODUCTION

1.1 Background

At present, almost all freight to St Helena Island is imported via the combined passenger-cargo ship, the RMS *St Helena* (RMS). The RMS calls at the island 15 times per year and delivers approximately 2,000 tonnes of cargo per trip. There are currently no permanent quayside facilities on the island and so the RMS has to moor 500m offshore and all cargo has to be transferred to land via lighters – a risky undertaking, at the mercy of sea and weather conditions. There is limited space on the quayside at Jamestown for the storage, loading and offloading of containers and bulk cargo and there is limited security at the current offloading area (Plates 1 and 2). Furthermore, the low arch at the seaward entrance to Main Street comprises a major constraint to the size of vehicles that can access the quay and so all freight has to be loaded onto small trucks and transported through the middle of town, causing noise and traffic congestion.

Plate 1: Offloading at Jamestown wharf

Plate 2: View of Jamestown wharf

All liquid fuels are delivered by tanker four times a year via a mooring buoy, a floating pipe and boom system located offshore in Rupert's Bay (Figure 1.1 and cover photograph).

However, once the airport is in operation and the regular cargo service offered by the RMS ceases, there will need to be a safer and more efficient solution to accommodate the predicted increase in commercial cargo ships to the island. Thus the St Helena Government (SHG) (the Employer) and the Department for International Development (DfID) selected Rupert's Bay as the location for the construction of a permanent wharf. The Employer included this facility as part of the 'Design, Build, Operate' (DBO) contract for the airport project, which was won by the South African contractor, Basil Read (Pty) Ltd (BR). The contract requires BR to construct a permanent wharf at Rupert's Bay to cater for a wide range of cargoes, including dry and liquid bulks, general cargo, containers and petroleum products. It is thus proposed that the new wharf facility will replace Jamestown as the commercial port of entry for St Helena (DBO Contract, Vol 3b, s. 16).

In 2006, Atkins Limited completed a pre-feasibility study on various wharf locations and configurations in Rupert's Bay. On the basis of this report, known as the Marine Options

Report, the Employer selected option 4 as the one which best meets the future requirements of the island. This option, described in more detail in chapter 4, became known as the Reference Design, and was the basis for *inter alia,* the environmental impact assessment carried out by Faber Maunsell (later known as AECOM) in 2007/08.

1.2 Environmental impact assessment process

Subsequently, the position and layout of the wharf have been optimised by BR and their marine consultants, PRDW. In view of these changes, the Airport Project Director, Miss Janet Lawrence, requested an EIA Scoping Opinion[2] from SHG, as to whether a new EIA would be required for the wharf. The response received from Mr A Isaac of the St Helena Planning Division in a letter dated 15th March 2013, indicated that a new EIA was required (Appendix A). However, it was also acknowledged that a substantial Environmental Statement (ES) had already been compiled (Faber Maunsell, 2008) and that parts of it would still be relevant. Thus, the Planning Division suggested that the new EIA should be treated as an Addendum to the original Environmental Statement (ES).

The same letter set out the terms of reference for the ES Addendum, itemising the aspects which need to be addressed and that the following studies would be required:

- Biodiversity assessment;
- Landscape and visual assessment;
- Cultural heritage and archaeology assessment;
- Water quality study;
- Cliff stability assessment.

It is not the intention of this Addendum to rewrite aspects of the original ES which may still be relevant, but given the time that has elapsed since the work for the ES was undertaken (in 2006-7) and given the number of changes in the Rupert's Bay environment since airport construction commenced, much of the information contained in the ES is now out of date or has been replaced by more recent studies. Furthermore, the emphasis in the ES was on the airport and all its related facilities, while the permanent wharf was assessed in less detail. Thus, to allow for an informed decision about the wharf to be taken, this Addendum will focus on all the key issues relating directly and indirectly to the construction and operation of the permanent wharf. The approach to the study therefore, is to provide a concise report covering the following topics, as prescribed in Schedule II of the Land Planning and Development Control Ordinance (LPDCO), 2008, and in the Procedural Manual for EIA on St Helena, 2010:

- The method and approach followed (Chapter 2);
- Aspects of the legal, institutional and planning framework which have changed since the 2008 ES (Chapter 3);
- An evaluation of the various wharf locations and layout alternatives (comparing the Reference Design with other potential options) and a description of the preferred alternative (Chapter 4);
- A description of the baseline environment (Chapter 5);

[2] In terms of s.32 of the Land Planning and Development Control Ordinance, 2008

- An assessment of the impacts, including a comparison of the impacts of the Reference Design with the optimised BR design (Chapter 6);
- An Environmental Management Plan (EMP) specifically for the permanent wharf. For ease of application, the measures included in the AECOM EMP of 2011 have been repeated in this wharf-specific Addendum where still relevant, and additional measures have been added (Chapter 6). Those mitigation measures which are not already covered by the existing Contractor's Environmental Management Plan (CEMP), will be developed into standard procedures and protocols and added to the CEMP;
- The conclusions of the study are provided in Chapter 7.

Supporting specialist studies are included in the appendices.

1.3 Scope of work

The detailed scope of work was determined during meetings held with SHG and the airport Project Management Unit (PMU) during the period 15-19 April 2013 (Appendix B). The ES Addendum will thus include the following components of the permanent wharf facility:

- All aspects relating to the construction of the wharf up to the Port Control Area, including the bridge over Rupert's Run (Figure 1.1);
- The access road through Rupert's Valley and associated construction traffic;
- A quarry in mid or upper Rupert's Valley;
- The pre-cast and Core-Loc yard (above the permanent Bulk Fuel Installation (BFI));
- A possible concrete batch plant located at the pre-cast yard;
- Airport sea rescue boat facility and launch ramp;
- All aspects relating to wharf operations up to the entrance to the Port Control area.

The scope of the Addendum *excludes* the Port Control area, which will include at least the following:

- Construction of the Port Control buildings and facilities;
- Bonded, refrigerated and break-bulk warehouses;
- Container storage area;
- Port operations relating to the Harbour Master, BioSafety, Port Health, fisheries department, disaster management, etc;
- Traffic leaving the Port Control area.

The key environmental issues to be addressed in this Addendum, compared to the 2008 ES, are summarised in Table 1.1 below.

Table 1.1: Detailed scope of the Addendum

Environmental topic	How addressed in 2008 ES	Coverage in this Addendum
Planning context	The summary of the relevant planning policy in the original ES covers the key issues.	The Land Planning and Development Control Ordinance was proclaimed shortly after the ES was completed (in 2008) and there is a new procedural manual for EIA on St Helena (2010), which elaborates upon the provisions of the LPDCO, but does not add anything new since the original ES was compiled. There are a number of new policies in the drafting stage. Those that are relevant to the wharf will be listed. The institutional arrangements have changed since 2008 and the new structure relating to the EIA process will be described.
Land use	Covered issues relating to the development of a quarry, the need for laydown areas, site offices and worker accommodation. Suggested that the beach would have to be moved and the sand replenished using dredged material. Required that access around the coast to Bank's Bay be maintained.	The impacts of quarrying in Rupert's were addressed in the ES and will not be looked at in any more detail. The laydown areas and site offices in Rupert's Valley have already been set up and will not be assessed further in this Addendum. The construction workers' accommodation is at Bradleys and not in Rupert's Valley. The beach should not be directly affected by the construction and operation of the wharf in its new location, but the impacts of the wharf on sediment and water circulation in the bay will be assessed in this Addendum (s.5.4 and Chapter 6), and access issues will be addressed in s. 6.2.9 and s. 6.3.8. The new wharf location will not require dredging and therefore there is no opportunity to replenish the beach (if it is required). The new location of the wharf will not have any impact on access to Bank's Bay and fishing spots on the north side of Rupert's Bay, but it may temporarily impact on fishing activities on the south side of the bay, which will be addressed (s. 6.2.9 and s. 6.3.8).
Noise and vibration	Description of the pre-airport construction environment was provided. Noise and vibration impacts associated with wharf construction only. No impacts of wharf operation were assessed.	A new baseline will be provided using monitoring data from Rupert's Valley. The assessed noise from construction at the wharf site itself will be slightly less than originally assessed as the construction site is further away from residential areas, but the impacts of haul trucks on noise and vibration will still occur and will be assessed here. The impact of wharf operations on noise and vibration will be assessed in this Addendum.
Air quality, dust and	No data on air quality were available for the	Use will be made of the monitoring data

Environmental topic	How addressed in 2008 ES	Coverage in this Addendum
carbon emissions	2008 ES and therefore the description of air quality in Rupert's Valley is qualitative. Dust is identified as an issue arising from the quarry, construction of the temporary and permanent wharf and from the contractor's compounds. The ES provided a comparison of relative CO_2 emissions for various RMS *St Helena* and air, and air only scenarios, but not for regular visits by cargo ships.	collected during construction and quarrying operations to update the baseline. The temporary jetty has already been constructed and will not be considered further. The issue of dust during construction of the wharf will be similar to that predicted in the ES. The ES did not consider the potential dust impacts from the presence of a concrete batch plant and pre-cast yard in Rupert's Valley. The dust emissions from this will be assessed in the Addendum. The ES did not give consideration to greenhouse gas emissions from cargo ships and transport vehicles during wharf operation. These aspects will be addressed qualitatively.
Terrestrial ecology and nature conservation	The original wharf site in Rupert's Bay was deemed to have low ecological value and no description of the terrestrial fauna and flora was provided.	The impact of the new location is unlikely to have any impact on terrestrial ecology either, *except for* the potential for disturbance of cliff-nesting birds during construction. Observations of cliff-nesting birds on the south side of Rupert's Bay will be made and the relevant information will be included in the Addendum.
Landscape and visual amenity	The proposed wharf was identified as a key issue in the ES and therefore the land- and seascapes were described and the impacts assessed.	The landscape has changed since 2008 as a result of the following: construction of the new haul/access road out of Rupert's Valley; the new access road to, and the construction of, the bulk fuel facility; the temporary fuel facility; the contractor's laydown areas and stores; and the construction and operation of the temporary jetty. Thus a new baseline will be described (s. 5.10.3). The position of the wharf has changed and so new photo montages from three view points will be created for the Addendum and the impacts assessed accordingly (s. 6.3.9).
Cultural heritage and archaeology	All the heritage features in Rupert's Valley were described in the ES. The impacts of the Reference Design on the specific features at that location were assessed.	No further descriptions will be added to the Addendum. However, the heritage features that may be affected by the new location of the wharf will be different to those affected by the Reference Design and so a new desk top assessment will be conducted.
Roads, traffic and footpaths	Predicted traffic volumes during construction of the airport and temporary jetty were provided based on 2005 traffic census data. According to the ES, Munden's Path is closed due to instability.	For the purposes of this Addendum, we will obtain newer traffic statistics and determine the impact of wharf construction on existing roads and traffic volumes. We will check the status of Munden's Path and assess impacts of the wharf construction and operation accordingly.
Geology, contaminated land and hydrogeology	No issues were identified relating to the permanent wharf.	The new position of the wharf off the southern point of Rupert's Bay lies under a cliff and steep scree slope. The Addendum will address issues relating to cliff stability and risk.
Marine environment	Marine ecological surveys were undertaken in	The 2006 data are considered to be still valid,

Environmental topic	How addressed in 2008 ES	Coverage in this Addendum
	Rupert's Bay in 2006, but the transects surveyed only partially covered the area to be affected by the new position of the wharf.	but will be augmented by data obtained from the Darwin-funded Marine Biodiversity and Mapping Project currently being undertaken (s. 5.6).
Surface water	Construction of the permanent wharf will not affect surface water drainage per se. The impacts of the quarry on surface water resources were addressed in the ES.	No new studies will be required to address the impact of wharf construction and operation on surface water resources (impacts on the marine environment will be considered under that heading). The impact of litter and poor quality water emanating from the stormwater and effluent drains emptying into Rupert's Bay will need to be considered in the water circulation study.
Waste management	The current situation regarding waste management on the island is summarised in chapter 16 of the ES.	No further studies will be required, but the necessary mitigation measures specifically for the wharf will be included in Chapter 6.

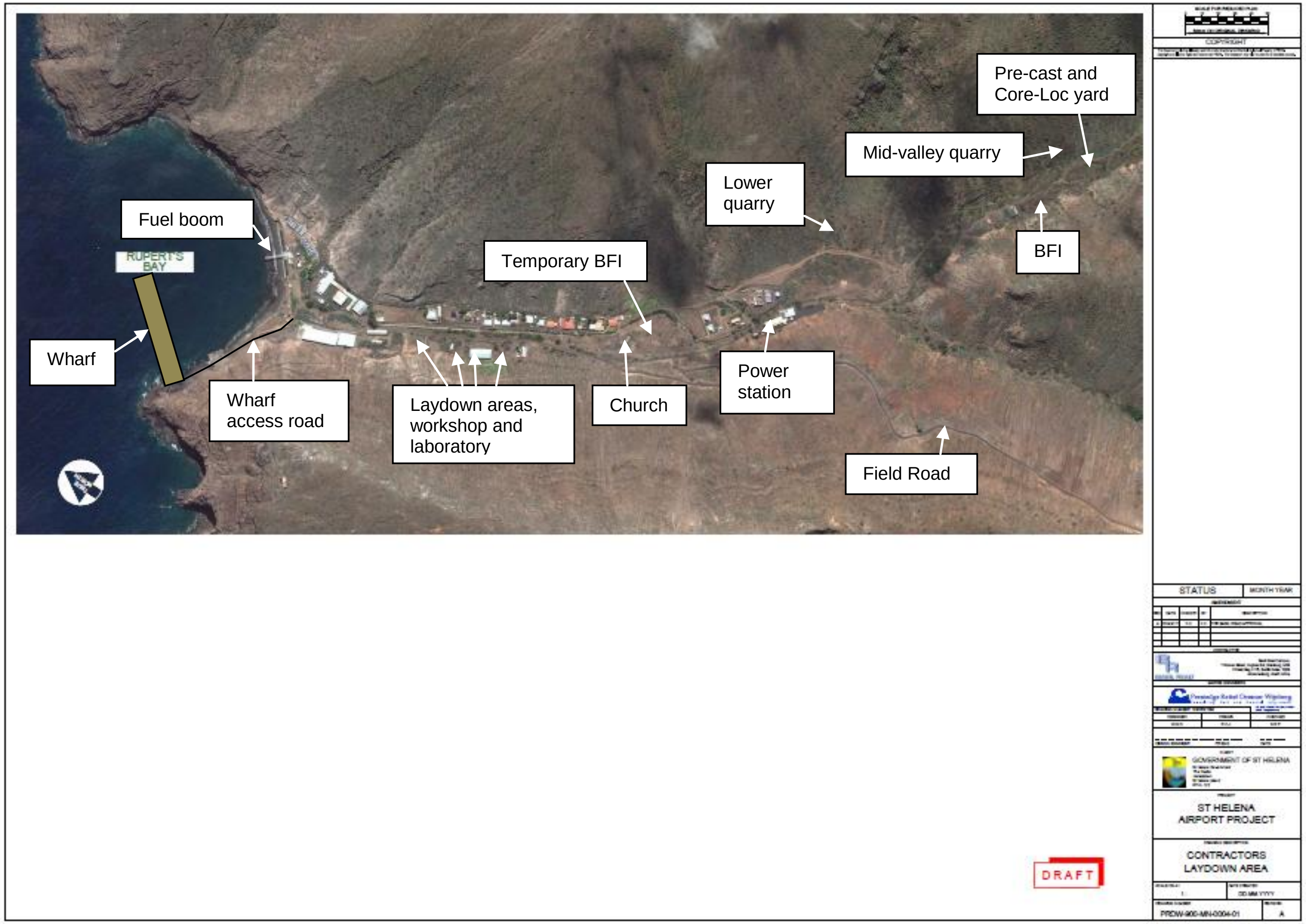


Figure 1.1: Project area and scope of work

1.4 Assumptions and limitations

We assume that all information contained in the ES (2008) was correct at the time of writing.

Normally the scoping study for an EIA should coincide with the pre-feasibility stage of a project, with the detailed EIA being synchronised with the detailed feasibility stage, when more quantitative information is available and the assessment of impacts can be predicted with greater certainty. However, given the time constraints and the need to submit a planning application supported by this Addendum prior to development permission being granted, the impact predictions of this Addendum are based on the preliminary design, but are not expected to change significantly for the final design.

The scope of the Addendum has been limited to the construction and operation of the wharf facility only and does not include the Port Control facilities and operation thereof (see s. 1.3 above).

There are numerous other inter-related projects being planned for Rupert's Bay and Valley, which are outside the scope of this Addendum. Thus the cumulative impacts of these other proposed developments, combined with the impacts arising from the permanent wharf, need to be addressed in a separate Strategic Environmental Assessment.

1.5 Consulting team

Basil Read requested Ms Bryony Walmsley of the Southern African Institute for Environmental Assessment to undertake this ES Addendum on their behalf. Ms Walmsley is a certified Professional Natural Scientist with the South African Council for Natural Scientific Professions, and has over 33 years experience as an environmental consultant specialising in large infrastructure and mining projects. She has some relevant experience on harbours and jetties, having acted as the external reviewer for the Chonguene Mineral Sands dedicated haul road and jetty, and she is currently the external reviewer for the Matola Coal Terminal expansion project, both in Mozambique.

The rest of the project team, their area of specialisation and their credentials are presented in Table 1.2.

Table 1.2: Consulting team

Name	Company	Contribution to EIA addendum	Credentials
B Walmsley	SAIEA	Lead consultant	MA Geography, MSc Geography, PrSciNat
S Luger	PRDW	Sediment and water circulation modelling	BSc Civil engineering MSc Civil engineering PrEng
J Burns	PRDW	Shipping risk assessment	BComm Transport economics MComm Maritime economics (in prog)
G Young	Newtown Landscape Architects	Visual impact assessment	MLArch Landscape Architecture

Name	Company	Contribution to EIA addendum	Credentials
E Clingham and Dr J Brown	Marine Conservation Officer, EMD Marine Darwin Project Manager	Marine ecology	
E Baldwin	Acting Museum Curator	Heritage	
D Breed	Basil Read	Cliff stability assessment	BSc (Hons) Civil Engineering Member SAICE PrEng

2 METHOD AND APPROACH

2.1 Use of previous documentation

As mentioned in Chapter 1 above and detailed in Table 1.1, we will not repeat what was previously written, where that information remains current and relevant to the new wharf location. Where such information is introduced, a full reference to the relevant volume, chapter and section of the ES will be provided.

2.2 Surveys, assessments and modelling

Two additional surveys, three assessments and two modelling exercises were undertaken specifically for the new wharf location:

- A marine ecological survey;
- A traffic survey undertaken by the Roads Department on Field Road;
- A cliff stability assessment;
- A shipping risks assessment;
- An assessment of risk to cultural heritage;
- Marine dispersion modelling in Rupert's Bay; and
- Sediment movement modelling in the bay.

The methods used are described in detail in the appendices, but a summary of the data sources and approach used for each of these surveys is presented in the relevant sections of Chapter 5.

2.3 Observations

During April 2013, observations were made, from both land and sea, of the following pertinent aspects of the environment in Rupert's Bay:

- New location for the permanent wharf and access road;
- Cliff-nesting birds (observed from land and sea);
- Munden's and Bank's Battery footpaths;
- Rupert's Lines and Battery;
- Current operation of the temporary jetty;
- Current levels of disturbance in Rupert's Valley (noise, vibration, visual);
- Use of the beach and recreation area;
- Recreational angling;
- Cliff stability.

In addition photographic panoramas were taken from the following points:

- the footpath to Bank's Battery;
- the recreational amenity area; and
- Munden's Path.

From these, photo simulations were created showing views during wharf operations.

2.4 Consultation programme

It should be noted that international best practice requires a public participation process to be carried out during an EIA in order to provide stakeholders with an opportunity to comment on the proposed project and its related impacts. However, we were advised by SHG and the Project Management Unit (PMU) that public meetings will take place during the planning application phase of the work, rather than during the EIA. Therefore we held focus group meetings with various user groups e.g. boat tour operators, fishing association, etc in order to obtain their issues and concerns and held interviews with key informants, such as government personnel and BR project team members (see Appendix B for the complete list of meetings, dates and minutes).

The purpose of the meetings was to obtain:

- Up to date information, data, survey results, etc;
- Design inputs regarding the permanent wharf;
- Information on the actual logistics of wharf operation;
- Professional opinions on potential impacts;
- Issues and concerns of various user groups e.g. boat tour operators, divers, fishermen, etc.

3 LEGAL, INSTITUTIONAL AND PLANNING FRAMEWORK

3.1 Legal framework

There are two key pieces of legislation relevant to the ES Addendum for the Permanent Wharf:

- The Airport Development Ordinance, 2006; and
- The Land Planning and Development Control Ordinance, 2008

3.1.1 Airport Development Ordinance, 2006

The Airport Development Ordinance is described in detail in Chapter 4 of the ES, but it is worth noting the following.

The Airport Development Ordinance came into force in September 2006. This Ordinance makes provisions to facilitate the design, construction and operation of an airport in St Helena. Under sections 4 and 5 power is given (subject to safeguards) to designate any land as an Airport Development Area (ADA).

The effect of this, under the subsequent provisions of the Ordinance, is to enable the Governor to grant exemptions from certain existing laws. The Ordinance states that nothing done in an ADA with the consent of the Governor in Council shall be held to be in contravention of the Land Planning and Development Control Ordinance.

In a later development, an Airport Development Order Area (ADOA) has been delineated. The permanent wharf lies within the designated ADOA, which means that a planning application will need to be submitted to SHG, using the streamlined process set out in the Airport Development Ordinance.

3.1.2 Land Planning and Development Control Ordinance, 2008

The Land Planning and Development Control Ordinance, 2008 (LPDCO) came into effect after the original EIA was completed. The main steps of the required environmental authorisation process and therefore described below.

Section 29(3) states that an application for development permission in respect of a development which may have significant effects on the environment must be accompanied by an EIA report. Developments requiring an EIA may be categorised into two types:

- Type A developments, which are large, complex and are likely to have wide-ranging, significant effects on the environment by virtue of their scale, location and physical and operational characteristics (s. 30(1)(a)); or
- Type B developments which may have significant effects but where the associated impacts are likely to be few and limited in severity and extent (s. 30(1)(b)).

The new wharf is considered to be a Type A development and thus needs an environmental statement. The LPDCO sets out the contents of an EIA report for Type A developments in s.

30(2) and also states that the cost of preparing the EIA report must be borne by the applicant (s. 20(3)).

The administrative process to be followed in order to obtain development permission is described in the LPDCO and is set out in detail in the Procedural manual for EIA on St Helena (Version 1, December 2010). The process is summarised in Figure 3.1 below.

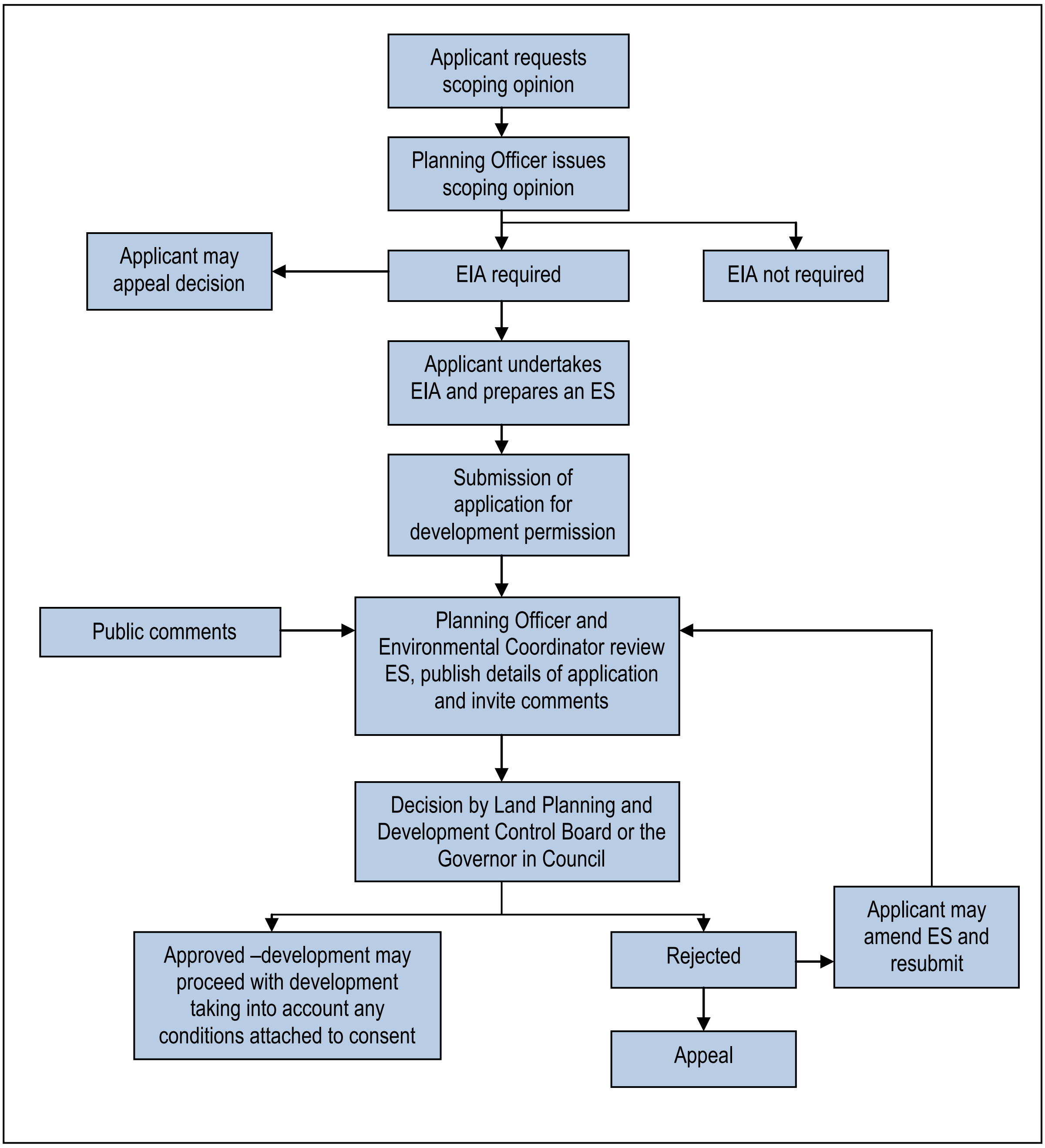


Figure 3.1: Administrative process for development permission

In making a decision about an application, the Board or the Governor in Council will take the following into consideration:

- Provisions of all relevant development plans;
- All information, studies and reports provided by the applicant;
- The EIA report;
- Any specific information requested;
- Any representations made;
- The impact of the proposed development on the natural or built environment and on uses of adjacent land;
- Relevant land and building preservation orders;
- Whether the proposal is for commercial or industrial development;
- Traffic considerations;
- The benefits or disadvantages which may be imposed on economic, social and welfare facilities, including prospects of employment and the effect on the infrastructure of St Helena;
- The area of land required;
- Whether building plans comply with relevant regulations;
- Any other relevant matters.

3.1.3 Future environmental legislation

A new initiative which needs to be highlighted for the future, is the development of an overarching environmental law for the island, which aims to consolidate, update and harmonise all existing environmental legislation under one framework act. This will be drafted over the period April to June 2013 (Head, EMD, pers. comm.), but is not expected to come into effect until late 2013.

3.2 Policy and planning framework

The only new relevant policy or plan that has been adopted since the original ES was compiled is the Oil Spill Response Plan, which was developed in early 2010 in response to a pollution incident in James Bay. According to disaster management personnel, this plan is fairly basic and needs to be strengthened to cater for more regular cargo ship movements in Rupert's Bay.

However, there are a number of new policies and plans currently in draft, which may need to be taken into consideration depending on the timing of the construction programme. Wharf operations will need to adapt to the evolving policy regime as it changes.

The proposed policies and plans, relevant to the wharf include:

- Underwater blasting protocol (being developed) – aims to prohibit blasting from June to December;
- Policy (based on an existing best practice leaflet) on how to approach cetaceans;
- Marine Conservation Plan – one of the outputs of the Marine Darwin Project;
- National Environmental Management Plan (NEMP) for the island (at drafting stage). The NEMP will form one of a suite of three key documents aimed at ensuring the

sustainable development of the island - the other two being a sustainable economic development plan and a social development plan;

- Solid waste management strategy;
- Climate change response policy.

3.3 Institutional framework

The institutional structure relating to all aspects of environmental management and control on the island has been completely revised since the ES was completed and the new structure came into effect on 1st April 2013. The new overarching body is called the Environmental and Natural Resources Directorate (ENRD), which comprises three main divisions:

- Nature conservation;
- Environmental risk and management; and
- Environmental assessment and advocacy.

Management of the EIA process is the responsibility of the Environmental Assessment and Advocacy Division[3] (EAAD). This ES Addendum will therefore be submitted to EAAD for review and approval.

3.4 International conventions

Three of the most important and relevant environmental conventions relating to shipping and use of the new wharf are: the United Convention on the Law of the Sea (UNCLOS), the Convention for the Control and Management of Ships' Ballast Water and Sediments, and the London Convention, better known as the Convention on Marine Pollution (MARPOL).

UNCLOS, concluded in 1982 came into force in 1994 and was acceded to and ratified by the United Kingdom in July 1997. The accession to the Convention by the UK specifically included St Helena. The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources (www.wikipedia.org).

The Convention on ballast water came into effect in 2004; it requires all ships to implement a Ballast Water and Sediments Management Plan. All ships will have to carry a Ballast Water Record Book and will be required to carry out ballast water management procedures to a given standard. Parties to the Convention are given the option to take additional measures which are subject to criteria set out in the Convention, and to International Maritime Organisation guidelines.

MARPOL 73/78 is one of the most important international marine environmental conventions. It was designed to minimize pollution of the seas, including dumping, oil and exhaust pollution. Its stated objective is: to preserve the marine environment through the complete elimination of pollution by oil and other harmful substances and the minimization of accidental discharge of such substances.

[3] Formerly known as the Environmental Management Directorate

The original MARPOL Convention was signed on 17 February 1973, but did not come into force. The current Convention is a combination of 1973 Convention and the 1978 Protocol. It entered into force on 2 October 1983. As of 31 December 2005, 136 countries, representing 98% of the world's shipping tonnage, are parties to the Convention including the United Kingdom.

All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail and member nations are responsible for vessels registered under their respective nationalities (www.wikipedia.org). All ships flying the Red Ensign are deemed to fall under the UK for the purposes of this Convention. It is also worth noting that South Africa is a signatory to MARPOL.

Marpol contains 6 annexes, concerned with preventing different forms of marine pollution from ships:

- Annex I Oil
- Annex II Noxious Liquid Substances carried in Bulk
- Annex III Harmful Substances carried in Packaged Form
- Annex IV Sewage
- Annex V Garbage
- Annex VI Air Pollution

A State that becomes party to MARPOL must accept Annex I and II. Annexes III-VI are voluntary annexes. A description of each annex is provided below (www.imo.org).

Annex I: Regulations for the Prevention of Pollution by Oil

Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.

Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk

Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 nautical miles of the nearest land.

Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form

Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.

For the purpose of this Annex, “harmful substances” are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.

Annex IV Prevention of Pollution by Sewage from Ships
Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.

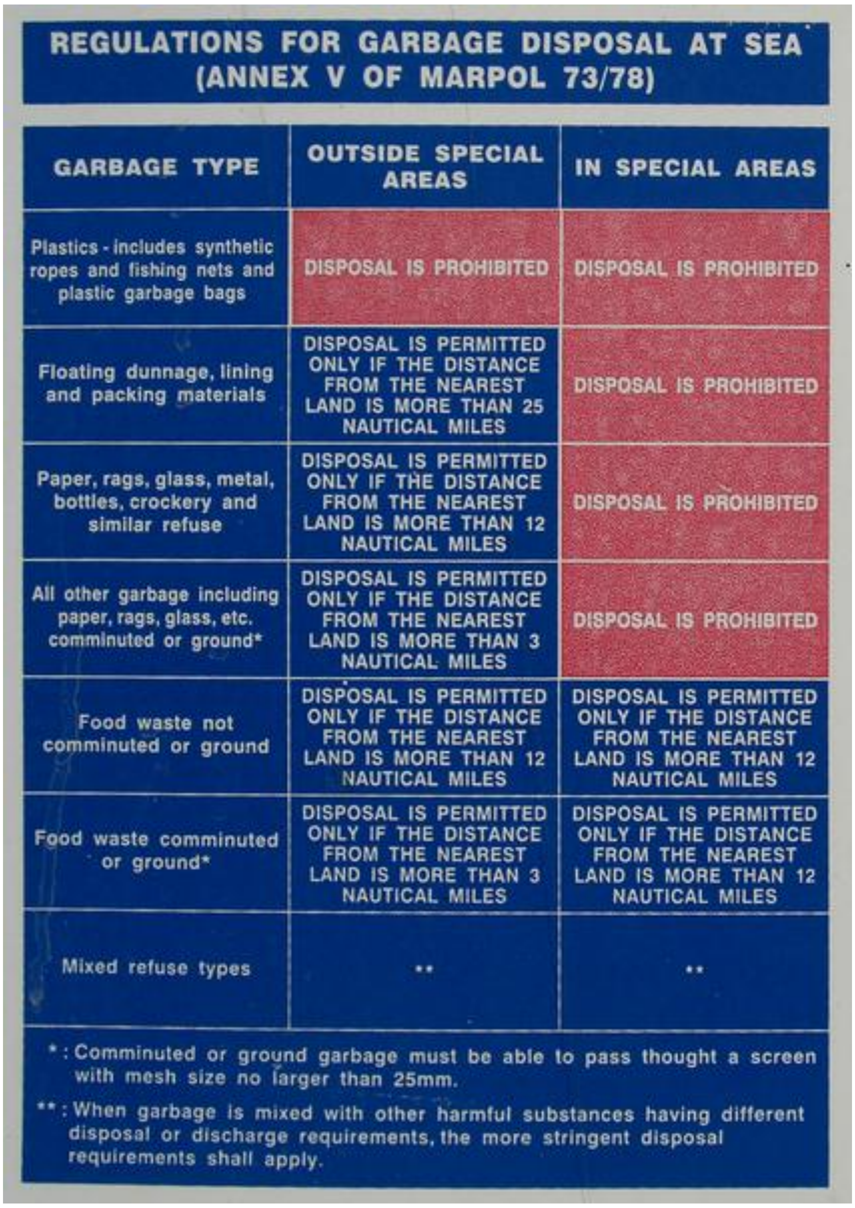
Annex V Prevention of Pollution by Garbage from Ships
Deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of (see Figure 3.1); the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.

Annex V has been amended and entered into force on 1 January 2013. The revised Annex V prohibits the discharge of all garbage into the sea, except as provided otherwise, under specific circumstances.

Annex VI Prevention of Air Pollution from Ships

Sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter. St Helena does not lie in a designated emission control area.

In 2011, after extensive work and debate, the International Maritime Organisation adopted ground breaking mandatory technical and operational energy efficiency measures which will significantly reduce the amount of greenhouse gas emissions from ships; these measures are included in Annex VI and entered into force on 1 January 2013.



REGULATIONS FOR GARBAGE DISPOSAL AT SEA
(ANNEX V OF MARPOL 73/78)

GARBAGE TYPE	OUTSIDE SPECIAL AREAS	IN SPECIAL AREAS
Plastics - includes synthetic ropes and fishing nets and plastic garbage bags	DISPOSAL IS PROHIBITED	DISPOSAL IS PROHIBITED
Floating dunnage, lining and packing materials	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 25 NAUTICAL MILES	DISPOSAL IS PROHIBITED
Paper, rags, glass, metal, bottles, crockery and similar refuse	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 12 NAUTICAL MILES	DISPOSAL IS PROHIBITED
All other garbage including paper, rags, glass, etc. comminuted or ground*	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 3 NAUTICAL MILES	DISPOSAL IS PROHIBITED
Food waste not comminuted or ground	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 12 NAUTICAL MILES	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 12 NAUTICAL MILES
Food waste comminuted or ground*	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 3 NAUTICAL MILES	DISPOSAL IS PERMITTED ONLY IF THE DISTANCE FROM THE NEAREST LAND IS MORE THAN 12 NAUTICAL MILES
Mixed refuse types	**	**

* : Comminuted or ground garbage must be able to pass thought a screen with mesh size no larger than 25mm.

** : When garbage is mixed with other harmful substances having different disposal or discharge requirements, the more stringent disposal requirements shall apply.

Figure 3.1: Regulations for garbage disposal at sea (note: St Helena does not lie in a designated Special Area) (www.wikipedia.org)

In addition to UNCLOS and MARPOL, St Helena is bound by the following international conventions and protocols (note that only those relevant to the construction and operation of the wharf have been listed in Table 3.1).

Table 3.1: List of relevant international conventions and protocols

Convention/Protocol/Agreement name	Date of accession / signature	Relevance to wharf project
Convention on the Conservation of Migratory Species Agreement on the Conservation of African-Eurasian Migratory Waterbirds	23 July 1985 22 February 1999	Relates to specified migratory species such as whales, dolphins, turtles and seabirds. Specified migratory seabirds.
Convention on Biodiversity	3 June 1994	Obliges countries to develop a National Biodiversity Strategic Action Plan relating to species of specific risk and interest.

Convention/Protocol/Agreement name	Date of accession / signature	Relevance to wharf project
Convention on the Regulation of Whaling	17 February 1973	Prohibits harvesting of specific species within territorial waters
Convention on Fishing and Conservation of the Living Resources of the High Seas	14 March 1960	All States have a duty to adopt, or cooperate with other States in adopting measures necessary for the conservation of the living resources of the high seas. Such measures should be formulated with a view to securing a supply of food for human consumption.
Convention on the Conservation and Management of Fishery Resources in the South-east Atlantic Ocean	20 April 2001	To ensure the long term conservation and sustainable use of the fishery resources in the South East Atlantic Ocean. When implementing the Convention, Parties undertake to, inter alia, adopt measures based on the best scientific evidence available, apply the precautionary principle, take due account of the impact of fishing operations on ecologically related species, and protect biodiversity in the marine environment
Convention of the High Seas	14 March 1960	This treaty was created to codify the rules of international law relating to the high seas. It forms part of a suite of treaties under UNCLOS.
Convention on the Continental Shelf	11 May 1964	This treaty was created to codify the rules of international law relating to continental shelves. The treaty dealt with seven topics: the regime governing the super-adjacent waters and airspace; laying or maintenance of submarine cables or pipelines; the regime governing navigation, fishing, scientific research and the coastal state's competence in these areas; delimitation; tunnelling (www.wikipedia.org). It forms part of a suite of treaties under UNCLOS.
Provisions in terms of UNCLOS relating to the Conservation and Management of Straddling Fish Stock and Highly Migratory Fish Stocks	9 January 2002	Sets out principles for the conservation and management of straddling fish stocks and establishes that such management must be based on the precautionary approach and the best available scientific information. The Agreement elaborates on the fundamental principle, established in UNCLOS, that States should cooperate to ensure conservation and promote the objective of the optimum utilization of fisheries resources both within and beyond the exclusive economic zone.
Convention relating to Intervention on the High Seas in Cases of Oil Pollution	8 September 1982	This is an international maritime convention affirming the right of a coastal State to “take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution of the sea by oil following upon a maritime casualty or acts related to such a casualty” (www.wikipedia.org)
Protocol to amend the Convention on Civil Liability for Oil Pollution Damage	15 May 1998	This is an international maritime treaty that was adopted to ensure that adequate compensation would be available where oil pollution damage was caused by maritime casualties involving oil tankers.
Convention for the Protection of the Ozone Layer Montreal Protocol on Substances that Deplete the Ozone Layer	15 May 1987 16 December 1988	The Vienna Convention acts as a framework for the international efforts to protect the ozone layer. However, the legally binding reduction goals for the use of CFCs, the main chemical agents causing ozone depletion are laid out in the accompanying Montreal Protocol. These instruments relate to refrigerants used in reefers and cold storage facilities

4 PROJECT DESCRIPTION

The various project alternatives that were considered are described and evaluated in section 4.1 and the preferred alternative is described in more detail in section 4.2.

4.1 Options considered to determine the Reference Design

The construction of the permanent wharf forms part of the strategic decision taken by SHG to build an airport to cater for future tourist access, rather than commission a new ship to replace the ageing RMS. This meant that bulk cargo (excluding fuel) would not be shipped to the island on board the RMS on a near-monthly basis anymore. Furthermore, the current system of unloading freight onto lighters at sea is neither a safe nor efficient means of offloading cargo. The third key factor was the need for a ramp to launch a sea rescue boat, as part of the required airport safety management measures. Thus to address these issues, SHG decided to construct a new permanent wharf.

After an initial screening assessment of possible locations for the wharf at Prosperous Bay and Rupert's Bay, the latter was selected for a number of reasons including ease of accessibility, lower environmental impact, location close to the main centres, and more conducive oceanographic conditions. Atkins was then commissioned to undertake an assessment of a range of options relating to a wharf in Rupert's Bay, including:

- Location within Rupert's Bay;
- Wharf configuration and form of construction;
- Shipping options and vessel types;
- Cargo handling requirements.

The following key assumptions were set down at the outset:

- Breakwater options shall not be considered due to high associated capital costs;
- The minimum alongside water depths shall be around 5.0 to 6.0m, or as required by vessel types under consideration;
- The quay length should be around 100m to 120m to accommodate the range of vessels under consideration;
- The wharf facilities shall be capable of accommodating bulk cargoes (sand, cement), general cargoes (including containers) and Roll on – Roll off (Ro-Ro) vessels;
- All the options under consideration should have the ability – as exists at Jamestown – to handle lighters during periods when ocean-going ships would have to anchor offshore;
- There will be no passenger throughput, as passenger operations will continue at Jamestown (Atkins, 2006)[4].

[4] This requirement has been reconsidered and the wharf structure will now include steps and a landing platform to allow passengers to disembark.

4.1.1 Location in Rupert's Bay

An initial options study carried out by Atkins in February and March 2006 found that the optimum position for the wharf within Rupert's Bay was in the middle of the bay near the current fuel boom (Figure 4.1).

4.1.2 Construction options

The construction options taken into consideration by Atkins (2006) are summarised as follows:

1. Floating Port: heavy duty concrete pontoons anchored to the seabed;
2. Piled Jetty: open-piled structure with berthing normal to the shoreline or alongside T-Head;
3. Alongside Wharf: solid quay retaining reclaimed area parallel to the shoreline;
4. Solid Jetty: solid structure with berthing normal to or parallel to the shoreline connected by a solid causeway.

These options were evaluated using the following technical and operational criteria:

- Hydrodynamic loading;
- Ship manoeuvring factors;
- Marine construction technologies; and
- Comparative costs.

The only environmental criterion considered was 'loss of seabed'.

On the basis of the initial brainstorming session the preferred form of construction was Option 4 above since it uses traditional rockfill, rock armouring and mass concrete blockwork construction, all of which are well understood, tried and tested for marine works of this nature and in similar locations elsewhere in the world.

4.1.3 Shipping options and vessel types

The main aim of the permanent wharf is to provide a multi-user wharf facility capable of accepting a number of vessel types and handling a range of cargoes. For each option it was assumed that there would be the flexibility to handle Ro-Ro vessels and self-unloading of cargo using the ship's gear. In addition it was assumed that a shore-based mobile crane will be provided with flexibility to transfer and handle a range of cargo types.

The principal factors relating to shipping options and vessel types considered by Atkins in the Options Report (2006) included the safety and efficiency of shipping movements within Rupert's Bay, other marine users, and the dimensions of various cargo ships likely to visit St Helena (deadweight tonnage (dwt), length, beam width and design draft). The study found that general cargo ships up to, say 2,600dwt, with a length of about 100m, beam of <16m and a draft of 6m would be appropriate for operation alongside a berth with a dredged pocket of 6.5m.

4.1.4 Cargo handling requirements

The design of the wharf also had to consider the following factors regarding the width of a quayside general cargo handling ‘apron’:

- Space for ‘buffer’ storage of cargo;
- Space for lateral transport of cargo to and from open storage or transit sheds within the port back-up area; and
- Space for access of trucks for direct unloading of inbound cargo.

4.1.5 Consolidated options analysis

Based on an analysis of all the above factors, the options short-listed by Atkins (2006) were identified as:

- **Option 1**: Causeway with wharf parallel to the seabed contours and the shoreline (inner berthing);
- **Option 2**: Causeway with wharf parallel to the seabed contours and the shoreline (outer berthing);
- **Option 3:** Causeway with jetty berth normal to seabed contours and shoreline;
- **Option 4**: Causeway with jetty berth angled to seabed contours and to shoreline (to provide increased shelter) (Figure 4.1).

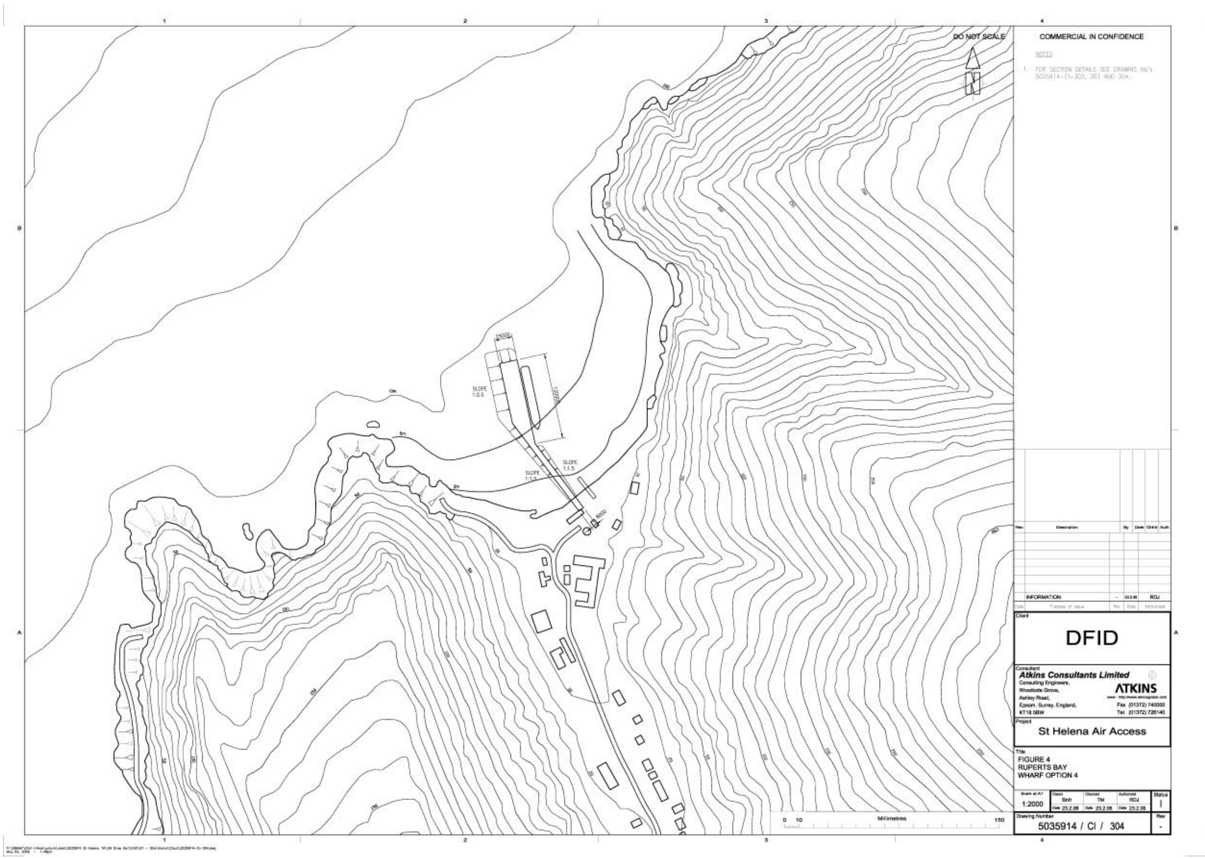


Figure 4.1: Option 4 – Reference Design (Atkins, 2006)

Table 4.1 sets out the initial evaluation of these layout options taking account the shelter, safety and efficiency of marine operations, scope for future development and comparative capital costs. Atkins suggested that Option 1 should be eliminated on the grounds of manoeuvring and future development constraints and that Option 2 and Option 4 (which is, in effect an optimised version of Option 3) should be examined in more detail with regard to the potential 'trade off' between operability and capital cost. Option 4 became what is known as the Reference Design.

Table 4.1: Indicative evaluation of layout options for preferred construction involving rock fill, armoured revetments and blockwork quay walls

Layout Option	Local Shelter	Marine Operations (manoeuvring)	Future Expansion	Costs (Indicative ranking – volume based)	Other Comments
Option 1 Causeway with parallel wharf (inner berthing)	Very good	Very poor	Very poor	2	Discount on manoeuvring and future development constraints
Option 2 Causeway with parallel wharf (outer berthing)	Very poor	Fair	Fair	1 (Lowest)	Provides option for sheltered small craft harbour in the lee of the wharf.
Option 3 Causeway with jetty berth – normal to shoreline	Fair	Good (Preferred)	Good	4 (Highest)	Optimum configuration dependent on wave climate assessment
Option 4 Causeway with jetty berth – angled to shoreline.	Good	Good	Good	3	Optimum configuration dependent on wave climate assessment

4.2 Description of preferred project option

The airport DBO contractor, Basil Read, priced their tender on the basis of the Reference Design described in section 4.1 above. However, subsequent to the award of the tender, BR contracted the specialist marine engineering firm Prestedge Retief Dresner Wijnberg (PRDW) to carry out an engineering optimisation study for the permanent wharf, looking at:

- Wharf location within Rupert's Bay;
- Wharf design; and
- Shipping options.

In order to inform the optimisation study, data were collected from various sources and detailed modelling was undertaken relating to:

- Waves, currents, tides, swells and winds;
- Ship type and size availability;
- Island's current and predicted tonnage of imported goods.

This resulted in a new wharf location off Munden's Point on the south-west side of the bay and an optimised design (Figure 4.2). There were found to be a number of financial, technical, operational and environmental advantages of the new layout and design, and also some disadvantages, as shown in Table 4.2 below.

Table 4.2: Key advantages and disadvantages of the optimised layout and design over the Reference Design

Advantages of optimised layout and design	Disadvantages compared to the Reference Design
No need for dredging and disposal of dredge spoil because located in deeper water	Further from proposed secure Port Control area and bonded warehouses
Further from recreational area and beach and will only impact on access during ship calls	Construction will interfere with access to the beach, recreation area, fishing spots on south side of bay and fishing operations
Will not affect the Boer Desalination Chimney	The presence of Rupert's Lines will pose a minor constraint to access but this can be readily mitigated
Refuelling operations will be further out to sea	Need cliff stabilisation measures
Lower operational costs (dredging kit)	Increase in construction/capital costs due to depth of wharf
Affords greater protection from rollers and swells	
Increases availability and usage of quayside (days/annum)	
Allows more space for ship manoeuvring	
Allows more space for other sea users in the bay	
Longer life-span due to orientation and design	

On balance, the scoping and optimisation study (carried out in early 2012) found that the advantages far outweighed the disadvantages. A further optimisation study was carried out between July and November 2012 and the preliminary design has proceeded on this basis. The preliminary design and costing was submitted to DfID for discussion at the end of May 2013 and it was decided to further optimise the design based on priorities for the operation of the wharf. Two new options were priced and presented to DfID based on a 95m long and 13m wide wharf. In July 2013, a compromise between these two options was selected (Option 2BA) whereby the wharf alignment was rotated counter-clockwise by 10 degrees from Option 2B, the lighter berth was consolidated into the main quay, 7 tonne Core-Locs were proposed in favour of 5 tonnes to provide better protection, a heavier underlay was to be used and a passenger landing facility was included.

If the preliminary designs are approved, the detailed design phase is expected to take 5-6 months, and preliminary on-site planning and logistics will commence in late 2013. Actual construction of the wharf is scheduled to start in April 2014.

4.2.1 Description of overall scheme

It should be noted that the following description is based on a preliminary design and that the final layout of the wharf and associated structures may change slightly. As noted in section 1.4, the scoping study for an EIA normally coincides with the pre-feasibility stage of a project, with the detailed EIA being synchronised with the detailed feasibility stage. However, given the time constraints and the need to submit a planning application supported by this Addendum prior to approval to proceed being granted, the impact predictions of this Addendum are therefore based on the preliminary design (Option 2BA) described below.

The scope of work for the design stage is the preliminary engineering design of the following marine and land-side elements:

- Breakwater;
- Main quay wall;

- Ro-Ro berth;
- Lighter berth included as part of main quay;
- Navigational aids;
- Sea Rescue facility and fixed concrete boat ramp for launching sea rescue boats;
- Access road to the wharf from the Shears jetty;
- Electrical power supply and lighting;
- Water supply and fire-fighting water points;
- Wharf-side ablution facilities;
- Space for vehicle manoeuvring;
- Loading and offloading quayside equipment e.g. crane, container stacker, etc;
- Quayside fenders and bollards;
- A quarry/quarries to obtain armour rock and rockfill;
- A pre-cast yard to provide the reinforced concrete block wall structures and Core-Locs;
- A concrete batch plant (possible).

The locations of these features are shown in Figures 1.1 and 4.2.

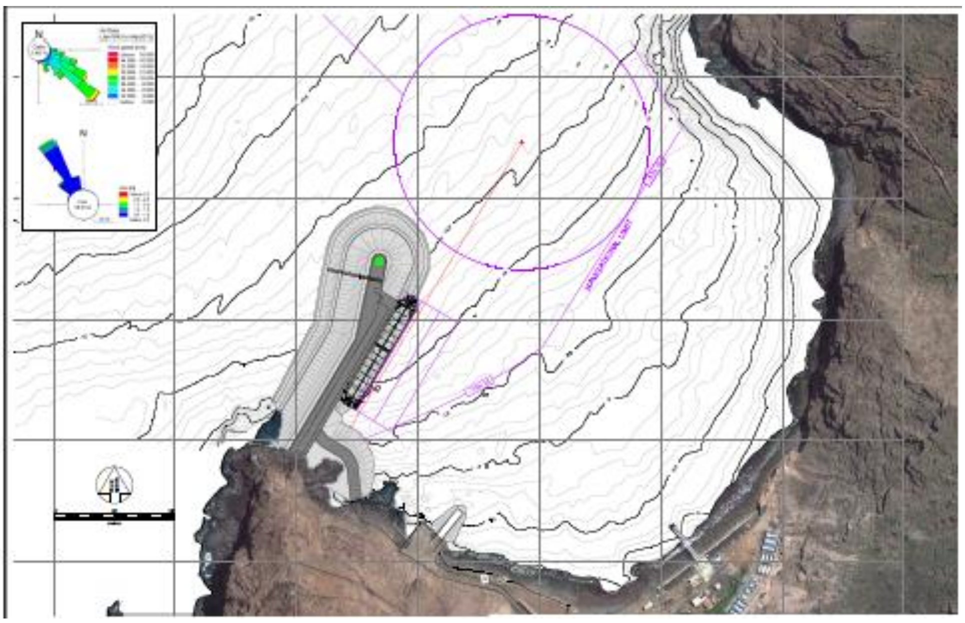


Figure 4.2: Wharf layout (option 2BA) (PRDW, 2013)

The design aims to provide the most cost effective permanent wharf solution while keeping safety and efficiency of navigation and ship operations paramount. The design criteria were specified in Vol 3b – Technical Specifications of the Employer's Requirements, Section 16, Cl 16.3 (SHA, 2011a) and section 4.2.5 of the EMP (2011) as follows:

- The wharf must sympathetically reflect the coastal landscape;
- The structure should avoid impeding the natural flow of water and sediment around the bay;
- Rock armour shall be used in preference to concrete armour units provided that the structural integrity of the marine structures is not compromised;
- Primary marine structures shall have a design life of 70 years;
- Capital and maintenance costs must be optimised;

- Degree of shelter must be maximised to reduce the amount of annual down time during adverse wave conditions;
- Maximise the safety and efficiency of navigation, ship manoeuvring, berthing and unberthing manoeuvres;
- Avoid any land uptake;
- Avoid adverse impacts on Rupert's beach and amenity area;
- Avoid disturbance of the Boer prisoner of war desalination chimney;
- Minimise direct effects on Rupert's Lines (the fortification wall);
- Minimise the effects on water quality;
- Minimise adverse impacts on the marine and coastal ecology. Mitigation for the loss of littoral benthic habitats must include the provision of substrates and cavities for marine fauna and flora.

In addition to the criteria listed above, the design had to meet British and International Design Codes.

The Reference and preliminary design specifications for the quay are shown in Table 4.3 and are illustrated in Figures 4.1, 4.2 and 4.3.

Table 4.3: Design specifications for the wharf

Facility	Reference Design	Preliminary optimised design	Comment
Length of quay	120m	95m	Shortened based on typical ships operating in the south Atlantic region (PRDW, 2012)
Back of quay width	25m	13m	Adequate for limited and temporary storage and traffic movements
Ro-Ro ramp	15m	15m	The Ro-Ro ramp at the temporary jetty will be refurbished to provide the permanent ramp
Berth depth	>7m	>7m	
Lighter berth length	40m	Steps and landing platform	Steps and a landing platform will be provided on the main quay for lighters. Shears jetty will be retained for fish unloading.
Lighter berth depth	>3m	>3m	

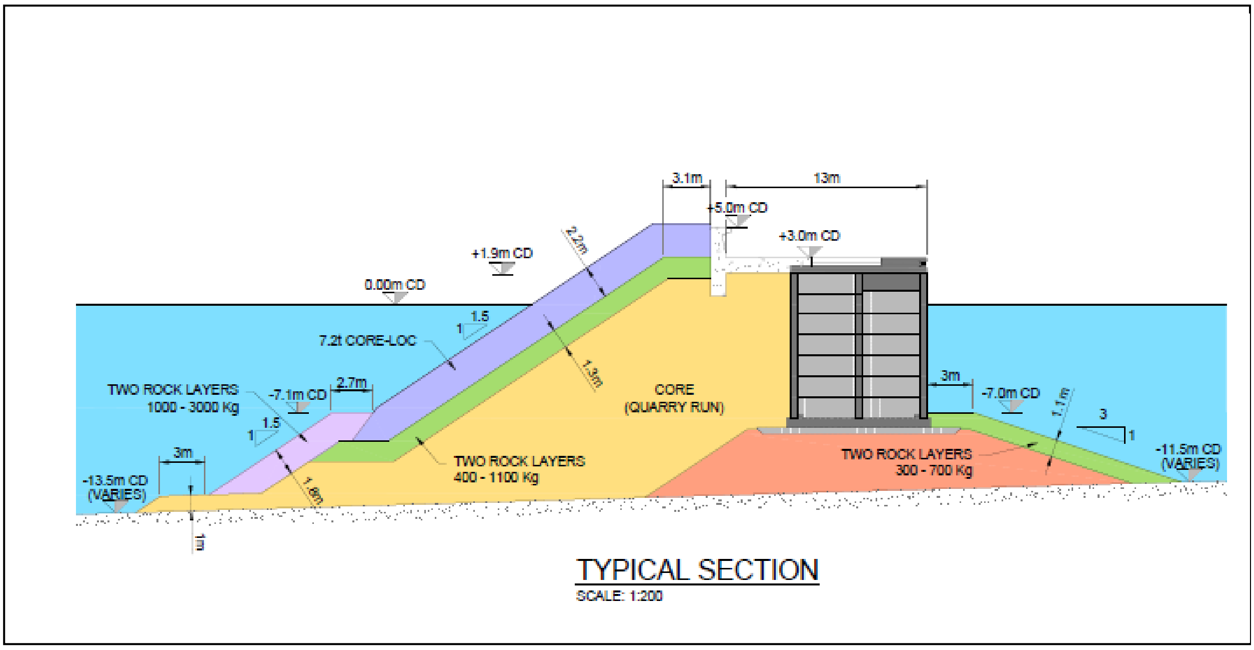


Figure 4.3: Cross-section through wharf structure

The inner face of the wharf will be designed as a quay wall to provide a safe berthing environment for the design vessel while the outer face will be protected by a rubble mound rock revetment with 7t concrete armour units (Core-Locs) (Figure 4.3)[5]. The breakwater crest elevation and crown wall will be designed according to the EurOtop Manual, which specifies the requirements to protect pedestrians and vehicles on the quay.

The quay wall structure will be designed as a gravity wall concept as the site's subsea conditions are suitable for gravity type wall structures supported on a sufficiently thick stone bed. The preferred block shape is the prefabricated rectangular reinforced concrete box. These blocks will be placed on top of each other from -8m Chart Datum (CD) up to +3m CD with the voids filled with rock material thereby minimising block weight but maximising utilisation of local materials (Figure 4.3). A constant shape and size for all blocks is proposed to streamline the fabrication, transport and placing processes.

The quay walls and associated structures will be designed for maximum durability in the marine environment. Durability will be ensured by providing sufficient concrete cover for all reinforced concrete elements and detailing all exposed steel elements as stainless steel or hot tip galvanised.

Mooring bollards, fendering, mooring hooks and ladders will be designed to accommodate the berthing and mooring loads from the largest design vessel in accordance with international standards and procedures.

All moorings, berths and approach channels will have lights and marker buoys which conform to the International Association of Lighthouse Authority Regulations (PRDW, 2012).

Power, water, lighting and communications will be provided on the quay. Currently power is supplied to the nearby Argos factory via an 11kV line. Power supply to the wharf will be via

[5] Unfortunately the rock in the proposed quarries (and elsewhere on the island) was found to be unsuitable for the outer armouring of the wharf as per the design criteria, thus necessitating the need for Core-Locs.

an underground cable with an 11kV step-down substation located either at Argos (preferably) or on the wharf. At present it is not intended to store refrigerated containers (reefers) on the quayside, and therefore power requirements are purely for lighting and supply to ships, if required.

Currently, Rupert's Bay is supplied with water from a 10m^3 storage tank and 2 inch diameter main. The water tank is leaking and the water supply to Rupert's is already insufficient to meet domestic demand when Argos is processing fish. Furthermore, the small diameter main is insufficient to provide the required quantity of fire water at the correct pressure (4-5 Bar) at the wharf (M Squibbs, pers. comm.). It is clear, therefore that new water infrastructure is required to provide enough water to supply vessels and fight fires. The assessment of impacts of any new water infrastructure beyond the wharf area is not included in the scope of this Addendum or BR's contract.

At present, all houses and factories in Rupert's Valley use septic tanks and, in most cases, a soak-away system for sewage disposal. For obvious reasons this system cannot be used at the wharf and ablution facilities will have to comprise chemical toilets or pumped-out tank systems.

Surface water runoff from the quay will be positively drained via stormwater channels and discharged to the sea. Prior to discharge, the water must pass through a litter trap, sediment trap and a 'full retention' oil trap. The system will be designed to prevent surcharging under a 1:2 year storm event and to prevent flooding under a 1:30 design storm event. . Pollution from the breakwater cap can be minimised by ensuring that it is cleaned regularly as well as providing a designated wash down area for contaminated equipment draining to an oil separator.

Provisions for a fuel services corridor on the permanent wharf will be provided. The corridor will accommodate a fixed fuel pipeline extending from the end of the permanent wharf to the emergency shutdown valve on the shoreline. The end of the permanent wharf will accommodate the fuel hose support structure as well the storage of deployment and recovery equipment required for the floating hose (Figure 4.4b). The fixed mooring points and fuel hose buoy will be re-deployed further out to sea.

The permanent wharf will make provision for the export of waste/oil disposal from the Island. Waste oil will be transported to the quay, as is presently being done in Jamestown, and pumped into a ship's waste oil sludge tank for onward disposal in accordance with the requirements of MARPOL (see section 3.4). Facilities will also be provided for the reception of waste from vessels in accordance with the provisions of MARPOL.

4.2.2 Construction methods

4.2.2.1 Access road

Access to the wharf will be via the main road through Rupert's Valley. At the T-junction at the seaward end, the access road will follow the current track to Argos fish factory. This road crosses Rupert's Run stormwater drain on a narrow (single vehicle-width) bridge, contained on the seaward side by the historical fortification wall of Rupert's Lines (see section 5.9) and on the landward side by a low parapet wall

(Plates 3 and 4). The latter has no historical value, but has been faced with stone, with a pointed arch over Rupert's Run. This bridge will need to be widened by 4m to a width of 8m to accommodate the container reach-stacker and other heavy vehicles. Given the significant heritage value of Rupert's Lines, the bridge will be widened on the landward side by 4m. The new retaining wall will be re-faced with stone in keeping with the treatment of Rupert's Lines and a trash screen will be installed to prevent litter from washing into the bay.

Plate 3: Bridge over Rupert's Run

Plate 4: Rupert's Lines on left side of road

From the bridge, the access road will follow the alignment of the existing track to a point near the security boom. From here the access road will follow the existing track down to the level of Shears jetty (Plate 5) and the temporary wharf. From the temporary jetty the road will be built up on a rock platform, topped with sub-base and base layers, to a level of 3m above CD (height of wharf deck). The road will be surfaced with interlocking block pavers or concrete and will have a final width of 8m.

Plate 5: Road to Shears Jetty. Note historical stone-packed wall that formed part of Rupert's Lines

Protection of the access road, traffic and pedestrians from falling rocks and stones will be achieved by a combination of catch fences, possible additional retaining walls and 'New Jersey' barriers spaced slightly away from the rock face and filled with beach sand to absorb the impact of falling rocks, as recommended in section 6.2.1.

4.2.2.2 Wharf

Construction of the wharf will start with a seabed survey to determine geological founding conditions. Should unsuitable founding material be discovered, this will be ‘vacuumed’ and deposited +- 50m away from the founding bed.

The next step would be to build up a level base using rock fill (quarry run) placed in a layer on the sea floor via a chute from a floating barge (Figure 4.3). The placement will be assisted by construction divers to ensure that the rock is contained in the correct place. A total of about 81,000m^3 (145,800t) of core rock fill is required (for the entire wharf) comprising +- <1 - 300kg rocks obtained from a combination of sources:

- Spoil from the construction of the haul road, which has been stockpiled in upper Rupert’s;
- One or more of the quarries identified in the Reference Design in Rupert’s Valley;
- And possibly the airport site.

The first priority will be to use the spoil material, but it is estimated that only some 25,000t of suitable material will be available from this source. Both the lower and middle quarries in Rupert’s Valley have been opened up, and although neither yielded rock suitable for armouring of the wharf (400 – 1,100kg rocks and larger), these quarries may provide the smaller sized material suitable for the core. If there is still need for additional rock, it will have to be sourced from the airport site.

The rock will be transported to site using 30 and 40 tonne articulated dump trucks. This equates to 4,860 x 30t trucks (one way) or 3,645 x 40t trucks (one way) over a period of approximately 8 months. Assuming working hours of 07h00-18h00 Monday to Friday and from 07h00 to 13h00 on Saturdays, this translates into approximately 2 trucks per hour every working day for the 8 month period, but since each truck has to make a return journey, the worst case scenario will be 4-5 trucks per hour passing through the centre of Rupert’s Valley. It should be noted that these are average conditions and in reality, higher truck densities may be expected during peak construction hours or during certain times of the day. Most of these trucks will emanate from higher up Rupert’s Valley, but some will travel from the airport site and down the new haul road.

Once a level rock base has been established along the whole length of the wharf footprint, it will be covered with a 300mm layer of crushed stone (40mm aggregate), which will be obtained from the crusher plant at the airport. Again, the placement of the stone will be carried out using a floating barge and chute system, assisted by divers. This will provide a stable and level base on which to place the precast block walls.

The initial block walls will be placed underwater using a crane on a floating barge and filled with rock using the same method described above. Once the first blocks have been placed, it will be possible to work back towards the shore and upwards. The approximate number of block walls required for each component of the wharf structure is shown in Table 4.4.

Table 4.4: Number and tonnage of block walls required for wharf construction

Block walls	Main quay	
	Quantity	Total tonnage
Type A (26.5t each)	268	7,102
Type B (27.1t each)	29	786
Total	**297**	**7,888**

Once the filled block walls reach the final apron height at the point of contact with land, they will be capped with a thick concrete layer to provide a flat platform accessible from the shore. Thereafter, blocks will be placed and filled progressively out to sea using mobile cranes working from the end of this platform. As each set of blocks is built up and filled, a layer of rock protection will be built up on the seaward side to protect the blocks from wave and current action (Figure 4.3). The bulk of the protection layer will comprise rocks of <1 - 300kg, but a double layer of armour rock (1 - 1.5m thick), with each rock weighing between 400 – 1,100kg, will be placed on top. The toe of the wharf structure on the seaward side will be protected with large rocks weighing between 1t and 3t. This material will be sourced from Rupert's quarry or the airport site. Placement of these protective layers will be via barges, crane and skip, long boom excavator and end-tipping to a final gradient of 1:1.5.

Once the required thickness is achieved along the length of the wharf, the top will be capped with a concrete layer and the outside wall of the wharf will be given further protection with the placement of approximately 1,800 7t Core-Locs (Figure 4.3). The wharf has been designed to withstand a 1:1,000 year storm event using a 4.6m design wave height, with a 7% risk of failure on a 70-year design life.

The block walls will be cast in the designated pre-cast yard, located above the BFI in upper Rupert's Valley. The pre-cast yard will be developed on top of levelled spoil (generated during haul road construction) and will measure approximately 100m x 30m (0.3ha). The Core-Locs will also be fabricated in the pre-cast yard, with the concrete being sourced from either the batch plant located at the airport site, or a second batch plant will have to be established in Rupert's Valley. The latter option will only be considered if the peak concrete requirements for the airport and the wharf coincide. If a new batch plant is set up in Rupert's, crushed stone and sand will be trucked from the airport site to the pre-cast yard batch plant. It is not envisaged to set up a second crushing plant in Rupert's. Water for concrete mixing will be sourced from the current temporary supply dam located below the new BFI. The pre-cast block walls and the Core-Locs will be transported to the wharf site using 30t and 40t trucks.

Once the wharf structure has been completed, the concrete apron will be laid, wave wall constructed, and quayside furniture will be installed. The quay and apron will be at 3m above CD. This level has been set based on the mean high water spring tide level of 0.94m, the residual 1:100 year storm event above the mean high water spring (MHWS) tide level (0.33m) and an additional compensation of 0.65m to allow for sea level rise over the design life of the wharf (70 years). Thus the design extreme water level has been calculated at 1.92m CD (PRDW, 2013). Workers and operations on the quay will be protected with a 2m high wave deflector wall.

A set of steps will run down the wall of the quay to a landing platform, where lighters and yachts will be able to tie up and passengers can safely disembark. The Shears jetty will be retained and it is likely that fish offloading will continue at this facility.

The current ramp at Shears jetty will be upgraded to allow the launch of the sea rescue vessels (in this case, rigid inflatable boats (RIBs) will be used). The ramp will have a 1:8 slope allowing the launch and recovery of the boat by a vehicle with a boat trailer. All concrete ramp surfaces will have a roughened finish to ensure tyre traction. No provisions for a jetty structure adjacent to the ramp have been made. All loading/unloading of personnel or equipment, not launched with the boat, will take place at the new steps and landing platform at the main wharf. An alternative launch method still being considered is to use a davit crane to lift the sea rescue boats directly into and out of the water. This crane would be on the main quay wall.

4.2.3 Wharf operations

4.2.3.1 Cargo estimates

With the advent of air access, it is expected that the level of shipped cargo tonnage to the island will increase. Various calculations[6] have been made based on conservative economic growth figures, but since the airport construction has started, the island has a much stronger plan to increase tourism numbers over the next 20 years. Therefore, the latest projections regarding freight tonnage, based on higher economic growth forecasts as well as more robust increases in tourist numbers - have been made, as shown in Table 4.5 below (SHG, 2012).

Table 4.5: Predicted freight tonnage 2013 – 2028

Year	Forecast freight tonnage
2013	23,000
2018	28,000
2023	31,000
2028	35,000

4.2.3.2 Vessel types and call frequency

The estimated cargo demand for St. Helena in year 2028 is approximately 35,000t (Table 4.5). It is assumed that this cargo will be carried solely in containers. This would equate to approximately 2,500 twenty foot equivalent units (TEU) per annum (based on a nominal container weight of 14t). Assuming that the average number of calls per annum is 15, this results in a container demand of approximately 166 containers per call in 2028. The corresponding vessel size required to suit this operation is a vessel within a range of 2,500dwt, with a length of approximately 85m, beam width of 13m and a draft of 5m (PRDW, 2012).

As a result of this recommendation, PRDW conducted a basic search to determine the availability of this range of vessels which are currently being used for such

[6] EDP, 2012; DfID, 2010

operations. The criteria were that the vessels are either feeder vessels and/or geared multi-purpose vessels with a TEU capacity less than 600 TEU and an estimated length of less than 115m. Essentially, the vessel needs to resemble the characteristics of the RMS *St. Helena* excluding the passenger component of the vessel (PRDW 2012).

The results of the vessel search indicated that there are several vessels available within the range from 63m to 115m in length that could accommodate the container demand required (i.e. 166 containers, or less if ships called more frequently). One of these vessels could be chartered on a long term charter from Cape Town to St. Helena. The requirement for a shore crane would be dependent on vessel selection as many of the vessels currently operating in the south-east Atlantic are gearless.

(a)

(b)

Plate 6: Examples of typical ships which may call at the permanent wharf; (a) with lifting gear; (b) gearless

In addition to cargo ships, the wharf will cater for larger fishing vessels. The provision of steps and a landing area in the lee of the permanent wharf will allow lighters and tour boats to take advantage of the protection provided by the wharf (Figure 4.4a). It will also be possible for yachts to pull alongside for refuelling and re-provisioning.

The temporary jetty will be refurbished and it will become the permanent Ro-Ro facility.

According to the airport contract, sea rescue boats have to be deployed half an hour prior to all aircraft arrivals and departures. Two sea rescue boats are required and these must be housed in a shed or storage area or sea rescue facility, with facilities for rapid deployment such as a slipway or davit crane.

<u>4.2.3.3 Manoeuvring and mooring</u>

The shipping channel width and turning circle requirements have been calculated based on the maximum vessel size under consideration (length 105m; beam 17m). This indicates that a maximum channel width of 68m is required and a 210m diameter turning circle (Figure 4.2).

The mooring layout for Ro-Ro vessels will use the existing system at the temporary jetty while general cargo vessels will use a conventional mooring layout on the main quay. Bollards will be spaced at 10m centres with two bollards forward and aft offset from the berthing line.

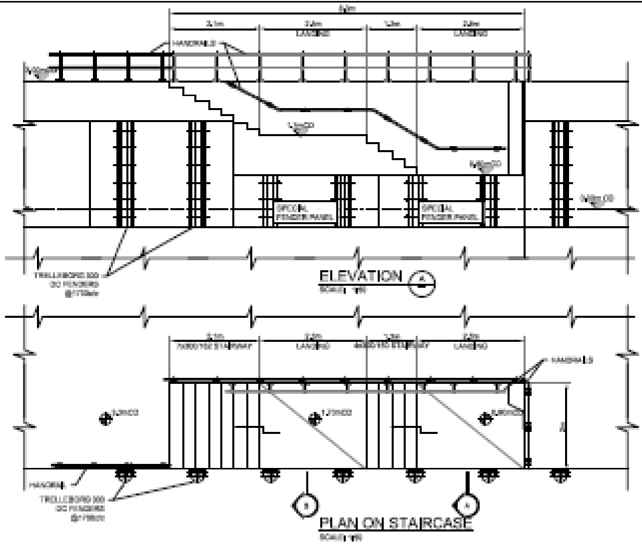


Figure 4.4a: Plan and elevation of staircase and landing platform

Figure 4.4b: Proposed fuel hose support structure at end of wharf

4.2.3.4 Bulk fuel offloading

The mooring buoy which presently comprises three anchor legs, will be relocated approximately 75m seaward of the breakwater head. The mooring legs will be consolidated into two mooring legs anchored to the sea-bed by gravity anchors. Two additional mooring buoys will be installed perpendicular to the stern of the tanker in order to ensure that sufficient lateral support is provided to the mooring system. The floating hose will be deployed from the end of the wharf, using a winch and roller system (Figure 4.4b).

4.2.3.5 Cargo handling

The quay will be equipped with a crawler crane which will be used to offload containers where a ship is gearless. Containers will be transferred using a reach-stacker or container vehicle, to the Port Control Area for inspection and further processing and unpacking.

Vehicles and mobile equipment will be offloaded via the Ro-Ro ramp and driven to the Port Control Area. The access road between the wharf and the Port Control Area will be closed to the public during loading and offloading activities for safety and security purposes.

5 BASELINE ENVIRONMENTAL DESCRIPTION

5.1 Climate

The only climatic issue of real importance for this study is wind. The implication of possible sea level rise associated with climate change is addressed as part of the design in s. 4.2.2.

Data sources

The official Meteorological Station on St Helena Island (WMO No 61901) is located at Horse Point on the north-east side of the island at an elevation of 436mamsl. The duration of the data set is from June 2004 to December 2012, but the data coverage over this period is only about 50% complete. While this wind data set is not considered representative of the micro-climatic conditions in Rupert's Bay, it is the only official source of data and was thus used in the marine dispersion model and in the interpretation of air quality and noise data.

Description

St Helena Island lies in the south-east trade wind belt and therefore the predominant wind direction is south-easterly (Figure 5.1). Rupert's Valley is aligned in a south-east to north-west direction suggesting the dominant south-easterly winds will funnel down the valley exacerbated by natural adiabatic down-slope air flow. These winds are countered by weaker on-shore air flows during certain periods. The maximum recorded wind speed at Horse Point is 21.9m/s, with a mean velocity of 6.5m/s. Calm conditions are rare and on average, only occur 0.61% of the time.

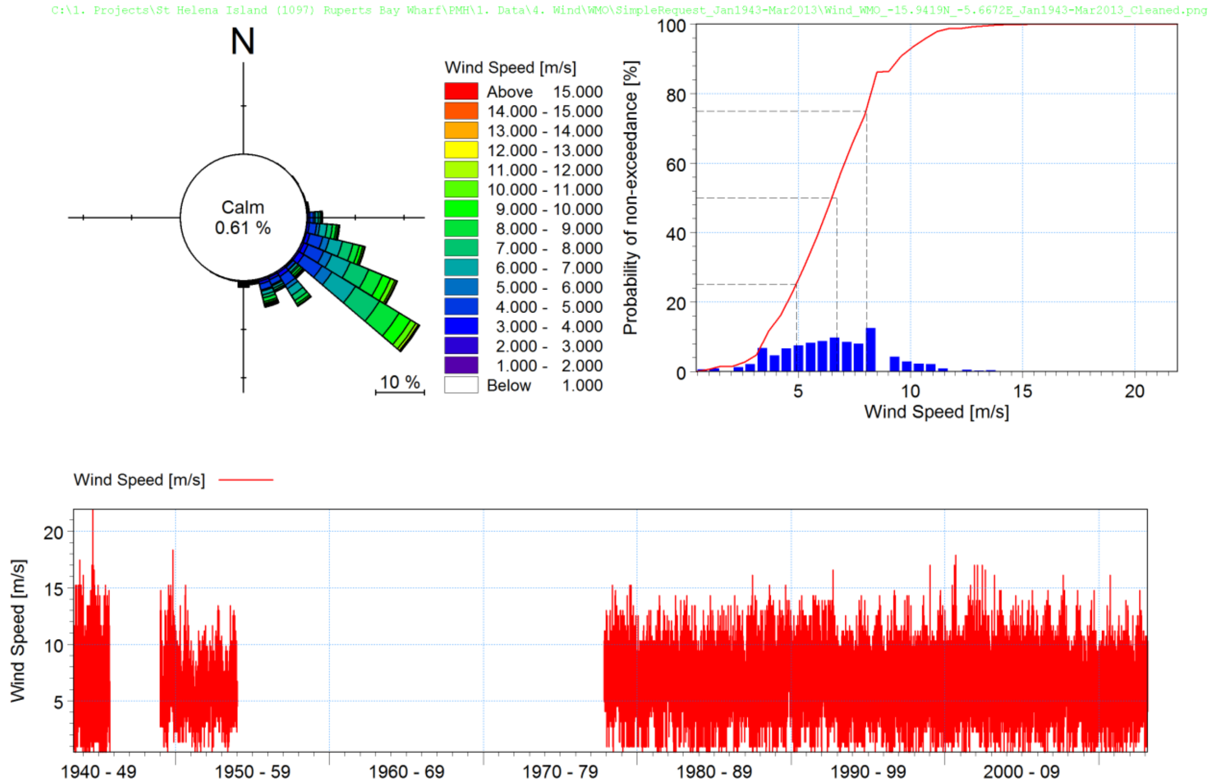


Figure 5.1: St Helena measured wind data

Implications for the project

The prevailing south-easterly wind direction means that the residents of Rupert's Valley will be largely unaffected by dust and noise associated with the construction activities at the wharf site itself. However, noise and dust associated with the movement of construction vehicles through Rupert's Valley will continue to be experienced.

The second benefit of a prevailing south-easterly wind is that gaseous ship emissions while in port will be quickly dispersed out to sea, as will any surface pollution such as oil, plastic and litter.

However, the prevailing wind, combined with the outgoing tide and currents may result in effluent from the Argos overflow drain and litter from the stormwater drain and recreational area accumulating on the land-ward side of the wharf (see also sections 5.4 and 5.5).

5.2 Geology

Data sources

The geology of the island is described in Appendix 13 of the ES (Faber Maunsell (2008)), but it largely focuses on the geology of Prosperous Bay Plain.

For the purposes of this EIA Addendum, Mr Dawid Breed of Basil Read undertook a qualitative cliff stability assessment (Appendix C). The following description is derived from his report.

Description

The layered volcanic rock formation is highly fractured and may be, as elsewhere on the island, layers of *trachyandesite*. These layered, rocky outcrops have a general downward slope and are weathered to various colours of brown. Relative hard ash layers (fine to coarse grained) divide these andesite faces and some of them appear to be cemented together into a stiff stable matrix – especially lower down.

Plate 7: Layered rock and ash formation above wharf location.

Plate 8: A closer view of the cemented ash/tuff layers

The area above the masonry wall has the appearance of loose to stiff *talus*, which shows some signs of superficial erosion. As may be seen in Plates 7 and 8, the lower portions have a typical cliff-like appearance which becomes a steep slope approximately 40 - 45m above the shoreline. Munden's Path generally forms the boundary between these two slopes. Large portions of the old masonry structures along Munden's Path are in a sad state of disrepair.

The bay itself is underlain by hard igneous rock with a shallow layer of fine to medium grained sand interspersed with some rocky reef outcrops.

Implications for the project

The overall, macro-stability of the slopes above the wharf location appears stable and probably more so in this dry environment. This also applies to the stiff ash/tuff layers separating the layers of extrusive andesite.

Micro-stability issues pose the more demanding problem. Loose boulders, cracked rock surfaces and the crumbling retaining walls of Munden's Path require protection measures to be applied.

5.3 Topography and Bathymetry

Data sources

Topographical information was obtained from the 1:25,000 topographic map of the island (1990) and visual observations.

The bathymetry of Rupert's Bay was determined from a single-beam bathymetric survey performed by Tritan Surveys in 2006 and a multi-beam survey undertaken in 2012.

Description

Rupert's Bay is located on the north-west side of the island, just north of Jamestown Bay. The bay is a classical half heart-shaped bay, approximately 500m across from Munden's Point in the south to Birddown Point on the north side of the bay (see Figure 5.2).

Most of the bay is surrounded by vertical to near-vertical cliffs, rising up to 150mamsl at Munden's Point and 150-200mamsl above Birddown. The topography flattens out around the south side of the bay at the entrance to Rupert's Valley, which is about 200m wide at this point (Plates 9 and 10).

Plate 9: View of Birddown Point on north side of Rupert's Bay (photo courtesy of G Temlett)

Plate 10: Topography of Rupert's Valley

The sea floor in the bay is characterised by a fairly gentle slope from the rocky shore to a water depth of approximately 10m at the entrance to the bay (Figure 5.3). The even contours suggest a relatively calm wave regime for most of the year.

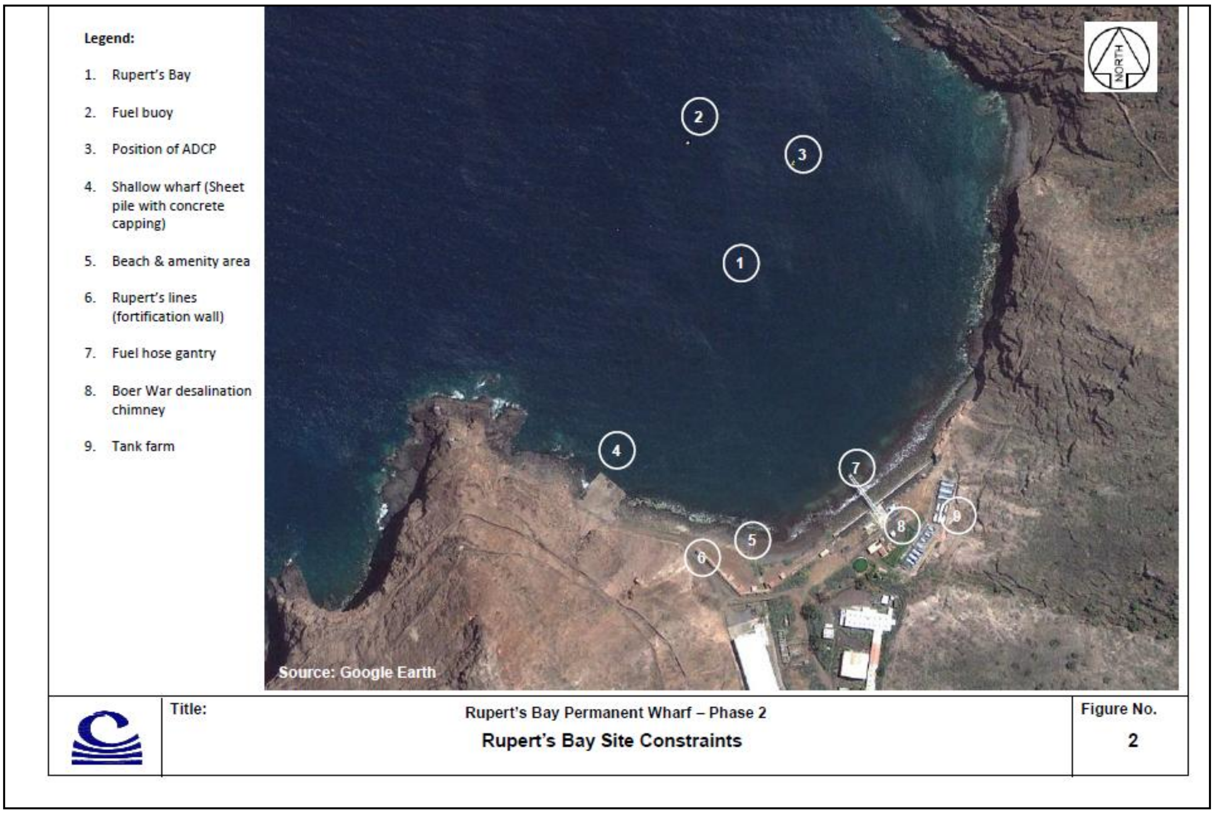


Figure 5.2: Location and topography of Rupert's Bay

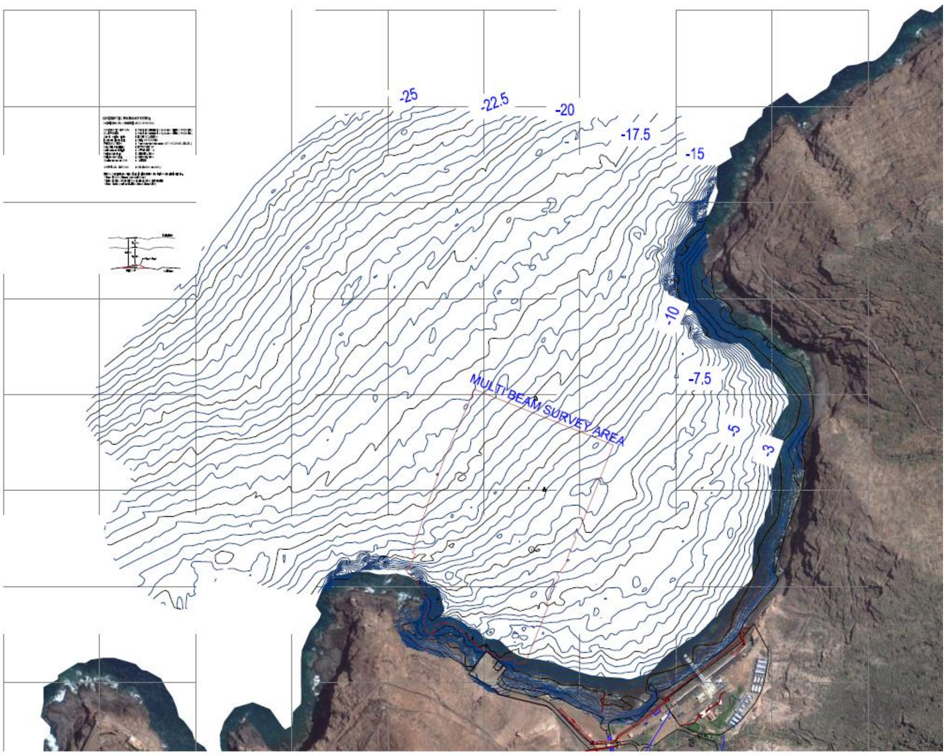


Fig 5.3: Bathymetry of Rupert's Bay

<u>Implications</u>

The high cliffs above the bay limit the options as to where the wharf can be located, including the access routes. The limited space on the seaward side of the cliffs will require the access road to the wharf to be built on a rockfill platform extending into the sea. Some rock drilling may be required to level the rocky outcrops along the sea shore, but no blasting of cliffs is envisaged in this area.

As discussed under section 5.2 above, the steep, unstable slopes have major implications for the safety of people and machinery operating below.

The new wharf location extends into deeper water than the Reference Design meaning that there will be no need for dredging of the berth pocket. However, there is a possibility that sand and silt along the footprint of the wharf may need to be removed using a suction hose and discharged on the seabed nearby in order to provide a stable rock base for the wharf.

5.4 Oceanographic processes

This section will provide a baseline description of the tides, wave regime, currents and sediment processes in Rupert's Bay.

<u>Data sources and modelling</u>
Tidal data were obtained from Admiralty Chart 1771, which was last updated in October 2005 (PRDW, 2013a).

Detailed current measurements were taken by an Aquadopp (AQD) Acoustic Doppler Current Profiler (ADCP) in a depth of 11m of water in Rupert's Bay in August and September 2012 (Figure 5.2). Measurements were taken at 10-minute intervals throughout the water column, thereby providing detail on the depth profile of currents in Rupert's Bay. The measured current profiles indicated little variation with depth. In addition, the ADCP recorded wave pressure and velocity readings at 3-hourly intervals. These data were used to calibrate the hydrodynamic model (see below).

In order to assess the impact of the wharf on sediment movement within the bay, a total of 12 sediment sampling points were identified around the shores of Rupert's Bay and at the site of the proposed permanent wharf. Samples were collected in February 2013 and analysed for particle size distribution and other geotechnical properties (PRDW, 2013c).

In addition to actual measurements and sampling, a large-scale 2D hydrodynamic model (the MIKE 21 Flow Flexible mesh model) was used to determine pre- and post-wharf oceanographic processes in Rupert's Bay such as wave heights, tide and wind-driven currents. To include the effect of wind driven currents in the bay, a time series of wind data from Horse Point (see s 5.1) was applied as a time-varying, but spatially constant wind field. The 2D model also takes into account, ebb and flood tidal currents, coriolis force and bottom friction.

The model was calibrated against the ADCP measurements and the predicted tidal levels in Jamestown. The marine dispersion model was found to accurately reproduce the predicted surface elevation at the Jamestown tide station. Furthermore, the tidal oscillation of the current direction in Rupert's Bay was modelled with reasonable accuracy. However, the modelled current speeds were generally lower than the measurements. As discussed in the coastal processes report (PRDW, 2013c), the measured currents include a number of events with higher speeds that show no correlation to the measured tides, wind or waves, i.e. the forcing mechanism for these events is at present uncertain and thus cannot be included in the hydrodynamic model. The model is nonetheless considered sufficiently accurate for the present study where the focus is on the impacts of the wharf on inner bay water circulation and effluent dispersion.

The 2D model was then run in 3D mode (the MIKE 3 Flexible Mesh model) in order to resolve the complex processes present in the bay. Details of the input parameters, assumptions and modelling processes are provided in the marine dispersion specialist study in Appendix D.

Sediment transport within the bay, before and after the wharf is constructed, was modelled using the MIKE Coupled Flexible Mesh model. The model comprises a dynamic coupling between the following models:

- Spectral wave model;
- Hydrodynamic model (described above); and
- Non-cohesive sediment transport model.

The assessment was performed for discrete storm events, with return periods of 1, 5, 10, 20, 50 and 100 years (PRDW, 2013c).

More information on the models used can be found in Appendix D and PRDW, 2013c. Sensitivity analyses were performed on all modelled parameters and the base case relating to sediment movement described below was found to be sufficiently accurate for this level of study.

<u>Description of tidal regime</u>
The tidal regime in St Helena is characterised as semi-diurnal with a range of 1.0m and a mean sea level of 0.5m.

Table 5.1: Predicted tide levels

Tidal condition	Height (m in relation to Chart Datum)
Highest Astronomical Tide (HAT)	+ 1.06
Mean high water springs (MHWS)	+ 0.94
Mean high water neaps (MHWN)	+ 0.72
Mean sea level (MSL)	+ 0.50
Mean low water neaps (MLWN)	+ 0.28
Mean low water springs (MLWS)	+ 0.07
Lowest Astronomical Tide (LAT)	- 0.06

The tidal range for Rupert's Bay is relatively small, with the present design water level set at 1.22m CD based on the MHWS tide of +0.94m plus a 1:100 year residual of 0.28m (PRDW, 2013b). The designs have further allowed for a sea level rise of 0.65m due to the impacts of climate change.

Figures 5.4 and 5.5 show the tidal currents during spring ebb and flood tides respectively. The tidal currents can be seen to flow clockwise during ebb tide and counter-clockwise during flood tides.

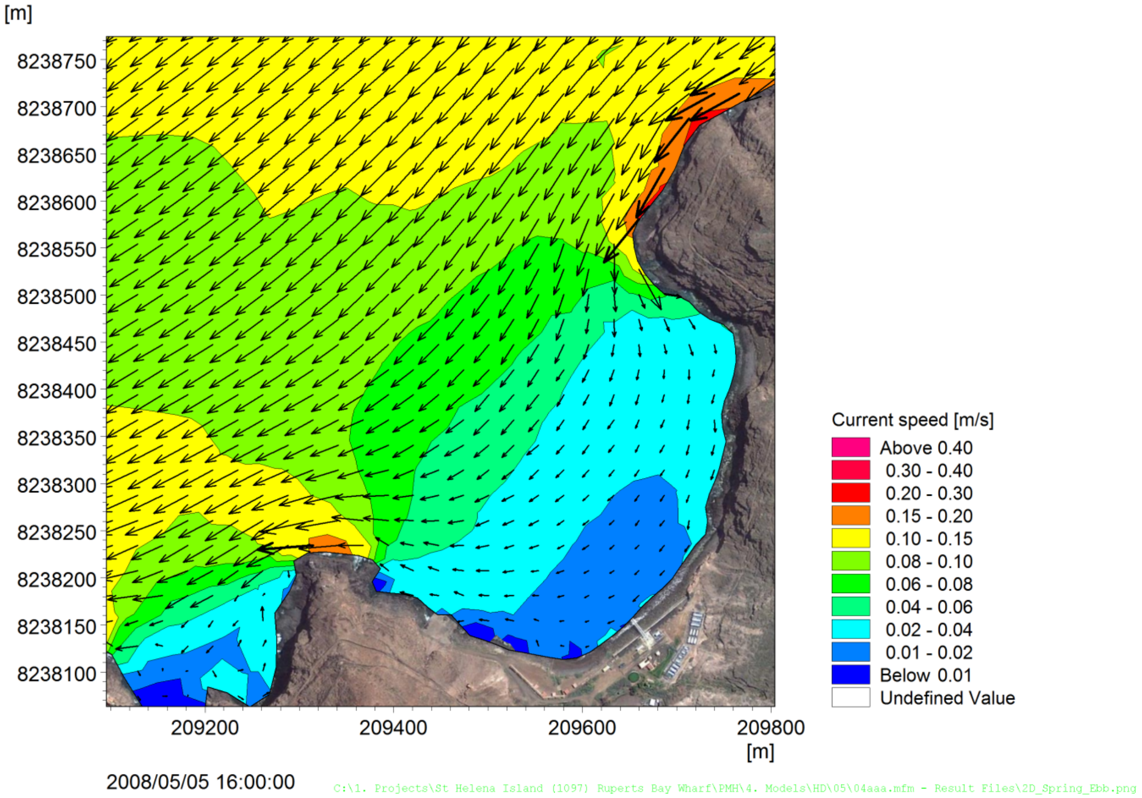


Figure 5.4: Tidal flow patterns in Rupert's Bay during spring ebb tide

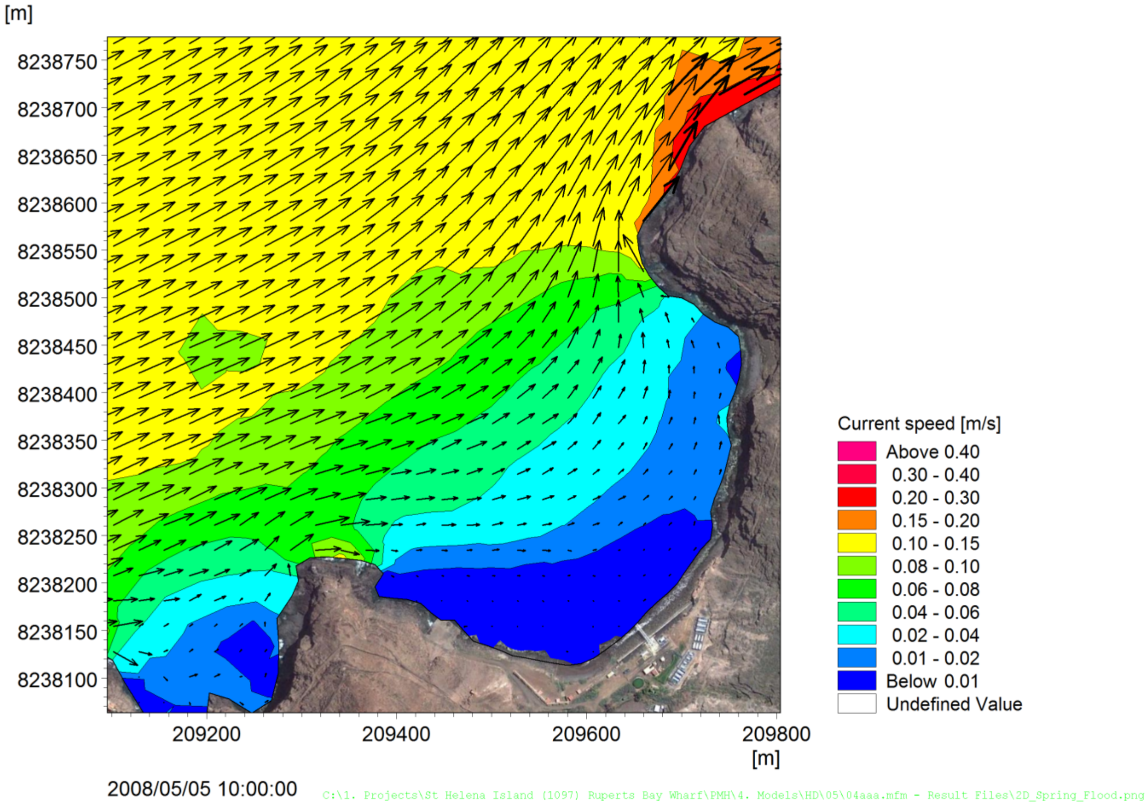


Figure 5.5: Tidal flow patterns in Rupert's Bay during spring flood tide

<u>Description of wave regime</u>

The significant wave heights within Rupert's Bay at the peak of the 1:100 and 1:1 year return period events are provided in Figures 5.6 and 5.7 respectively. Wave heights are significantly reduced for the 1 year return period event, with a significant wave height of around 2.0m in the bay, compared to 3 - 4m for the 100 year return period event.

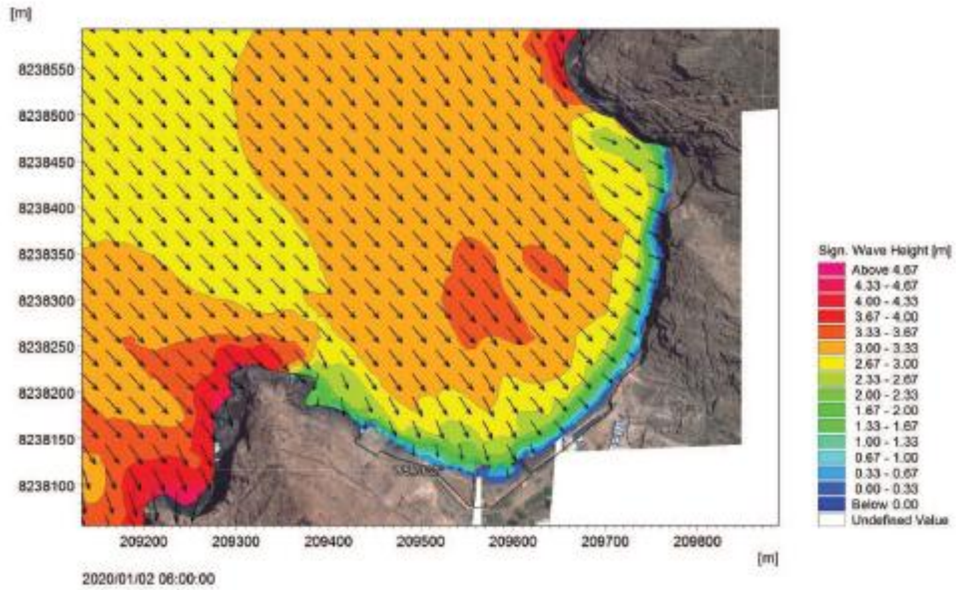


Figure 5.6: Waves during a 1:100 year storm event

Waves rotate in an anti-clockwise and clockwise direction along the northern and southern boundaries of Rupert's Bay respectively, due to the process of refraction. Wave heights peak in the central area of the bay due to wave shoaling and reflection (PRDW, 2013c).

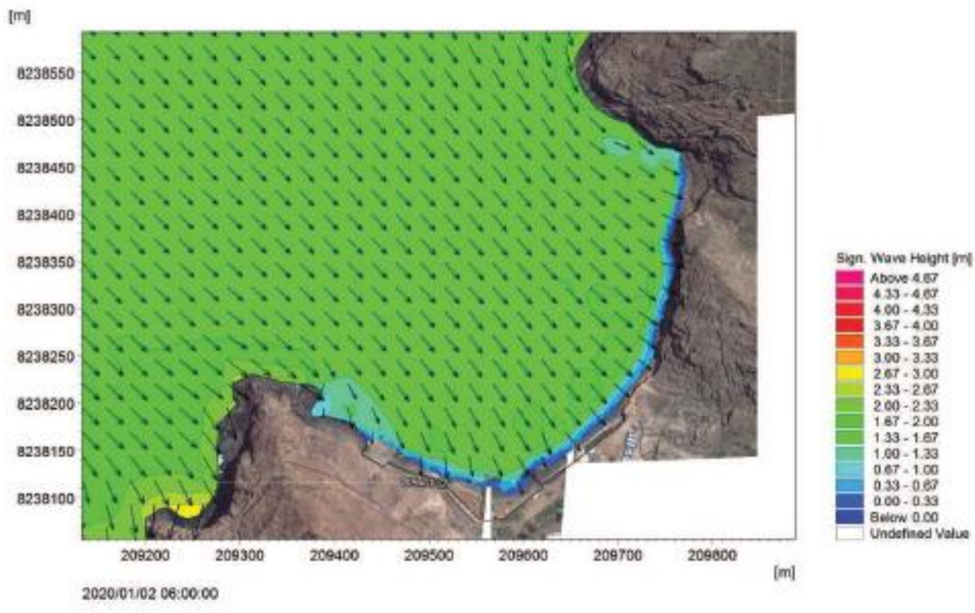


Figure 5.7: Waves during a 1:1 year storm event

Description of currents

Figures 5.8 and 5.9 present the water circulation patterns during a typical flood and ebb tide respectively, for the baseline condition prior to construction of the wharf. In each of the figures, the surface and bottom currents are presented so as to indicate the complex three-dimensional effects of the various processes concerned.

At present under both flood and ebb tide conditions, the wave-driven currents cause a rip current to form approximately in the centre of the bay. Near the surface, this offshore-directed current is reinforced by the offshore-directed wind, since the wind-driven currents are at their strongest near the surface. The effect of the wind-driven currents can be seen throughout the bay, with surface currents flowing offshore and bottom currents flowing onshore through the process of upwelling.

Directly outside the bay, the tidal currents near the surface are directed slightly more offshore than the shore-parallel bottom currents, also due to the wind-driven currents at the surface.

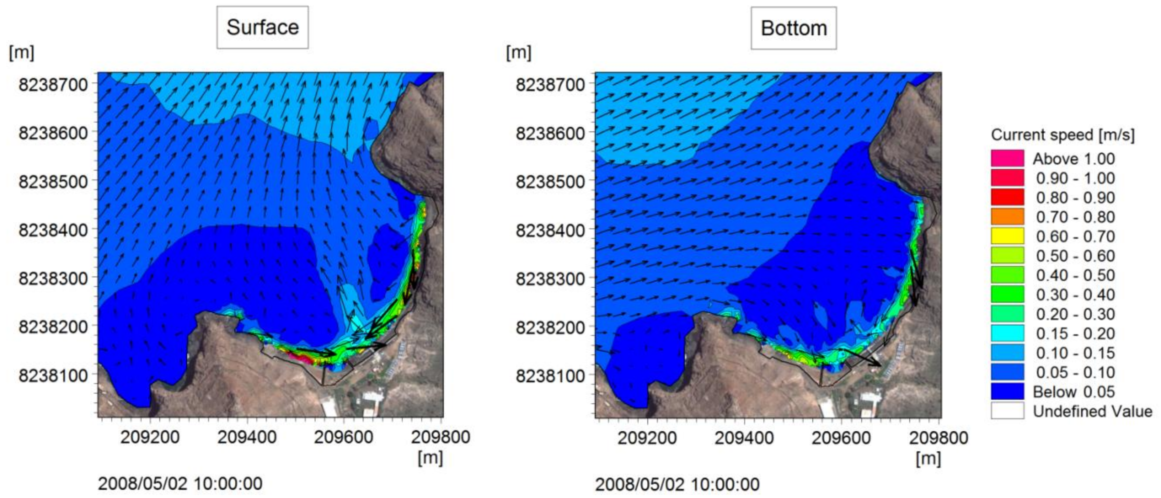


Figure 5.8: Surface and bottom currents during flood tide

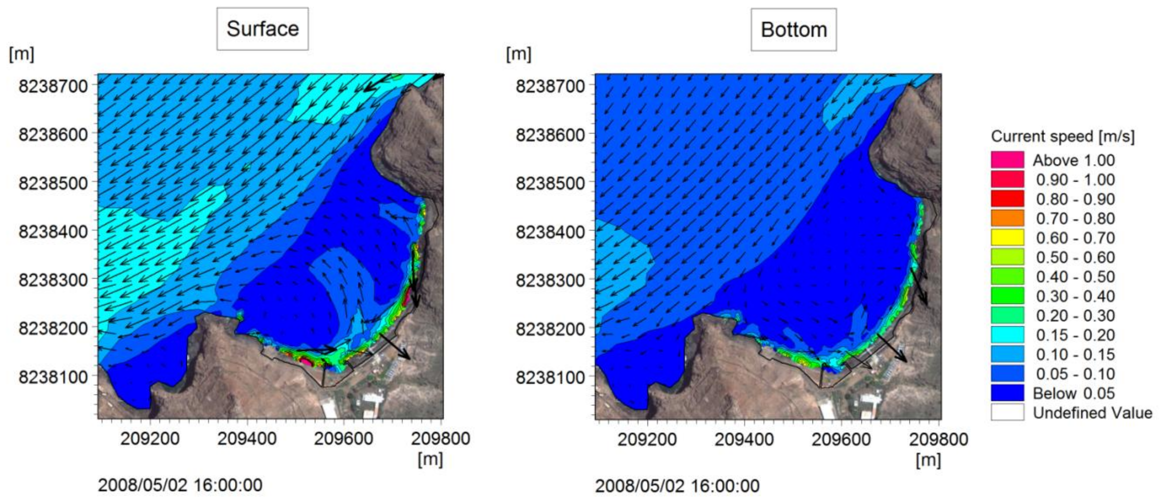


Figure 5.9: Surface and bottom currents during ebb tide

As can be seen in Figures 5.8 and 5.9 above, current speeds are generally low (less than 1.0m/s), but there are locations in the bay where stronger currents can occur, notably in the surf zone and near Shears jetty, off Munden's point and in the centre of the bay.

Description of sediment movement

The average of the median grain diameter, as determined from the bay-wide grab sampling campaign is approximately 0.15mm. The sediment on the swimming beach is 0.26mm. The maximum thickness of the sediment has been assumed to be 1m, which reduces to zero around the edges of Rupert's Bay. The sediment thickness on the swimming beach has been assumed to be 1m, whilst it has been assumed that the sand is 0.5m thick on the beach on the north-eastern corner of Rupert's Bay (Figure 5.10).

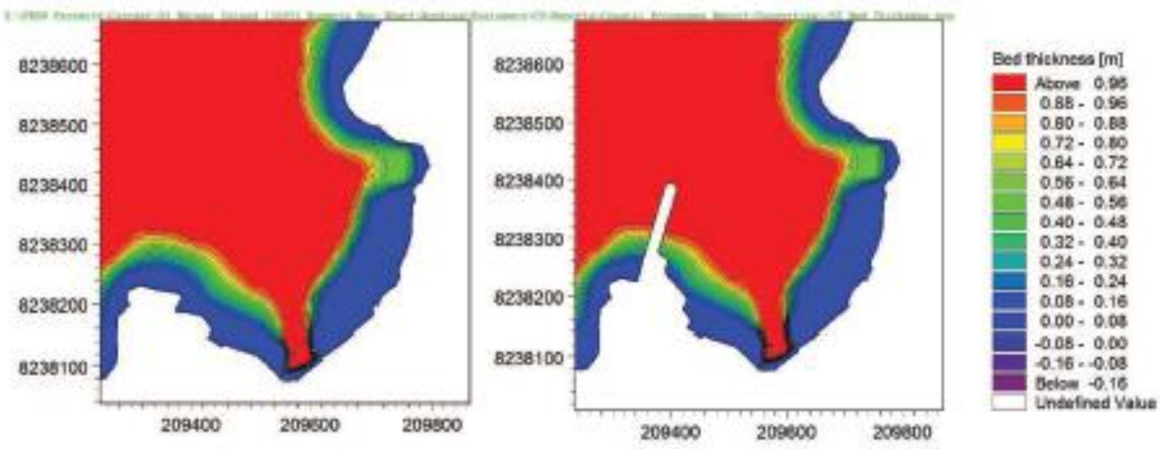


Figure 5.10: Sediment thickness

Figure 5.11 shows the changes in bathymetry following a 100 year return period storm event, using a storm direction of 320º and a constant wave peak period of 16.6 seconds. Erosion is identified along the south-western area of Rupert's Bay, as well as offshore the swimming beach and along the north-eastern boundary of the bay. For the 100 year return period event, the maximum accretion is approximately 1.8m, occurring in the central area of Rupert's Bay. Erosion to the extent of 0.8m is observed immediately offshore of the swimming beach, whilst approximately 0.4m of erosion is observed immediately offshore of the beach in the north-eastern corner of the bay.

Comparing this to the bed level changes observed during the 1 year return period event (Figure 5.12), a significant reduction is identified, due to the smaller waves and weaker currents. The maximum accretion in the bay for the 1 year event is approximately 0.6m, and this is located closer to the shoreline compared to the 100 year return period event. Similarly, erosion in front of both of the beaches is reduced.

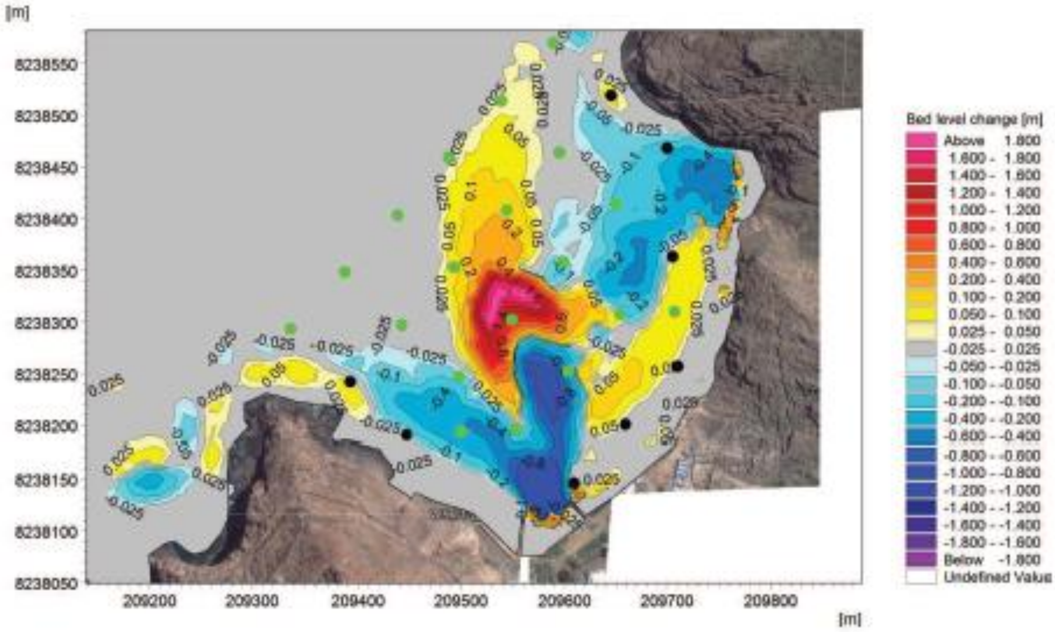


Figure 5.11: Erosion and accretion in Rupert’s Bay for the 1:100 year storm event

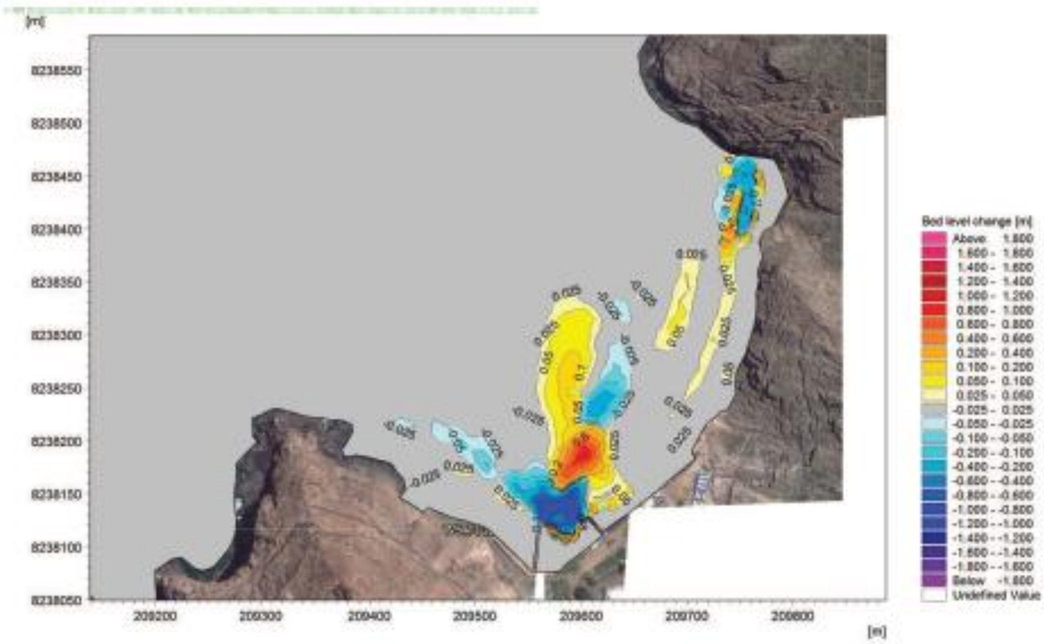


Figure 5.12: Erosion and accretion in Rupert’s Bay for the 1:1 year storm event

<u>Implications</u>

The changes in circulation pattern will have an impact on the direction and dispersion of pollutants, both from point sources e.g. the sewage outfall pipe and Rupert’s Run (see s. 5.5 below), and from non-point sources such as litter and waste discharged or blown from ships, the wharf itself and from land-based sources.

The changes in sediment movement are minimal and will have little impact on erosion and accretion processes at the beach.

5.5 Water quality

Data sources

There are two sewer outfalls into Rupert's Bay: one is the stormwater drain which flows through Rupert's Valley, known as Rupert's Run; and the second is an overflow pipe from the septic tank at the Argos fish factory.

No empirical data on the quantity or quality of flow in Rupert's Run are available, but the flow volumes have been modelled by Worley Parsons, based on storm events with return periods of one in 2, 5, 10, 20, 30 and 100 years. The frequency of flow in Rupert's Run was obtained from local knowledge. The quality of water flowing from this drain into the sea has never been tested.

The Argos factory has a double septic tank system: one for grey water and sewage; the second is for fish factory effluent. Neither tank has a soak-away and therefore the liquid overflow drains via a 110mm diameter pipe to a marine outfall located some 30m west of the beach at Rupert's Bay (Plate 11).

Plate 11: Location of Argos sewer pipeline outfall in relation to the swimming beach at Rupert's Bay

It would appear that no sample analyses have been performed on the actual Argos effluent quality (M. O'Bey, pers. comm.). However, sea water samples have been taken by SHG Health Officers at various points in Rupert's Bay on four occasions in the last three years (G. Young, pers. comm.).[7] The samples were analysed *inter alia* for *E. coli*, total coliforms and Enterococci (faecal streptococci) – all indicators of faecal pollution from humans and warm-blooded animals. Faecal indicators are always present in sewage-polluted water and their numbers are in relatively close correlation with levels of pollution and the time since the pollution event occurred (DWAF, 1996).

In order to augment the available data and to provide input to the hydrodynamic dispersion model described in s. 5.4 above, the MIKE ECO Lab model was used to simulate the transport and fate of pollutants in three dimensions based on advection-dispersion and ecological processes. The constituent modelled was faecal coliforms with an assumed die-off factor, described by the following equation:

[7] It should be noted that no supporting documentation has been provided detailing the sampling protocols followed, the methods used to preserve the samples, or the analytical techniques used. It should also be noted that the sampling frequency does not conform with UK or EU directives regarding the monitoring of water quality at bathing beaches. The conclusions drawn therefore need to be read with caution.

$$\frac{dC_F}{dT} = K_{dF}.C_F$$

where:
C_F is the concentration of faecal coliforms (No/100 ml); and
K_{dF} is the decay coefficient for faecal coliforms (1/day) (dependent on light conditions, salinity and water temperature.

For this study, a constant ambient water temperature of 22°C and a salinity of 35 practical salinity units (PSU) was specified for the months of August and June respectively. The maximum insolation at noon was set at a constant 1.1kW/m^2, with an assumed Secchi Disk depth of 10m (i.e. clear water conditions). The decay coefficients resulting from the above assumptions are presented in Figure 5.13. This shows that about 90% of the coliforms die within 5.4 hours at noon.

In the absence of data regarding the quality of the discharged effluent from the Argos fish factory, assumptions were made regarding the composition and flow rate of the discharge. The factory used 4,990m^3 of water in 2011 and 3,430m^3 in 2012. The amount used fluctuates from year to year depending on fish catches (M O'Bey, pers. comm.). If 33% of this water is used for making ice, approximately 3,343m^3 (0.11l/s) and 2,300m^3 (0.072l/s) of untreated effluent was discharged to the sea in 2011 and 2012 respectively.

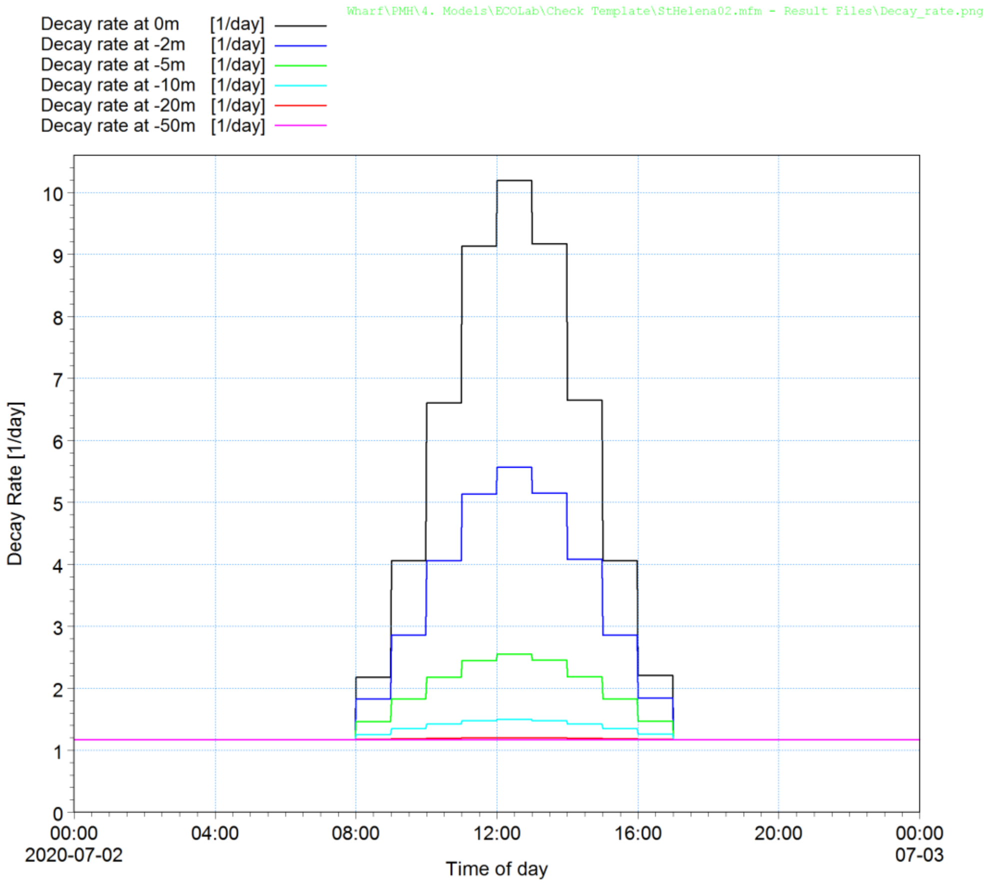


Figure 5.13: Decay rate as a function of time of day and depth

Since the discharge considered here is very low, a peaking factor (i.e. the ratio between the peak flow and the average flow) of 10 was assumed in this modelling exercise (ASCE, 2007; Alberta Environmental Protection, 1997). This results in a peak flow rate of 1.1l/s for the higher discharge volume recorded in 2011. Based on the above, a theoretical diurnal flow was assumed in which zero flow occurred during the night, with 0.11l/s during the day, which increases to a peak flow of 1.1l/s at noon. In the absence of actual effluent quality analyses, it was further assumed that the sewage discharged into the sea would have the characteristics of untreated sewage. Based on typical ranges for untreated sewage, a faecal coliform concentration of 1 x 10^7per 100ml was assumed (Henze, 2008).

Description

The modelled flow volumes in Rupert's Run at its outlet to the sea for different storm return periods are shown in Table 5.2. It can be seen that volumes are generally very low, which is to be expected given that average annual rainfall in the catchment is less than 300mm. Most residents of Rupert's Valley report that flows reach the sea only about once per year.

Table 5.2: Flow volumes at the sea outlet of Rupert's Run for different return periods

Storm return period	Discharge volume (m^3/s)
1:2 years	20.45
1:5 years	29.03
1:10 years	40.32
1:20 years	54.87
1:30 years	63.09
1:100 years	108.08

Anecdotal evidence from local Saints indicates that most of the runoff in Rupert's Run is stormwater, which is of reasonable chemical quality with some sediment and a high amount of litter. Grey water has occasionally been seen in this drain, but the volume is so low that it usually evaporates before reaching the sea outfall.

The results of the sea water sample analyses (kindly supplied by SHG) are shown in Table 5.3 in relation to South African and EU guidelines for bathing beach water quality. Although the results show that the EU guidelines have not been exceeded, the South African Target Water Quality range for direct contact (i.e. swimming) for Enterococci (0-30/100ml) was exceeded at Rupert's beach on one occasion (37/100ml).

Table 5.3: Sea water sample results for Rupert's Bay

Date	Sample location	E. coli/100ml	Coliforms/100ml	Enterococci/100ml
18/05/10	Middle beach (shallow)	0	0	Not examined
08/06/10	Rupert's beach	3	3	Not examined
	Rupert's beach	5	2	Not examined
12/06/10	Opposite Needle's Eye	0	0	Not examined
	Rupert's Battery	0	0	Not examined
	Shears jetty	0	0	Not examined
	Rupert's beach	0	0	Not examined
	Buoy area	0	0	Not examined
	Toilets at fuel farm	0	0	Not examined
09/05/11	Rupert's beach	25	16	**37**
	Shears jetty	51	1	23
SA Target Water Quality Range (1996) • Direct contact (swimming) **SA Coastal waters (recreation) (1995)**		0 – 130	- 100 (80th percentile) 2000 (95th percentile)	0 – 30
EU Bathing Water Directive 2006/7/EC (for 2015) for coastal waters • Excellent quality (95th percentile) • Good quality (95th percentile) • Sufficient quality (90th percentile)		250 500 500	- - -	100 200 185
EU Directive 76/160/EEC (old)		-	100 (80th percentile) 2000 (95th percentile)	-

Figures 5.14 and 5.15 present the *modelled* maximum near-surface and near-bottom concentrations of faecal coliforms reached in the 15-day simulation period under worst case conditions.

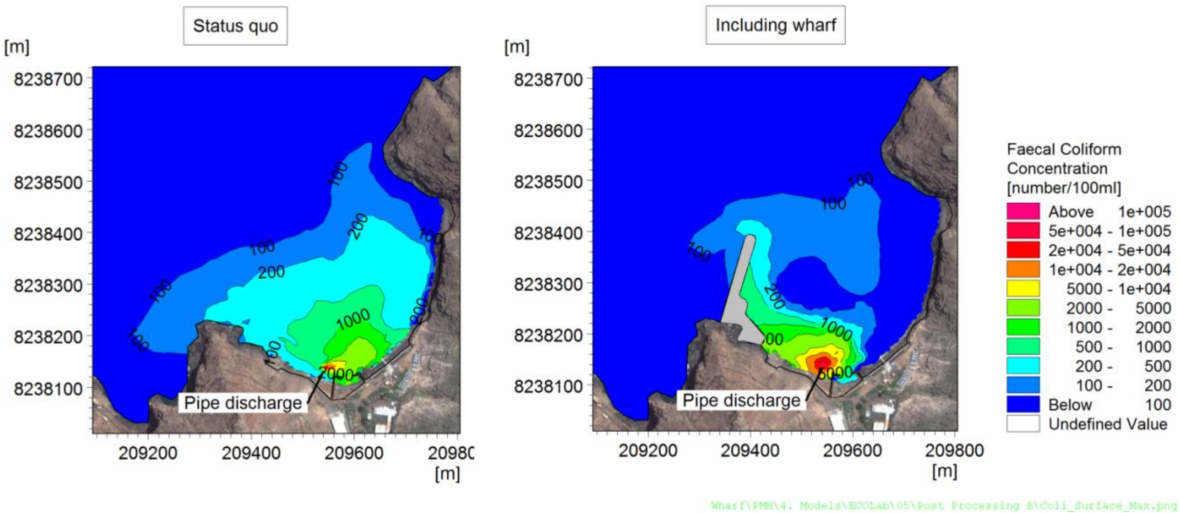


Figure 5.14: Maximum near-surface faecal coliforms

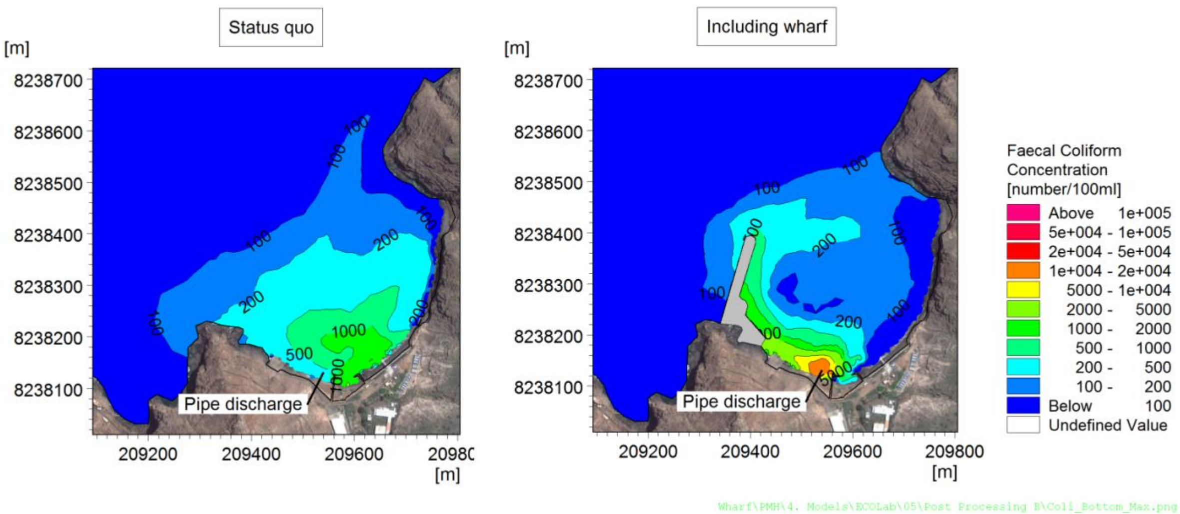


Figure 5.15: Maximum near-bottom faecal coliforms

As seen in the typical transport patterns, the coliform concentrations at the surface are higher than those at the bottom. However, bottom concentrations are more widespread. The model shows that for the baseline condition, the maximum bay-wide concentration reached exceeds 100 coliforms per 100ml, with a maximum concentration of over 20,000 coliforms per 100ml reached at the discharge point. At the swimming beach, the maximum concentration exceeds 2,000 coliforms per 100ml, which exceeds the 80th percentile (but not the 90th) EU guideline (76/160/EEC) for faecal coliforms.

<u>Implications</u>

The flow of stormwater from Rupert's Run is negligible and the only implications relate to the amount of litter discharged and whether this will be prevented from dispersing due to the location of the wharf.

The available sea water quality monitoring results (Table 5.3) do not confirm the modelled findings, but this could be due to a number of factors and uncertainties:

- The sampling and sample preservation protocols followed;
- The analytical techniques used and laboratory quality control;
- The time of day and time of year the samples were taken compared to the input data used in the model;
- The prevailing weather conditions at the time of sampling;
- The actual (as opposed to assumed) quality of the effluent at the discharge point;
- The actual (versus assumed) effluent flow rates; and
- The conservative assumptions in the model (worst case scenario).

However, it is clear that pollution is occurring and that the proximity of the effluent outfall to the swimming beach is not considered to be an acceptable practice as it puts public health at risk. The impact of the wharf on water circulation and the dispersion of sewage effluent is thus of considerable importance and the modelled results are discussed in s. 6.3.3.6 together with various mitigation options.

5.6 Marine ecology

Data sources

The ToR for the ES Addendum (Appendix A) indicated that a marine survey was required in order to cover the area of the new wharf location and to verify the survey work undertaken for the ES in November and December 2006. The work required for the Addendum coincided with a marine survey being undertaken for the whole island under the Darwin-funded Marine Biodiversity and Mapping Project. The SHG has kindly provided the Darwin project survey findings to the BR consultants for inclusion in this ES Addendum (Appendix E).

Prior to the survey being undertaken, Basil Read divers marked the outline of the proposed jetty with blue buoys. Within the marked area the survey team were able to conduct an exploration dive to decide the best locations for marine ecology and habitat surveys to fully represent the area of proposed development.

From this exploratory dive, it was determined that three survey transects would be required: two along the length of the proposed jetty and one parallel to shore.

The methodology used to conduct these surveys is slightly different to the surveys conducted by (the former) Agriculture and Natural Resources Directorate (ANRD) in 2006. The new survey methods are more comprehensive as they cover all fish and invertebrate life within a larger survey area, whereas the previous surveys concentrated on fish, benthos and turtles. The methodology used in the surveys and the detailed record sheets may be found in the specialist report in Appendix E.

Description

The marine ecology surveys in Rupert's Bay show that there is a low diversity of both the fish and invertebrate fauna found on the sandy areas where the proposed jetty will be situated. Seven species of fish were noted, with the Stonebrass Scad being by far the most numerous along both long-profile transects. The second most abundant fish was the St Helena Butterfly fish. A few individuals of the following were also noted: St Helena Flounder, Pompano, St Helena Gregory, Sergeant Major and St Helena Pufferfish (see Appendix E). There were numerous worm holes seen within the sandy habitat but these surveys did not cover any of the infauna species which will be impacted by disturbance of the sediments. However, the proposed impacted habitat area is small compared with the size of the sandy habitat in the bay.

There was a greater species richness and diversity within the rocky habitat close inshore, including some endemic species. Here, 20 species of fish were observed, with the most abundant being the Brown Chromis, St Helena Butterfly fish and the St Helena Gregory. One species of starfish, four types of sea urchin, two species of crab, as well as fireworms, whelks and cowries were found in the rocky substrate along the shore. While some of these are endemic, none are rare or endangered in the context of the island and there is abundant rocky habitat around the entire shoreline.

There have been frequent turtle sightings in the Rupert's Bay area, with the majority of sightings being of Hawksbill turtles. Green turtles are less commonly seen and one leatherback turtle was recorded in 2005 (Appendix E). Although this is not a breeding area for any of these species, mitigation measures should be put in place to ensure no plastic litter is discarded during wharf construction (and post-construction) which can cause potential harm to turtles.

Implications

The proposed jetty will impact the species described above, however, as this is a relatively small area and this is not a rare habitat type, the direct impact due to loss of habitat should be minimal. The wharf will however create an area of much calmer water on its lee side, which may contribute to an environment which is more conducive for fish breeding and recruitment. On the other hand it would appear that water exchange will be reduced and currents will be altered in the bay, which could cause a deterioration in water quality in the southern part of the bay if nothing is done to reduce the amount of litter and effluent entering the bay. This issue is addressed more fully in sections 6.2.3 and 6.3.4 and some mitigation options are suggested.

5.7 Avifauna

Data sources

Observations of the cliffs above the wharf position were made by B Walmsley (member of BirdLife Africa) from the ground, from Munden’s Path and from the sea. The presence of seabirds in the bay and up Rupert’s Valley was also noted. In addition, a meeting was held with C Hillman (Director, St Helena National Trust), where the preliminary findings were confirmed.

Description

There are between 5-10 pairs of Fairy Terns nesting on the cliffs immediately above the wharf location, but these birds are common on the island and tolerate human disturbance. Brown Boobies were observed feeding in the bay, but do not breed or roost here.

No wirebirds are known to nest in the upper parts of Rupert’s Valley in the location of the proposed pre-cast yard, but recently, some wirebirds have been observed foraging in this area.

Implications for the project

None

5.8 Terrestrial fauna and flora

Data sources

Observations of the terrestrial fauna and flora were made in the surroundings of the wharf and in the location of the pre-cast yard. In addition, a meeting was held with C Hillman (Director, St Helena National Trust) to discuss the presence of any species of scientific interest.

Description

Very few terrestrial plants occur on the shoreline or on the cliff above the wharf, and the few species that were found are common (e.g. samphire) or invasive plants (e.g. Leucaena) (see also Appendix 9.2 of the ES).

According to Ashmole and Ashmole (2000), there is a small lava tube (0.5 – 1m diameter) just above Munden's Path (50m above sea level), which contained a minute, colourless, wingless and blind species of booklice (psocid). This was later found to be a new species and the first blind psocid ever found (Lienhard and Ashmole, 1999). The nature of the insect indicates that it was highly adapted to subterranean life and the lack of eyes implies a long evolutionary history of underground life on the island. The opening of the lava tube was boarded up (at some time in the past) to maintain the dark environment and humidity levels but it has subsequently been broken open (by unknown persons) and it is not known if the psocid is still present.

The area to be used for the pre-cast yard and fabrication of the Core-Locs has been used to spoil excess material from the construction of the haul road and therefore the vegetation has already been destroyed (it was previously a mix of invasive plants such as lantana, wild mango, wild cotton, prickly pear, etc).

The quarry area falls within the ADA of Rupert's Valley, already described in Appendix 9.2 of Volume 4 of the ES.

Implications for the project

The only implications for the project relate to the possible existence of the psocid in the lava tube above Munden's Path. Care must be taken if protection netting or catch fences are installed in close proximity to the lava tube.

5.9 Cultural heritage

Data sources

Information on cultural heritage sites in and around Rupert's Bay was sourced from the following:

- Appendix 11 of Volume 4 of the ES;
- A sketch plan of Rupert's Lines (undated);
- The Saint Helena Historic Environment Record (B Jeffs, undated);
- A marine survey of the bay undertaken in 2006, in which a combination of bathymetry, side-scan sonar and sub-bottom profiling was employed to detect shipwrecks and associated debris (Tritan Surveys 2006).

The latter covered the whole of the bay up to the -15m contour, with specific focus on the location of the Reference Design wharf. Although the proposed position of the wharf still falls within the -15m contour, it was decided to conduct a verification survey focussing on the new wharf location. This survey was undertaken as part of the Darwin Project marine survey on the 25th March 2013. The survey involved swimming along two transects parallel to the length of the wharf and one transect perpendicular to the wharf, as described for the marine survey in section 5.6 above. One of the observations required for the Darwin marine survey is to note the presence of man-made objects. No items of archaeological interest were encountered, thus confirming the Tritan survey findings.

Description

From the original cultural heritage study in the Environmental Statement (Appendix 11 of Volume 4 of the ES), five sites of heritage interest may be affected by the wharf in its new position:

Table 5.4: Heritage features in the vicinity of the proposed wharf

Ref No (Vol 11 of ES)	Description	Category/Significance	Condition	Location in relation to wharf
CH72	Rupert's Lines	A: Scheduled Ancient Monument	Damaged	Forms west retaining wall of road culvert crossing and extends to the stone-packed retaining wall to the south-west
CH73	Rupert's Battery	A: Scheduled Ancient Monument	Damaged	On a ledge on Munden's Hill above the wharf position
CH44	Footpath from Rupert's Bay to Jamestown (Munden's)	C: UK local importance	Near-destroyed	Above new position of wharf and access road
CH67	Shears jetty	D: UK low importance	Intact	Adjacent to new wharf
CH69	Miniature railway	D: UK low importance	Destroyed	Used to run from Shears jetty to area behind Rupert's Lines

Of these, CH72 is the monument most at risk, as the road to the current and future jetty site crosses a bridge over Rupert's Run, the west wall of which comprises the old fortification wall (Plate 4). The fortifications of Rupert's Lines used to extend in an unbroken wall, linking in to the stone-packed retaining wall to the south and west (Plate 5). It is thought that the wall was broken in about 1840 and the current access track passes through this breach. The edge of the stone-packed retaining wall was not repaired, or it has deteriorated with time, and is currently in an unstable state (Plate 12). The remainder of the wall is in a surprisingly good condition, given the loading from the slope above (Plate 5), and shows no signs of instability. Rupert's Battery (CH73) and Munden's Path around the cliff above the wharf site should not be affected by any of the construction works at the wharf, as it is proposed to build all appurtenant structures out to sea, rather than blast and make space on the land-side below the cliffs. Furthermore, the construction method should not involve any blasting which could destabilise these structures.

The Cultural Heritage Assessment in the ES stated that "no wreck sites are recorded in the Bay" referring to Rupert's Bay (Appendix 11 of Volume 4 of the ES). The bathymetric survey only found some old ropes and chains on the sea floor. The detailed survey conducted by the Darwin project marine survey confirmed these findings.

Implications for the project

The bridge over Rupert's Run will have to be widened to accommodate the container reach-stacker and other large vehicles, but this will occur on the landward side of the bridge and the historic wall of Rupert's Lines will not be affected.

It will be necessary to stabilise the rock face above the wharf and access road to protect men, vehicles and equipment from falling rock. The protection works will have to be designed to avoid Munden's Path (as already done above Jamestown) and any historical features above the path. There is an opportunity to rebuild the end of the retaining wall in a sympathetic manner during construction of the access road to the permanent wharf.

Plate 12: Unfinished edge of the retaining wall which used to form part of Rupert's Lines

5.10 Aesthetics

5.10.1 Noise and vibration

Data sources

The pre-development environment was described in Appendix 6 of Volume 4 of the ES. This information was supplemented with actual noise and vibration monitoring data taken during 2012 in Rupert's Valley as part of the airport project EMP monitoring requirements.

Description

The noise and vibration environment in Rupert's Valley has changed significantly since the airport project commenced due to the movement of heavy vehicles and equipment being transported to the airport site, an increase in the amount of daily light traffic to and from the Basil Read workshops, stores, laboratory and laydown areas, as well as from blasting at the quarries and construction of the new haul road. In anticipation of this, three locations in Rupert's Valley were established as noise monitoring points (labels ending in '–N' in Figure 5.16).

One site was chosen to monitor vibration from blasting, located at the nearest residence to the quarries (label ending '-V' in Figure 5.16).

The noise monitoring data (excluding blasting) from over a period of 7 months in 2012 show that noise levels have exceeded the maximum allowable limit of 70dB(A) on four occasions: three of these may be ascribed to strong wind noise, while the fourth (70.6dB(A)) was due to heavy haul traffic (Figure 5.17).

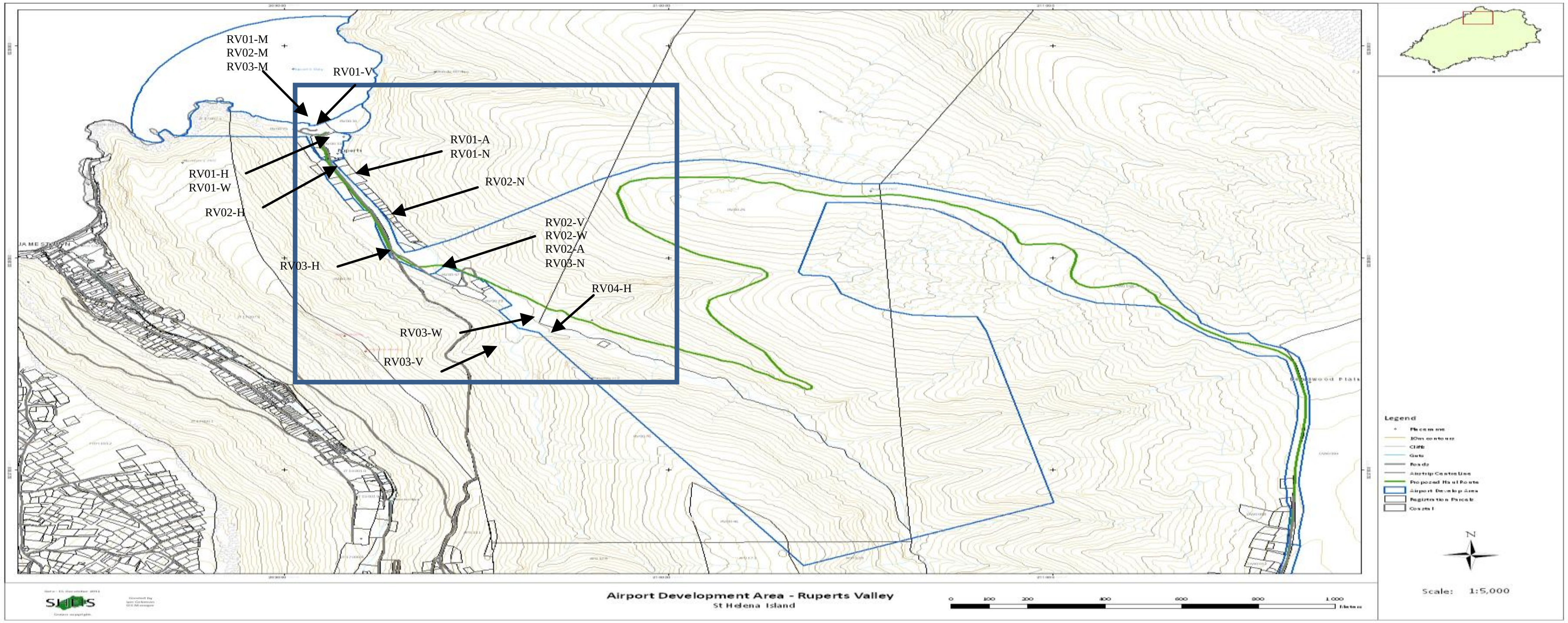
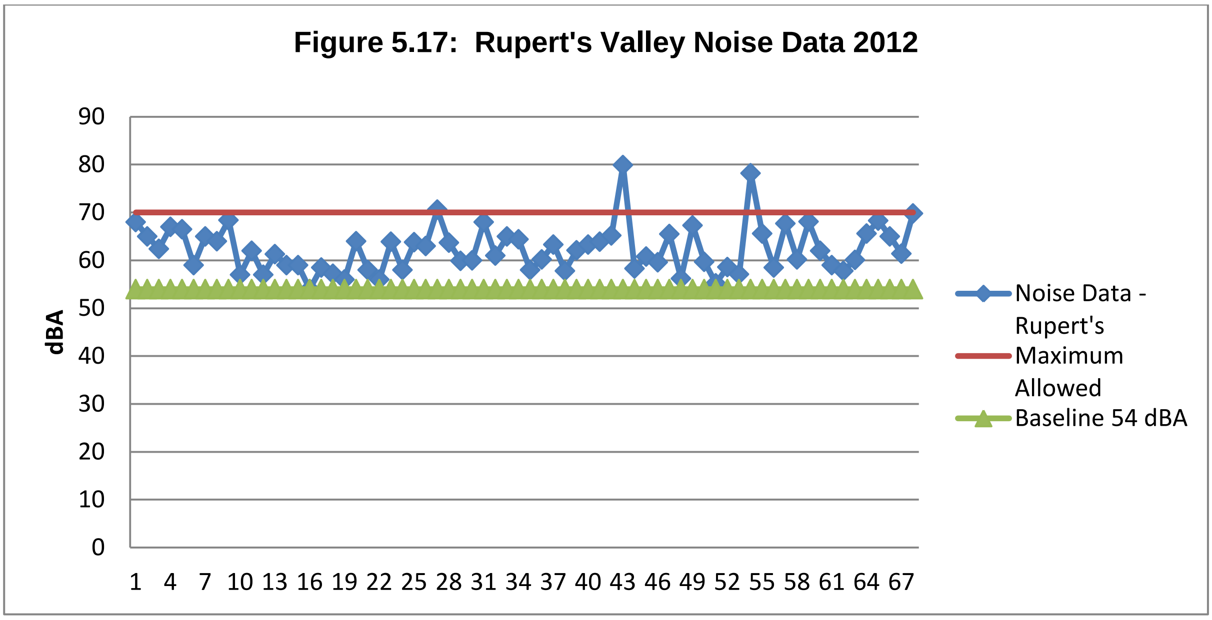


Figure 5.16: Location of environmental monitoring points in Rupert's Valley



There appears to be little discernible difference between the three monitoring points in terms of the average, maximum and minimum noise levels, as shown in Table 5.5.

Table 5.5: Average, maximum and minimum noise levels at the Rupert's Valley monitoring sites

Monitoring point No	Location	No measurements taken	Average sound levels dB(A)	Maximum sound level recorded dB(A)[8]	Minimum sound level recorded dB(A)
RV01-N	Outside Haytown House	24	62.29	70.6	57.0
RV02-N	Mid-way up residential area	23	62.24	66.5	54.0
RV03-N	At Rupert's church	21	62.30	79.9	59.0

Clause 4.6.4 of South African National Standards SANS 10103 states that it is highly probable that noise is annoying or otherwise intrusive to a community, or a group of persons, if the rating level of the ambient noise (including the noise under investigation) exceeds the residual (or background) noise (in the absence of the noise under investigation). The typical levels in SANS 10103 are in line with the recommendations of the World Health Organisation. In accordance with SANS 10328, the assessment of the estimated road traffic noise impact is established by determining the probable community response from Table 5 of SANS 10103, reproduced in Table 5.6 below.

The guideline noise levels for a sub-urban area with little traffic (i.e. Rupert's Valley) are 55dB(A) during daytime and 45dB(A) at night (WHO; SANS 10103).

[8] Excluding blasting

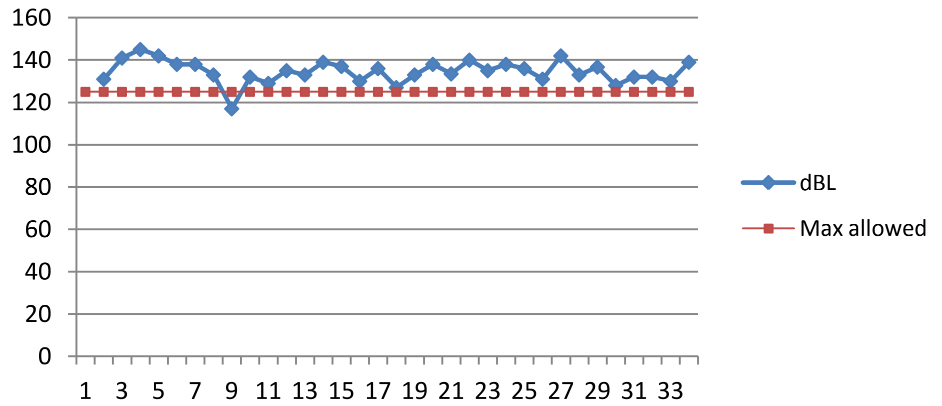
Table 5.6: Typical community response categories and the frequency of occurrence of noise in relation to these categories

SANS 10103 Categories relating to community response					
dB(A) above background	**Level of response**	**Estimated community response**	**Range for Rupert's Valley[9] (dB(A))**	**Frequency of occurrence**	**Impact-making activities**
0-10	Little	Sporadic complaints	54-64	47	Light traffic
5-15	Medium	Widespread complaints	59-69	47	Drilling at quarry, haulage, traffic, wind, road sweeper, work at temporary BFI
10-20	Strong	Threats of community action	64-74	22	Heavy traffic and equipment, hauling from quarry, work at temporary BFI, strong wind
>15	Very strong	Vigorous community action	>69	4	Very strong wind, haulage

It is clear that the majority of the sound level readings fall within 15dB(A) of the background level and that wind is a significant contributor to the noise levels. However, analysis of the data clearly indicates a correlation between heavy vehicle movements, rock drilling and noise levels throughout the valley. Given that the activities during wharf construction will be similar to those that have already been occurring i.e. movement of haul trucks, rock drilling at the quarry and general traffic, the noise levels during the construction of the wharf can be expected to be similar.

The noise levels from blasting are not supposed to exceed 125dB(A), but the average sound level during blasting operations for the Rupert's haul road was 134.55dB(A), with a maximum of 145dB(A) and a minimum of 117dB(A) being recorded (Figure 5.18). It is expected that noise levels from future quarry operations in Rupert's Valley will generate similar levels, with those at the lower quarry being loudest for Rupert's residents and the noise from blasting at the proposed new upper quarry will most likely have greater impact on Deadwood residents.

Figure 5.18: Noise levels from blasting in Rupert's Valley



[9] Calculated from the baseline of 54dB(A)

The eight vibration measurements show that the average Vibration Dose Value (VDV) is 0.003m/s$^{1.75}$, with a maximum recorded VDV of 0.008m/s$^{1.75}$ experienced during one of the early blasts for the haul road, and a minimum of 0.0004m/s$^{1.75}$ while blasting occurred at Williams Quarry (near Horse Point). These figures can be compared to the VDVs used in BS 6472 to determine likely community response, shown in Table 5.7. It can be seen that the VDVs experienced in Rupert's Valley are unlikely to trigger an adverse community response.

Table 5.7: Vibration Dose Values with likely adverse community response in residential areas

Place and time	VDV with low probability of adverse comment m/s$^{1.75}$	VDV where adverse comment is possible m/s$^{1.75}$	VDV where adverse comment is probable m/s$^{1.75}$
Residential area (16 hour day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential area (8 hour night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

A building condition survey was also conducted in Rupert's Valley prior to the first blast at the quarry to establish the structural integrity of the houses. This survey found that most houses were in a good condition with few structural weaknesses. St Michael's Church on the other hand was found to have major cracks due to poor construction techniques. A building condition survey is currently being conducted in Deadwood and a post-blasting follow up survey in Rupert's is planned.

Implications

It is clear from the noise monitoring results already obtained and the predicted number of truck movements (section 4.2.2.2) required to move all the construction materials to the wharf, that noise will be one of the most significant issues associated with the construction of the wharf. A number of mitigation measures will be required to ensure that noise levels stay within 15dB(A) of the ambient (i.e. less than 69dB(A))and that the area is monitored regularly.

The results show that current blasting activities have not adversely affected residential structures in Rupert's Valley, but ongoing vibration monitoring needs to continue in Deadwood and Rupert's Valley during quarrying activities for rockfill for the wharf.

5.10.2 Air quality and dust

Data sources

The pre-development environment was described in Appendix 7 of Volume 4 of the ES. This information was supplemented with actual inhalable dust monitoring data collected during 2012 in Rupert's Valley as part of the airport project EMP monitoring requirements. Regular monitoring of inhalable particulates (PM_{10}) takes place at three locations in Rupert's Valley (labels ending in '-A' in Figure 5.16). Monitors are deployed for a period of one week and the total dust collected is weighed (grams) and recorded. The quantities collected are then converted to obtain the standard measure of μg/m^3.

Unfortunately, total particulate monitoring has not yet been undertaken due to logistical problems in obtaining the correct dust buckets from South Africa, but this will be rectified before wharf construction commences.

Description
As with the noise environment, the air quality has been negatively affected by construction activities in Rupert's Valley due to the number of vehicle movements along the road through the residential area and from blasting activities associated with the construction of the haul road (Appendix 7, Volume 4 of the ES). However, the recorded data show that the one year and 24 hour average emissions of inhalable particulates (PM_{10}) are well within the WHO Guideline Values and the EC Directive Limits, as shown in Table 5.8.

Table 5.8: Ambient inhalable dust guidelines compared to PM_{10} results for Rupert's Valley

Averaging period	WHO Guideline Limit (μg/m^3)	EC Directive Limit (μg/m^3)	Rupert's Valley monitoring station (RV02-A)		
			Average (μg/m^3)	Maximum (μg/m^3)	Minimum (μg/m^3)
1 year	30 (IT-3)[10]	40	20.08	25.33	14.49
24 hour	75 (IT-3)	50	0.0550	0.0694	0.0397

Implications
Given the expected number of trucks which will be using the access road through Rupert's Valley during construction of the wharf, more effort will be required to prevent dust from occurring from the backs of vehicles, tyre entrainment and from the road surface – see additional mitigation measures in section 6.2.6.

A further source of dust will be from quarrying activities, but as most of the rock for the wharf will be sourced from the mid- and upper-valley quarries, the dust impact on Rupert's residents will be less than that experienced during haul road construction and the operation of the lower quarry in Rupert's Valley.

5.10.3 Landscape and visual impact

Data sources
The pre-development environment was described in Appendix 10 of Volume 4 of the ES. This information was supplemented by observations and photographs taken during the site visit in April 2013.

Description
The physical landscape has not changed significantly since the ES was completed, with the exception of the new haul road from Rupert's Valley up to Bank's Ridge (Plate 13). However there are a number of temporary and permanent structures in Rupert's which were not there in 2008. The temporary structures include the BR laydown areas, workshop, temporary BFI, small temporary jetty, while the permanent features include the new BFI, lower and middle quarries and the spoil area in upper Rupert's (Plates 14 and 15). The impacts of these were covered in the original ES (Appendix 10 of Volume 4 and Chapter 10 of Volume 2) and so

[10] Interim Target 3

will not be described any further in this Addendum, except to note that the new wharf (and associated Port Control buildings) will be built within an increasingly industrialised landscape.

Plate 13: Haul road out of Rupert's Valley

Plate 14: Temporary laydown areas in Rupert's Valley (indicated with arrows)

Plate 15: Permanent bulk fuel installation in upper Rupert's Valley (under construction)

<u>Implications</u>
The introduction of the permanent wharf will add to the increasingly industrialised 'feel' of Rupert's Valley. However, given that Rupert's Valley has been designated as an industrial area in the Land Development Control Plan, the presence of the wharf is consistent with this vision. Nevertheless, mitigation measures will be put in place to minimise the overall impact, such as sensitive lighting, appropriate finishes, etc. (see section 6.3.9).

5.11 Social and economic structure

<u>Data Sources</u>
Although there is a considerable amount of new activity in Rupert's Valley due to the airport project, with several new temporary and permanent structures, the actual number of residents and houses has not increased since 2008. Thus the social profile relating to demographics, employment, community health etc. is unlikely to have changed significantly since the socio-economic impact assessment (Volume 6 of the ES) was compiled, and the therefore the information will not be repeated in this Addendum.

5.12 Traffic

Data sources

The Roads Department kindly set up a traffic counter on Field Road for the week starting 18th April 2013 and provided the data for this report. *These data need to be treated with caution as they still have to be validated.* Historical traffic data were also provided by the Roads Manager.

The information regarding the footpaths in Rupert's Valley is the same as that provided in Appendix 12 of Volume 4 of the ES.

Description

A 2010 count of traffic from the Side Path/Field Road junction to Rupert's Valley on a non-RMS Tuesday indicated a total 12 hour (06h00-18h00) traffic flow of 137 vehicles. On a corresponding day (Tuesday 23 April) in 2013, the total traffic count for the same period was more than double, at 325 vehicles. This can be attributed mostly to airport construction traffic and related service deliveries.

The following statistics were extracted from the one week traffic count data for April 2013.

Table 5.9: Traffic statistics for Field Road, 18-25 April 2013

Variable	Number of vehicles	Comment
Maximum per day (24 hour)	384	Wednesday 24th April
Minimum per day (24 hour)	159	Sunday 21st April
Maximum per hour	44	17h00-18h00
Minimum per hour	0	Often at night
Average morning peak	28	07h00-08h00
Average mid-morning peak	25	11h00-12h00
Average evening peak	30	17h00-18h00

The daily traffic volumes for Field Road are shown in Figure 5.19 and the average number of vehicles per hour is shown in Figure 5.20. The latter clearly shows the early morning and evening peaks, as well as heightened activity mid-morning (11h00-12h00).

Munden's Path is still officially closed for safety reasons, but this path has the potential to be restored since it offers scenic views of Rupert's Bay, James Bay and Roman's Cove – all within a short walking distance of Jamestown.

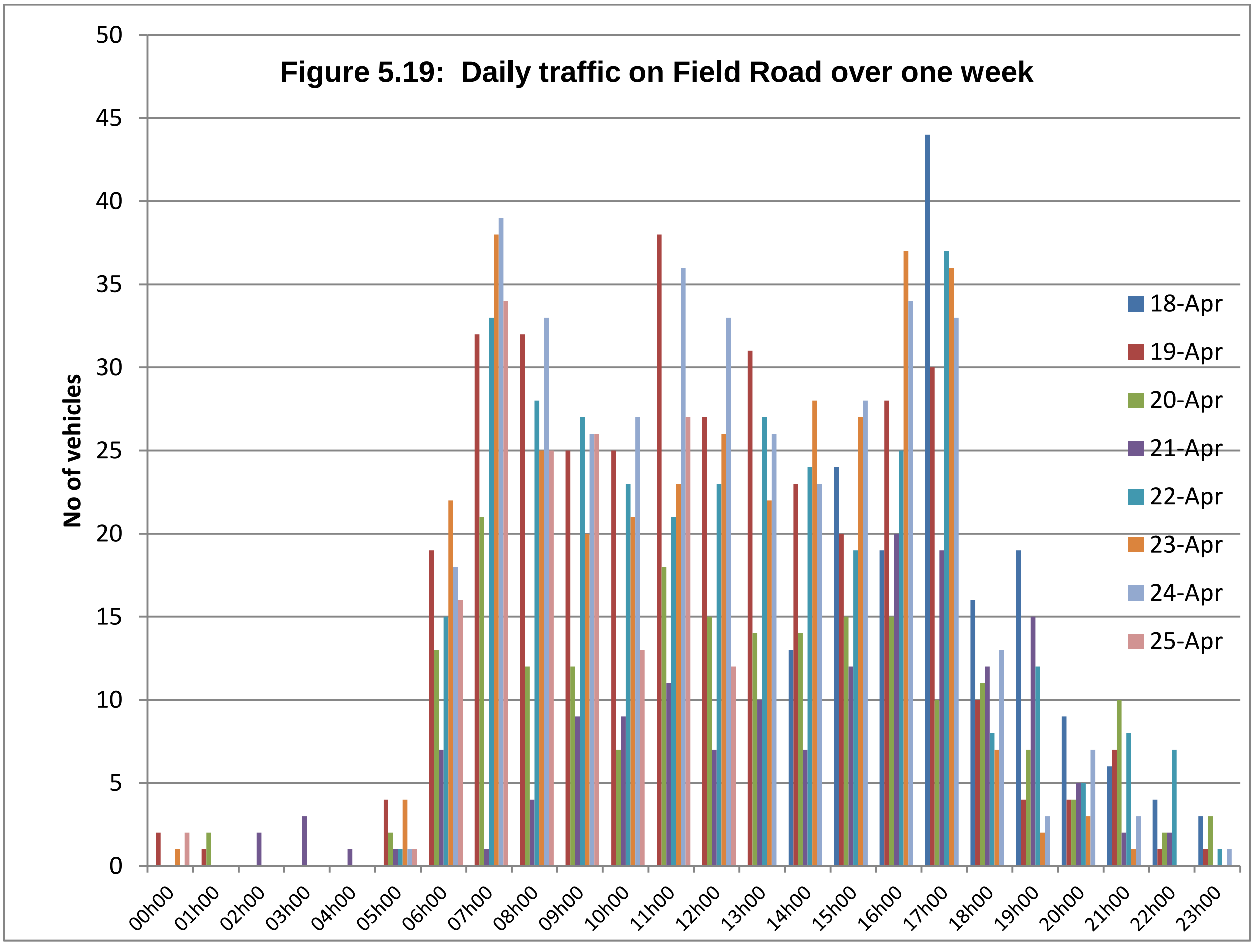
Bank's Battery footpath is still accessible, but does not appear to be used much.

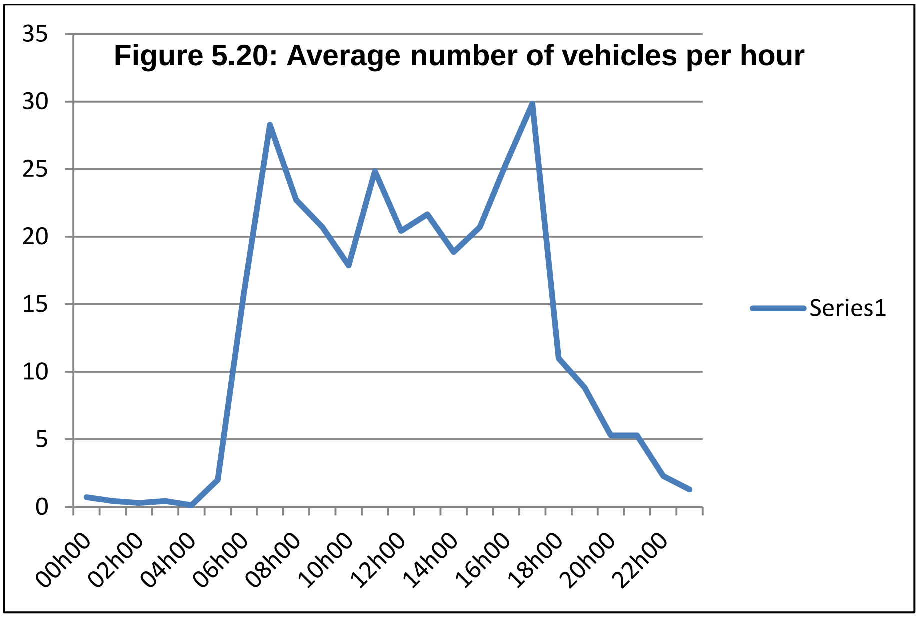
Implications

Traffic volumes have more than doubled along Field Road as a result of airport construction. Even though most of the heavy haulage for the wharf will be along the main road through Rupert's Valley and along the haul road from the airport, it is likely that traffic volumes on Field Road could increase further once construction of the wharf commences.

Once construction is complete, traffic volumes on Field Road are likely to drop, but not to pre-airport levels reported above, as there is expected to be more economic activity in Rupert's Valley. In the days following a vessel call, there will be an increase in vehicle numbers as delivery trucks will have to travel down Field Road to Rupert's to collect unloaded goods from the Port Control Area. This will be a displaced activity, as this occurs already in Jamestown following the arrival of the RMS. However, the traffic will disperse more easily from Rupert's Valley once the new access road to Deadwood and Longwood is completed, freeing up Side Path and Ladder Hill roads to a certain extent.

It is expected that with an increase in tourists once the airport is operational and given the proposed tourist development plans for Jamestown, the popularity of Munden's Path will increase, necessitating an upgrade in its safety. The path will afford panoramic views over Rupert's Bay including the new wharf.





5.13 Community facilities and services

<u>Data sources</u>

Much of the information contained in the Socioeconomic Impact Assessment (Volume 6 of the ES) relating to community facilities and services is still current and will not be repeated here. Information about diving, fishing and tourist operators was obtained from published tourist leaflets and the internet. Figures on beach usage and recreational angling at Rupert's Bay are not available.

<u>Description</u>

Rupert's Bay offers one of only two beaches on the island which can be reached by vehicle and it is the only beach in close proximity to the main residential areas on the island. The beach at Rupert's is very small and mostly comprises cobbles, shingle and a little bit of sand (Plate 16), but it is very popular over weekends, with the added attraction of a picnic area immediately behind the beach (Plate 17).

Plate 16: Swimming beach at Rupert's Bay

Plate 17: Picnic area (photo courtesy of G Temlett)

There are at least three companies that offer diving, snorkelling, sport fishing and dolphin viewing boat tours out of Jamestown. As noted in section 5.6, marine life in Rupert's Bay is not very diverse owing to the sandy substrate and there are no seabird colonies or other marine attractions in the bay, so most of these tours depart from Jamestown and travel south and west of the island. Nevertheless, the new wharf in Rupert's will be highly visible from the sea outside of Jamestown.

Currently there are some well-known fishing spots on the rocks below Munden's Point (Plate 18) and from the rocks at Birddown, on the north side of the bay. Fishing from Shears jetty and the temporary wharf is also popular on weekends (Plate 19).

<u>Implications</u>

The new wharf will have significant implications for beach and bay access during construction and when ships are in port. Measures to mitigate these impacts are provided in sections 6.2.9 and 6.3.8.

Plate 17: Fishing at Munden's Point

Plate 18: Shears jetty is popular on weekends for fishing

6 IMPACT ASSESSMENT AND MITIGATION

6.1 Assessment methodology

The determination of the significance of the impacts arising from the proposed wharf is a key stage in the EIA process. It is this judgement that is crucial to informing the decision-making process. However, defining what is significant is not a simple task. The following criteria, where appropriate to the issue being addressed, are used in the EIA to inform the assessment of the significance of an impact. This system largely follows that used by AECOM, but a much finer extent and duration scale has been used to better reflect impacts relating to the wharf. In addition, a risk-based approach for defining significance has been used.

- Type of impact (adverse/beneficial);
- Extent and magnitude of impact:
    - Local: impacts restricted to the wharf site;
    - Rupert's Bay or Valley: impacts confined to the bay or valley;
    - National: impacts will affect the broader island community, national interest and environment;
    - International: the impact will have international repercussions.
- Duration of impact:
    - Permanent: the impact will persist after construction/operation of the wharf has been completed;
    - Long-term constant: the impact will persist throughout the construction or wharf operational period;
    - Short-term constant: the impact will persist for a period of weeks or months within the construction or operational period;
    - Frequent: a single event may occur on a regular basis during the construction or operational period;
    - Occasional: a single event might occur on a few, sporadic occasions during the construction or operational periods;
    - Once-off: a once-off event.
- Reversibility of impact.

For the purposes of this Addendum, we have used a standard risk assessment methodology to assess significance, where the probability of occurrence is considered together with the severity of the consequences (or sensitivity of the receptor to change).

The scale used to assess the probability of occurrence is as follows:

- Probable: more than an 80% chance of the action occurring;
- Possible: between 50 – 79% chance of the action occurring;
- Low: between 20 – 49% chance of the action occurring;
- Negligible: less than a 20% chance of an action occurring.

The scales used to assess the severity of consequences are shown in Tables 6.1 (safety risks) and 6.2 (pollution/contamination risks).

Table 6.1: Severity of consequences due to safety hazards

		Severity of the Consequences				
		Negligible	Low	Moderate	High	Catastrophic
PEOPLE	Public safety (number of people)	Does not require medical treatment	Injuries that may require medical treatment, but not hospitalisation for one or two individuals	Moderate injuries requiring hospitalisation or reversible disability of <50% of a group of people	Death of 1 person; OR Severe irreversible disability of >50% of a group of people	Multiple fatalities or severe irreversible disability of more than 50 people
ENVIRONMENT	Protected, Cultural or Environmentally Sensitive Areas (area or sites affected by physical damage)	None	< 1 ha	1 - 10 ha; OR cultural heritage sites of local importance	>10 ha; OR cultural heritage sites of regional/national importance	Not applicable
ENVIRONMENT	Terrestrial Fauna and Flora	No species injured or killed	1-4 individuals of one species injured or killed per year	5-10 individuals of one or more species injured or killed per year	>10 individuals of one or more species injured or killed per year	-

Table 6.2: Severity of the consequences for pollution/contamination

		Severity of Consequences				
		Negligible	Low	Moderate	High	Catastrophic
PEOPLE	Public Health (nº of people that could come into contact with the contaminant – dust, noise, polluted water)	None	1 - 9 people on a once-off basis	10 - 99 people on a once-off basis; OR 1-9 people on a regular basis	100 - 500 people on a once-off basis; OR 10 – 99 people on a regular basis	> 500 people on a once-off basis; OR 100 – 500 people on a regular basis
ENVIRONMENT	Aquatic Life (surface area or length of coast affected by contamination)	No habitat loss	< 10% of total habitat; OR < 0.5 km of coast	11-50% of total habitat; OR 0.5 - 2 km of coast	> 50% of total habitat; OR >2 km of coast	Not applicable
ENVIRONMENT	Aquatic Life (loss of biodiversity)	No biodiversity loss	Some loss of biodiversity. Ecosystem under low threat. Effects would be reversible	Biodiversity low. Species limited to a few tolerant individuals. Ecosystem under stress. Possible irreversible impacts.	No biodiversity. No living creatures evident. Ecosystem dead. Irreversible effects.	Not applicable
ENVIRONMENT	Terrestrial Fauna & Flora (total area of habitat affected)	No habitat loss	< 10% of total habitat	11-50% of total habitat	> 50% of total habitat	Not applicable
ENVIRONMENT	Terrestrial Fauna & Flora (biodiversity loss)	No biodiversity loss	Some loss of biodiversity. Ecosystem under low threat. Effects would be reversible	Biodiversity low. Species limited to a few tolerant individuals. Ecosystem under stress. Possible irreversible impacts.	No biodiversity. No living creatures evident. Ecosystem dead. Irreversible effects.	Not applicable

		Severity of Consequences				
		Negligible	**Low**	**Moderate**	**High**	**Catastrophic**
	Protected, Cultural or Environmentally Sensitive Areas (area or sites affected by contamination)	None	< 10% of area	11-50% of area; OR cultural heritage sites of local importance	> 50% of area; OR cultural heritage sites of regional/national importance	Not applicable
ECONOMIC ACTIVITIES	Aquaculture and Fishing	No loss of income	<20% drop in production. Limited impact on livelihoods	Loss of 21-50% in production and/or income due to contamination. Some products cannot be sold or consumed. Moderate impact on livelihoods	Loss of >50% in production and/or income. Business has to be abandoned. Major impact on livelihoods	Not applicable
	Tourism - impacts of contamination on tourist operations (diving, boat tours)	Absent	1 tour operator or 1 tourist site	2-5 tour operators or tourist sites	>5 tour operators or tourist sites	Not applicable

Once the probability of occurrence and the associated severity of consequences have been determined for an unmitigated situation, the ratings are then adjusted taking into account the effectiveness of mitigation. A **residual impact** is any impact that would remain following the implementation of proposed mitigation measures.

Using these criteria, the significance of the impacts (positive or negative) arising from the proposed development will be categorised using the following table:

Table 6.3: Assessing significance based on probability and severity of consequences

	Severity of consequences				
Probability of occurrence	**Negligible**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Probable	Low	Low	Moderate	High	High
Possible	Low	Low	Moderate	High	High
Low	Low	Low	Moderate	Moderate	High
Negligible	Low	Low	Low	Moderate	High

Generally, significant residual effects are those assessed as having a 'high' or 'moderate' adverse impact after mitigation measures have been applied. Impacts assessed as 'low' are not considered to be significant.

6.2 Assessment of construction impacts

For each impact identified in this Addendum, we have taken the **residual** impacts identified for the construction of the permanent wharf in the ES and compared them with the assessed impacts of the wharf in its new position. A detailed description of the impact is provided in cases where the new assessment rating differs from the original rating provided in the ES. Where no new impacts are envisaged, or where they are the same as in the ES, no further discussion is provided.

The discussion of each impact in this section includes the proposed mitigation measures; the summary impact table at the end of each sub-section shows the assessed impacts before and after mitigation measures are applied.

6.2.1 Cliff stability

Cliff stability was not an issue for the wharf in the reference location, but two possible impacts have been identified for the wharf in its new position, relating to the potential risks of falling rocks on people and equipment in the area immediately below the cliff face. These were:

- The impact of large falling rocks which could kill or seriously injure people and cause significant damage to vehicles and equipment;
- The impact of small rocks and stones which could injure people and cause minor damage.

The difference lies in the probability of the two events, with the chances of mass slope failure or significant rock falls being considered low, while the likelihood of small rocks and stones falling is considered to be much greater (see Appendix C). However, the risks can be effectively mitigated using either netting and catch fences (as found on the north face of James Bay), (Figures 6.1 and 6.2; Plate 2) or the selective use of gunnite on the loose surfaces (Figure 6.3). In both cases the mitigation itself can cause three possible impacts: on the terrestrial ecology, Rupert's Battery and Munden's Path.

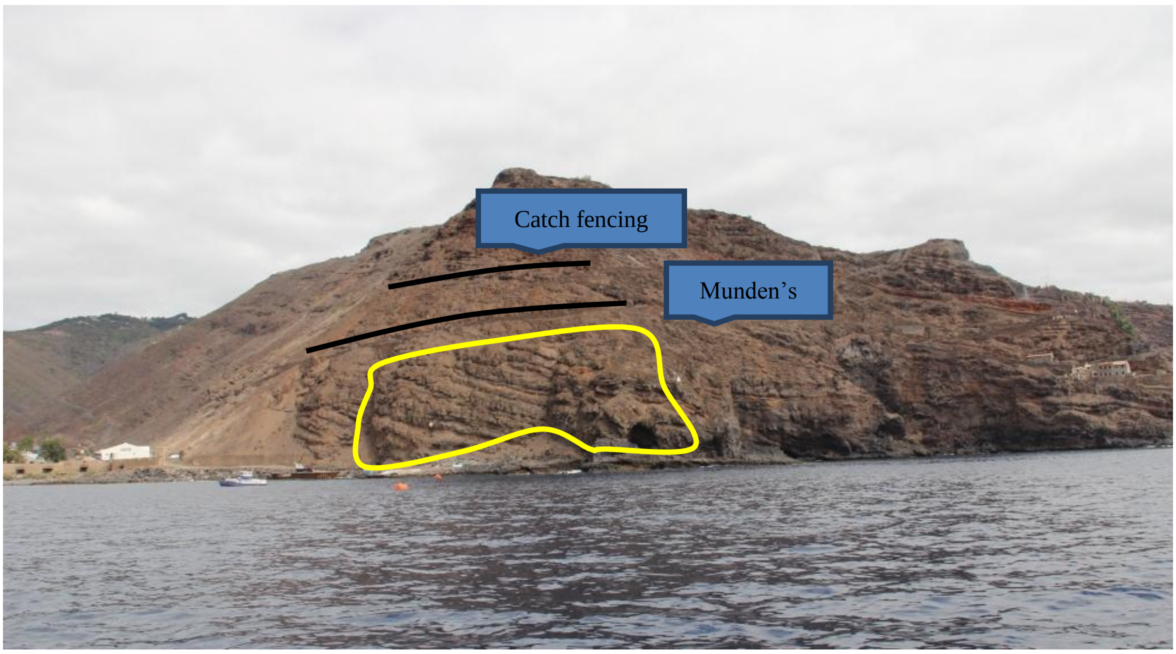


Figure 6.1: Catch fencing above Munden's Path and netting below

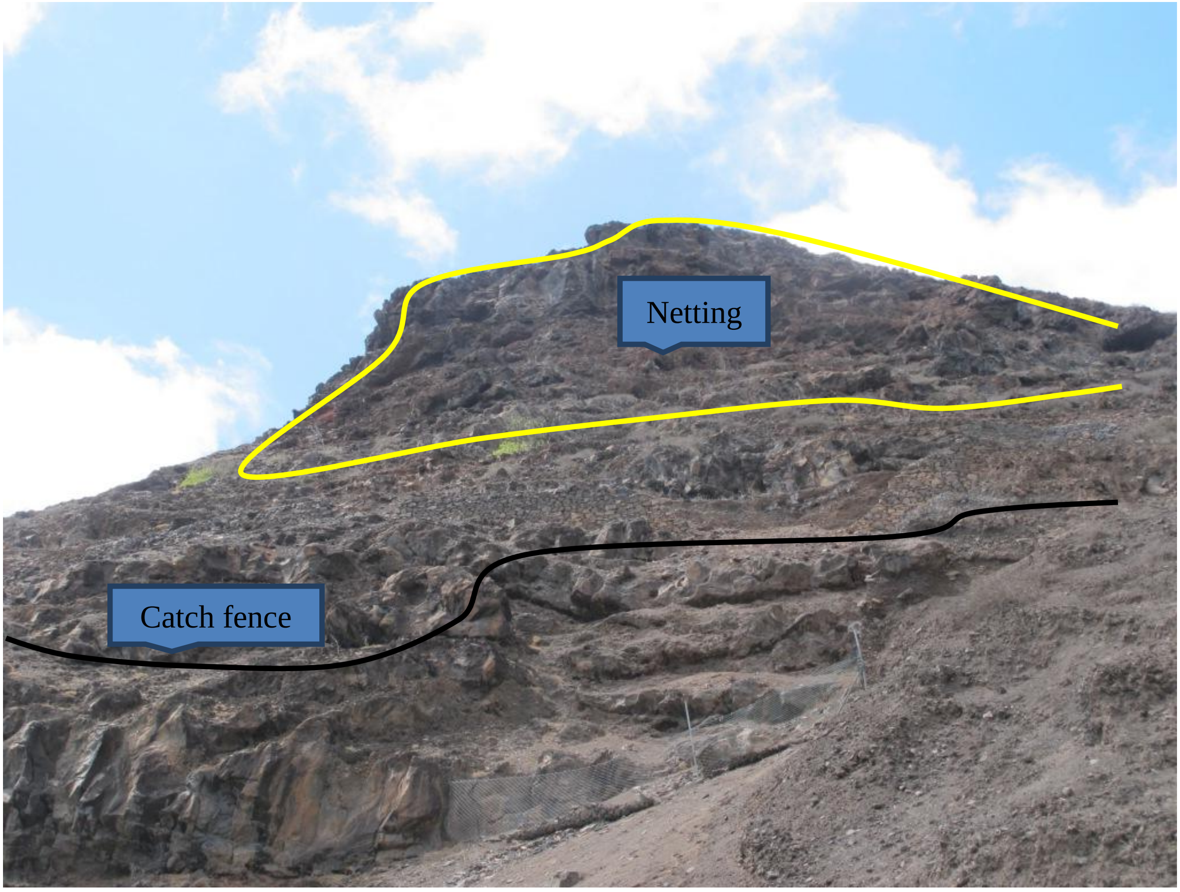


Figure 6.2: Netting above Munden's Path and Catch Fence below

Figure 6.3: 'Gunnite' to certain selected areas prone to weathering

The netting and gunnite could adversely affect Fairy Tern breeding sites, but since these birds are extremely common on the island and breed in most locations, this impact is considered to be low. However, there is a possibility that the rare, endemic psocid may still exist in the small lava tube above Munden's Path. This needs further investigation, but irrespective of the findings, it is unlikely that the protective netting would need to be extended above Munden's Path. The impact is therefore considered to be low.

Another mitigation option under consideration is the installation of 'New Jersey' barriers, spaced slightly away from the rock face and filled with sand to absorb the impact of falling rocks. These structures would not affect the historical fortifications on Munden's Hill.

Rupert's Battery occurs high up on the slopes of Munden's Hill, above the footpath. Although it is a Scheduled Ancient Monument, it is already badly damaged, and as indicated above, it is unlikely that the netting would need to extend above Munden's Path. If catch fences are required on the upper slopes, these could be placed in such a way as to avoid any further damage to the old fortification lines (Figure 6.1).

Finally, although Munden's Path is officially closed to the public due to safety issues, the path is still used. However, it will have to be properly closed to the public during cliff stability works using barricades, advisory signage and public notices in the media. The netting and catch fences will also have an impact on the aesthetics of the walk, but large parts of this path already have been affected by the presence of netting and catch fences. The additional impact is therefore considered to be low.

Table 6.4: Impact assessment of cliff stability and the proposed mitigation measures

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Reversibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effectiveness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Large falling rocks may injure or kill people and damage equipment	Not assessed	Local	Permanent	No	Low Major adverse	High	Low Minor adverse
Loose small rocks and stones may injure people and cause minor damage	Not assessed	Local	Permanent	Yes	Possible Moderate adverse	High	Low Minor adverse
Cliff stabilisation netting may affect terrestrial ecology	Not assessed	Local	Permanent	No	Possible Negligible adverse	Low	Possible Negligible adverse
Cliff stabilisation netting may affect heritage resources	Not assessed	National	Permanent	Yes	Possible Minor adverse	High	Low Negligible adverse
There could be reduced accessibility to Munden's Path during cliff stability works	Not assessed	National	Short-term constant	Yes	Possible Minor adverse	Low	Possible Minor adverse

6.2.2 Impact of sediment removal from wharf footprint

Under the Reference Design, it would have been necessary to undertake dredging to create sufficient draft in the berthing pocket. With the new location, dredging will not be needed during construction as the water depth is sufficiently deep, thus significantly reducing the adverse impact relating to sediment liberation identified in the 2008 ES. However, PRDW have indicated that the sandy sediments along the wharf footprint may have to be removed to provide a more stable base for the wharf. If this is required, the sediments will be sucked up using a suction hose and discharged on the seabed nearby. This could have an impact on marine biodiversity, but given the low biodiversity found on the sandy floor of Rupert's Bay, the severity of the impact would be low. The mitigation measures to be implemented include the following:

- Make sure there are no turtles or cetaceans in the bay prior to this activity;
- Discharge sediment in an area determined in consultation with ENRD and the Darwin Marine project team.

Table 6.5: Assessment of the impact of sediment removal

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Suction and discharge of sediment may affect marine biodiversity	Not assessed	Local	Short-term constant	No	Probable Minor adverse	Moderate	Probable Low adverse

6.2.3 Impact of construction on water quality and marine ecology

The 2008 ES identified three possible impacts of construction activities on water quality:

- Sediment-laden runoff from activities in Rupert's Valley, such as quarrying, could enter Rupert's Run and flow into the marine environment;
- Sediment plumes may develop around the wharf construction site from dumping of rockfill;
- Accidental spills and leaks of chemicals (e.g. paint) or hydrocarbons (e.g. diesel, lubricants) into the marine environment.

These three impacts could also occur with the new wharf location and so will not be discussed any further in this Addendum.

A number of mitigation measures relating to surface water pollution in general were recommended in the 2008 ES and EMP (2011). The specific mitigation measures required for the wharf include:

- Install a litter and sediment trap at the seaward end of Rupert's Run and clean out regularly;
- Rockfill for the wharf will be put through a screen to remove loose soil, small stones and debris prior to transport to the wharf site (however, see below);
- Standard procedures to prevent oil spills set out in the EMP will be followed;

- The CEMP will be updated to include a protocol to prevent, control and manage oil spills in the marine environment during construction. This will include the need for oil spill clean-up equipment to be present at all times at the wharf construction site.

One of the requirements of the EMP (2011) is that silt curtains should be erected to prevent silt escaping from the working area into the marine environment. Curtains made from geofabric were used to contain sediment during the construction of the temporary jetty, but they were found to be ineffective due to the material used, their method of construction, and the marine conditions prevailing at Rupert's Bay. Regular secchi disk monitoring showed that the sediment settled out very quickly and thus the impact was short-term and minor. In view of this finding and given the size of the wharf construction site, the depth of water where it will be constructed and the use of block walls (which will reduce the amount of sediment liberated), the use of silt curtains is unlikely to be practical or effective, therefore this mitigation measure is not recommended.

A detailed marine water quality protocol will be developed to monitor hydrocarbons (visual), turbidity (secchi disk), and litter (visual). Water clarity will be monitored in the days prior to construction commencing and during the entire construction period. If high levels of turbidity are recorded during placement of the core rock (i.e. more than 30% of background), the Contractor will liaise with PMU to determine the need to screen the material to remove soil, organics and small rocks.

The work site will be regularly audited and a specific awareness programme regarding the sensitivity of the marine environment will be designed and presented to all those working at the wharf site.

Table 6.6: Impacts of construction on water quality

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
The mobilisation of sediment laden runoff in Rupert's Valley which could enter local watercourses, drains and the marine environment.	Minor adverse Direct temporary Short term	Rupert's Valley	Occasional	Yes	Low Negligible adverse	High	Low Negligible adverse
Sediment could enter the marine environment during wharf construction.	Minor adverse Direct temporary Short term	Local	Short-term constant	Yes	Probable Minor adverse	None possible	Probable Minor adverse
The potential risk of chemical and fuel (oil) spillages entering the marine environment	Neutral Direct temporary short term	Local	Occasional	No	Probable Minor adverse	Medium	Possible Minor adverse

6.2.4 Impact of road construction on heritage resources

The location of the Reference Design would have had a far greater impact on heritage resources compared to the new position. The previous location would have affected the Boer desalination chimney as well as Rupert's Lines. The new location will not affect either of these features directly, but the new access road may affect Rupert's Lines at the point where the bridge over Rupert's Run is widened. Theoretically, the historical wall should not be affected at all, as it is planned to widen the bridge on the non-historical upstream side (Plate 3), but inadvertent damage could occur during construction works. In order to prevent any damage, the contractor will be required to:

- Erect protective hoarding and/or barricades;
- Erect warning signs;
- Impose speed limit of 15mph on bridge;
- Hold tool box talks with all drivers regarding the sensitivity of the historical walls.

The landward face of the new bridge structure will be faced with stone and the arch over the culvert re-pointed, as it is currently.

The new access road will be built out to the seaward side of the cliff face onto a rock-filled platform and thus should not affect the old stone-packed retaining wall. However, the rough end of this wall (left from when it was cut through circa 1840) (Plate 12) should be rehabilitated using a historically sympathetic treatment during the road upgrading works to prevent further deterioration and reduce the safety risk from falling rocks; this would be a beneficial action. It is recommended that a heritage specialist should be consulted in order to ensure that appropriate methods of construction and materials are used.

Table 6.7: Impact of road construction on cultural heritage resources

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
The risk of damage to Rupert's Lines during widening of the bridge over Rupert's Run and construction of a permanent access road	Various depending on mitigation chosen	National	Short-term constant	Yes	Possible Major adverse	High	Low Minor adverse
Opportunity to repair the rough end of the stone-packed wall	n/a	National	Permanent	-	Neutral	High	Possible Minor beneficial

6.2.5 Impact of quarrying and traffic on noise and vibration

Although noise and vibration impacts were identified in the 2008 ES and the assessed ratings are similar, more information is available now relating to both the predicted number of truck movements and actual noise measurements taken in Rupert's Valley during construction of the haul road.

Table 6.8 shows the predicted number of truck movements required to transport the estimated amount of rockfill, armour rock, precast blockwalls and Core-Locs from the source areas in upper Rupert's Valley (or the airport site) to the wharf construction site.

Table 6.8: Estimated number of truck movements

Material	Tonnes required	Total Number	No of 30t trucks	No of 40t trucks
Rockfill	145,800	-	4,860	3,645
Blockwalls	7,888	267	297[a)]	297[a)]
Core-Locs	10,950	1,564	782[b)]	521[c)]
Total one-way trips			6,000	3,828
Total trips (two ways)			12,000	7,656

a) assume one blockwall unit per 30 t or 40 t truck
b) assume 2 x 7t Core-Locs per truck
c) assume 3 x 7t Core-Locs per truck

If the trucks operate every day for an 8 month period during the stipulated working hours[11] (total 2,013 hours), there will be **on average** between 4-5 heavy truck trips per hour. All of these will have to travel down the road from the haul road intersection to the wharf and most will emanate from the quarries and pre-cast yard in upper Rupert's Valley. Some heavy trucks may have to travel from the airport site to the wharf via the new haul road, thus affecting residents in Deadwood and Bottom Woods. In reality, there may be more trucks on the road during certain times of the day and during peak construction periods than at other times.

The noise impacts of transporting rock to the wharf is one of the most significant impacts identified for the wharf project. Analysis of the noise monitoring data (s. 5.10.1) showed that there is a correlation between heavy traffic, hauling activities and higher noise levels, although few events exceeded the maximum allowable daytime noise level of 70dB(A) as stipulated in the EMP. With the predicted increase in heavy truck activity through Rupert's Valley, greater efforts will be required to minimise noise levels, such as:

- No night time hauling should be considered;
- Repair the corrugations and potholes in the tar road;
- Observe the speed limit of 15mph;
- Prohibit the use of engine retarders for braking;
- Prohibit truck idling in residential areas for more than 1 minute;
- Make sure that trucks are regularly maintained.

Loading of rock at the quarry and unloading at the wharf are considered to have less impact on valley noise levels, while the batch plant and pre-cast operations will contribute little to overall noise levels. Nevertheless, noise levels will have to be monitored on a regular basis in Rupert's Valley and in the residential areas of Deadwood and Bottom Woods during hauling operations from the airport site to Rupert's Bay.

Monitoring results of blasting activities during the construction of the haul road and quarrying activities in lower Rupert's Valley indicate that the stipulated noise limit of 125dB(A) was frequently exceeded. Given that approximately 145,800t of rockfill will be required for the wharf, this will necessitate a number of blasts over a period of about 8 months. If most of the

[11] 07h00 - 18h00 Monday to Friday; 07h00 – 13h00 on Saturday

quarrying occurs at the mid-valley or upper-valley quarries, the noise impact on Rupert's residents may be lower than previously experienced, but the Deadwood community may be more greatly affected.

It is therefore recommended that noise levels from blasting should be monitored to make sure that noise levels stay within the stipulated limit of 125dB(A). If this limit is exceeded, additional mitigation measures will need to be applied, such as limiting the size of each blast. The relevant communities will be advised 24 hours prior to every blast as per current protocols.

The vibration readings during blasting to date have been negligible, but this impact will need to be monitored whenever blasting takes place to make sure that vibration dose levels do not exceed the guidelines set out in BS 6472 (see Table 5.7 and s. 2.5.2 of the EMP (2011)). Building condition surveys must be conducted before and after the main blasting period.

Table 6.9: Impacts of quarrying, loading and transporting rock on noise and vibration

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Noise from dump trucks delivering fill and rock armour.	Moderate adverse Short-term, temporary reversible	Rupert's Valley	Long-term constant	Yes	Probable Major adverse	Medium	Probable Moderate adverse
Noise from loading/unloading operations	Minor adverse Short-term, temporary reversible	Rupert's Valley	Long-term constant	Yes	Possible Minor adverse	Low	Possible Minor adverse
Noise from concrete batch plant and pre-cast yard	Not assessed	Rupert's Valley	Long-term constant	Yes	Low Minor adverse	Low	Low Minor adverse
Vibration from dump trucks delivering fill and rock armour.	Minor adverse Short-term, temporary reversible	Rupert's Valley	Long-term constant	Yes	Probable Moderate adverse	Low	Probable Moderate adverse
Noise and vibration from blasting at the quarry	Moderate adverse Short-term, temporary reversible	Rupert's Valley	Frequent	Yes	Probable Major adverse	Medium	Probable Moderate adverse

6.2.6 Impact of quarrying and traffic on air quality

Air quality impacts associated with dust were assessed in the 2008 ES. The PM_{10} dust monitoring in Rupert's Valley confirms the original ES predictions (Table 6.10 below), but further validation is required as well as measurement of total suspended particulates. A number of measures to reduce dust impacts are recommended, including:

- Regular road sweeping;
- Road maintenance (to prevent it breaking up);
- Dust suppression on gravel roads;
- Enforcement of speed limits;
- Install dust minimisation equipment on the batch plant.

If monitoring shows that excessive dust is being generated from the back of the trucks, then consideration should be given to wetting the rockfill prior to transportation. If none of these mitigation measures reduce dust levels to acceptable limits, then tarpaulin covers will have to be used, although this will increase the turn-around time for each truck and will place additional burden on the timetable for construction.

The standard operating procedures currently being applied at the concrete batch plant at the airport site will be applied to the batch plant in Rupert's Valley (if needed), and PM_{10} and TSP will be monitored.

Table 6.10: Impact of construction activities on air quality (dust)

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Dust impacts from traffic possible at the fish processing plant during wharf construction.	Minor adverse Short-term, reversible	Rupert's Valley	Long-term constant	Yes	Probable Moderate adverse	High	Low Minor adverse
Dust from haul trucks and increased traffic	Not assessed	Rupert's Valley	Long-term constant	Yes	Probable Moderate adverse	High	Possible Minor adverse
Dust impacts from concrete batch plant and pre-cast yard	Not assessed	Rupert's Valley	Long-term constant	Yes	Low Minor adverse	High	Low Negligible adverse

6.2.7 Impact of traffic on community safety and ease of access

Two key traffic-related impacts were identified in the 2008 ES:

- An increase in traffic in Rupert's Valley; and
- Temporary road closures or diversions.

While both these impacts will be experienced for the new wharf location, we feel that the impact of increased traffic was under-estimated in the 2008 ES. Traffic survey data show that the amount of traffic has more than doubled on Field Road since airport construction started and it is likely to increase more once construction of the wharf commences. Most of this increase will comprise cars, pick-ups and light delivery vehicles, as the haul trucks will use the haul road. The actual increase in numbers is not known, but it is probable that more delays can be expected on Field Road, resulting in a longer travelling time. There is little that can be done to mitigate this beyond trying to eliminate all unnecessary journeys and enforcing speed limits. Inevitably, an increase of traffic on a narrow, steep road will give rise to an increased road safety risk, which could have major consequences. A similar increased risk will occur where the haul road passes through populated areas such as Deadwood and Bottom Woods.

Another potential issue is that the current access road to Argos factory may have to be closed while the bridge over Rupert's Run is widened. This will have to be mitigated by providing an alternative permanent or temporary access route to Argos, and notifying the public of such changes.

There may have to be temporary road diversions during upgrading/repair of the road through Rupert's Valley, and the road to Shears jetty may be closed for some time during the construction phase. These road closures and diversions must be adequately signed and the public notified in advance through the media.

Table 6.11: Impacts on traffic and road access

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Rever-sibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
There will be an increase in construction traffic especially in Rupert's Valley, on Field Road and through Deadwood and Longwood.	Moderate adverse Temporary, short-medium term	National	Long-term constant	Yes	Probable Major adverse	Low	Probable Major adverse
Temporary diversions and possible temporary closures of roads	Minor adverse Temporary, short-medium term	Rupert's Valley	Short-term constant	Yes	Probable Major adverse	High	Possible Minor adverse

6.2.8 Impact of an influx of construction workers on the Rupert's Bay community

Impacts on the social structure and economy of St Helena were addressed at a generic level in the ES. As this Addendum focuses on the construction of the wharf in Rupert's Bay, the impact table below reflects specific issues of relevance to the residents of Rupert's Valley. There is a possibility that the levels of petty crime could increase in the valley due to an increased number of people coming and going, particularly those who may not respect the Saint culture. To avoid this, the contractor will need to focus on raising community awareness on the one hand, and reinforcing codes of behaviour amongst the workforce on the other. However, it is anticipated that the existing micro-, small and medium-sized enterprises in the valley should experience a moderate improvement in economic activity, while opportunities for new businesses may arise.

Table 6.12: Social and economic impacts on Rupert's Valley

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Reversibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effectiveness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Influx of daily workers to Rupert's Valley could result in an increase in crime	Minor adverse	Rupert's Valley	Long-term constant	Yes	Low Minor adverse	Low	Low Minor adverse
Influx of daily workers to Rupert's Valley could result in increased economic activity for SMMEs	Moderate beneficial	Rupert's Valley	Long-term constant	Yes	Probable Moderate beneficial	-	Probable Moderate beneficial
Job creation and opportunities for and skills development	Not assessed	National	Long-term constant	-	Probable Minor beneficial	High	Probable Moderate beneficial

6.2.9 Impact of construction on community facilities, services and amenities

Two impacts on amenities were identified in the 2008 ES: the loss of access to the beach and picnic area; and the loss of access to recreational fishing spots (Plates 16-19). Of these two impacts, the temporary loss of access to the beach and amenity area is the more significant as there are no other beaches easily accessible by car near to Jamestown. However, as opposed to the reference position of the wharf, these areas will be less affected by construction of the wharf in its new location. While closures may be necessary for short periods of time from a public safety point of view, pedestrian access will be possible for most of the time via the cutting through the wall near the public toilets. The proposed dates when the beach and picnic area will be closed must be published at least 2 weeks in advance in the local media and appropriate signage erected.

Access to fishing spots along the south shore of Rupert's Bay, including Shears Jetty will probably be lost for the entire construction period. However, there are many other fishing spots in the area which could be used instead.

Three additional impacts identified during this assessment were:

- Modelling (Figures 5.8 and 5.9) shows that the on-shore flowing bottom currents may cause sediment to disperse towards the shore during wharf construction which could affect water clarity in the vicinity of Shears Jetty and the bathing beach under certain circumstances. The mitigation measures set out in s.6.2.3 apply;
- The increased demand for water during construction may result in water shortages in Rupert's Bay. This fairly significant impact can be readily mitigated by ensuring that BR only uses borehole water for concrete mixing, dust suppression and other uses;
- Pressure on sewerage systems due to increased utilisation. This can be remedied by ensuring that BR provides portable toilet facilities at the wharf and prohibiting worker use of the public conveniences.

Table 6.13: Impacts on amenities

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Reversibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effectiveness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
The beach including the amenity area at Rupert's Bay will not be available at times for recreational use during the construction of the permanent wharf.	Moderate adverse Temporary	National	Short-term constant	Yes	Probable Moderate adverse	Low	Probable Moderate adverse
Access to recreational fishing spots on the south side of Rupert's Bay will be restricted	Minor adverse Temporary	National	Long-term constant	Yes	Probable Minor adverse	Low	Probable Minor adverse
Possible shortages in water supply to Rupert's Valley due to increased construction water demand	Not assessed	Rupert's Valley	Long-term constant	Yes	Probable Moderate adverse	High	Low Negligible adverse
Pressure on sanitation facilities	Not assessed	Local	Long-term constant	Yes	Probable Moderate adverse	High	Low Minor adverse

6.2.10 Impact of construction on sea-based economic activities

It is likely that the access road to the wharf will have to be raised to 2-3m above CD. In addition, a launch ramp and boat house will be required for the sea rescue boats. Although the detailed designs have not yet been finalised, one or both of these may cause disruption of fish landing at the Shears for a considerable amount of time. Furthermore, access to Shears may not be allowed for safety reasons during actual wharf construction. The long-term (up to 18 months) cost implications of this for the fishing industry are likely to be significant and various mitigation measures will need to be considered, such as maintaining the existing access in some way, creating a new temporary offloading jetty, or the payment of compensation for the additional cost of offloading in Jamestown and transporting the fish to the Argos factory in Rupert's.

The impact on commercial boat operators is likely to be minor as most tours head southwards from Jamestown as the diving and fishing opportunities are greater in this direction compared to Rupert's Bay. The construction of the new fuel offloading facilities will have to be timed to avoid the scheduled fuel deliveries so as not to interrupt island supplies.

Table 6.14: Economic impacts on sea users

Impact	Rating in 2008 ES	Extent / magnitude	Duration	Reversibility of the effect / impact	Probability of occurrence and severity of consequences (before mitigation)	Effectiveness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
There could be disturbance and / or reduced accessibility to the Shears at Rupert's Bay for commercial fish unloading	Minor adverse	Rupert's Valley	Long-term constant	Yes	Probable Major adverse	Medium	Probable Moderate adverse

Disruption to navigation, tour boats, diving and snorkelling activities in Rupert's Bay	Not assessed	National	Short-term constant	Yes	Probable Moderate adverse	Medium	Possible Minor adverse

6.3 Assessment of impacts expected during the operation of the wharf

The impacts associated with the operation of the wharf will be addressed under the following broad headings:

- Cliff stability;
- Erosion and sedimentation;
- Pollution;
- Biodiversity impacts;
- Noise impacts;
- Air quality impacts;
- Economic impacts;
- Social issues;
- Visual impacts.

The discussion of each impact in this section includes the proposed mitigation measures; the summary impact table at the end of each sub-section shows the assessed impacts before and after mitigation measures are applied.

6.3.1 Cliff stability

The same impacts as those described in section 6.2.1 pertain for wharf operation and will not be described further.

Table 6.15: Cliff stability assessment

Impact	Rating in 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effectiveness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Large falling rocks may injure or kill people and damage equipment	Not assessed	Local	Permanent	No	Low Major adverse	High	Low Minor adverse
Loose small rocks and stones may injure people and cause minor damage	Not assessed	Local	Permanent	Yes	Possible Moderate adverse	High	Low Minor adverse

6.3.2 Erosion and sedimentation

The following assessment is drawn from the PRDW Coastal Processes Report (PRDW 2013c).

The change in bathymetry for the 1:100 and 1:1 year return period event including the proposed wharf development is provided in Figures 6.4 and 6.5, respectively. The navigation areas of the proposed development have been superimposed on the figures. From these figures, it is clear that the sediment transport mechanism has changed in response to the change in wave and current climate. For the 100 year return period event, sedimentation of up to 1.4m is expected to occur in the lee of the proposed structure. Erosion patterns on the northern extent of the bay are generally expected to remain unchanged, with erosion expected to occur immediately offshore of the north-eastern beach.

Similarly, erosion immediately offshore of the south-eastern swimming beach is expected to remain similar to the status quo. It is noted that due to the expected sedimentation along the south-eastern area of Rupert's Bay, the exposed rock reefs are likely to be covered by sand, and may have a localised adverse impact on benthic fauna.

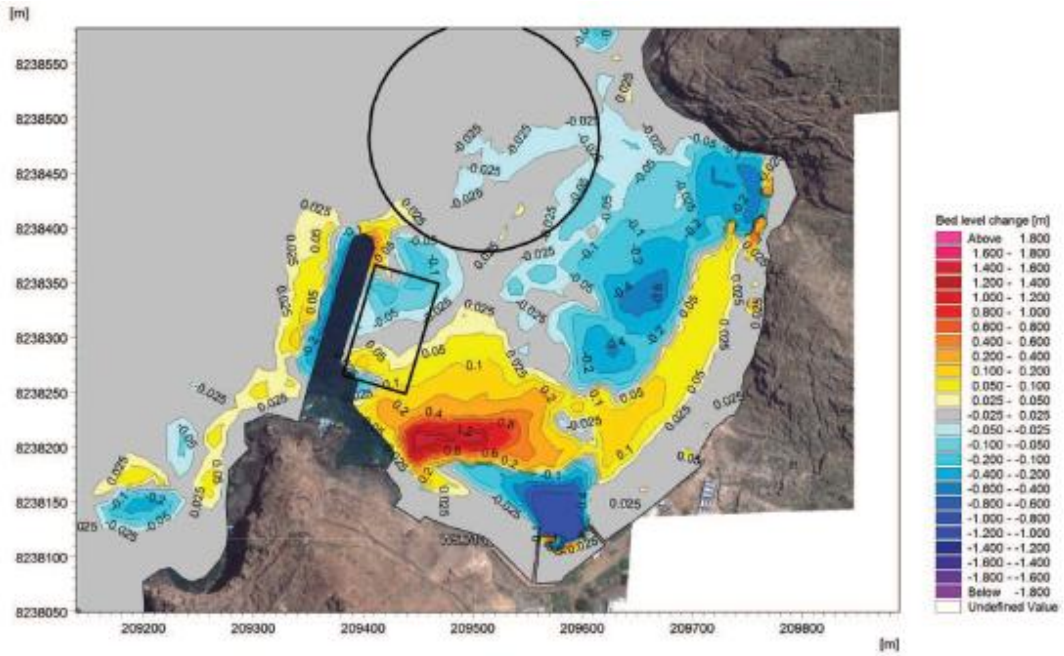


Figure 6.4: Bed level change for the 1:100 year event after wharf construction

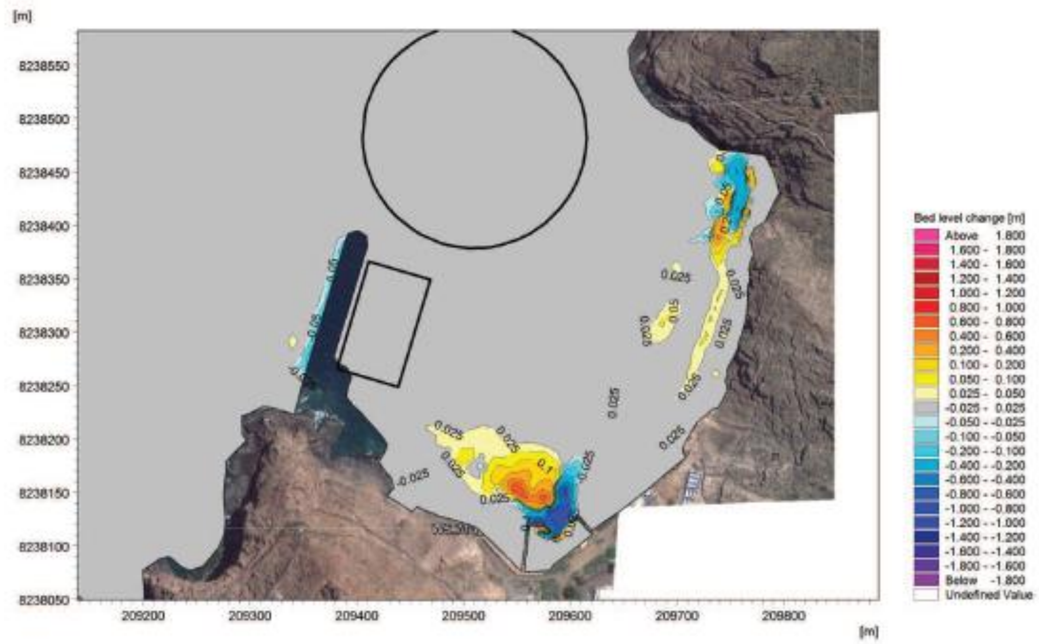


Figure 6.5: Bed level change for the 1:1 year event after wharf construction

For the 1 year return period event, sedimentation to the extent of approximately 0.5m is expected to occur offshore of the south-eastern swimming beach, which is similar to the sedimentation magnitude expected for the status quo situation. Referring to Figure 6.4, minimal sedimentation of the facility's navigational areas is expected for the 100 year return period event, whilst no sedimentation is expected for the 1 year event (Figure 6.5). The limited sedimentation is expected to be highest in the south-eastern corner of the berth pocket, reaching approximately 0.1m during the 100 year return period event. No sedimentation is expected in the approach channel and turning circle for either of the events.

The impact of the proposed development on the stability of the south-eastern swimming beach is presented in Figures 6.6 and 6.7. As under present conditions, limited accretion is expected to occur on the beach, whilst erosion to the extent of approximately 0.8m is expected immediately offshore. As such, the proposed development is not expected to have a significant impact on the stability of the swimming beach in Rupert's Bay.

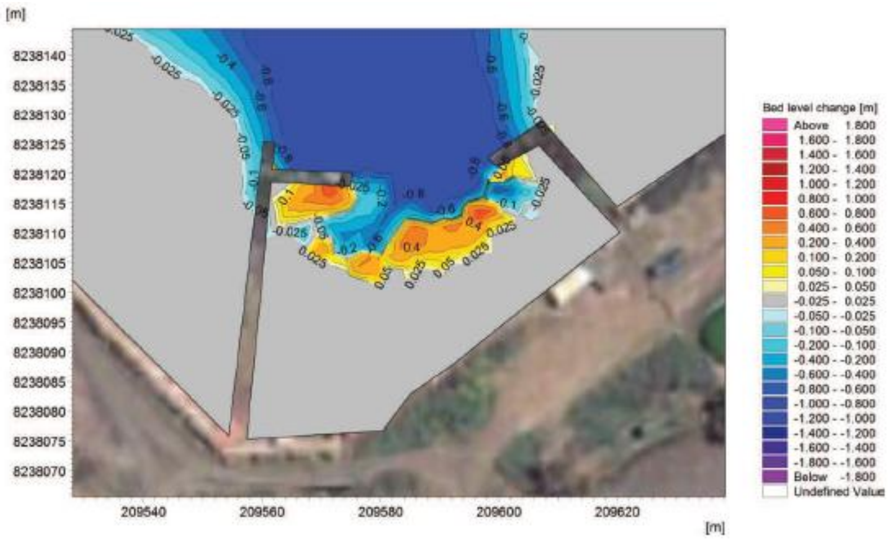


Figure 6.6: Bed level change at swimming beach for 1:100 year event after wharf construction

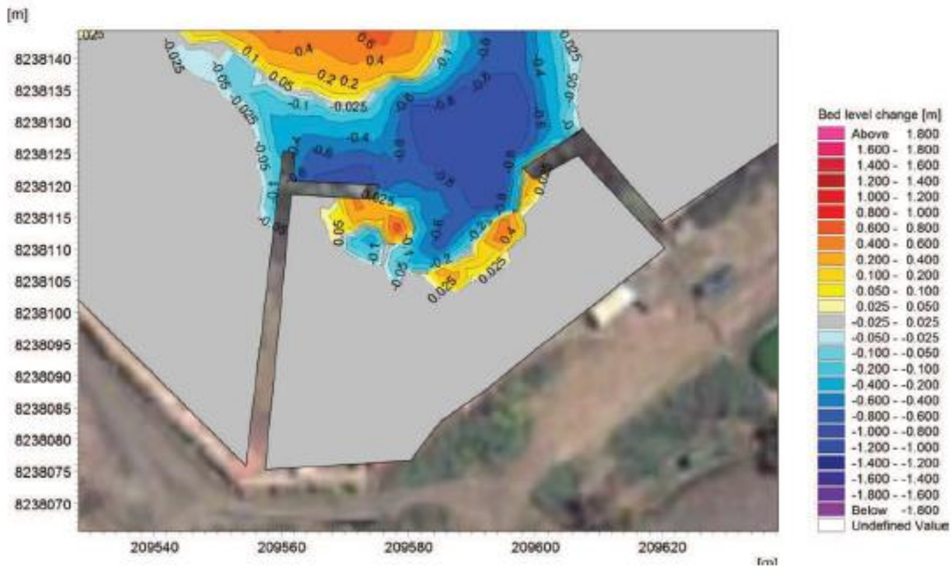


Figure 6.7: Bed level change at swimming beach for 1:1 year event after wharf construction

The modelling described above shows that the impact of the Reference Design on sediment movement at the swimming beach was predicted to be greater than the impact of the wharf at its new location (Table 6.16).

Table 6.16: Impact of the wharf on sediment movement

Impact	Rating in 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Impact of wharf on sediment movement in Rupert's Bay	Moderate adverse	Rupert's Bay	Permanent	No	Probable Minor adverse	None possible	Probable Minor adverse

6.3.3 Pollution aspects

There are a number of activities and potential incidents which could cause pollution of the marine environment with consequences for marine biodiversity, human health and aesthetics. These are:

- Risk of oil spills during product transfers;
- Risk of oil spills due to vessel grounding;
- Risk of oil spills due to vessel contact with the wharf;
- Risk of collisions with other vessels and sea craft;
- Pollution from ships and wharf area (waste water, spills, leaks, food waste, litter, etc);
- Impacts on human health due to decreased water circulation in the bay which may affect the dispersion of effluent from Argos sewer outfall.

Each of these is discussed in more detail in the following sub-sections:

<u>6.3.3.1 Risk of oil spills during product transfers</u>

Two risks are described below – those which may occur during the transfer of fuels from tankers at the bulk fuel installation, and those which may occur during refuelling of lighters at the quay (for detailed analysis, please refer to Appendix F).

Hydrocarbon spills occurring during cargo transfer operations can occur as a result of a rupture of the floating hose or a leak at either the vessel or shore manifolds. It is assumed that the operation will be daylight-only operation so that a visual watch on the floating hose and manifolds can be maintained at all times. This will reduce the likelihood of a significant cargo spill as the system can be shut-down immediately on sighting a hose rupture or manifold leak. A small volume cargo spill will occur relative to the size of the cargo hose (8" to 12" diameter) and the duration prior to an emergency shut-down of the system.

In addition, spills of Marine Diesel Oil (MDO) may occur during refuelling of small recreational or fishing vessels at the main quay. The volumes pumped during any transfer operation will range from approximately 100 litres (sailing vessel) to a maximum of 40m^3 (small tug or large fishing vessel). The volumes of bunker fuel transferred can be considered small and providing good operational procedures are in place, the consequences of a spill can be kept to a minimum and confined to close to the ship. Any dispersion of a surface slick would be seawards, driven by the prevailing south-easterlies (Figures 6.8 and 6.9).

In order to minimise the risks of oil spills during fuel transfer operations, it is recommended that the following measures should be implemented:

- Ongoing training in refuelling procedures and environmental awareness of personnel;
- Update the existing SHG marine pollution control and spill response plan;
- Enforce adherence to port safety regulations and procedures;
- Restrict fuel offloading to daylight hours only;
- Provide emergency shut-down systems;
- Make sure oil spill response equipment is in good condition and ready for immediate deployment.

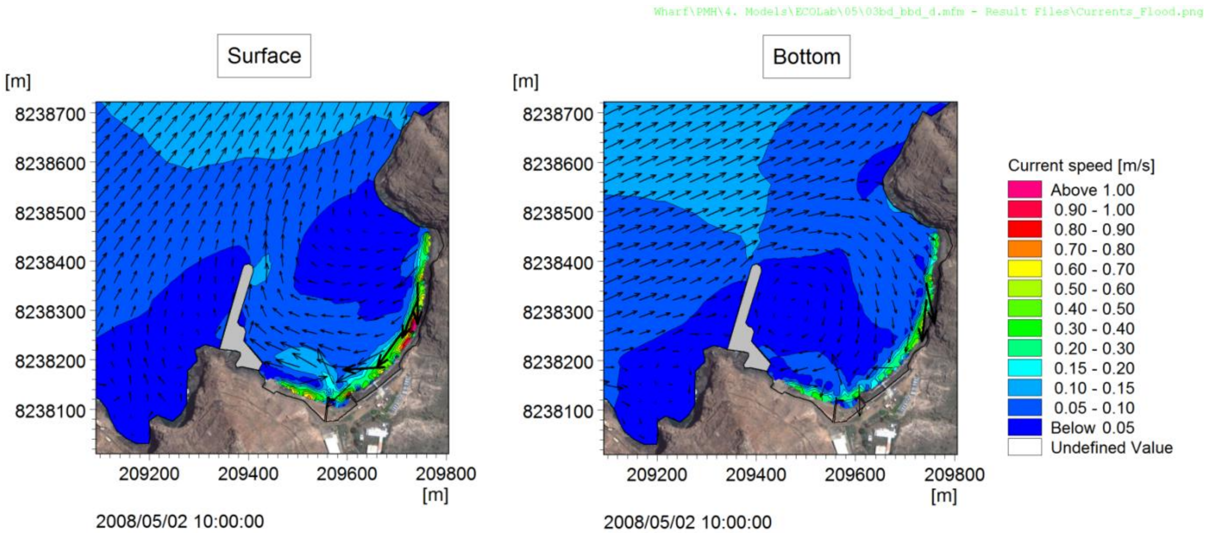


Figure 6.8: Surface and bottom currents during flood tide

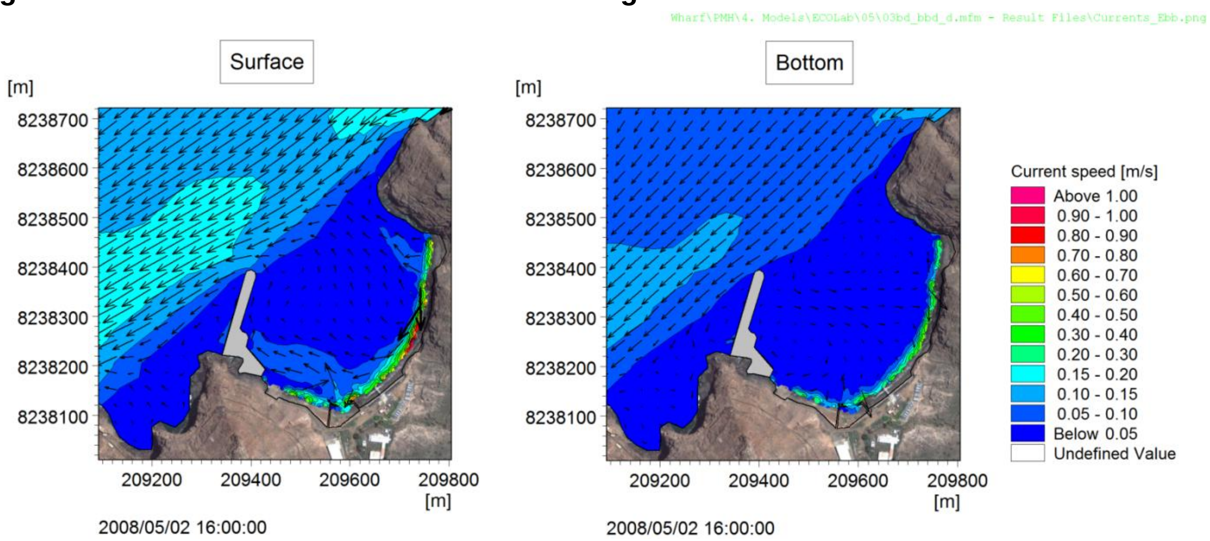


Figure 6.9: Surface and bottom currents during ebb tide

6.3.3.2 Risk of oil spills due to vessel grounding

The risk of a vessel grounding incident may result from the following conditions:

- Where the vessel's draught exceeds the available depth of water;
- When the vessel departs from the designated manoeuvring area.

Oil spill incidents from vessel groundings are judged to be very low frequency, but high severity incidents. The low frequency is attributable to the short time period that these vessels are in contact with areas where there is a risk of the vessel's draught exceeding the available depth of water. Human error, navigational error, steering failure, electrical failures and/or loss of engine power would be the main causal factors for such incidents. Additionally, deteriorating weather conditions and strong current conditions will affect the likelihood of grounding. In the case of vessel grounding it can be assumed that there will be a 50% outflow of bunker oil resulting from a bunker spill from a ruptured tank (Michel, Winslow, 2000), but the probability of the incident occurring is low. Thus in the case of a typical oil tanker (design vessel) at St Helena, an amount of some 700m^3 of heavy fuel oil (HFO) and MDO could be released, while a typical cargo vessel visiting the island may lose some 140m^3 of HFO and MDO.

If a spill were to occur in Rupert's Bay, oil on the sea surface would be driven seawards by the prevailing south-easterly winds, which are the predominant driving force (Figures 6.8 and 6.9).

In order to minimise the potential for ships to ground in Rupert's Bay, the following mitigation and control measures are recommended:

- Provide advisories to ships' captains and update all marine charts;
- Develop and regularly update a marine pollution control and spill response plan;
- Ensure that a system of ship and shipping company vetting is in place;
- Provide aids to navigation demarcating navigation limit (these have been included in the wharf designs in accordance with the most recent guidelines of the International Association of Marine Aids to Navigation and Lighthouse Authorities;
- Adherence to operational limiting conditions and port safety regulations.

6.3.3.3 Risk of oil spills due to vessel contact with the wharf

Vessel contact refers to the damage sustained by a vessel in contact with a hard structure such as the quay structure. Human error, navigation error and severe weather conditions are causal factors for vessel contact. The potential consequence of this type of incident is the possible breach of the design vessel's wing fuel tanks as a result of contact with the quay structure. Smaller vessels, such as the design vessels for this wharf, tend to carry their bunker fuel oil in double bottom tanks (Michel, Winslow, 2000). The risk of a bunker fuel oil spill from a wing tank rupture due to vessel contact at the permanent wharf can therefore be considered low.

The same mitigation measures as those listed under s. 6.3.3.2 above apply here.

6.3.3.4 Risk of collisions with other vessels and sea craft

Vessel collisions include the potential damage sustained by the design vessels due to collisions with other traffic vessels. It is assumed that vessel manoeuvring operations in Rupert's Bay will not occur at the same time as refuelling operations are taking place. It is also assumed that small craft will not be allowed to enter Rupert's Bay while a cargo ship is manoeuvring or in port. Therefore the risk of vessel collision and the resultant oil spill is considered low. A further control will be to impose a 250m wide exclusion zone around the bulk fuel moorings and buoys.

6.3.3.5 Pollution from ships and wharf area

The disposal of all wastes from ships into the marine environment in near-shore waters is expressly prohibited in terms of Annex V of MARPOL (see s 3.4). This includes: plastics, netting, synthetic ropes, waste water, food waste, litter, etc. Nevertheless inevitably some waste from ships and the wharf will end up in the marine environment. This can be controlled by stringent port management, with the imposition of fines for any infringements. Waste receptacles and relevant signage can also be provided on the wharf to encourage responsible waste disposal practices.

Floating litter and other waste has well-documented, significant impacts on biodiversity, especially turtles, cetaceans and seabirds, while the sight of floating debris in the water is aesthetically unpleasant. As with the oil spill scenarios described above, floating debris will be driven out to sea by the prevailing winds, however, any contaminants that enter the deeper water column could be circulated back into the bay via the slow moving bottom currents (Figures 6.8 and 6.9). The proposed mitigation measures include:

- Provide litter bins on the wharf and empty on a scheduled (at least weekly) basis;
- Erect appropriate signage for waste disposal;
- Enforce the MARPOL regulations regarding the disposal of waste within 25 nautical miles of the coast;
- Penalise offenders for littering and waste dumping.

6.3.3.6 Impacts on human health due to decreased water circulation in the bay which may affect the dispersion of effluent from Argos sewer outfall

The dispersion model described in s. 5.5 shows that the longshore current caused by the construction of the wharf draws the sewage effluent plume towards the wharf and away from the swimming beach. Surface concentrations are observed to be higher than bottom concentrations due to the initial buoyancy of the sewage (Figure 6.10). However, bottom concentrations are seen to spread further away from the source, due to the reduced die-off of bacteria at greater depths (Figure 6.11). The dispersion characteristics during ebb tide are similar (see Appendix D).

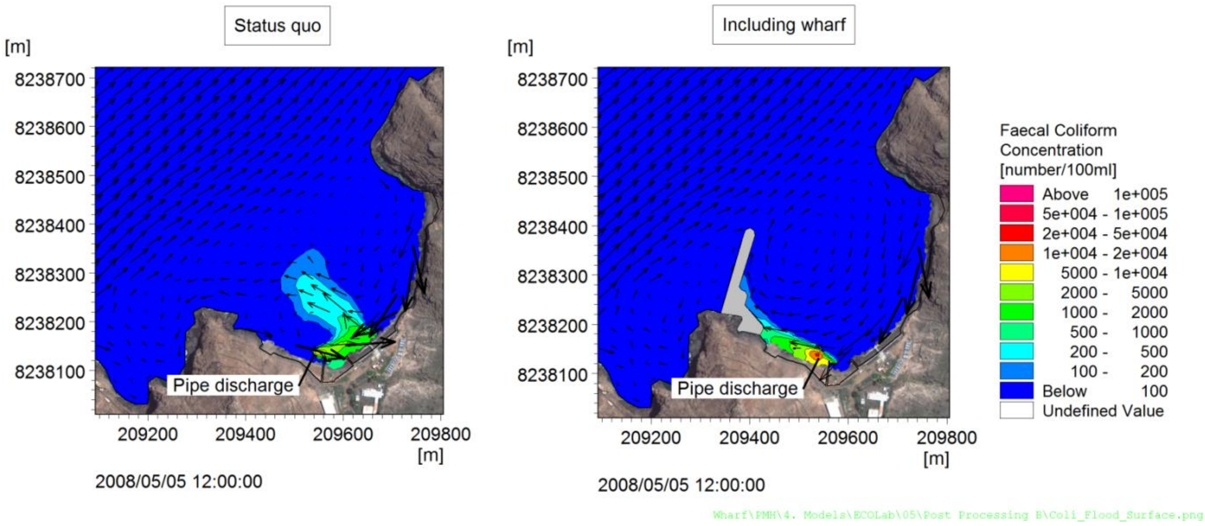


Figure 6.10: Dispersion of sewage discharge during flood tide: surface concentration

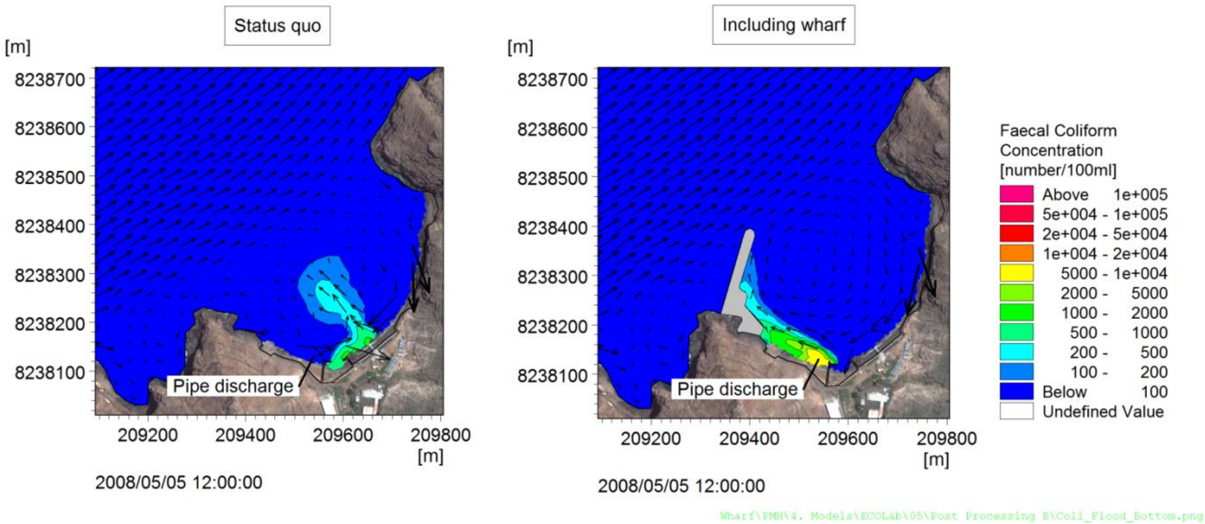


Figure 6.11: Dispersion of sewage discharge during flood tide: bottom concentration

Figures 6.12 and 6.13 present the maximum near-surface and near-bottom concentrations of faecal coliforms reached in the 15-day simulation period at the swimming beach. As seen in the typical transport patterns, the coliform concentrations at the surface are higher than those at the bottom. However, bottom concentrations are more widespread.

Prior to wharf construction, the modelled maximum bay-wide concentration of coliforms exceeds 100 coliforms per 100ml, with a maximum concentration of over 20,000 coliforms per 100ml reached at the discharge point. At the swimming beach, the maximum concentration exceeds 2,000 coliforms per 100ml.

Following from the changes to the current circulation in the bay due to the proposed wharf, maximum concentrations exceeding 100 coliforms per 100ml are confined to the south-western part of the bay. However, maximum concentrations at the discharge point are higher and reach a concentration of over 50,000 coliforms per 100ml. Since the currents flow in the north-westerly direction at the discharge point, the maximum concentration reached at the swimming beach is approximately 1,000 coliforms per 100ml, i.e. less than half the concentration for the status quo. While this is a possible improvement over the current situation, it still indicates that some urgent actions need to be taken by SHG to prevent sewage being discharged within 50m of a public beach.

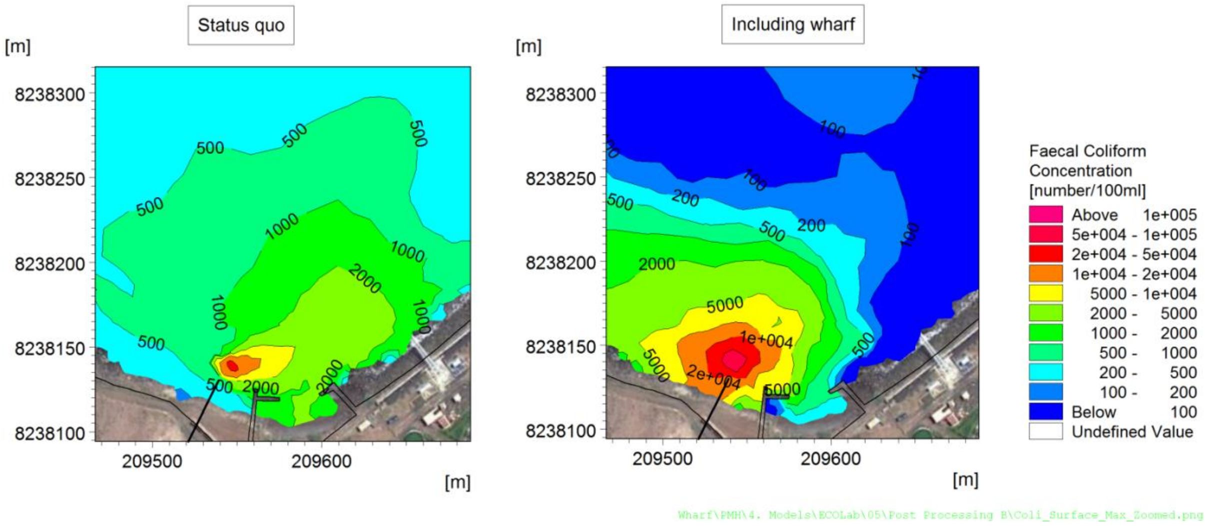


Figure 6.12: Maximum near-surface coliforms: swimming beach detail

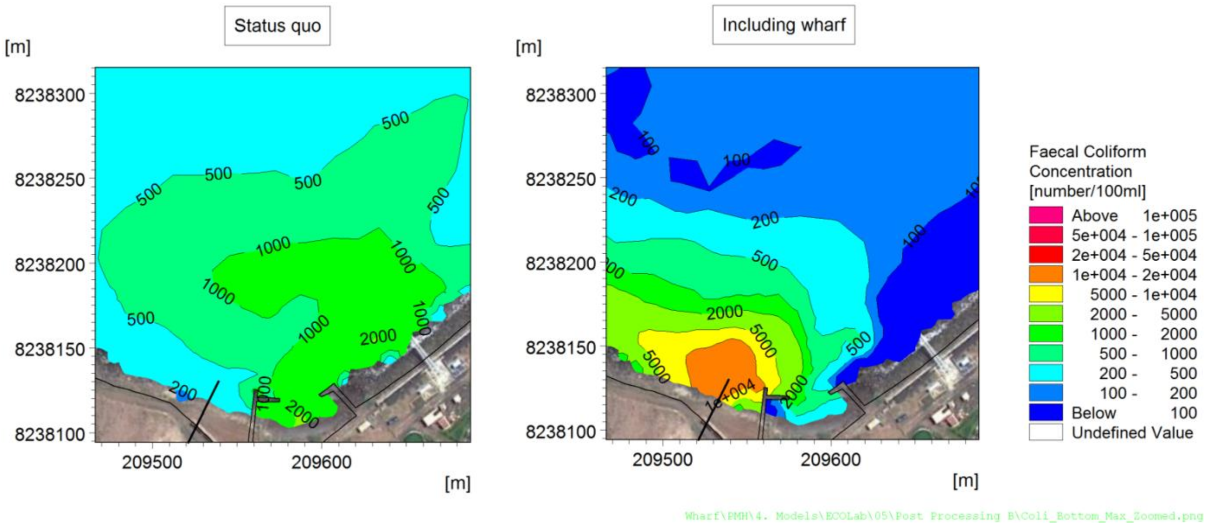


Figure 6.13: Maximum near-bottom coliforms: swimming beach detail

In order to minimise the impacts of pollution on human health at the swimming beach, the following mitigation measures are recommended:

- Install a soakaway at Argos and remove effluent discharge pipe;
- Install a litter trap at the seaward end of Rupert's Run and clean out on a regular basis (at least every 3 months);
- Provide larger litter bins at the picnic area and empty on a weekly basis (preferably immediately after a weekend);
- Erect appropriate signage;
- Erect information boards detailing the negative impacts of litter on marine ecology (it could form part of the island-wide waste management strategy.

A summary of the impacts described above is provided in Table 6.17.

Table 6.17: Potential pollution impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Risk of oil spills during product transfers	Not assessed	Rupert's Bay	Occasional	No	Possible Minor adverse	High	Low Minor adverse
Risk of oil spills due to vessel grounding	Not assessed	National	Once-off	No	Low Major adverse	High	Negligible Major adverse
Risk of oil spills due to vessel contact with wharf	Not assessed	Rupert's Bay	Occasional	No	Low Major adverse	High	Low Minor adverse
Increased risk of ship collisions with other sea craft	Not assessed	National	Occasional	No	Low Moderate adverse	High	Low Minor adverse
Potential for pollution from ships and wharf area (litter, waste water, spills, leaks, food waste)	Not assessed	Rupert's Bay	Frequent	Yes	Probable Minor adverse	Moderate	Possible Minor adverse
Impacts on human health due to decreased water circulation in the bay causing an increase in pollution concentrations from sewer and stormwater outfalls	Not assessed	Rupert's Bay	Permanent	-	Possible Minor beneficial	High	Probable Moderate beneficial

6.3.4 Impacts on biodiversity

There are four potential negative impacts on biodiversity and one possible beneficial effect:

- Impacts on marine biodiversity due to decreased and altered water circulation patterns in the bay thus causing an increase in pollution concentrations;
- Risk of ship collisions with cetaceans;
- Impact of wharf lighting at night on the foraging behaviour of seabirds, fish and cetaceans (as currently noted at Jamestown steps);
- Risk of introduction of invasive marine species through ballast water;
- Possible increase in habitat for 'rocky shore' benthic species along the seaward side and head of the breakwater.

These are discussed in more detailed in the sub-sections below.

<u>6.3.4.1 Impacts on marine biodiversity due to decreased and altered water circulation patterns in the bay thus causing an increase in pollution concentrations</u>

In addition to the impact of litter, waste and pollution from ships on biodiversity, there is the additional risk of litter being washed down Rupert's Run, and/or blown into the water from the amenity area at the beach due to poor waste management practices in these areas. It can be seen in Figures 6.8 – 6.11 that circulation in the bay will be affected by the wharf and that

a clockwise pattern will prevail for surface currents, possibly creating a ‘dead zone’ in the lee of
the wharf. A build up of nutrients and waste in this area could reduce water quality and clarity, and some marine species may be attracted to the area because of the presence of nutrients. This would expose species to a greater risk of contact with plastic pollution. Fortunately the bay has low marine biodiversity which would mean that the severity of the impacts would be low, although marine turtles may be at risk. This issue could be significantly reduced by:

- Installation of a soakaway at Argos to prevent the direct discharge of sewage into the bay;
- Installation of a litter trap at the seaward end of Rupert’s Run;
- Provision of larger bins at the amenity area, with regular emptying;
- Appropriate signage and information boards for the public regarding the impacts of litter on marine species.

6.3.4.2 Risk of ship collisions with cetaceans

Marine mammals, such as whales and dolphins risk being struck by ships causing death or injury. A review of the stranding records for Southern Right Whales in southern African waters by Best et al (quoted in Laist et al., 2001) found that ship collisions accounted for 20% of the recorded deaths. This is likely to be an underestimate, given that the study was restricted to examining stranded whales only. Most studies show that ships longer than 80m and going at speeds greater than 14 knots cause the greatest number of impacts (ibid.). Although the design vessels calling at St Helena will be a little longer than 80m, speeds within the coastal area could be restricted to less than 14 knots in order to minimise the risk of collisions. Any collisions that do occur must be reported immediately to the Port Authorities.

6.3.4.3 Impact of wharf lighting at night on seabird behaviour

Many seabirds — including most of the Procellariiformes (shearwaters, petrels and albatrosses) — are active at night. This allows them to avoid predation, which is particularly important during the breeding season when they must evade diurnal avian predators, such as gulls when returning to and leaving their nesting sites (Montevecchi 2006). Nocturnal seabirds often exploit bioluminescent and vertically migrating prey and may also use the night sky to navigate (Imber 1975, Reed *et al*. 1985). Unfortunately, many nocturnal seabird species are sensitive to the disorientating and often injurious influences of artificial light (Montevecchi 2006) (www.birdlife.org).

Vulnerability to artificial lighting varies between different species and age classes and according to the influence of season, lunar phase and weather conditions. In general, young birds are more likely to become disorientated by man-made light sources. Most collisions occur in poor weather, when the moon is new or during periods of peak migration (Montevecchi 2006). For example, on the Hawaiian island of Kauai, coastal lighting has been responsible for massive fallout events of young Procellariiformes including small numbers of Madeiran Storm-petrels *Oceanodroma castro* – a species present on St Helena (ibid.).

The impacts can be reduced effectively by removing unnecessary illumination, choosing 'green' or 'blue' lights rather than 'white' or 'red' lights, reducing light intensity and eliminating unnecessary skyward and seaward light projection.

6.3.4.4 Risk of introduction of invasive marine species through ballast water

Cruise ships, large tankers and bulk cargo carriers use a huge amount of ballast water – often taken on in coastal waters of one region and discharged in another as the ship takes on cargo and passengers. Ballast water typically contains a variety of biological materials including plants, animals, viruses and bacteria which may become a nuisance or invasive in new environments, causing immense damage to native marine ecosystems. Fortunately, in most cases, vessels calling at St Helena will arrive fully laden and will depart with smaller loads – this means that they would have to take on ballast water, rather than discharge it. Nevertheless, the risk of alien species being introduced into St Helena waters remains. Therefore, ship captains must be advised that discharge of ballast water is prohibited within the shelf area of the island, unless the water undergoes some form of biocide treatment e.g. ultra-violet dosing in accordance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) 2004.

6.3.4.5 Possible increase in habitat for 'rocky shore' benthic species along the seaward side and head of the breakwater

It was reported that the habitat created by the temporary jetty was swiftly colonised by benthic organisms, giving rise to the suggestion that the new breakwater may provide suitable habitat for typical 'rocky shore' species (pers comm. J Brown).

The impacts on biodiversity are summarised in Table 6.18 below.

Table 6.18: Impacts on biodiversity

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Increased risk of ship collisions with cetaceans	Not assessed	National	Occasional	No	Low Minor adverse	Low	Low Minor adverse
Possible increase in habitat for benthic fauna around breakwater	Not assessed	Rupert's Bay	Permanent	-	Probable Minor beneficial	-	Probable Minor beneficial
Impacts on biodiversity due to decreased water circulation in the bay causing an increase in pollution concentrations from sewer and stormwater outfalls	Not assessed	Rupert's Bay	Permanent	Yes	Possible Minor adverse	High	Low Negligible adverse
Risk of introduction of invasive marine species through discharge of ballast water	Not assessed	National	Permanent	No	Low Major adverse	Low	Low Major adverse

Impact of wharf lighting at night on seabirds	Not assessed	Local	Long-term constant	Yes	Possible Minor adverse	Moderate	Low Minor adverse

6.3.5 Noise impacts

As this EIA Addendum is only considering impacts of wharf operations up to the Port Control building, only those noise impacts relating to cargo offloading and transportation to the Port Control building are considered here. Given the distance of the wharf from the nearest residence (approximately 400m) and the prevailing south-easterly wind direction, the impact of noise from offloading operations at the wharf is considered to be intermittent and of low impact. Nevertheless, it will be important to minimise the use of reverse beepers and to maintain all equipment in good condition to ensure that noise levels in the nearby residential areas are acceptable.

Table 6.19: Noise impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Increased noise levels caused by ship offloading/loading activities	Not assessed	Rupert's Valley	Occasional	Yes	Low Minor adverse	Low	Low Minor adverse

6.3.6 Air quality impacts

Ships are a significant source of air pollution, contributing 18-30% of all nitrogen oxide and 9% of sulphur dioxide pollution globally. Most ships burn high sulphur fuel oil which produces these gases, as well as carbon monoxide, carbon dioxide and particulates. The degree of air pollution caused by ships depends on the atmospheric conditions in port (especially wind and atmospheric stability) as well as the number of ships. The infrequent ships calls (approximately one every 3-4 weeks), the fact that there will only be one ship in port at a time, and the prevailing offshore south-easterly winds together indicate that pollution from greenhouse gas emissions will be low to negligible. Furthermore, the recent introduction (January 2013) of Annex IV of MARPOL will help to ensure that ships are equipped with the latest technology to minimise GHG emissions.

Table 6.20: Air quality impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequenc es (after mitigation)
Increased concentrations of GHG emissions from ships in port	Not assessed	Rupert's Bay	Occasional	Yes	Possible Minor adverse	Moderate	Low Negligible adverse

6.3.7 Economic impacts

A report on the Jamestown and Rupert's Bay shipping options undertaken by SHG economist, Owen James (SHG, 2012) highlighted the following quantifiable economic benefits for the island of St Helena:

- The largest benefit from having cargo ships dock directly with the jetty, is the elimination of the need for cargo lighterage, with an estimated saving of almost £33 million over a 30 year period (see Table 6.21);
- Docking also increases the speed at which cargo ships can turn around and reduces the days lost due to bad weather – a saving of over £9 million over 30 years;
- Docking also means St Helena can charter geared (as opposed to gearless) vessels, which itself has a cost saving, estimated at over £8 million for the 30 year period. *(However, a recent preliminary study[12] of shipping currently operating in the Southern African region identified seven vessels that would be capable of using the new facilities in Rupert's Bay; of these, only two were geared, therefore the estimated saving must be treated with caution);*
- There is also provision at the wharf for fuel to be offloaded at night through a well-lit floating hose operation. Allowing fuel to be offloaded at night (currently not permitted), reduces the time required in port for the tanker and thus costs. *(This benefit may not accrue, as it was recommended in the shipping risks report (Appendix F) that all fuel offloading should take place during daylight hours to reduce risks of spillage and accident);*
- Based on the Royal Haskoning report *"St Helena Safe Landing Facility: Feasibility Study Interim Report"* (2006) it is estimated that approximately 4,000 additional tourists (including crew) would visit the island per annum with safer wharf landing. This equates to approximately three additional visits per year, or an increase to five from the two expected in 2013.[13] Local data suggests that each tourist from a cruise liner spends on average £40 per visit[14], in addition to the £12 landing fee. It is possible that if the island's tourism economy develops and more products and services are available to the tourist, that both the average spend and landing fee figures could rise at a rate greater than inflation. It is difficult to speculate if and by how much such a change might be. Given that the economic impact of such is likely to be small, it has not been quantified at this stage. As such, it is estimated that making landing facilities (steps) available at the Rupert's wharf would result in an additional £208,000 spend on St Helena per annum. However, this benefit to the island must be measured net of any opportunity cost of labour/capital[15] and leakage.[16] When you factor in conservative estimates of leakage[17], opportunity costs and indirect tax take, the estimated additional spend on the island by cruise ship day

[12] Rupert's Bay Permanent Wharf - Phase 1, Shipping Review Report, Prestedge Retief Dresner Wijnberg (Pty) Ltd, October 2012

[13] Solomon & Company Shipping

[14] See SHG, "*Sensitive outline description for application: Proposed phase 2 wharf development works*"

[15] Opportunity cost of labour and capital refers to the fact that if growth in gross spends simply covers growth in resource cost (and nothing more) the net welfare benefits are minimal.

[16] Leakage refers to the fact that tourists will spend their money on many things which have to be imported. Tourism spend has a decreased positive impact on the economy the more imports that are incurred to elicit such spend.

[17] Leakage refers to the fact that tourists will spend their money on many things which have to be imported. Tourism spend has a decreased positive impact on the economy the more imports that are incurred to elicit such spend.

visitors equates to £32,240 per year. In order to ensure that these benefits are realised, it is recommended that the SHG conducts a publicity campaign to raise awareness about the improved passenger facilities in order to promote the island as a cruise ship destination.

Table 6.21: Summary of costs and benefits of a wharf in Rupert's Bay

Item	Amount (GBP over 30 years)	Comment
COSTS		
CAPEX	14,905,792	
OPEX	927,733	
Total Costs	**15,833,525**	
BENEFITS		
Increased passenger landing probability (increased spend)	758,343	
Savings on lighterage	32,972,277	
Faster turn-around and reduced number of days lost	9,220,549	
More efficient tanker offloading	662,418	May not be possible if fuel offloading cannot be undertaken at night for safety reasons
Savings from use of geared ships (over gearless ships)	8,034,369	May not be possible if geared ships are not widely available
Total Benefits	**52,709,825**	
Net Present Value	36,876,300	
Internal Rate of Return	12.9%	
Benefit-Cost Ratio	3.33	

The report also identified a range of unquantifiable benefits associated with the construction of a wharf in Rupert's, such as:

- A benefit of realising a substantial saving, quite possibly as much as £10 million, by utilising the mobilised airport contractor (Basil Read) for this project, relative to carrying out the project at some point in the future, when such a capability is not present on the island;
- The splitting of passenger and cargo operations opens up the Jamestown wharf for tourism development, which is likely to increase spending on the island, however, given the uncertainty on the scale of this impact, quantification has not been undertaken;
- There is evidence that moving cargo operations to Rupert's Valley will result in a much more effective employment of the available land and this would result in economic benefit;
- Potential for the single handling of goods (i.e. a container could go straight from ship into a wholesalers / retailers bonded store area), rather than the minimum of double handing at the moment. Again the benefit of this is likely to be small and speculative, so quantification has not been attempted;
- The new wharf and Port Control facility will possibly result in new job opportunities and more efficient processing of incoming cargo;
- The new quay wall will be able to accommodate larger fishing vessels. *(However the economic impact of a larger fishing industry, its sustainable catch and the ability of*

SHG to police its waters to prevent over-fishing and illegal fishing are issues that are beyond the scope of this EIA Addendum);

- The new facility will make St Helena island a much more attractive destination for visiting yachts by providing refuelling facilities, boat ramps and other wharfage services. These improvements would need to be advertised in yachting magazines and websites in order to raise awareness. The economic impact of this benefit has not been quantified.

However, there may be some negative economic impacts as well, such as loss of jobs and businesses associated with lighterage. This impact can be mitigated to certain extent by offering jobs at the new wharf to those currently employed or contracted at the Jamestown operation, and providing them with appropriate stevedoring training.

Table 6.22: Economic impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Direct ship offloading avoiding need for lightering	Not assessed	National	Long-term constant	-	Probable Moderate beneficial	-	Probable Moderate beneficial
Job losses due to termination of lighterage	Not assessed	National	Permanent	No	Probable Moderate adverse	High	Probable Minor adverse
Employment at new port	Not assessed	National	Long-term constant	-	Probable Moderate beneficial	-	Probable Moderate beneficial
Economic activity in Rupert's Valley will increase	Not assessed	Rupert's Valley	Long-term constant	-	Probable Moderate beneficial	-	Probable Moderate beneficial
Economic development of island	Not assessed	National	Long-term constant	-	Probable Moderate beneficial	-	Probable Moderate beneficial
Potential alternative landing place for cruise ship passengers	Not assessed	National/ International	Long-term constant	-	Probable Minor beneficial	Moderate	Probable Moderate beneficial
Larger fishing vessels can be accommodated	Not assessed	National/ International	Long-term constant	-	Probable Moderate beneficial	-	Probable Moderate beneficial
More/safer services for visiting yachts	Not assessed	National/ International	Long-term constant	-	Probable Minor beneficial	-	Probable Minor beneficial

6.3.8 Social issues

In addition to the broader social impacts identified for the whole airport project in the 2008 ES, there are three specific social impacts relating to the new port operations:

- Impact of visiting mariners on community health and social structure;
- Temporary closure of Rupert's beach during ship calls;
- Increased potential for fishing from the breakwater.

There will be an increased risk posed by mariners from visiting ships relating to community health and social issues. The impacts could encompass a range of communicable diseases (such as HIV, other STDs, swine flu-type diseases, etc) and social problems (teenage pregnancy, family rifts, increase in sex workers, substance abuse, etc). Most of these were identified in the 2008 ES, but were rated as minor issues. Given the vulnerability of the island to the introduction of new diseases (particular due to its aging and young population), we have assessed the residual impact as being moderate adverse – assuming that the proposed mitigation measures are put in place to address the potential problems. Some of the mitigation measures include:

- HIV and STD awareness campaigns in schools and communities;
- Availability of free condoms;
- Designated mariner accommodation;
- Port health screening for infectious diseases;
- Customs control on the importation of drugs.

Another social impact will be the temporary closure of Rupert's beach during ship calls. The duration of such closures will depend on the length of time it takes to offload and reload a ship. The Port authorities may also require the beach to be closed while containers are moved from the wharf to the Port Control building i.e. even after a ship has left port. The public will need to be informed in advance of the days when the beach will be closed.

Finally, fishermen may be allowed to access the wharf when ships are not in port to fish from the breakwater. This will help to compensate for lost fishing spots on the southern side of Rupert's Bay.

Table 6.23: Social impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
Increased potential for fishing from new wharf	Not assessed	National	Permanent	-	Possible Minor beneficial	-	Possible Minor beneficial
Temporary closure of Rupert's beach during ship calls	Moderate adverse Temporary Long-term	National	Short-term constant	Yes	Probable Minor adverse	None possible	Probable Minor adverse
Impact of visiting mariners on community health (risk of STDs, teenage pregnancy, communicable diseases etc)	Minor adverse	National	Long-term constant	Yes/No	Probable Major adverse	Moderate	Probable Moderate adverse

6.3.9 Visual impacts

Three visual simulations were created to show the before and after effects of the wharf on views from:

- Bank's Battery footpath;
- Rupert's beach; and
- Munden's Path.

These are shown in Figures 6.14 to 6.16 below.

It is clear that the wharf will have a major impact on the view of Rupert's Bay from these three points and many other, more distant viewpoints. Whether the perception of the changed view is positive or negative will depend on the viewer. Some may view the wharf as a sign of progress and connectivity to the world, with incoming ships a source of interest, while others may think that the dramatic scenery of Rupert's Bay has been adversely changed for the worse. It will be difficult to obtain a clear view of the wharf from any of the properties in Rupert's Valley due to the presence of other buildings, tall trees and vegetation.

Table 6.24: Visual impacts

Impact	Rating in the 2008 ES	Extent	Duration	Revers-ibility	Probability of occurrence and severity of consequences (before mitigation)	Effective-ness of mitigation	Probability of occurrence and severity of consequences (after mitigation)
The scale, design and characteristics of the proposals within the context of the local character area and adjoining seascape.	Minor – Major adverse	National	Permanent	No	Probable Moderate adverse	Low	Probable Moderate adverse
Views from residential properties in Rupert's Valley.	Neutral	Rupert's Valley	Permanent	No	Possible Minor adverse	Low	Possible Minor adverse
Views from various footpaths, including post box walks, fisherman's routes with immediate views of the wharf.	Moderate Adverse	Rupert's Valley	Permanent	No	Probable Major adverse	Low	Probable Major adverse

Before

After

Figure 6.14: Before and after views from Bank's Battery Footpath

Before

After

Figure 6.15: Before and after views from Rupert's picnic area

Before

After

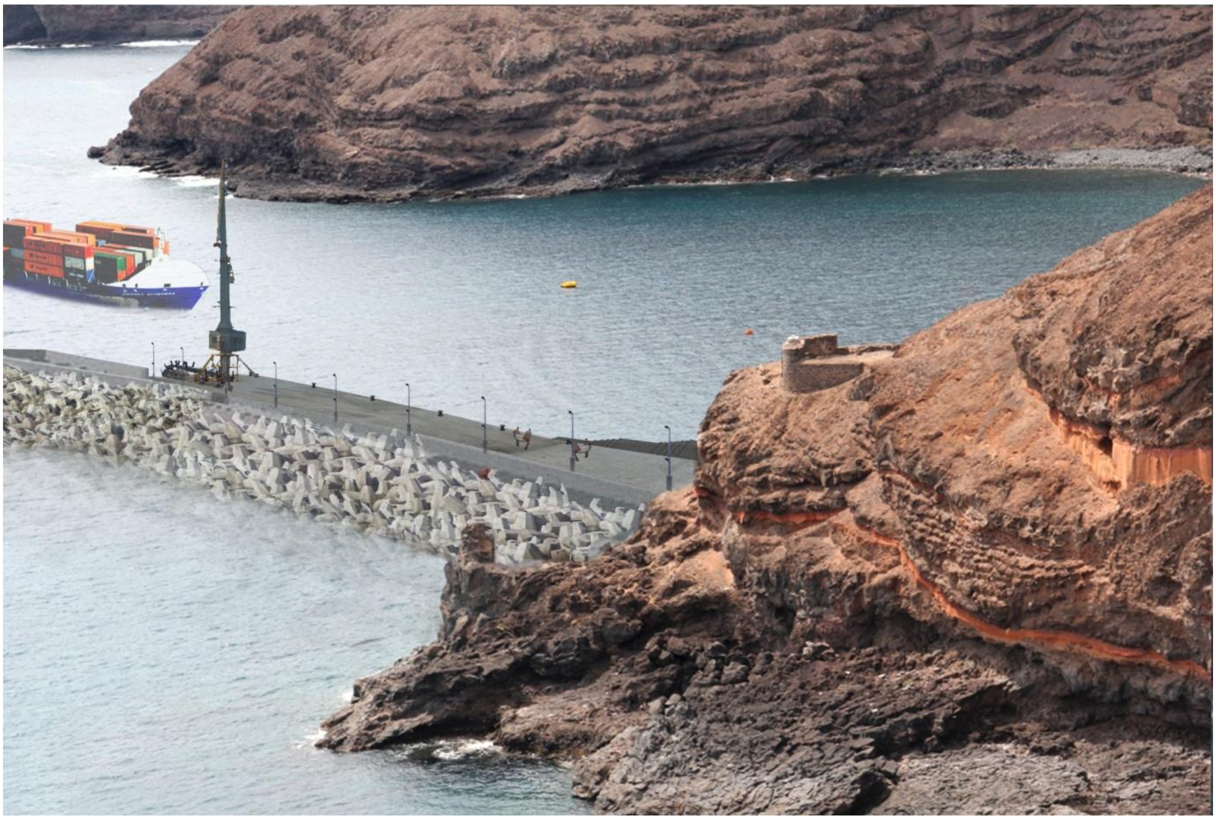


Figure 6.16: Before and after views from Munden's Path

7 CONCLUSIONS

This EIA Addendum has examined and assessed the impacts which could occur as a result of the construction and operation of a new permanent wharf in Rupert's Bay. Compliance with the design criteria specified in Volume 3b – Technical Specifications of the Employer's Requirements, section 16 and section 4.2.5 of the EMP (2011) is shown in Table 7.1. It can be seen that the design and proposed mitigation measures will ensure compliance with most of these criteria, with the exception of the following:

- Water circulation patterns in the bay will be affected, which will result in a moderate increase in the faecal coliform concentrations in the south-western corner of the bay, near the sewage outfall pipe from Argos. However, the change in the current direction caused by the wharf tends to transport the sewage away from the swimming beach, thus resulting in a moderate improvement in the water quality at the swimming beach compared to the status quo.
- Unfortunately the rock in the proposed quarries (and elsewhere on the island) was found to be unsuitable for the outer armouring of the wharf as per the design criteria, thus necessitating the need for Core-Locs.
- Access to the beach and amenity area during construction will be limited for certain periods of time in the interests of public safety. During port operation, it is likely that the beach and possibly the picnic area will be closed when a ship is entering and leaving the port for public safety reasons and it may remain closed while cargo is being transported to the Port Control Area.

Table 7.1: Design criteria and compliance

Design criteria	Comment on compliance
The wharf must sympathetically reflect the coastal landscape.	Depends on one's perspective, but the wharf has been designed to have minimal visual impact.
The structure should avoid impeding the natural flow of water and sediment around the bay	The impact on sediment movement will be minimal, but there will be changes to water circulation. The wharf will cause partial deflection of tidal currents and mean current speeds on the lee and outer sides of the wharf will be reduced slightly. The wharf will cause significant wave sheltering on its lee side (its main purpose), but this sheltering reduces wave-driven currents to such an extent that the existing rip current will be reduced and deflected to flow towards the wharf and then follow the trajectory of the wharf offshore.
Rock armour shall be used in preference to concrete armour units provided that the structural integrity of the marine structures is not compromised.	Unfortunately the rock in the proposed quarries (and elsewhere on the island) was found to be unsuitable for the outer armouring of the wharf as per the design criteria, thus necessitating the need for Core-Locs.
Primary marine structures shall have a design life of 70 years.	The wharf has been designed for at least 70 years,
Capital and maintenance costs must be optimised.	The capital costs for the permanent wharf structure have been optimised by using one type of precast concrete block wall unit for the quay structure. A single layer concrete armour unit system (Core-Loc) has also been selected for the breakwater which is almost 50% more cost effective than a double layer of Dolos concrete units. The use of one type of armour unit and pre-cast block wall unit allows for an efficient storage and a standardised method of transportation and placing of units. In terms of durability and

	maintenance, the block wall quay structure will have one concrete face exposed to chloride ingress and is less susceptible to vessel impact compared to a piled quay structures. The layout and functionality of the wharf have also been optimised to allow maximum use of the structure, by multiple users.
Degree of shelter must be maximised to reduce the amount of annual down time during adverse wave conditions.	See comments above. The wharf will achieve this objective.
Maximise the safety and efficiency of navigation, ship manoeuvring, berthing and unberthing manoeuvres.	Yes. The new location assures much safer and efficient ship berthing and manoeuvring.
Avoid any land uptake.	The wharf itself will not take up any land. The pre-cast and Core-Loc fabrication yard will be on spoil within the ADA.
Avoid adverse impacts on Rupert's beach and amenity area.	Access to the beach and amenity area during construction will be limited for certain periods of time in the interests of public safety. During port operation, it is likely that the beach and possibly the picnic area will be closed when a ship is entering and leaving the port for public safety reasons and it may remain closed while cargo is being transported to the Port Control Area. The sediment movement model showed that erosion/accretion patterns at the beach are unlikely to change significantly. The water circulation model demonstrated that the new circulation pattern in the bay could actually improve water quality conditions, by dispersing sewage effluent away from the beach.
Avoid disturbance of the Boer prisoner of war desalination chimney.	The new location of the wharf avoids the chimney completely.
Minimise direct effects on Rupert's Lines (the fortification wall).	There will be no direct impact on Rupert's Lines. Indeed it is recommended that the rough end of the stone wall should be re-built.
Minimise the effects on water quality.	The most effective way of reducing impacts on water quality in the bay would be to install a soakaway at Argos to prevent the flow of raw sewage into the sea next to the swimming beach, and to improve waste management practices to prevent litter from blowing and flowing into the bay. Oil spill prevention measures will be put in place and it will be necessary to actively police the wharf and ships to ensure that no wastes are dumped within territorial waters.
Minimise adverse impacts on the marine and coastal ecology. Mitigation for the loss of littoral benthic habitats must include the provision of substrates and cavities for marine fauna and flora.	The impact of the new wharf on marine ecology will be minor, due to the limited scale and size of the development, the low frequency of ships calling at the port and the low sensitivity of the biodiversity within the bay. Experience at the temporary jetty has shown that marine life quickly colonises a new marine structure and it is therefore expected that the Core-Locs and rock armour layer will provide suitable substrate and cavities for the colonisation by marine fauna and flora.

REFERENCES

AECOM (2011). Environmental Management Plan for St Helena Airport and Supporting Infrastructure.

Alberta Environmental Protection, (1997). Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, Alberta: Alberta Environmental Protection.

ASCE, (2007). Gravity Sanitary Sewer Design and Construction: ASCE Manuals and Reports on Engineering Practice No. 6: WEF Manual of Practice No. FD-5. 2nd ed. Virginia: ASCE.

Ashmole, P & Ashmole, M J (2000). St Helena and Ascension Island: a natural history. Anthony Nelson, Oswestry. 500 p.

Atkins (2006). Marine Facilities at Rupert's Bay: Final Options Report. Prepared for the St Helena Government and the Department for International Development. Report No 5035914/5597 V3, May 2006.

Basil Read (2013). Sediment Samples from Rupert's Bay.

DfID (2010). Review of the Use Scheduling and Financing of the RMS St Helena, and Wider Shipping Options for the Island 2012-16. November 2010.

Department of Water Affairs and Forestry (1995). South African Water Quality Guidelines for Coastal Marine Waters, Volume 2: Recreational Use. Pretoria, South Africa.

Department of Water Affairs and Forestry (1996). South African Water Quality Guidelines, Volume 2: Recreational Use. Pretoria, South Africa.

EDP (2012). Economic Development Plan. A Tourism Driven Economy: Small Footprint, Huge Step Forward, 2012.

Faber Maunsell/AECOM (2008). Environmental Statement for St Helena Airport and Supporting Infrastructure, including EMP (2011).

Henze, M., (2008). Biological Wastewater Treatment: Principles, Modelling and Design. 1st ed. London: IWA Publishing.

Imber, M. (1975) Behaviour of petrels in relation to the moon and artificial lights. *Notomis* 22: 302–306.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., Podesta, M. (2001). Collisions between ships and whales. Marine Mammal Science, Vol 17(1), PP 35-75, January 2001.

Lienhard, C & Ashmole, N P (1999). *Sphaeropsocopsis myrtleae* sp. n., a blind subterranean psocid from St Helena (Psocoptera: Sphaeropsocidae). Revue suisse de Zoologie 106: 905-912.

Michel, Winslow, (2000). Cargo Ship Bunker Tanks: Designing to Mitigate Oil Spillage. Marine Technology, Vol. 37, no. 4, October 2000

Montevecchi, W. A. (2006) Influences of artificial light on marine birds. Chapter 5 in C. Rich and T. Longcore, eds.*Ecological consequences of artificial night lighting*. Washington, D.C.: Island Press.

PRDW (2012). Shipping Review Report. Rupert's Bay Permanent Wharf, Phase 1. Report No. 1097/00/03, Rev 00, October 2012.

PRDW (2013a). Rupert's Bay Permanent Wharf – Phase 2. Design Basis. Report for Basil Read, Report No: 1097/02/01 REV D. February 2013.

PRDW (2013b). Rupert's Bay Permanent Wharf – Phase 2. Presentation to Basil Read Progress Meeting, 9 April 2013.

PRDW (2013c). Coastal Processes Report (Waves and Sediment). Rupert's Bay Permanent Wharf, Phase 2. In prep..

PRDW (2013d). Shipping Risks Report. Report No.: 1097/03/02 REV 00. May 2013.

PRDW (2013e). Marine Dispersion Modelling. Report No.: 1097/03/01 REV A. May 2013.

Reed, J. R., Sincock, J. L. and Hailman, J. P. (1985) Light attraction in endangered procellariiform birds: reduction by shielding upward radiation. *Auk* 102: 377–383.

Standards South Africa (2008). SANS 10103:2008. The measurement and rating of environmental noise with respect to annoyance and to speech communication. 6th Edition. ISBN 978-0-626-20832-5.

Standards South Africa (2008). SANS 10328: 2008. Methods for environmental noise impact assessments. 3rd edition. ISBN 978-0-626-20831-8.

SHG (2012). Project appraisal: Jamestown and Rupert's Bay Port development Options. December 2012.

Government of St. Helena
THE SECRETARIART
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Applicant Miss Janet Lawrence
Airport Project Director

Address Access Office
Post Office Building
Main Street
Jamestown

Date 15th March 2013

Dear Madam,

Application details/reference
Land Planning and Development Control Ordinance, 2008, s.32. Request for EIA Scoping Opinion

Thank you for your request for an Environmental Impact Assessment (EIA) Scoping Opinion dated 11th February 2013, received 11th February 2013, with regard to the proposed development at Rupert's Bay.

This Opinion has been prepared following the requirements of s.32 of the Land Planning and Development Control Ordinance, 2008 with regard to Scoping. It has also referred to the guidance included within *A Procedural Manual for EIA on St Helena*.

Scoping Opinion

Having considered the information provided by the Applicant, an EIA Scoping has been undertaken. This has determined that there may be a number of significant environmental impacts associated with the development proposed. An EIA is required for this proposed development and the main issues that should be addressed in the EIA are as follows:

Biodiversity:
- To include terrestrial and marine ecology
- The effect on endemic and native flora and fauna
- The effect on species or habitats of local importance including cetaceans

Landscape and visual amenity:

- The effect the development would have on the landscape and the visual amenity to or from views of high quality of nearby landscapes

Cultural Heritage and Archaeology:

- Disturbance or damage to archaeology or heritage features

Water Environment:

- The effect on water supplies during the construction and operational phases
- The effect of discharges directly or indirectly to the ocean during construction and operational phases

Air quality:

- The effect of emissions on local air quality
- The effect of the generation of dust during the construction phase

Noise & Vibration:

- The effect of noise activities during the construction and operation phase
- The effect of vehicular transport during construction and operational phases
- The effect on nearby residents, wild life and their habitats or other sensitive receptors

Traffic & Access:

- The effect of the increase in vehicle numbers, vehicle speeds or types of vehicles (e.g. heavier delivery vehicles) visiting the area during construction and operation phases and on the Rupert's and Field roads

Land Use & Other Assets

- The effect on recreational/community use including the impact on footpaths and access to the surrounding areas
- Changes in land levels
- Management of generated waste

Assessment of Alternatives

This should include an explanation on why this site was chosen over the site in the original planning application.

In order for the assessment to be fully informed, we recommend that the following data search, surveys or other studies be undertaken as a minimum:

- Biodiversity assessment –
  To inform the effect on the marine and terrestrial native flora and fauna

- Landscape and visual assessment –
  To inform the effect on seascape setting of Rupert's and Jamestown, this can be done in the form of photomontages from at least two identified receptors.

- Cultural Heritage and Archaeology Assessment–
  To inform the effect on marine and terrestrial features of heritage importance

- Assessment to determine the effect on the shoreline and coastal waters by water movement as a result of the proposed development

- Cliff Stability Assessment

Note that further surveys and studies may be undertaken at the discretion of the applicant in order to ensure that the EIA is based on the most accurate and up to date information possible.

<u>EIA Report</u>

It is recognized that a substantial environmental impact assessment was done prior to the application for planning permission for the airport project works, approved in 2008. Parts of the EIA for this development may therefore already be covered in the Environmental Statement (ES) and this EIA Report can therefore be treated as an Addendum to the original ES; for consistency and ease of reference, it should as far as possible follow the same format. Where it is evident that issues have already been adequately covered this should be noted with relevant references.

Notwithstanding the above, the EIA Report should include:

- A clear description of the proposed development at all stages of construction and operation;
- A plan showing the boundary of the application and principal components of the scheme to scale;
- An outline of the alternatives considered.
- A description of the current environment (baseline);
- A description of consultations undertaken and how these have affected the proposals;
- A clear and objective assessment of the environmental impacts of the proposed development, grouped by topic (e.g. noise, ecology, cultural heritage, landscape, etc., as required) both before and after mitigation;
- A description of the mitigation measures that will be used to avoid, reduce or offset negative effects;
- Such figures, plans and appendices as are required; and
- A Non Technical Summary (NTS) that sets out the details of the scheme, the main findings of the assessment and the significant impacts remaining after mitigation.

Note that the NTS must include a clear list of the proposed mitigation commitments that may form the basis of subsequent Planning Conditions.

The applicant is encouraged to refer to the following documents (available for download from http://www.sainthelena.gov.sh/pages/environment.html) for advice on how to prepare an EIA Report:

- *Land Planning and Development Control Ordinance, 2008, Schedule 2*
- *Environmental Impact Assessment – Guidelines for Applicants*
- *A Procedural Manual for EIA on St Helena*

It should be noted that the planning application cannot be determined until an adequate EIA Report has been prepared and submitted.

Yours sincerely,

Alfred V Isaac
Planning Officer

APPENDIX B: CONSULTATION PROCESS

Bryony Walmsley – St Helena Wharf EIA
Meeting Programme 14th to 22nd April 2013

Date	Time	Activity/Venue	Attendees	Agenda	Office Comments/Notes
Sunday, 14 April	TBA	Arrive St Helena			
Monday, 15th April	07:00 – 09:00	Site Visit *Venue: Collection point Jamestown*	Deon de Jager, Island Director (BR) Graham Temlett will be part of this visit as well.	Providing an overall introduction to all aspects of the St Helena Airport Project	MS to organise
	10:30 – 12:00	Introductory & EIA scope meeting *Venue: AG Conference Room*	Janet Lawrence, Airport Project Director (SHG) Clare Harris, Deputy Airport Project Director (SHG) Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Alfred Isaac, Planning Officer (SHG) Miles Leask, Acting Resident Engineer (PMU) Robert Kleinjan, Environmental Monitor (PMU) Graham Temlett, General Manager, Off Island (BR) Deon de Jager, Island Director (BR) Annina van Neel, (BR)	Introduction EIA scope Review of Programmes	CH to organise
Tuesday, 16th April	08:00 – 17:00	Wharf location and sites for landside activities site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)		Site visits that BW needs to observe/ inspect MS to organise
		Operation of temporary jetty site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)		Site visits that BW needs to observe/ inspect MS to organise

Date	Time	Activity/Venue	Attendees	Agenda	Office Comments/Notes
		Access road to temporary/permanent jetty site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)	Impacts on heritage features	MS to organise
		Munden's footpath site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)	Visual impact, heritage issues	Site visits that BW needs to observe/ inspect MS to organise
		Footpath to Bank's battery site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)	Visual impact	Site visits that BW needs to observe/ inspect MS to organise
		Recreation area and beach site visit	Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Annina van Neel, (BR)	Usage, visual impact	Site visits that BW needs to observe/ inspect MS to organise
Wednesday, 17th April	09:00 – 10:00	Port Operations *Venue: Access Office*	Barry Williams, Harbour Master (SHG) Peter Henderson, Director General HM Customs and Revenue (SHG) Georgina Young, Senior Environment Health Officer (SHG) Lewis Evans, Immigration Executive (SHG) Gill Key, Bio Security (SHG) Janet Lawrence, Airport Project Director (SHG) Miles Leask, Acting Resident Engineer (PMU)	Wharf operation Port operation, public access and safety, container storage, warehousing facilities, number and type of ships, policing of MARPOL requirements, port facilities for ships and mariners, employment at the wharf Facilities for mariners, disease control, etc	CH to organise
	10:30 – 11:30	Emergency Services	Peter Coll, Director of Police (SHG) Alan Thomas, Deputy Fire Chief (SHG) Wendy Henry, Accute & Community Health Manager (SHG)	Oil spill response, other shipping emergencies e.g. fire on board, ship grounding, etc	CH to organise

Date	Time	Activity/Venue	Attendees	Agenda	Office Comments/Notes
		Venue: Access Office	Barry Williams, Harbour Master (SHG) Janet Lawrence, Airport Project Director (SHG) Miles Leask, Acting Resident Engineer (PMU) Robert Kleinjan, Environmental Monitor (PMU)		
	11:30 - 12:30	Field Road *Venue: Access Office*	Tony Earnshaw, Director Environment & Natural Resources (SHG) Dave Malpas , Roads Manager (SHG) Janet Lawrence, Airport Project Director (SHG) Miles Leask, Acting Resident Engineer (PMU)	Traffic on Field Road, road upgrading	CH to organise
	13:00 – 14:00	Enterprise St Helena *Venue: Access Office*	Julian Morris, Chief Executive for Economic Development (ESH) Stuart Planner, Commercial Property Director (ESH) Janet Lawrence, Airport Project Director (SHG)	Economic opportunities for Rupert's Bay and island Shipping	CH to organise
	14:00 – 15:00	Water *Venue: Access Office*	Martin Squibbs, Head of Water (SC) Barry Williams, Harbour Master (SHG) Janet Lawrence, Airport Project Director (SHG) Miles Leask, Acting Resident Engineer (PMU) Robert Kleinjan, Environmental Monitor (PMU)	Water supply for construction and operation of the wharf, stormwater management and control, sewerage facilities	CH to organise
	15:00 – 16:00	Electricity *Venue: Access Office*	Barry Hubbard, Head of Energy (SC) Barry Williams, Harbour Master (SHG) Janet Lawrence, Airport Project Director (SHG) Miles Leask, Acting Resident Engineer (PMU) Robert Kleinjan, Environmental Monitor (PMU)	Power supply to wharf and lighting	CH to organise
	16:30 – 17:30	Use of Ruperts Bay	Mr Craig Yon , St Helena Dive Club Mr James Herne , The Yacht Club Anthony Thomas, Sub Tropic Scuba Adventures Craig & Keith Yon, Into the BlueRobert Bedwell- Gannett Boat toursJames Herne - Yacht Charters Environmental Directorate Marine Team Isabel Peters, Manager Environmental Assessment &	Use of RB Recreational and commercial diving in and around RB Cliff-nesting birds, flora, shoreline, cliff stability	MS to organise

Date	Time	Activity/Venue	Attendees	Agenda	Office Comments/Notes
		Venue: On site – Ruperts Beach	Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU) Julie George, Community Liaison Officer		
Thursday, 18th April	09:00 – 12:30	Stakeholder Engagement Forum *Venue: JT Community Centre*			CH to organise
	13:30 – 14:30	*St Helena National Trust* *Venue: SHNT Office*	Director St Helena National Trust Museum Director Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU)	Heritage issues	MS to organise Meeting confirmed
	15:00 – 16:00	Darwin Project *Venue: SHNT Office*	Darwin Project Survey team Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU)	Survey results, cetaceans	MS to organise Meeting Confirmed
	18:00 – 20:00	Public meeting St Michaels Church *Venue: TBA St Michaels Church*	Ruperts residents Ruperts businesses (including June Richards, Adrian Duncan, Gregory Cairnwicks, Argos, , St Helena Fisheries Corporation, Jason Thomas, Solomons, Energy Division, Quarantine Station, Incinerator) Gerald Benjamin, Senior Fisheries Officer (SHG) Daryl Harris, Fishermen's Association Julie George, Community Liaison Officer (BR) Annina van Neel, (BR) Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU)	General impacts Commercial fishing	JG to organise
Friday, 19th April	13:30 – 14:30	Noise, Dust and Water Quality Monitoring *Venue: BR Longwood Office?*	Annina van Neel, (BR) Isabel Peters, Manager Environmental Assessment & Advocacy (SHG) Robert Kleinjan, Environmental Monitor (PMU)	Noise and dust monitoring data from Rupert's Bay	MS to organise

Date	Time	Activity/Venue	Attendees	Agenda	Office Comments/Notes
	14:30 – 15:30	Geotech Study *Venue: BR Longwood Office*	Dawid Breed, (BR)	Geotech Study	MS to organise
	PM	Free for any follow up meetings			
Saturday, 20th April		Free for any follow up meetings			
Sunday, 21st April		Free for any follow up meetings			
Monday, 22nd April	TBA	Depart St Helena			

Notes from a Meeting on Port Operations
Held at the Access Office on Wednesday, 17th April 2013

Present

Basil Read	
Deon de Jager	Island Director
Graham Temlett	Off-Island Manager
Bryony Walmsley	Environmental Advisor (BWa)
Annina van Neel	CECO
PMU	
Miles Leask	Ag. Resident Engineer
Paul Welbourn	Health & Safety
SHG	
Dax Richards	Assistant Financial Secretary
Barry Williams	Port Manager/Harbourmaster (BWi)
Peter Henderson	Director General, HM Customs & Revenue (PH)
Gill Key	Bio-Security Officer
Lewis Evans	Immigration Executive
Georgina Young	Senior Environmental Health Officer
Janet Lawrence	Airport Project Director

Meeting Summary

Summary **Action**

1. Introductions.

Programming

2. BWa asked when the anticipated opening date for the jetty was. JL said that we should plan for this to be in late 2015/early 2016 to coincide with airport opening and alternative arrangements for shipping to the island.

Cargo/Shipping Forecasts

3.1 BWa asked about the availability of shipping forecasts. There is some data available in the Shipping Optimisation Study but Enterprise St Helena would have additional information.

3.2 BWa said that one of the studies had projected a 1% increase per annum in line with GDP. Those present felt that this was too low. PH said that there have already been increases in freight volumes prior to airport opening. JL said that there were a number of factors, including how tourism takes off, but it would be better to discuss this with ESH.

3.3 JL advised that the current situation should be taken as a minimum/baseline scenario. PH and BWi advised that there were currently 60-70 containers of cargo per call of the RMS and that breakbulk would also need to be considered. They advised that BWa should plan for a minimum of 15 calls of a cargo vessel carrying a combination of containers and breakbulk plus 2 calls of a fuel tanker per annum.

Facilities for Fishing

4.1 There is scope for expanding the local fishing industry and there are already plans for investing in offshore fishing vessels.

4.2 The fishing industry will require facilities for refuelling and victualing at Ruperts. Yachts would also make use of these facilities. At minimum, this would require access to fuel, water and electricity.
[Post-meeting note: there was general discussion around the fuelling arrangements for fishing vessels. As a return valve on the main fuel pipeline might be difficult, the best option was thought to be refuelling using a tanker truck from the BFI. This also needs to be incorporated into the discussions with the Fuel Management Contractor.] SHG

4.3

There was discussion around the facilities needed to meet MARPOL requirements. JL said that EMD (Environmental Management Division) had confirmed that St Helena is not signed up to MARPOL but is signed up to other treaties that would require consideration of the arrangements for waste.

Operational Arrangements

5.1 There was general discussion around the facilities required to operate the port. For example, consideration needs to be given to facilities for:

- Customs
- Port Management
- Immigration
- Sea rescue
- Warehousing/laydown areas
- Bio-security inspection areas
- Medical assessment room/disinfectant station etc to meet International Health Regulations

5.2 BWi confirmed that the cranes would need to be relocated from Jamestown Wharf to Ruperts.

5.3 Containers would need to be transported from the permanent jetty to warehouses/laydown areas in the general area of BR's existing laydown areas.

5.4

Those present were concerned that the Permanent Jetty project was proceeding without operational aspects being thought through. The Airport Project includes the sea rescue facility and the permanent jetty whilst alongside this, SHG is responsible for projects to provide the associated facilities and to upgrade Field Road. JL said that whilst BWa needed a general understanding of the port operations as all of these areas are interlinked, BWa's focus will be on the EIA of the permanent jetty.

Recreational Facilities

6.1 BWi confirmed that recreational fishing would still be permitted from the permanent jetty. The jetty would operate in the same way that the Jamestown Wharf does so that the public would be permitted access outside of ship/cargo operations.

6.2

Those present pointed out that Ruperts (e.g. the Shears and beach area) is an important location for fishing and recreational activities for the island.

HIV/AIDS Awareness

7. BWa asked if mariners would remain on the ship. There could be an increased incident of HIV/AIDS due to having vessels other than the RMS calling at the island. JL said that this is accepted and we need to consider that the island is no longer AIDS-free, there is an AIDS awareness campaign and the island is already managing this in the context of the NP Glory 4.

Navigational Aids

8. It was confirmed that these would all be solar powered so there would not be additional electricity requirements for these.

Arrangements for Sewage

9.1 There was general discussion around this. BWa said that the BR designers were preparing a circulation model. There was a risk that an area of dead water might be created as a result of the jetty construction. It was noted that the Argos outfall emptied into Ruperts Bay. BWa said that this was not best practice and asked what would happen when the fishing industry expanded.

9.2 The residences in Ruperts all have septic tanks so would not add to this problem.

BFI - Beach Site

10. PH suggested that some of the port facilities could be located in this area once the BFI is removed. However, he pointed out that consideration would need to be given to clean up of asbestos and oils etc during the decommissioning of the existing BFI. The decommissioning is a BR responsibility under the Airport Project. BR

Next Steps

11.1 BWa confirmed that she is on track to have a first draft of the EIA by 3rd May.

11.2 GT said that BR are still on track to submit the preliminary designs for the permanent jetty by 23rd May.

SHG, Access Office	The Project Management Unit, Halcrow	Basil Read

<u>Notes from a Meeting on Emergency Service Requirements</u>
<u>Held at the Access Office on Wednesday, 17th April 2013</u>

<u>Present</u>

Basil Read	
Bryony Walmsley	Environmental Advisor (BWa)
Annina van Neel	CECO
PMU	
Miles Leask	Ag. Resident Engineer
Paul Welbourn	Health & Safety
Robert Kleinjan	Environmental Monitor
SHG	
Peter Coll	Director, Police (PC)
Alan Thomas	Deputy Fire Chief (AT)
Barry Williams	Port Manager/Harbourmaster (BWi)
Wendy Henry	Acute & Community Health Manager
Eileen O'Rourke	?
Janet Lawrence	Airport Project Director

<u>Meeting Summary</u>

Summary		**Action**
1.	Introductions.	
	Sea Rescue Boat Facility	
2.1	ML confirmed that 2 RIBs will be provided under the Airport Project. The sea rescue facility will need to house these boats and the existing sea rescue boat. JL advised that there had been discussion in Access & Transport Committee regarding locating all 3 boats in Ruperts and Committee were in favour of this. This is still to be confirmed formally (JL to put this to Committee in writing) but Committee were content for the Airport Project to plan on this basis.	SHG
2.2	BWa asked what were the specs for how the boat would be launched. There was general discussion around this. BWa indicated that locating the slipway at the Shears might not be an option as the levels of the road leading to the Shears on one side and the permanent jetty on the other side would both be higher than the Shears.	
2.3	AT asked what the draft of the RIBs was. He indicated that the existing rescue boat can be launched in 3m of water. ML said that it would be similar for the RIBs.	
2.4	ML said that there is a requirement for the RIBs to be "on-standby" during each flight but not necessarily launched.	
2.5	There was discussion around options for locating the rescue boat facility and the slipway. JL said she was uncomfortable with the level of detail being discussed and that these should not be considered firm proposals as it	

is the role of BR's designers to present options for consideration. Whilst SHG is happy to assist with local knowledge, nothing discussed conveyed acceptance by SHG.

Oil Spill Response

3.1 PC said that this was part of the overall disaster management planning. In light of the RFA Darkdale incident, the island does have a basic response in place to an oil spill incident. PC will provide an extract from the Disaster Management Plan and JL to check with Clive McGill to see if information can be extracted from the Darkdale report. SHG

3.2 Solomon & Co also have procedures in place for dealing with the fuel tanker. AT advised that Solomons should be able to provide BWa with details of the equipment they carry and their procedures for Ruperts. BR

Vessel Grounding

4. PC said that this would be treated as a major incident. Whilst the local services would provide an initial response, they would also need to seek support from the UK Government.

Fire on Vessel in Port

5. AT said that fire hydrants needed to be built into the jetty design. These would need to be fed from the mains system and would need minimum of 4-5 bar pressure. BR

Fire at Sea

6.1 AT said that the Fire & Rescue Service has portable pumps that use seawater for firefighting purposes at sea. He envisages this continuing so that a fire at sea should not impose additional requirements for the design of the jetty.

6.2 PC outlined a disaster management exercise that had been carried out using a scenario around the RMS in James Bay. This had required a multi-agency response and had demonstrated that the island's local services would be capable of responding to such an incident.

Policing of MARPOL Requirements

7.1 In an earlier discussion, it had been queried whether St Helena was in fact signed up to MARPOL. In any event, the island is signed up to other treaties and has to meet certain environmental requirements. BWa asked who polices these requirements and who would police the MARPOL requirements if these take effect. BWi said that Port Management already undertake these responsibilities.

7.2 BWa asked about ballast waters. BWi confirmed that some discharge of ballast waters is permitted at St Helena but the environmental impacts and threat to bio-security should be minimal as generally the ballast is taken on when in St Helenian waters.

Fisheries Vessels

8. BWi said that there were plans for investment into fishing vessels that could fish the offshore seamounts. There was also talk of having a fisheries protection vessel. In future, the jetty would therefore have to cater to vessels larger than the normal inshore craft on a regular basis.

Rockfall Protection

9.1 BWa said that there is a risk to people operating on the apron area of the jetty. BR are recommending rockfall protection measures such as netting as part of the design. The extent of these measures will depend on where facilities are located on the jetty.

9.2 JL asked if this was just based on the advice received from Stacey English in early 2012 or whether BR had carried out further work on this. BWa said that this had been looked at further but was more informal advice at this stage rather than a formal geo-technical assessment.

SHG, Access Office	The Project Management Unit, Halcrow	Basil Read

Notes from a Meeting on Field Road
Held at the Access Office on Wednesday, 17th April 2013

Present

Basil Read

Bryony Walmsley	Environmental Advisor
Annina van Neel	CECO
PMU	
Miles Leask	Ag. Resident Engineer
SHG	
Tony Earnshaw	Director, Environment & Natural Resources
Dave Malpas	Ag. Transport Infrastructure Manager
Janet Lawrence	Airport Project Director

Meeting Summary

Summary		Action
1.	Introductions.	
	Construction Phase	
2.1	There was general discussion around volumes of traffic envisaged during the construction phase.	
2.2	BR plans to use spoil material from the haul road (currently deposited above the permanent BFI site) for fill at the jetty. However, this is not likely to be sufficient so BR are currently considering opening another quarry in Ruperts or getting material from Prosperous Bay Plain. Other suggestions were Bloody Bridge which had been investigated as part of the Wharf Improvements Project. There might also be the possibility that local quarry operators (Stephen MacDaniel or Nigel George) would be able to transport material via Breakneck.	
2.3	In any event, BR will need to manage the possible environmental impacts of increased traffic during construction e.g. noise, dust etc.	BR
	Operations Phase	
3.1	BW asked if there were traffic forecasts available. DM said that there were no projections but he should be able to provide some baseline data of traffic counts on Field Road and Side Path. He would aim to get this to BW in early May.	SHG
3.2	JL asked if data was available for Jamestown. For example, if this could be disaggregated to show a ship day versus a non-ship day in Jamestown, this could be used as a proxy for the potential increase in traffic in Ruperts during operations phase. DM said he would investigate.	SHG
3.3	BW asked if full containers would be carried out of Ruperts. JL said that the general idea was for the wholesale aspects currently carried out in Jamestown to move to Ruperts. Containers would be taken to the warehouse	

areas and destuffed.
DM said that only in exceptional circumstances would full containers be carried on the public highway as the current vehicle restrictions would still apply in future. There is currently a 14 tonne weight limit in place. There are also restrictions in terms of vehicle dimensions.
[Post-meeting note: the dimensions of a vehicle for use on the public
3.4 *highway should not exceed a width of 8 feet 6 inches or a length of 25 feet.]*

BW asked where these restrictions would apply in Ruperts. DM confirmed that these were applicable only to the sections of public highway; the port
3.5 area would be treated separately due to the obvious need to have large plant operating in this area.

There was general discussion around the need for large vehicles to travel
3.6 outside of the main port area in Ruperts up to the laydown areas. It will be necessary to widen the bridge across the Run to accommodate this.

BW raised the issue of the Run needing a sediment trap/trash screen etc. ML said that if this was thought necessary as part of the design, it should be included for consideration. DM said that the Roads Division is responsible for the structural maintenance of the Run.

There was general discussion around the need for public access to Ruperts and requirements for parking. It was agreed that this was not an issue solely for the Permanent Jetty project but one that needed to be considered in an overall plan for developing Ruperts.

Field Road Project

4.1 There was general discussion around plans for upgrading Field Road. This will be a large-scale project and there has been discussion previously about including this in the programme of infrastructure projects that could be single-sourced to Basil Read.

4.2

It will be necessary to ensure continued access to Ruperts whilst the Field Road project is underway. Access could be by sea but it might also be possible to time the works to coincide with the completion of the access road
4.3 under the Airport Project.

It is essential that the Field Road project is carefully timed alongside the other works taking place in Ruperts. The road improvements are needed so as not to constrain the operation of the jetty in Ruperts. SHG

Notes from a Meeting on Ruperts MasterPlan
Held at the Access Office on Wednesday, 17th April 2013

Present

Basil Read

Bryony Walmsley	Environmental Advisor
Annina van Neel	CECO
PMU	
Miles Leask	Ag. Resident Engineer (for item 3 only)
ESH	
Stuart Planner	Commercial Property Director
SHG	
Janet Lawrence	Airport Project Director

Meeting Summary

Summary **Action**

1. Introductions.

Ruperts MasterPlan

2.1 SP said that previously Ruperts had been written off as an industrial area but there was potential for so much more to happen there. Ruperts is one of only two places on St Helena where it is easy to access the sea. This makes it ideal not just for the port but for leisure and tourism activities.

2.2 SP said that Enterprise St Helena (ESH) was particularly keen to see the cargo facilities move from Jamestown to Ruperts as this would free up Jamestown for tourism development.

2.3 ESH has contracted PLC Architects, who have a specialism in ports, to design a MasterPlan for Ruperts. SP presented the first draft of the MasterPlan and provided BW with an electronic copy. The MasterPlan will retain the historic features (Ruperts line, the Chimney at the beach area, etc) whilst making provision for the port alongside tourism development, including a hotel, floating breakwater and marina development. The residential area will be unaffected. There is also provision for industrial use in the mid-valley area.

2.4

There was general discussion around this. BW said that the scale of the development planned requires an SEA (Strategic Environmental Assessment) to assess the cumulative impacts. JL said that this is something that could be looked into when there are firm plans in place; the MasterPlan is in its initial stages only. The focus right now needs to be on assessing the projects that have been given approval in Ruperts.

2.5

BW asked if the Ruperts MasterPlan would go ahead if Ruperts Jetty was not in place. SP said that the jetty is seen as the catalyst for much of the development proposed in the MasterPlan.

Proposed Marina Development

3.1 SP said that the MasterPlan includes provision for a marina in the medium-long term. There are 2 investors potentially interested in this.

3.2 The MasterPlan shows the slipway and rescue facility located near the Shears. BW said that earlier discussions had pointed out that this location was not technically feasible. It was suggested that the rescue boat facility could be located at the opposite side of the Bay, in what is currently the BFI beach site area. SP said that this could facilitate the marina development in future. ML said that this site is currently within the ADA. He expected that there would be more wave action here but there was no reason why BR should not consider this option. BR

3.3

ML said that he had concerns regarding the location of the floating breakwater shown in the MasterPlan: this would impact on the turning circle of vessels coming alongside the jetty. SP said he would look into this. ESH

Field Road

4. SP said that the Ruperts MasterPlan would also depend on Field Road being upgraded. There would be opportunities to link in with the airport access road and this would provide better access to Jamestown from the Longwood side of the island. Ruperts would then be an ideal location to have a park and ride scheme based there.

Facilities outside Ruperts

5. SP said that the MasterPlan did not make provision to create cold storage in Ruperts. The Longwood MasterPlan is considering locating this at Bottom Woods as this would serve the airport (either in terms of items imported via airfreight – possibly fruit and veg – or fish exports).

Data Requirements

6.1 BW asked if the economic impact of the jetty in Ruperts had been considered. JL said that a CBA had been prepared in January and she would provide a copy. SHG

6.2 ESH

SP said that he would provide cargo data available within ESH.

Enterprise St Helena	SHG, Access Office	The Project Management Unit, Halcrow	Basil Read

Notes from a Meeting on Water Requirements
Held at the Access Office on Wednesday, 17th April 2013

Present

Basil Read

Bryony Walmsley	Environmental Advisor (BWa)
Annina van Neel	CECO
PMU	
Miles Leask	Ag. Resident Engineer (ML)
Robert Kleinjan	Environmental Monitor
Connect St Helena	
Martin Squibbs	Operations Director (MS)
SHG	
Dax Richards	Assistant Financial Secretary (DR)
Barry Williams	Port Manager/Harbourmaster (BWi)
Janet Lawrence	Airport Project Director

Meeting Summary

Summary		Action
1.	Introductions.	
	Sewage Outfalls	
2.1	MS confirmed that the sewage outfall in Ruperts is not part of a public system; it is private and therefore not the responsibility of Connect St Helena.	
2.2	MS said that he was aware that there were two septic tanks at the Argos facility, one for the fish processing facility and one for the toilets. These empty into the same outfall. BWa said that she was aware of the existence of this outfall and would follow up with Argos regarding volumes etc. *[Post-meeting note: BWa confirmed that she had spoken to Melvin O'Bey, Argos General Manager, in the margins of the stakeholder meeting regarding this issue.]*	BR
2.3	MS said that all private residences in Ruperts have septic tanks. However, some soakaway effluent occasionally ends up in the run. MS also confirmed that the toilets near the beach area have a septic tank.	
	The Run in Ruperts	
3.1	BWa asked if there was data available on the flows of water through the run. BWi and DR said that there are times when the Run floods. This depends on rain events but they would estimate once each year. ML said that Worley Parsons had advised that they have done an in-depth assessment of the flows for the diversion of the Run at the BFI in upper Ruperts, although this has not been submitted to the PMU yet. This assessment should provide the information BWa is looking for.	BR
3.2	BWa asked about a trash screen for the Run. MS confirmed that Connect St Helena have no plans to install trash screens in the Run. BWa asked who	

would be responsible for this. ML said that if BR felt that this would be required to meet the specifications for either the permanent jetty or the access road in Ruperts, this should be built into their design. BR

3.3 BWa asked who would be responsible for maintaining the trash screen if it was installed. MS said that this was not a Connect St Helena responsibility and he believed that it would fall under the Roads Division. *[Post-meeting note: Ag. Transport Infrastructure Manager confirmed that the Roads Division has responsibility for the structural maintenance of the Run. However, they do not have responsibility for general cleaning/litter-picking in the Run.]*

Water Requirements for the Permanent Jetty

4.1 Requirements would likely be similar to the Wharf in Jamestown as well as a requirement for fire hydrants as flagged by the Deputy Fire Chief in a previous meeting.

4.2 MS said that he would be able to get 4-5 bar pressure to the hydrants but not sufficient volume. He indicated that the water supply to Ruperts was problematic. There is a $10m^3$ tank supplying Ruperts and this is depleted whenever Argos process fish. Therefore, there are difficulties in meeting current demand without planning for future development. Upgrading the supply to Ruperts is not currently included in any of the Water Infrastructure Projects and this will need to be considered further. SHG/CSH

OTEC Proposal

5. MS said that he is aware that Connect St Helena is considering a project to introduce Ocean Thermal Energy Conversion Technology. Potable water can be one of the by-products of this process and this could help alleviate the water demand situation in Ruperts. He recommended that we seek an update from Barry Hubbard, CEO of Connect St Helena, on this.

Sewerage Facilities

6.1 BWa asked what the plans were for the permanent jetty and Ruperts generally, especially in light of plans for development. MS said that this would need to be looked at further. There was general discussion around this issue and those present felt that the sewerage should not be disposed off via outfall into the Bay, particularly if there is a risk that the jetty construction could create an area of dead water. BWi suggested using the current arrangements in Jamestown where there is a septic tank that is emptied regularly.

6.2 JL said that in masterplanning for Ruperts, we also needed to be aware of the development constraint around sewerage. *[Post-meeting note: The Land Development Control Plan states "Development permission will be granted for a sewage treatment system for Ruperts Valley. Development permission will not be granted for development which, individually or cumulatively, will add 10 cubic metres or more per day to the volume of sewage discharged through the Ruperts Valley sewer until there is effective treatment." (LDCP, 2012-2022, pg. 23)]* SHG

Connect St Helena	SHG, Access Office	The Project Management Unit, Halcrow	Basil Read

Notes from a Meeting on Electricity Requirements
Held at the Access Office on Wednesday, 17th April 2013

Present

Basil Read
Bryony Walmsley — Environmental Advisor (BWa)
Annina van Neel — CECO
PMU
Miles Leask — Ag. Resident Engineer (ML)
Robert Kleinjan — Environmental Monitor
Connect St Helena
Barry Hubbard — Chief Executive Officer (BH)
SHG
Dax Richards — Assistant Financial Secretary
Barry Williams — Port Manager/Harbourmaster (BWi)
Janet Lawrence — Airport Project Director

Meeting Summary

Summary **Action**

1. Introductions.

Likely Requirements

2.1 There was general discussion around likely future requirements. It is anticipated that Ruperts jetty will have similar requirements to the wharf in Jamestown. This would include, for example:
- power points for reefers on the jetty, before these are transported to the laydown areas.
- lighting along the wharf.
- power points near boat repair areas, etc.

2.2 A mains power supply will not be needed for NavAids – these will be solar powered.

2.3 BWa asked if there was data available on the electricity requirements for Jamestown Wharf. BWi said that this could be extracted if necessary, the biggest energy user is the reefer containers. He did not see Ruperts jetty having much additional demand as starting off the operation would be very similar to that in Jamestown.

2.4 BH confirmed that there is significant spare capacity on Feeder 4 in Ruperts to be able to cater for the jetty requirements.

2.5 There is an existing 11kV supply to the Argos building. BH said that the easiest option would be to extend this to the jetty area. ML said that this would need to be underground as overhead lines would not be appropriate in the jetty area.

OTEC Proposal

3.1 BH said that Connect St Helena is considering a project to introduce Oceanic Thermal Energy Conversion (OTEC). A study has been conducted and found that the best locations for this are Jamestown (ruled out due to the tourism focus in Jamestown), followed by Sandy Bay (ruled out due to the lack of infrastructure) and Ruperts (the preferred option). BH said that potable water can be a by-product from the OTEC process; he agreed with comments made in the previous meeting by Martin Squibbs that this would be an advantage in Ruperts.

3.2

The OTEC proposal will involve having pipelines (2m diameter) along the seabed and will need a facility as near as possible to the shoreline. BH said that he had made representation to the Planning Section in respect of the area of land that will become available once the BFI beach facility is

3.3 removed. SHG

BWa flagged that this was another competing use for this land, for example, it is being considered for the rescue boat facility. JL said that there were lots of ideas for Ruperts that would need to be considered as part of an overall masterplan.

Boundary of the Jetty - Concreting Works

4.1 BWa asked where the boundary of the jetty would be in order to help define the scope of her study. ML indicated a point near the bridge which would then link into the access road through Ruperts.

4.2 This raised a related point. BWi queried the extent of the concreting works for the jetty as the port activities would involve the movement of large vehicles which might rip up an ordinary road surface. The concreting works would extend only to the boundary of the jetty (as indicated). It is likely that the largest vehicle that will need to travel outside the main port area will be the reachstacker moving between the jetty and the laydown areas. The access road will have an asphalt surface which will accommodate general travelling of the reachstacker but probably not turning. In light of this, PMU/SHG will need to consider whether any changes are needed to the design of this short section of the access road. PMU/ SHG

Attendees of Stakeholders meeting Rupert's Church 18th April 2013

Stakeholders
Mr Deon De Jager – Island Director, Basil Read
Mr Graham Temlett – Basil Read
Mr Terrence Richards – St Helena Fisheries Corporation
Mrs Georgina Young – Health & Social Welfare (Responsible - Incinerator facility at Rupert's Valley)
Mr Jason Thomas – Solomon & Co, BFI
Mr Melvin O'Bey – Argos Atlantic Cold Stores
Ms Anita Magellan – Queen Mary Stores
Mrs June Richards – Junes Takeaway Shop
Mr Keith Yon – Into the Blue (diving, tours)
Mr Robert Bedwell – (Gannett tours, ferry service operator)
Mr Robert Kleinjan – Environmental PMU
Miss Aninna Van Neel – Environmental Officer, Basil Read
Mr Dave Malpas – Roads Engineer, SHG
Miss Janet Lawrence – Director STH Airport project
Mr Gerald Benjamin – Senior Fisheries Officer, AN&RD
Miss Julie George – CLO Basil Read

Residents
Mr Nigel Thomas & Candice Thomas
Mr Pat Williams
Mrs Carol Yon
Lucas Benjamin
Mr & Mrs Thomas Benjamin
Mr Colin Benjamin
Mrs Deborah Fowler
Mrs Valerie Henry
Deon Maggot & Danielle Stevens
Glyniss Maggott
Mr Thomas

MINUTES OF STAKEHOLDERS MEETING AT RUPERT'S CHURCH, 18/04/13

The following issues were raised by residents and businesses at Thursday's Stakeholder Meeting in St Michael's Church, Rupert's Valley.

1. Some reservations about the findings with regards to the direction of heavy swells through Rupert's Bay. Local experience is that these tend to come in from the north rather than the northwesterly direction identified from the modeling and wave data.
2. Will fuel ship operations be affected during the construction of the wharf? If so, are there alternative arrangements?
3. Dust is a problem at Argos (fish processing plant) at present. There is a concern that this will increase during construction of the permanent wharf. What will be done to mitigate the impacts of dust?
4. Argos is concerned about access to their premises as the bridge behind Rupert's Lines is the only crossing of the Run. Suggestion for a separate crossing.
5. Loading and unloading of fishing boats: will there be interruptions to the Shears operations during construction? If so, will compensation be paid for increased operational costs?
6. Will the load-bearing capacity of the bridge behind Rupert's Lines be sufficient for construction traffic, particularly as there will be increased use of the bridge?
7. Will there be a facility for landing people on the permanent wharf? This will be particularly useful if sea conditions are deemed too rough for landing at Jamestown front steps.

Rupert's Bay – Permanent Wharf: A Preliminary Cliff Stability Assessment

A visual cliff stability assessment was undertaken and certain risks identified relative to the macro and micro stability of the cliff face on the landside, directly behind the proposed permanent wharf.

(Not being experts in this field, our observations may be subjective – the more we looked at the face and land head above, the more dangerous it became!)

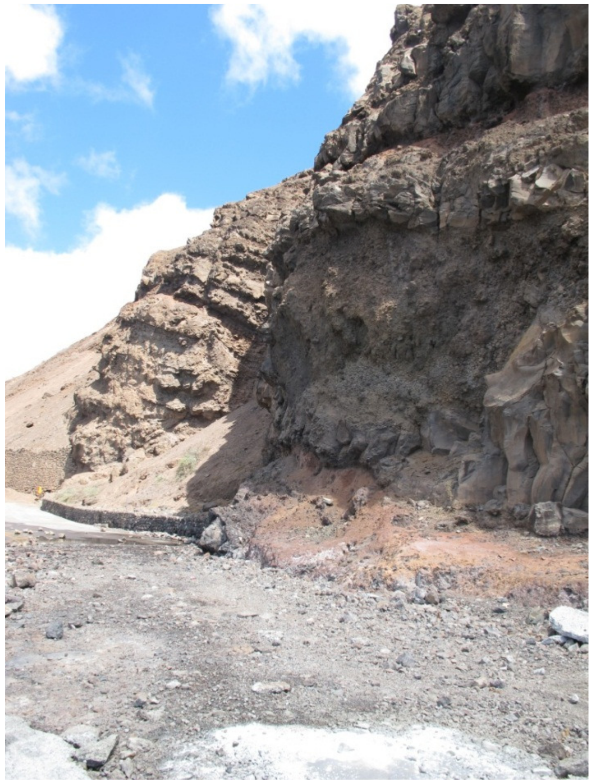
1.0 - Geology and landform.

Headland above showing layered rock formation with cemented ash layers in-between

The layered volcanic rock formation is highly fractured and may be, as elsewhere on the island, layers of *trachyandesite*. These layered, rocky outcrops have a general downward slope and are weathered to various colours of brown.

Relative hard ash layers (fine to coarse grained) divide these andesite faces and some of them appear to be cemented together into a stiff stable matrix – especially lower down.

The area above the masonry wall has the appearance of loose to stiff *talus*, which shows some signs of superficial erosion.



Closer look at the cemented ash/tuff layers

As may be seen from the photos, the lower portions have a typical cliff-like appearance which gradually flattens out to a steep slope approx. 30-35 metres above the shoreline. The old historic Munden's Road generally forms the boundary between these two slopes. Large portions of the old masonry structures along Munden's are in a sad state of disrepair.

2.0 – Stability issues

The overall, macro stability of the landform appears stable and probably more so in this dry environment. This also applies to the stiff ash/tuff layers separating the layers of extrusive andesite.

Micro stability issues pose the more demanding preventative measures. Loose boulders, cracked rock surfaces and the crumbling retaining walls of Munden's Road require expert input and probably expert advice on protection measures.

Risk Assessment:

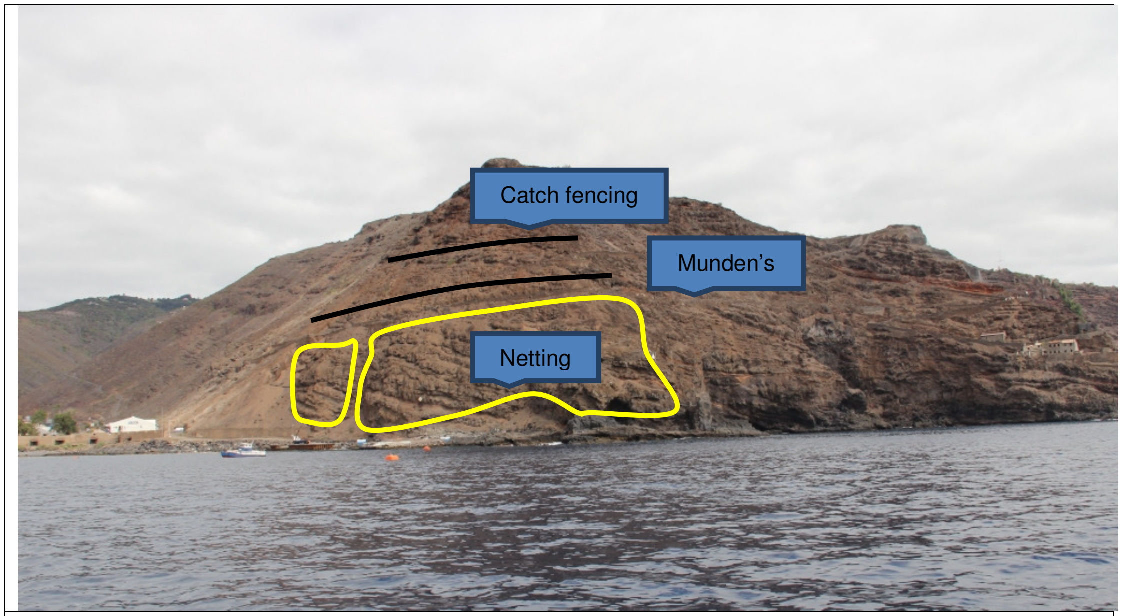
Macro stability					
Probability of occurrence	***Low***	***Medium***	***Med - High***	***High***	***Very High***
(1) Mass slope failure	✓				
Result of possible occurrence					
Damage potential					✓
Life threatening/Injuries				✓	
(2) Large groups of large rocks		✓			
Result of possible occurrence					
Damage potential				✓	
Life threatening/Injuries				✓	
Micro stability					
Probability of Occurrence	***Low***	***Medium***	***Med - High***	***High***	***Very High***
(1) Single small to large rocks			✓		
Result of possible occurrence					
Damage potential				✓	
Life threatening/Injuries				✓	
(2) Smaller rocks & pebbles					✓
Result of possible occurrence					
Damage potential		✓			
Life threatening/Injuries			✓		

3.0 – Mitigation measures

We discussed this on site and came up with possible mitigation measures.

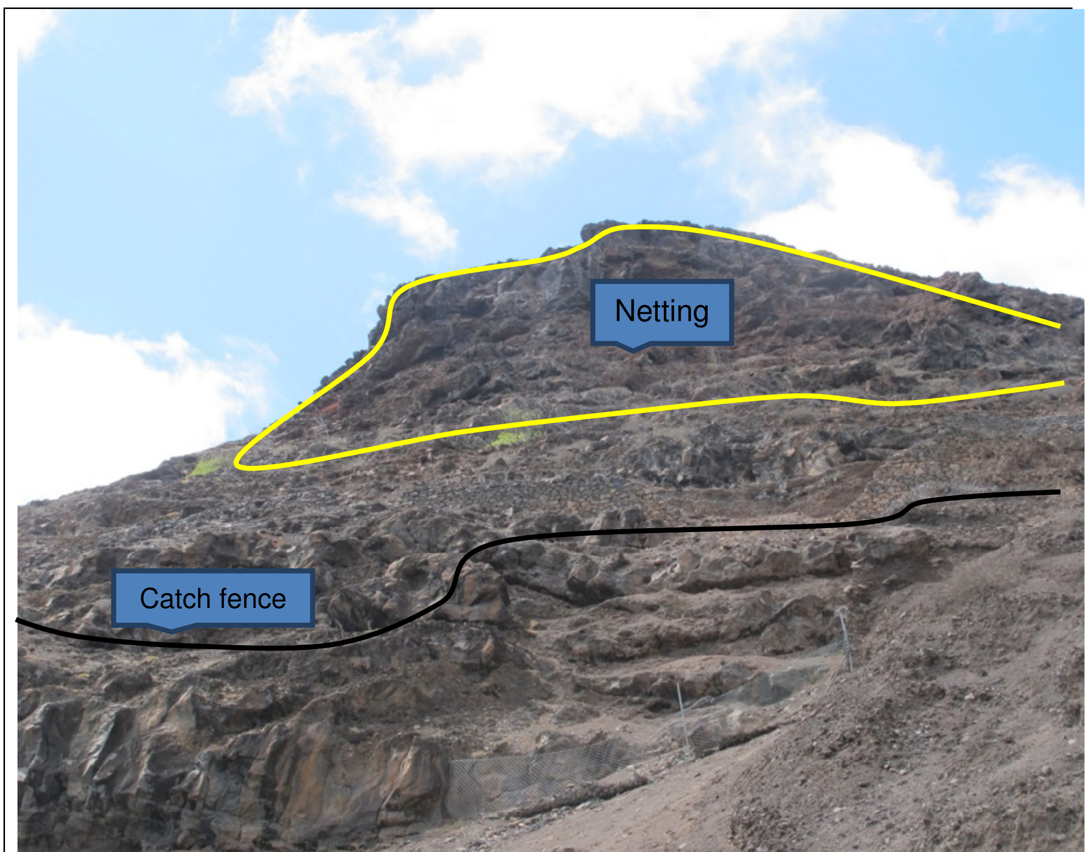
Note: All measures assume that the hill and cliff faces are made safer by first loosening and removing potential dangerous rocks, boulders etc.

(1) Cover lower slope with netting and provide catch fences above



Catch fencing above Munden's Road and netting below

(2) **Cover hill and lower slope with netting or provide catch fences**



Netting above Munden's Road and Catch Fence below

A proper assessment by specialists could decide which of the first two alternatives would be the most appropriate solution.

(3) **Selective use of 'Gunnite' on certain faces on all other areas over and above netting and catch fences –** *apply colouring to such surfaces to blend in*

'Gunnite' to certain selected areas prone to weathering etc.

The harder rocky outcrops are left and the softer ash/tuff layers are covered with 'Gunnite'

D Breed

01/03/2013

BASIL READ

ST HELENA ISLAND

RUPERT'S BAY PERMANENT WHARF - PHASE 2

MARINE DISPERSION MODELLING EIA STUDY

REPORT NO. : 1097/03/01 REV B

MAY 2013

PRESTEDGE RETIEF DRESNER WIJNBERG (PTY) LTD
CONSULTING PORT AND COASTAL ENGINEERS

Rupert's Bay Permanent Wharf – Phase 2: Marine Dispersion Modelling EIA Study Report No. 1097/03/01 Rev B					
Revision	**Date**	**Author**	**Checked**	**Status**	**Approved**
A	22 May 2013	PMH	SAL	Draft	
B	29 May 2013	PMH	SAL	For Issue	

Keywords: St Helena Island, Rupert's Bay, Permanent Wharf, Dispersion modelling, Faecal coliforms

BASIL READ

ST HELENA ISLAND

RUPERT'S BAY PERMANENT WHARF - PHASE 2

MARINE DISPERSION MODELLING EIA STUDY

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1. INTRODUCTION

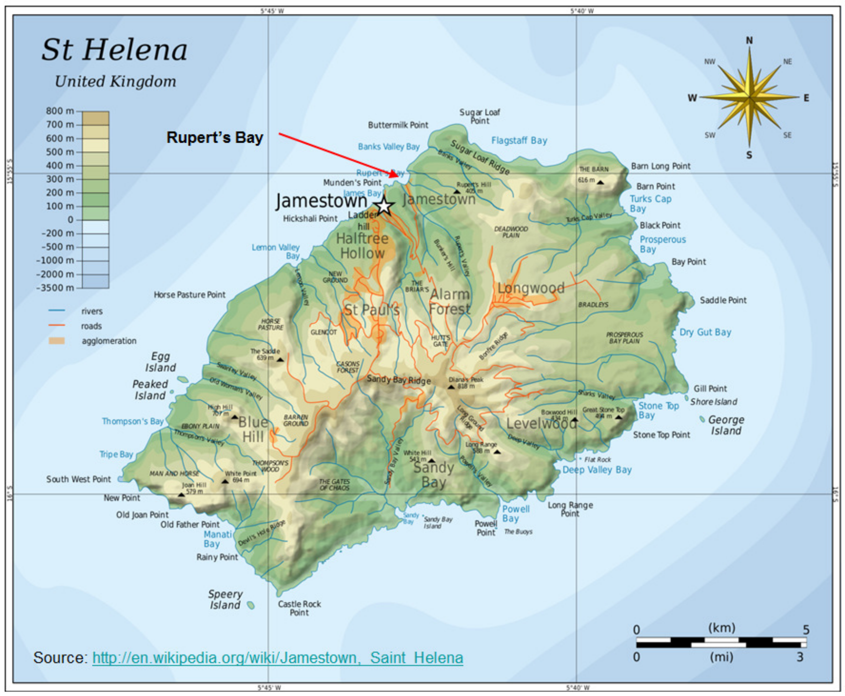
1.1 Background

The construction of a new airport on the island of St. Helena will require the existing port facilities on the island to be upgraded. These upgrades will include the provision of permanent wharf facilities for handling bulk cargo, petroleum products, general cargoes and, in the medium to long-term, containers. The site selected for this facility is Rupert's Bay on the North West coast of the island. The location of the site is shown in Figure 1-1.

Figure 1-1: St. Helena and Rupert's Bay locality map

Saint Helena Island

Geographic coordinates: 15° 56' S 5° 42' W



This study provides an analysis of the impact of the construction of the wharf on the water circulation and marine water quality in Rupert's Bay. Sewage from a septic tank at the Argos fish factory is reportedly discharged through a concrete pipe into the inter-tidal zone in Rupert's Bay close to the swimming beach (B Walmsley 2013, pers. comm., 2 May). The water quality study thus focuses on the dispersion of this sewage, both for status quo and including the proposed wharf development. This study is one of the specialist studies informing the Environmental Impact Assessment for the wharf development, which is being undertaken by the Southern African Institute for Environmental Assessment.

1.2 Scope of Work

The scope of work covered in this document includes the analysis of the following:

- The impact of the proposed wharf on the water circulation in Rupert's Bay
- The impact of the proposed wharf on the dispersion of faecal coliforms (an indicator species for sewage) discharged into Rupert's Bay

1.3 Report Structure

This report is composed of six sections, including the current section. Section 2 introduces the data that was used during the current investigation. Section 3 presents the modelling approach followed in this study, while the large-scale two-dimensional (2D) hydrodynamic modelling is discussed in Section 4. The nested three-dimensional (3D) hydrodynamic modelling with coupled wave and water quality models is discussed in Section 5. Section 6 presents the conclusions emanating from this study.

1.4 Conventions and Terminology

The following conventions and terminology are used in this report:

- Wave direction is the direction from which the wave is coming, measured clockwise from true north.
- Wind direction is the direction from which the wind is coming, measured clockwise from true north.
- Current direction is the direction towards which the current is flowing, measured clockwise from true north.
- H_{m0} is the significant wave height, determined from the zeroth moment of the wave energy spectrum. It is approximately equal to the average of the highest one-third of the waves in a given sea state.
- T_p is the peak wave period, defined as the wave period with maximum wave energy density in the wave energy spectrum.
- Mean wave direction (Dir) is defined as the mean direction calculated from the full two-dimensional wave spectrum by weighting the energy at each frequency.
- Seabed and water levels are measured relative to Chart Datum. Chart Datum (CD) is 0.50 m below Mean Sea Level.
- All figures are orientated such that north is at the top of the figure.

2. DATA

2.1 Nearshore Currents

Detailed current measurements were taken by an Aquadopp (AQD) Acoustic Doppler Current Profiler (ADCP) in a depth of 11 m in August and September 2012. Measurements were taken at 10-minute intervals throughout the water column, thereby providing detail on the depth profile of currents in Rupert's Bay. The measured current profiles indicated little variation with depth. The maximum depth-averaged current speed for this period was 0.22 m/s. These data were used to calibrate the hydrodynamic model (see Section 4.3).

2.2 Wind Data

Local wind measurements were available at WMO Station Nr 61901, located on St. Helena Island at an elevation of +436 m. The position of the station in relation to Rupert's Bay is shown in Figure 2-1. Taking into account missing data, the total record length is 46.3 years. The maximum wind speed measurement is 21.9 m/s with a mean of 6.5 m/s. The wind in St. Helena blows almost constantly from the south east. Figure 2-2 provides a rose plot, non-exceedance graph and a time-series plot of the data-set.

Figure 2-1: Locations of nearshore and offshore wind data

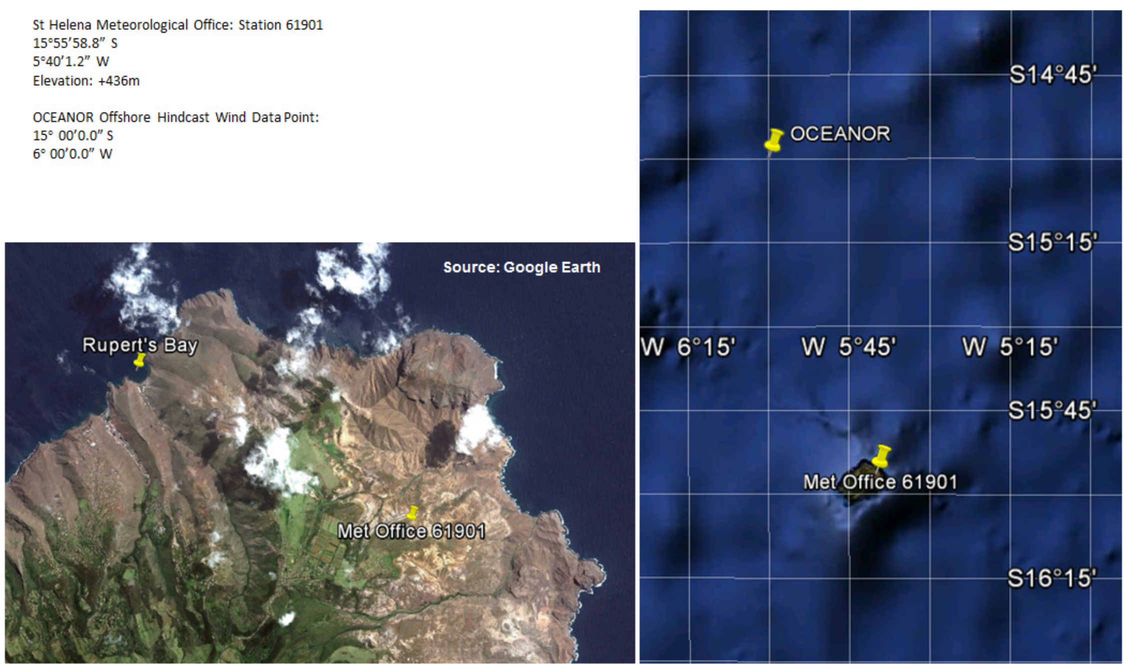
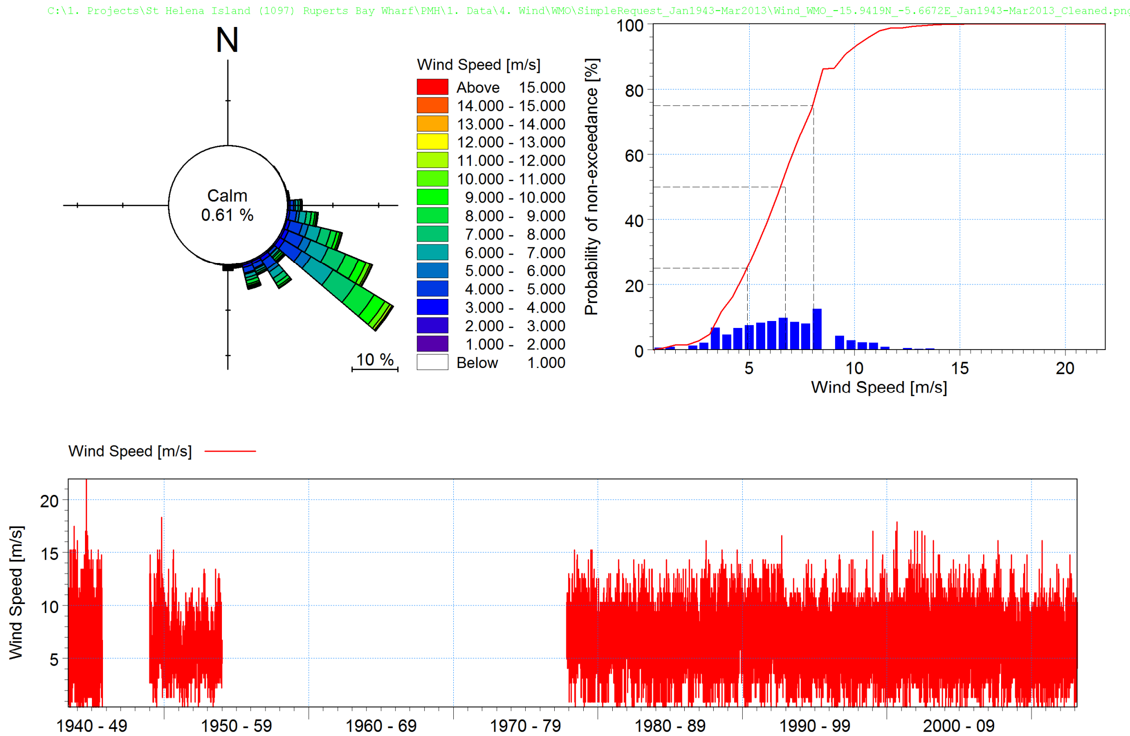


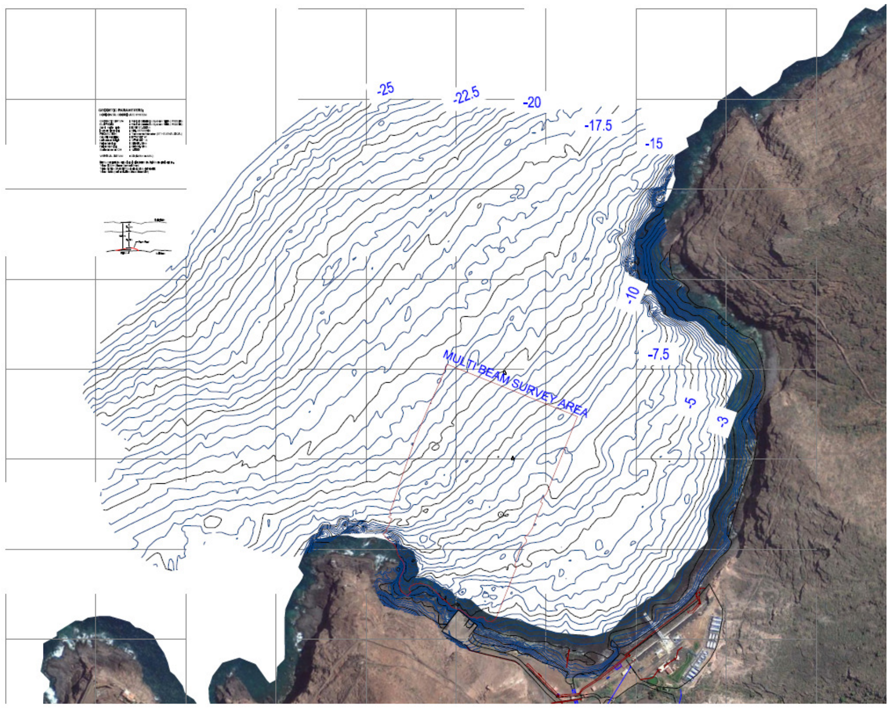
Figure 2-2: St. Helena measured wind data



2.3 Bathymetry

The results of a single-beam bathymetric survey performed in 2006 (Tritan, 2006) and a multi-beam survey performed in 2012 (Tritan, 2012) were used in this investigation. A datum discrepancy between the two surveys was discovered. Closer inspection revealed a change in the local control point which necessitated a downward adjustment of 0.22 m to the 2006 survey. In order to consolidate the full datum discrepancy between the two surveys, the 2006 single beam survey required a further downward adjustment of 0.43 m. The resulting bathymetry is presented in Figure 2-3.

Figure 2-3: Rupert's Bay bathymetry plan. Consolidated from the 2006 and 2012 surveys



3. MODELLING STRATEGY

In this study, a large-scale hydrodynamic model was used to produce nearshore boundary conditions from predicted tide levels available offshore. This model was used in 2D mode in order to achieve acceptable run times and since tidal currents are 2D phenomena.

Tide levels were extracted from the large-scale 2D model and were used as boundary conditions for a higher resolution hydrodynamic model of Rupert's Bay. This model was run in 3D mode in order to resolve the complex processes present in the bay. In addition to tidal currents, the 3D hydrodynamic model included wind-driven currents, while wave-driven currents were included through an online coupling with a spectral wave model.

From this model, the impact of the proposed wharf on the water circulation in Rupert's Bay could be assessed by repeating the model simulation with and without the wharf in place. In order to simulate the dispersion of faecal coliforms, a water quality model was coupled with the 3D hydrodynamic model.

4. REGIONAL 2D HYDRODYNAMIC MODELLING

4.1 Model Description

The MIKE 21 Flow Flexible Mesh model was used for hydrodynamic modelling. The application of the model is described in the User Manual (DHI, 2012a), while full details of the physical processes being simulated and the numerical solution techniques are described in the Scientific Documentation (DHI, 2012b).

The model is based on the shallow water equations, i.e. the depth-integrated incompressible Reynolds averaged Navier-Stokes equations. The time integration of the shallow water equations is performed using an explicit scheme. Horizontal eddy viscosity is modelled with the Smagorinsky formulation.

In this study, the model includes the following physical phenomena:

- Tidal currents
- Currents due to wind stress on the water surface
- Coriolis forcing
- Bottom friction
- Flooding and drying

4.2 Model Setup

4.2.1 Bathymetry

The model bathymetry was defined using the results of the two bathymetric surveys as described in Section 2.3. The model domain for the regional wave modelling includes the entire island and nearshore environment, extending approximately 15 km offshore in all directions. The location of the model boundary was chosen such that the depth along the boundary does not significantly affect the propagation of the tide. The model bathymetry is presented in Figure 4-1.

The model makes use of a flexible mesh, with the mesh becoming more refined, and therefore more accurate, closer to Rupert's Bay. This is visually presented in Figure 4-2.

Figure 4-1: 2D hydrodynamic model bathymetry

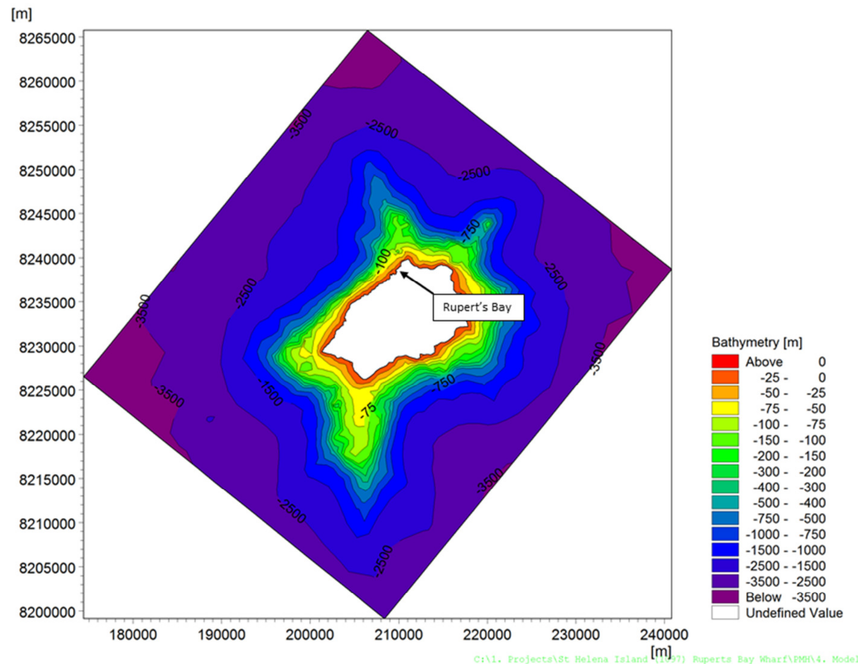
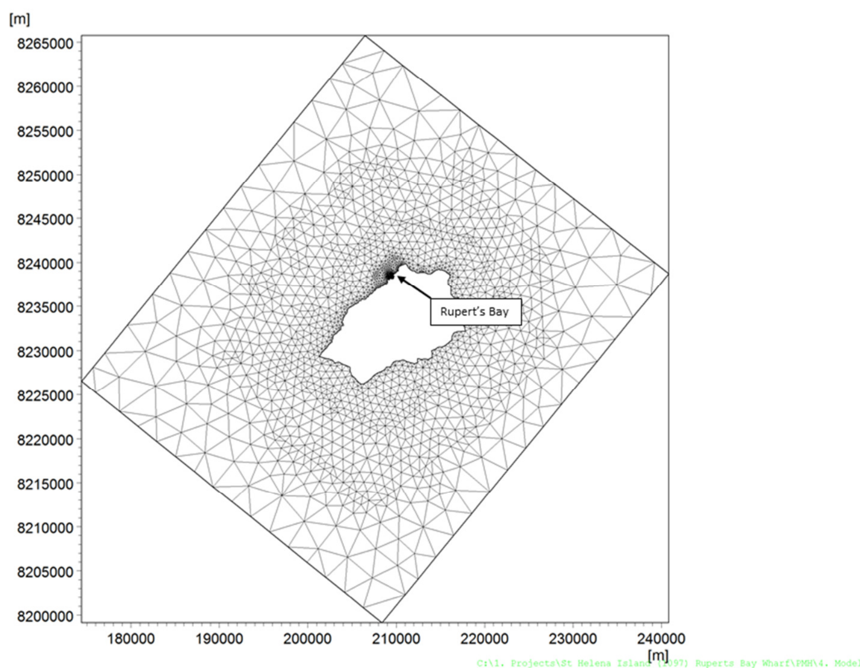


Figure 4-2: 2D hydrodynamic model flexible mesh



4.2.2 Boundary Conditions

In order to model the tide-driven currents in Rupert's Bay, a time series of predicted water levels was extracted from a global tidal model and were specified along each of the four model boundaries.

4.2.3 Wind Forcing

To include the effect of wind driven currents in Rupert's Bay, the time series of wind data measured on St. Helena Island (see Section 2.2) was applied as a time-varying but spatially constant wind field over the model domain. The wind was included for the calibration of the 2D hydrodynamic model, but was excluded in the production of boundary conditions for the nested 3D hydrodynamic model. This is further discussed in Section 5.

4.2.4 Bed Roughness

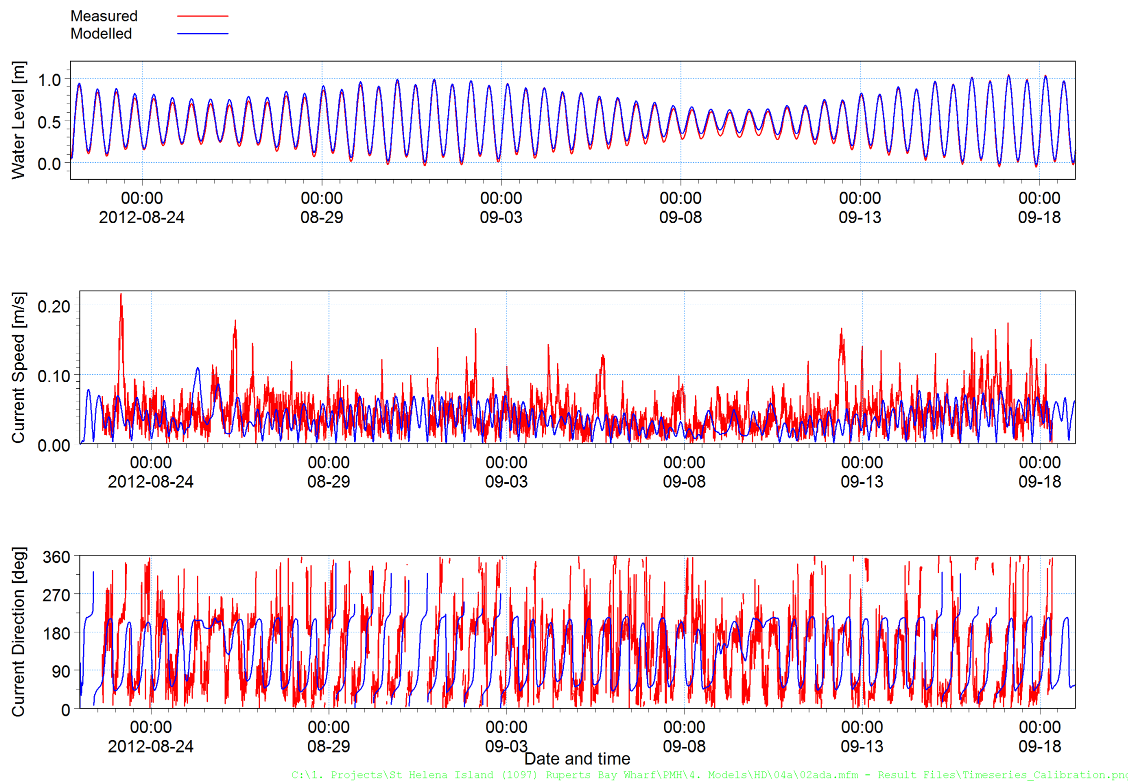
A constant bed roughness with Manning's number equal to 32 $m^{1/3}/s$ was applied over the whole model domain.

4.3 Model Calibration

The model was calibrated against the AQD ADCP current measurements taken during the 2012 measurement campaign (see Section 2.1) and the predicted tidal level for Jamestown (approximately 1 km south west of Rupert's Bay). The four week period between 22 August 2012 and 19 September 2012 was chosen to coincide with the available current measurements. The comparison of modelled and predicted water levels and modelled and measured currents is presented in Figure 4-3.

From the figure, it can be seen that the model is accurately reproducing the predicted surface elevation at the Jamestown tide station. Furthermore, the tidal oscillation of the current direction in Rupert's Bay is modelled with reasonable accuracy. The modelled current speeds are generally lower than the measurements. As discussed in the coastal processes report (PRDW, 2013a), the measured currents include a number of events with higher speeds that show no correlation to the measured tides, wind or waves, i.e. the forcing mechanism for these events is at present uncertain and thus cannot be included in the hydrodynamic model. The model is nonetheless considered sufficiently accurate for the present study, where the dispersion of sewage discharged into the inter-tidal zone is dominated by wave-driven currents that are an order of magnitude stronger than those measured offshore at the AQD location.

Figure 4-3: Calibration of the 2D hydrodynamic model



4.4 Model Results

The primary objective of the 2D hydrodynamic model was to produce the necessary boundary conditions for the smaller scale 3D hydrodynamic model. Therefore, only the results indicating the current circulation in Rupert's Bay during spring tide are presented here as examples of the model output. Figure 4-4 and Figure 4-5 indicate the currents during spring ebb and spring flood tide, respectively. The tidal currents can be seen to flow clockwise during ebb tide and counter-clockwise during flood tide. The current speed is stronger offshore and reduces with distance into the bay. An analysis of the water circulation in Rupert's Bay is presented in more detail in Section 5.

Figure 4-4: Tidal flow patterns in Rupert's Bay during spring ebb tide

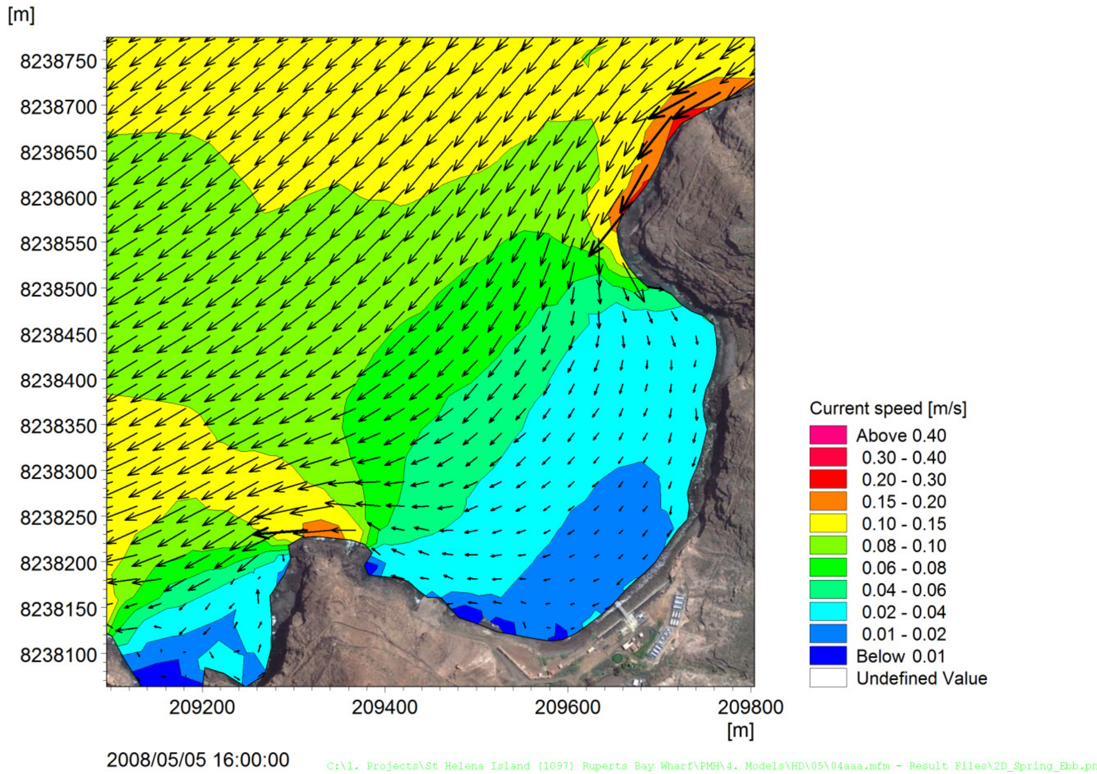
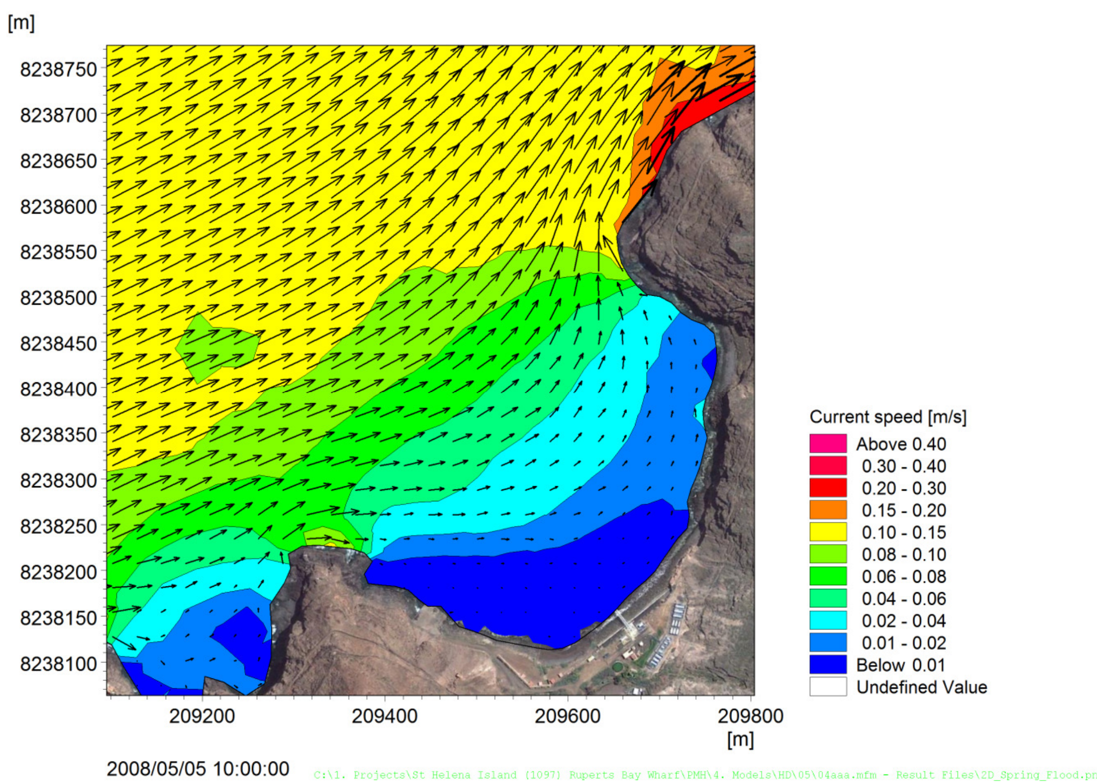


Figure 4-5: Tidal flow patterns in Rupert's Bay during spring flood tide



5. NESTED 3D HYDRODYNAMIC MODELLING

5.1 Model Description

5.1.1 Spectral Wave Model

The MIKE 21 Spectral Waves Flexible Mesh model was used for wave refraction modelling. The application of the model is described in the User Manual (DHI, 2012c), while full details of the physical processes being simulated and the numerical solution techniques are described in the Scientific Documentation (DHI, 2012d). The model simulates the growth, decay and transformation of wind-generated waves and swell in offshore and coastal areas using unstructured meshes.

The directional decoupled parametric formulation is based on a parameterization of the wave action conservation equation. The parameterization is made in the frequency domain by introducing the zeroth and first moment of the wave action spectrum as dependent variables.

MIKE 21 SW includes the following physical phenomena:

- Refraction and shoaling due to depth variations
- Dissipation due to bottom friction
- Dissipation due to depth-induced wave breaking
- Effect of time-varying water depth and flooding and drying.

The discretization of the governing equation in geographical and spectral space is performed using cell-centred finite volume method. In the geographical domain, an unstructured mesh technique is used.

MIKE 21 SW is also used in connection with the calculation of wave-induced currents. The wave-induced current is generated by the gradients in radiation stresses that occur in the surf zone. MIKE 21 SW can be used to calculate the wave conditions and associated radiation stresses. Subsequently the wave-induced flow is calculated using the MIKE 3 Flow Model.

5.1.2 Hydrodynamic Model

The three-dimensional hydrodynamic model used was the MIKE 3 Flow Flexible Mesh Model. The application of the model is described in the User Manual (DHI, 2012a), while full details of the physical processes being simulated and the numerical solution techniques are described in the Scientific Documentation (DHI, 2012b).

The model is based on the numerical solution of the three-dimensional incompressible Reynolds averaged Navier-Stokes equations invoking the assumptions of Boussinesq and of hydrostatic pressure. The model consists of the continuity, momentum, temperature, salinity and density equations and is closed by a k-ε vertical turbulence closure scheme. Horizontal eddy viscosity is modelled with the Smagorinsky formulation.

The time integration of the shallow water equations and the transport equations is performed using a semi-implicit scheme, where the horizontal terms are treated explicitly and the vertical terms are treated implicitly. In the vertical direction a structured mesh, based on a sigma-coordinate transformation is used, while the geometrical flexibility of the unstructured flexible mesh comprising triangles or rectangles is utilised in the horizontal plane.

MIKE 3 Flow Flexible Mesh Model includes the following physical phenomena:

- Currents due to tides
- Currents due to wind stress on the water surface
- Currents due to waves: the second order stresses due to breaking of short period waves can be included using the radiation stresses computed in the MIKE 21 SW model
- Coriolis forcing
- Bottom friction
- Flooding and drying
- Sources and sinks

5.1.3 Water Quality Model

The water quality model used was the MIKE ECO Lab Model. The application of the model is described in the User Manual (DHI, 2012e), while full details of the physical processes being simulated and the numerical solution techniques are described in the Scientific Documentation (DHI, 2012f). The model simulates the transport and fate of constituents in three dimensions based on advection-dispersion and ecological processes. The hydrodynamics are obtained via an online coupling to the MIKE 3 Flow Flexible Mesh Model.

In this study the constituent modelled was faecal coliforms. The die-off of faecal coliforms is described by the following first order decay equation (DHI, 2012g):

$$\frac{d\,C_F}{dt} = -K_{dF}\,.\,C_F$$

where

C_F = concentration of faecal coliforms (number/100 ml)

K_{dF} = decay coefficient for faecal coliforms (1/day)

The decay coefficient is dependent on the light conditions as well as the salinity and water temperature.

5.2 Model Setup

5.2.1 General

5.2.1.1 Selection of simulation period

The simulation period was selected based on the following criteria:

- The period should represent a conservative selection, i.e. calm conditions
- The period should cover at least one spring-neap tidal cycle to allow for variations in the tidal currents
- The period should fall within the limitations of available data required as input to the model.

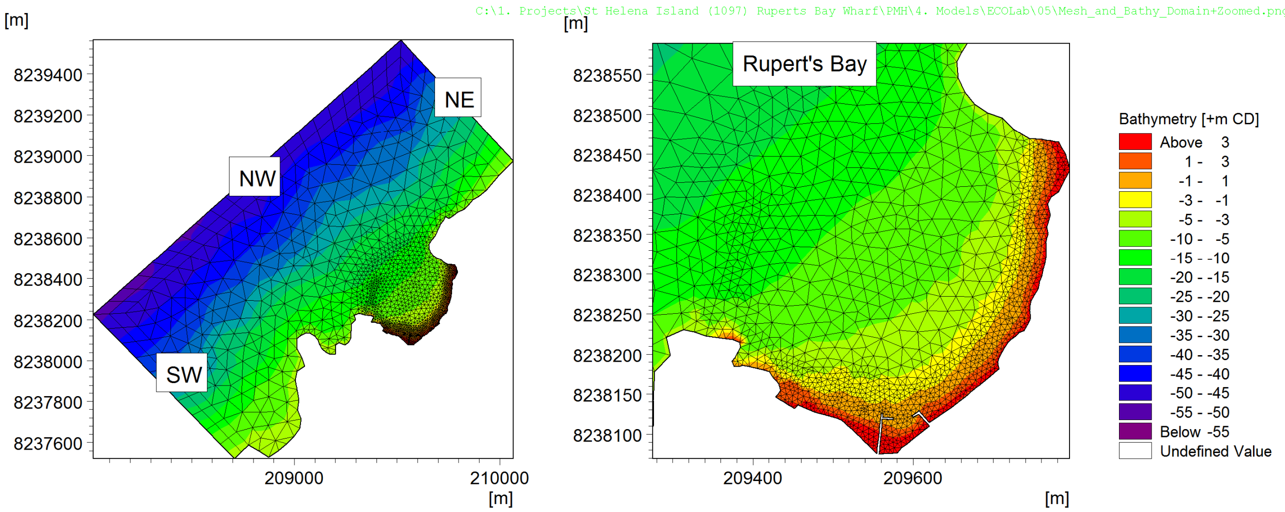
The wave data required as input to the spectral wave model was only available between November 2007 and October 2008. A 15-day period within this year was therefore selected to be modelled. Based on the findings of the Coastal Processes Report (PRDW, 2013a), the first two weeks of May 2008 were selected. This period falls outside the summer months when heavy rollers are present and within the autumn months when wind speeds are statistically the lowest. The limited scope of this study precluded the simulation of additional periods.

5.2.1.2 Bathymetry and mesh

In order to enable online coupling between the models used in this study, the same mesh and bathymetry was used by all three models described in Section 5.1. The bathymetry was based on the same bathymetric data used for the 2D hydrodynamic model. The model boundaries were chosen such to exclude boundary effects at the site under consideration while maintaining acceptable run times. A flexible mesh was constructed with refined elements within Rupert's Bay in order to accurately resolve the relevant processes. The element size at the discharge was 2.5 m. The bathymetry and mesh are presented in Figure 5-1.

In the vertical direction five uniformly spaced sigma layers were used, i.e. the layer depth was 20% of the local water depth.

Figure 5-1: Bathymetry and mesh used in the 3D model



5.2.2 Spectral Wave Model

5.2.2.1 Boundary Conditions

The boundary conditions for the spectral wave model were obtained from the regional wave model described in the Coastal Processes Report (PRDW, 2013a). A time series of wave parameters was extracted from the regional wave model at the location of the offshore boundary of the model used here. This time series was therefore specified at the offshore boundary (labelled NW in Figure 5-1). Along each of the lateral boundaries (SW and NE), the condition was specified in which a one-dimensional wave refraction calculation is performed in order to account for the effect of the varying depth along these boundaries.

5.2.2.2 Bottom Friction

Bottom friction was included with a constant Nikuradse roughness of 0.04 m specified over the model domain.

5.2.3 Hydrodynamic Model

5.2.3.1 Boundary Conditions

To produce the boundary conditions of the nested 3D hydrodynamic model, the 2D hydrodynamic model was run for the simulation period described in Section 5.2.1.1, including two additional days to allow for model spin-up. A time series of surface elevation was extracted along each of the three boundaries shown in Figure 5-1, and was specified as the boundary condition of the 3D model. Where wind was included in the nested 3D model, a correction for the effect of wind setup was applied along the lateral boundaries. Additionally, corrections for the effects of the Coriolis force and wave radiation stresses were also applied along these boundaries.

5.2.3.2 Bed Roughness

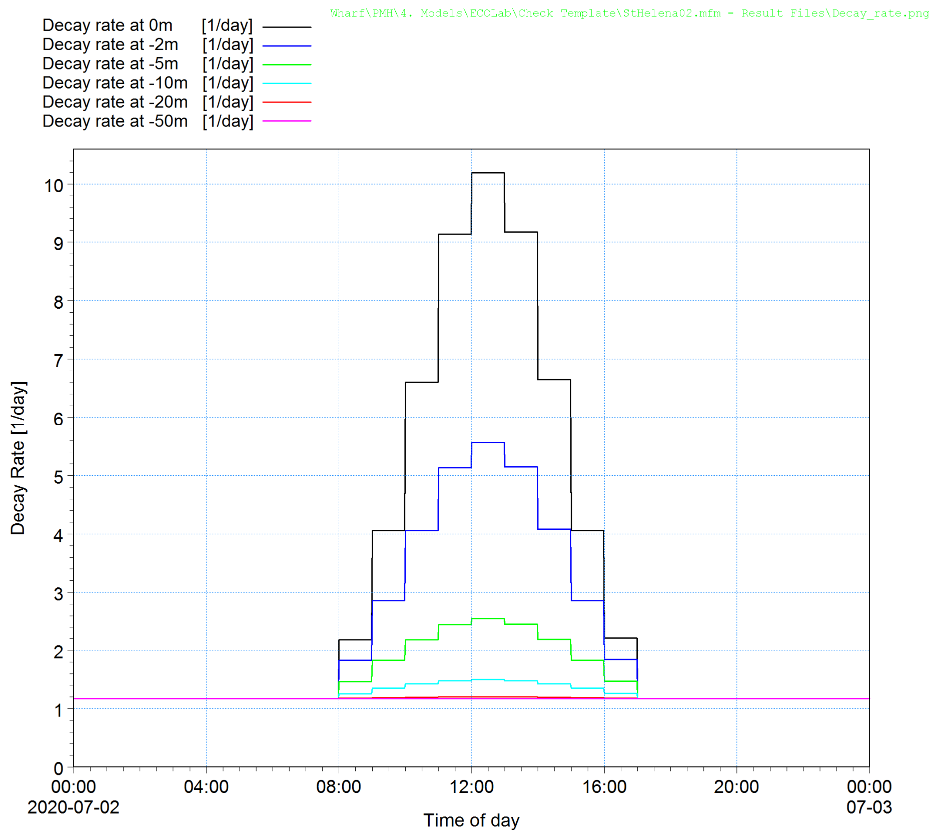
A roughness height of 0.05 m was used.

5.2.4 Water Quality Model

5.2.4.1 Decay of Faecal Coliforms

As described in Section 5.1.3, the decay of faecal coliforms is dependent on the temperature and salinity of the ambient water as well as the amount of sunlight penetrating the water. For this study, a constant temperature of 22°C and salinity of 35 PSU was specified, as presented in the Africa Pilot (UK Hydrographic Office, 2002) for the months of August and June, respectively. The maximum insolation at noon was specified to be a constant 1.1 kW/m^2, with an assumed Secchi disk depth of 10 m, which corresponds to clear water, as evident on aerial photographs where the seabed within the bay is clearly visible. The model accounts for the latitude as well as the time of day in the calculation of the coliform die-off. The decay coefficients resulting from the above assumptions are presented in Figure 5-2 as a function of time of day and depth below the water surface. At the water surface at noon, the decay rate of 10.2 /day translates to a T_{90} of approximately 5.4 hours at noon, i.e. 90% of the coliforms die off in 5.4 hours. The corresponding T_{90} at night is approximately two days.

Figure 5-2: Decay rate as a function of time of day and depth

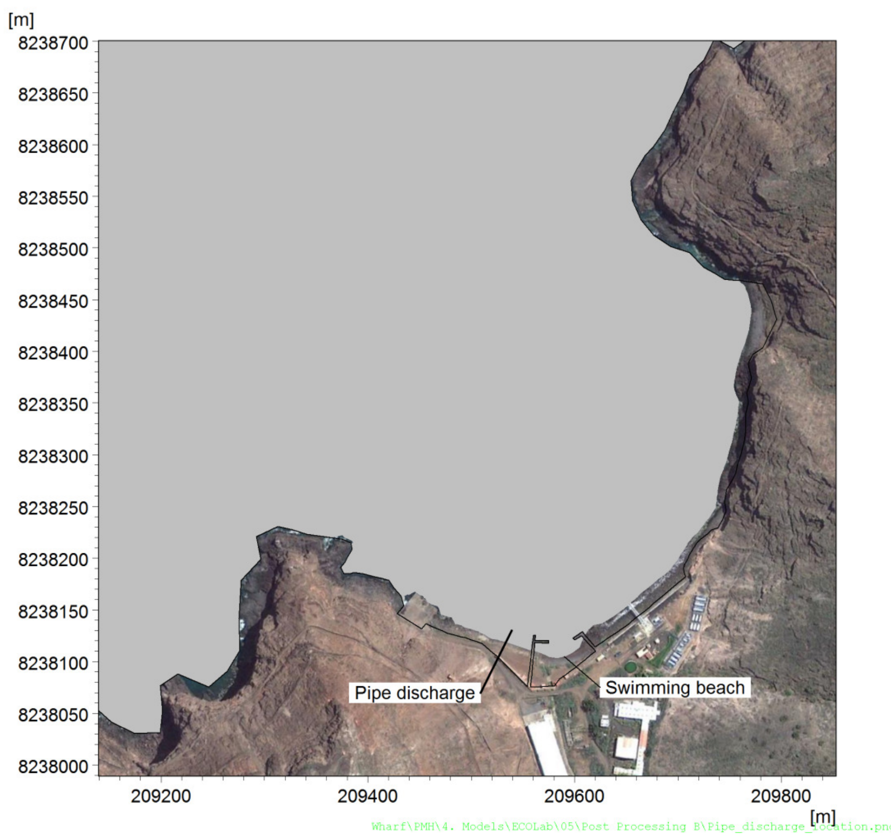


5.2.4.2 Effluent discharge

Sewage from a septic tank at the Argos fish factory is reportedly discharged through a concrete pipe into the inter-tidal zone in Rupert's Bay close to the swimming beach (B Walmsley 2013, pers. comm., 2 May). The discharge point is located in the intertidal zone and is an open-ended pipe with a diameter of approximately 110 mm (B Walmsley 2013, pers. comm., 2 May). The discharge pipe is indicated in Figure 5-3, and it's location in Figure 5-4. The location of the swimming beach close to the discharge point is also indicated in Figure 5-4.

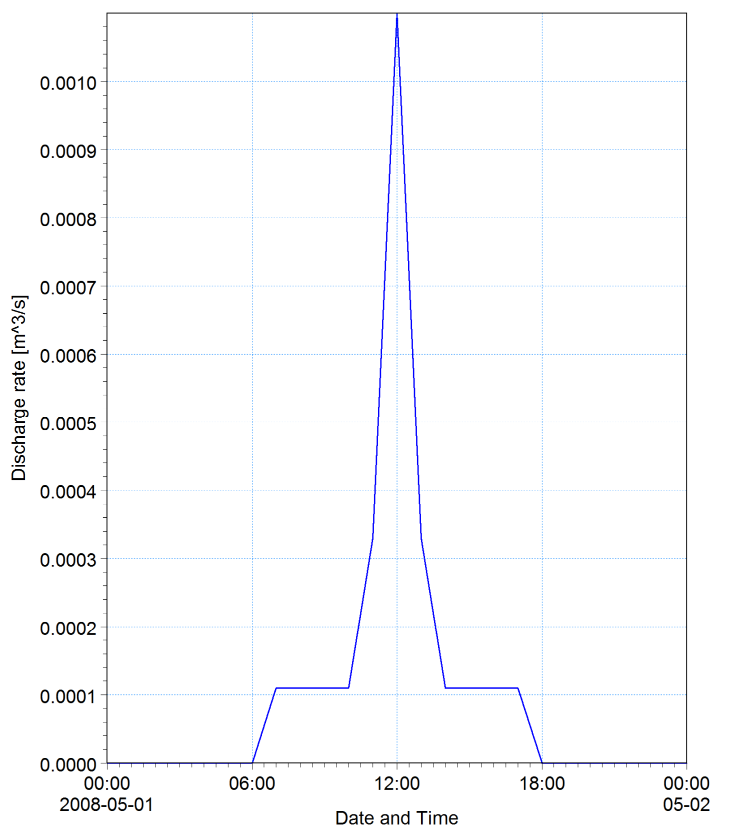
Figure 5-3: Discharge pipe carrying sewage from the Argos fish factory (photo courtesy of Bryony Walmsley)

Figure 5-4: Location of discharge pipe and swimming beach



In the absence of data regarding the discharge from the Argos fish factory, assumptions were made regarding the composition and flow rate of the discharge. The flow rate of the discharge was based on the total water usage by the Argos fish factory for 2011, i.e. 4990 m^3/year (B Walmsley 2013, pers. comm., 2 May). It was assumed that approximately two thirds of the usage is discharged into the sea, resulting in an average flow of 0.11 l/s. Typical peaking factors (i.e. the ratio between the peak flow and the average flow) for sewage flow are between 2 and 5, with higher peaking factors for lower flow rates (ASCE, 2007; Alberta Environmental Protection, 1997). Since the discharge considered here is very low, a peaking factor of 10 was assumed in this study. This results in a peak flow rate of 1.1 m/s. Based on the above, a theoretical diurnal flow was assumed in which zero flow occurred during the night, with 0.11 l/s during the day, which increases to a peak flow of 1.1 l/s at noon. The schematisation of the flow is presented in Figure 5-5. The total annual discharge using this schematisation is 3471 m^3/year – slightly higher than two thirds of the 2011 water usage of the fish factory. The limited scope of this study precluded the simulation of additional flow rate scenarios.

Figure 5-5: Schematisation of the discharge from the Argos fish factory

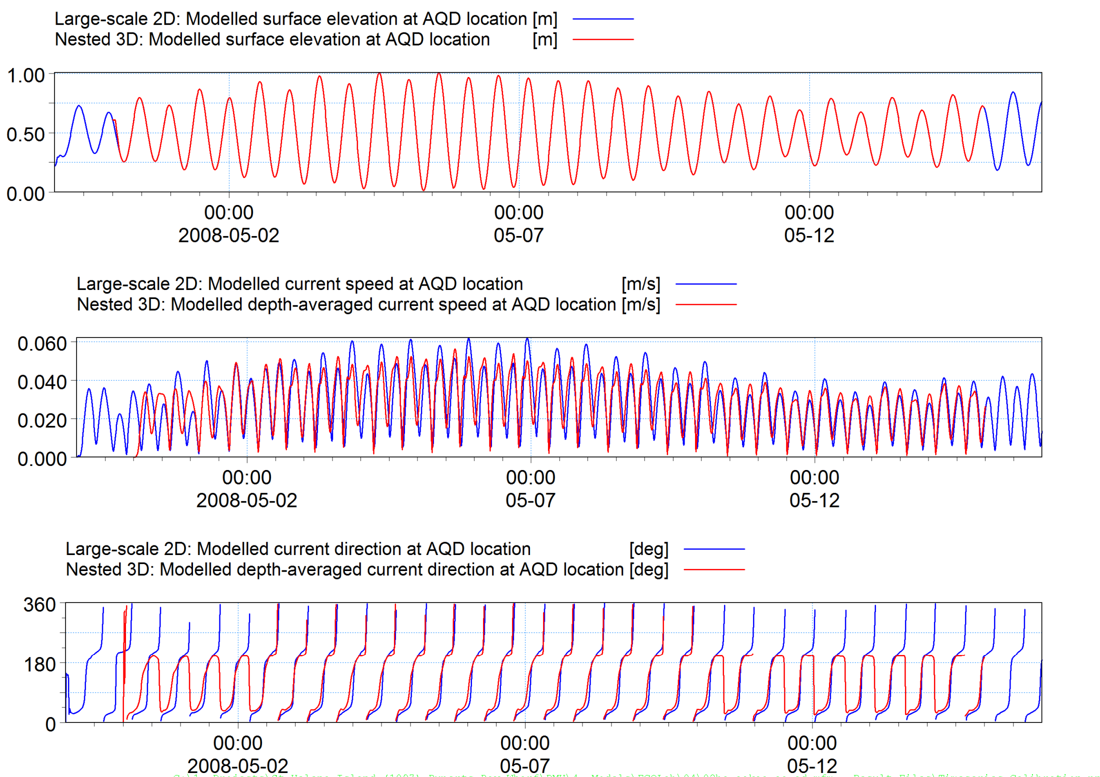


In the absence of further information it was assumed that the sewage discharged into the sea would have the characteristics of untreated sewage. Based on typical ranges for untreated sewage, a faecal coliform concentration of 1×10^7 per 100 ml was assumed (Henze, 2008).

5.3 Model Validation

Due to the lack of calibration data available for the period modelled, the 3D model was validated against the calibrated 2D hydrodynamic model. For comparative purposes, the 3D model was run by including the same forcings as those used in the 2D model, i.e. tidal forcing was included, but wind and waves were excluded. A comparison of the surface elevation and depth-averaged currents of the two models at the location of the AQD ADCP used for the calibration of the 2D model is presented in Figure 5-6. The comparison indicates a good agreement between the nested 3D and 2D models.

Figure 5-6: Comparison of the nested 3D hydrodynamic model to the 2D hydrodynamic model

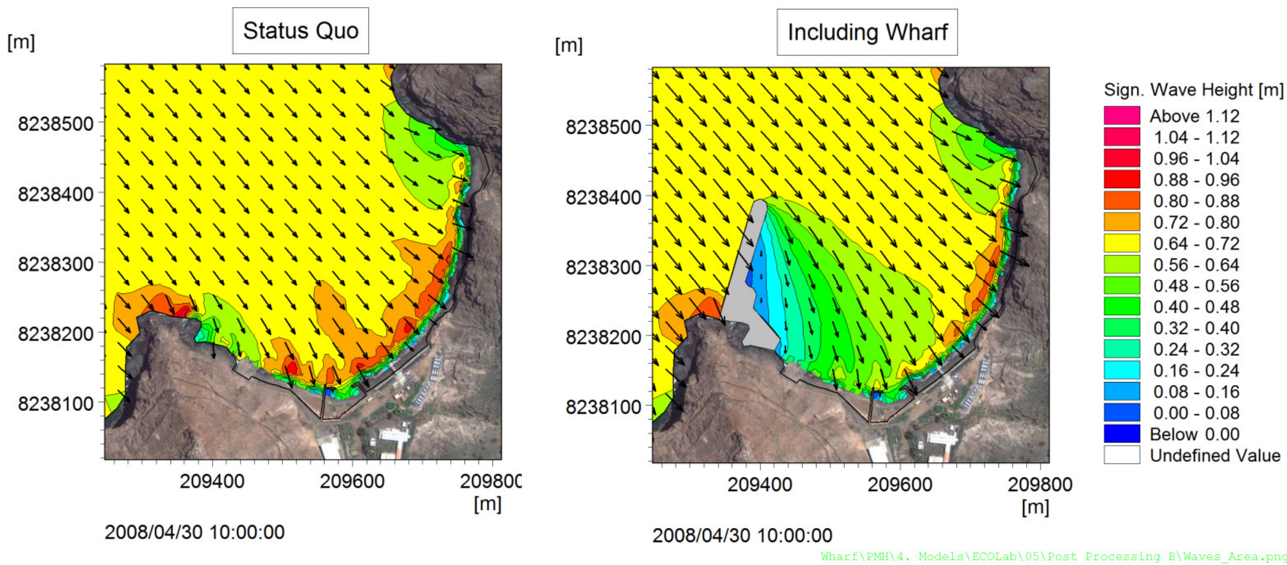


5.4 Model Results

5.4.1 Spectral Wave Model

In order to indicate the effect of the proposed wharf on the penetration of waves into Rupert's Bay, the model results for a typical wave condition are presented in Figure 5-7 for both the status quo and including the proposed wharf. It can be seen that the inclusion of the wharf provides significant sheltering to the south-western part of the bay. The effect of the reduced wave heights in the lee of the wharf on the water circulation in the bay is further discussed in Section 5.4.2.

Figure 5-7: Example of wave penetration into Rupert's Bay: status quo and including wharf



5.4.2 Hydrodynamic Model

In this section, the results of the hydrodynamic model are presented to indicate the effect of the proposed wharf on the water circulation in Rupert's Bay.

Figure 5-8 and Figure 5-9 present the water circulation during a typical flood tide for the status quo and following construction of the wharf, respectively. In each of the figures, the surface and bottom currents are presented so as to indicate the complex three-dimensional effects of the various processes concerned.

At the status quo, the wave-driven currents cause a rip current to form approximately in the centre of the bay. Near the surface, this offshore-directed current is reinforced by the offshore-directed wind, since the wind-driven currents are at their strongest near the surface. The effect of the wind-driven currents can be seen throughout the bay, with surface currents flowing offshore and bottom currents flowing onshore through the process of upwelling. Directly outside the bay, the tidal currents near the surface are directed slightly more offshore than the shore-parallel bottom currents, also due to the wind-driven currents at the surface.

The sheltering effect of the inclusion of the wharf reduces the wave-driven currents in its lee such that the rip current is translated and deflected.to flow toward the wharf approximately 50 m from the coast, and ultimately follows the wharf offshore. The effect of upwelling due to the wind-driven currents remains present.

Figure 5-8: Surface and bottom currents during flood tide: status quo

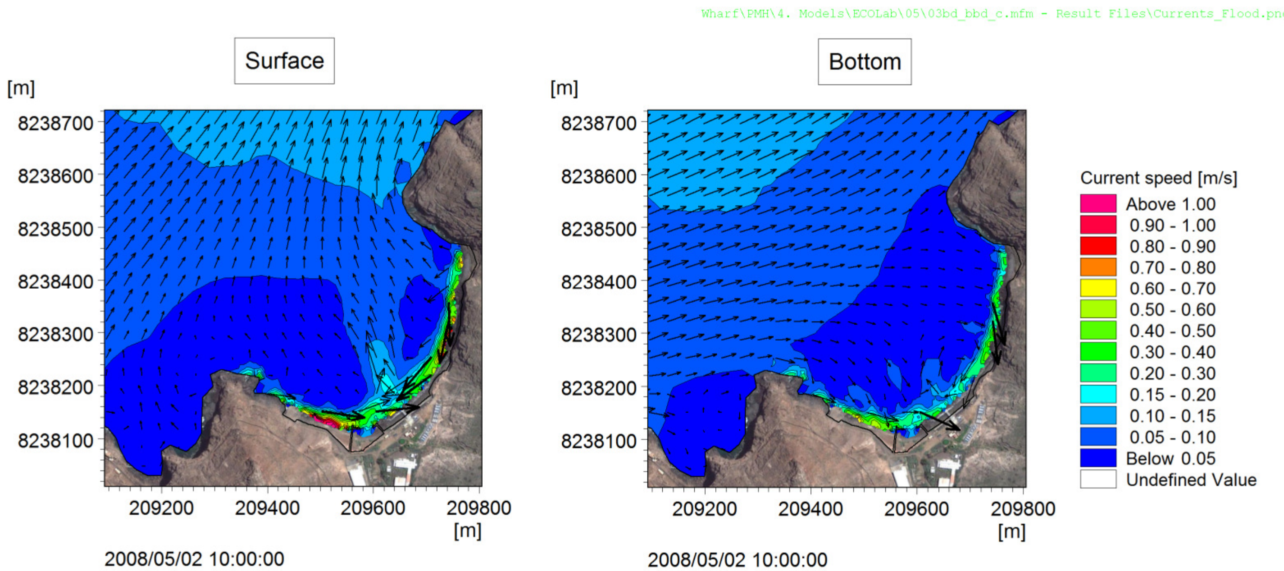


Figure 5-9: Surface and bottom currents during flood tide: including wharf

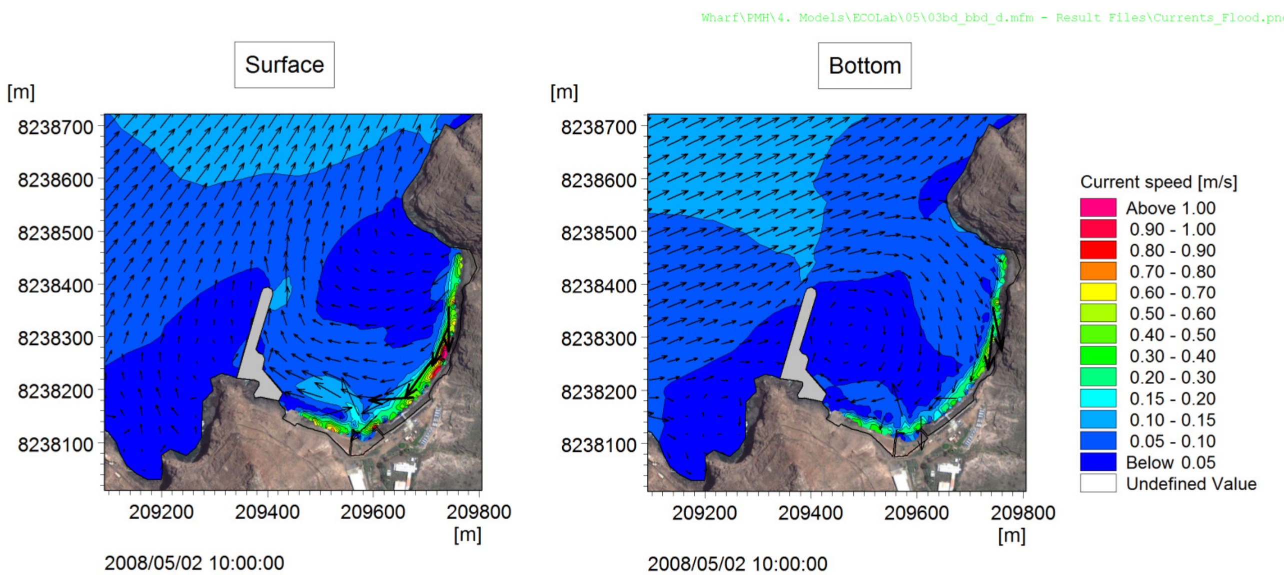


Figure 5-10 and Figure 5-11 present the same plots, but for the subsequent ebb tide. In this case, the rip current is once again seen to be translated and deflected. The observed change in current pattern is therefore considered to be present irrespective of the direction of tidal currents.

Figure 5-10: Surface and bottom currents during ebb tide: status quo

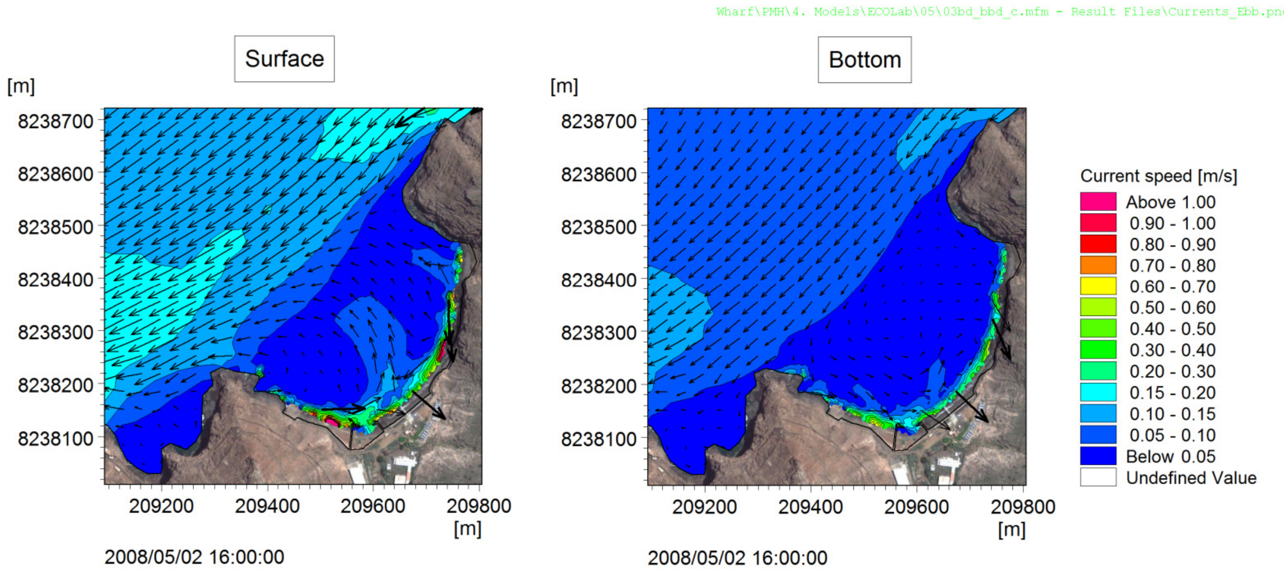


Figure 5-11: Surface and bottom currents during ebb tide: including wharf

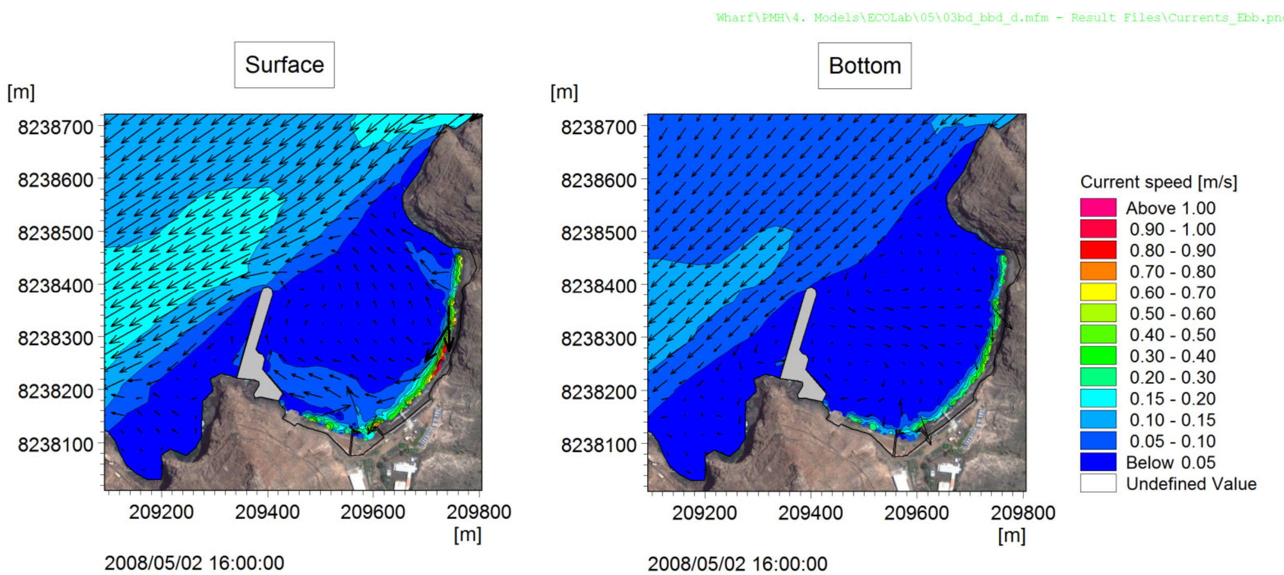


Figure 5-12 and Figure 5-13 present the mean near-surface and near-bottom currents over the 15-day simulation. Each of the figures presents the mean currents at the status quo and following the construction of the wharf. The figures indicate relatively light currents in the bay, while strong currents are present in the surf zone. Surface currents are observed to be generally stronger than bottom currents. Following the construction of the wharf, the surf zone currents in the lee of the wharf are seen to be reduced.

Figure 5-12: Mean near-surface currents: status quo and including wharf

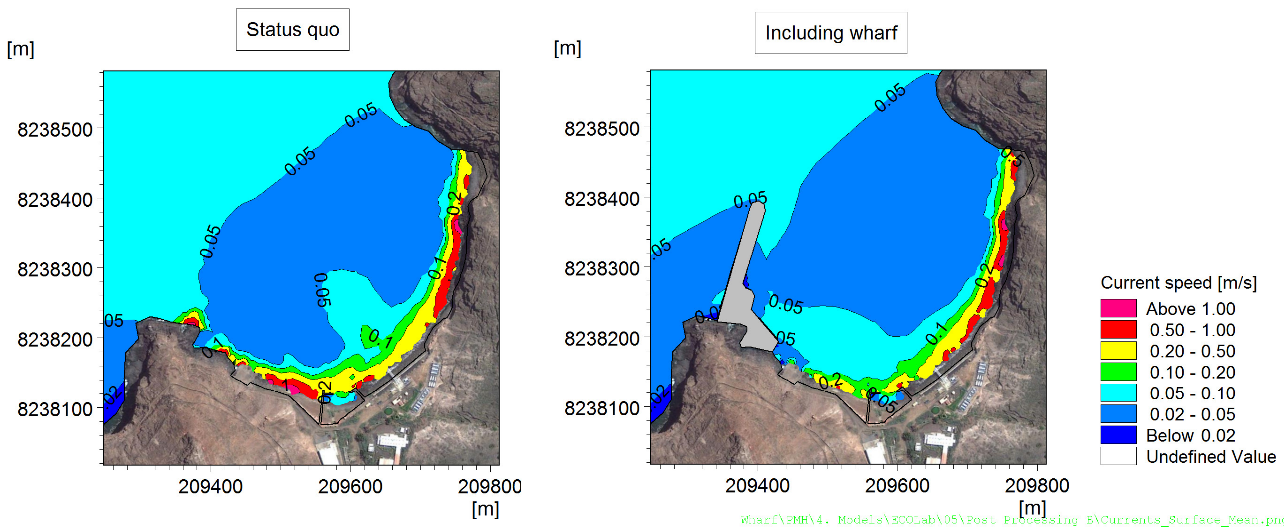


Figure 5-13: Mean near-bottom currents: status quo and including wharf

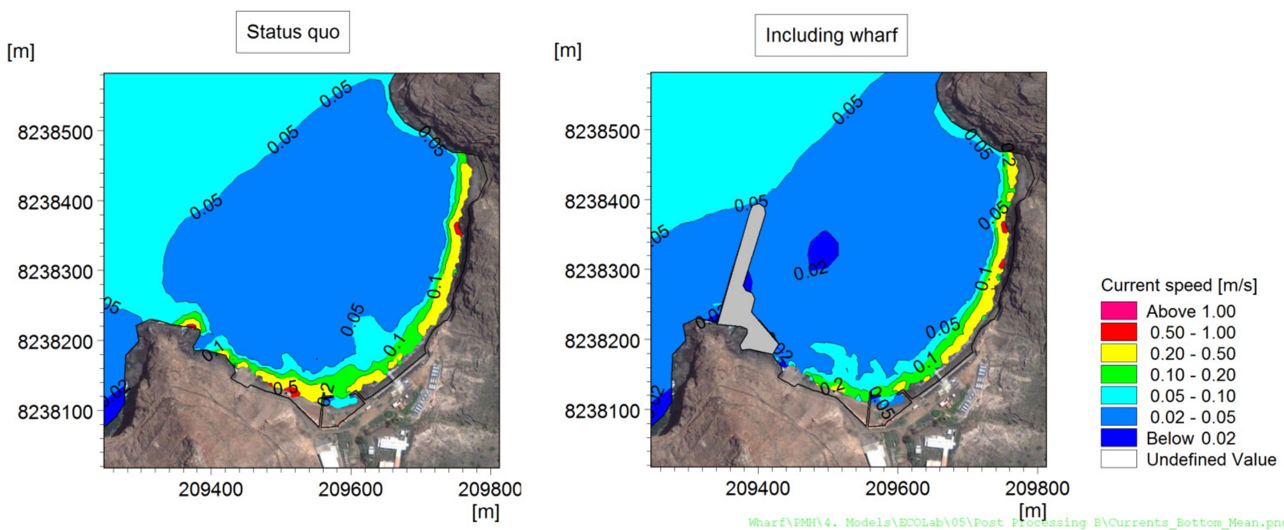
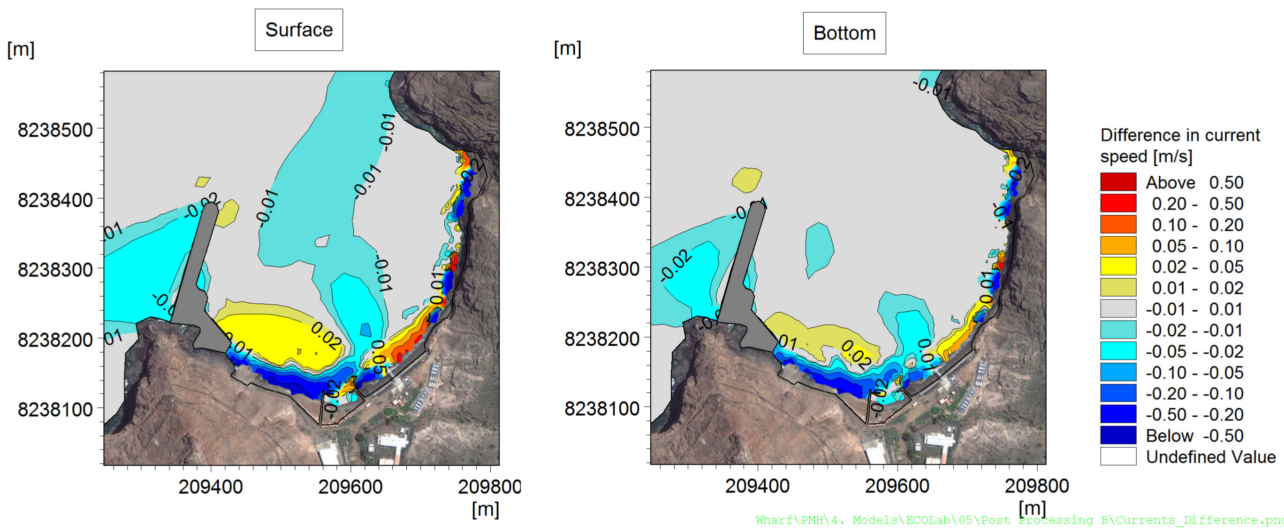


Figure 5-14 presents the difference in the near-surface current speed caused by the construction of the wharf. The figure indicates clearly the shift of the rip current from the centre of the bay toward the wharf, as is evident from the lower currents in the centre of the bay and the higher currents beyond the surf-zone toward the wharf. The wave sheltering also reduces the surf-zone currents along the south-western shoreline of the bay. Furthermore, the more subtle sheltering effect of the wharf on the tidal currents is observed in the lower mean current speeds around the wharf. Currents are reduced on the inside during flood tide and on the outside during ebb tide. Since the currents in the bay are forced to flow along the wharf, a slight increase in current speed is observed near the breakwater head.

Figure 5-14: Change in mean near-surface current speed due to construction of the wharf



5.4.3 Water Quality Model

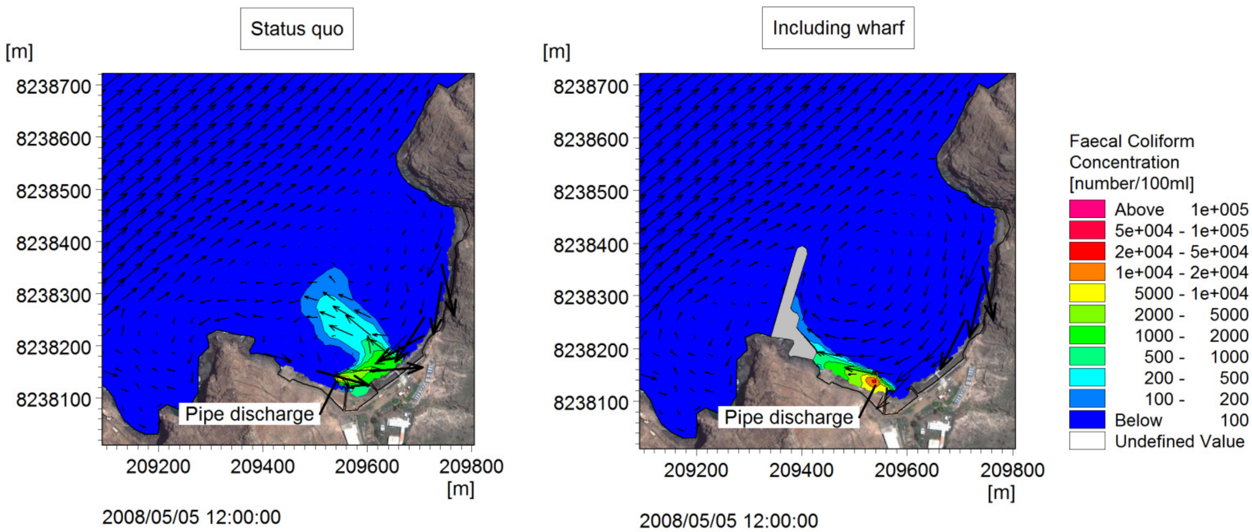
In this section, the results of the water quality model are presented to indicate the effect of the proposed wharf on the dispersion of faecal coliforms in Rupert's Bay.

5.4.3.1 Typical transport patterns

Figure 5-15 and Figure 5-16 present the surface and bottom concentration of faecal coliforms resulting from the peak discharge at noon during a flood tide. Each of the figures presents the status quo and the case including the proposed wharf.

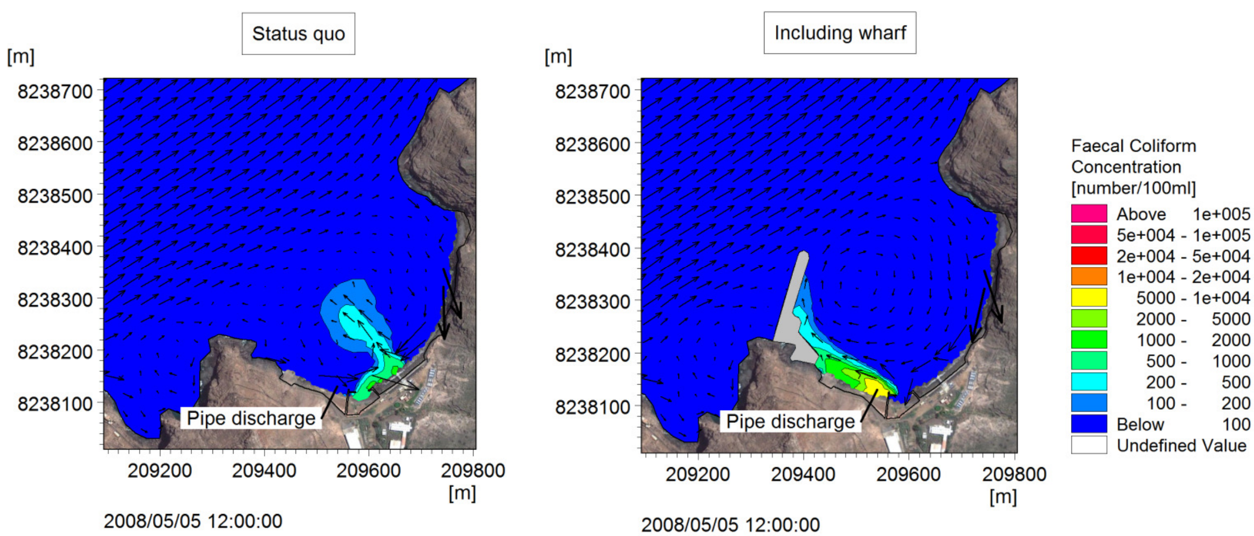
At the status quo, the coliform plume is transported past the swimming beach towards the rip current in the centre of the bay, from where it is transported offshore. The longshore current caused by the construction of the wharf draws the plume toward the wharf and away from the swimming beach. Surface concentrations are observed to be higher than bottom concentrations, due to the initial buoyancy of the sewage. However, bottom concentrations are seen to spread further away from the source, due to the reduced die-off at larger depths. Therefore, the coliform concentration both at the surface and at the bottom need to be considered when investigating the extent of the areas in which high coliform concentrations are present.

Figure 5-15: Discharge during flood tide: surface concentration



Wharf\PMH\4. Models\ECOLab\05\Post Processing B\Coli_Flood_Surface.png

Figure 5-16: Discharge during flood tide: bottom concentration



Wharf\PMH\4. Models\ECOLab\05\Post Processing B\Coli_Flood_Bottom.png

The discharge during ebb tide is presented in Figure 5-17 and Figure 5-18. The impact of the wharf is similar to the observations made above.

Figure 5-17: Discharge during ebb tide: surface concentration

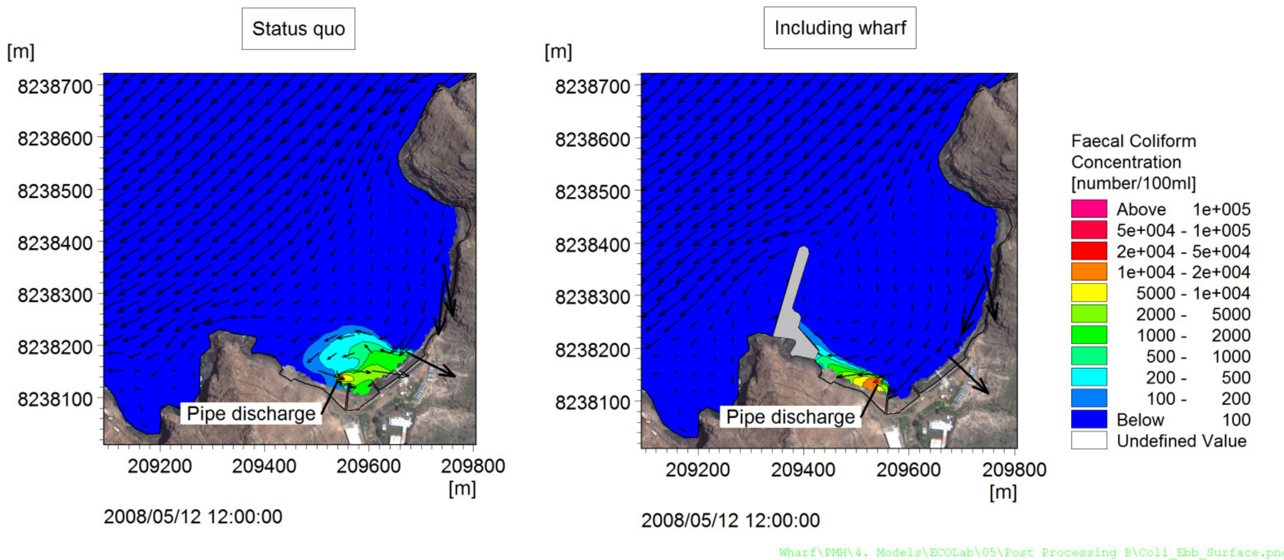
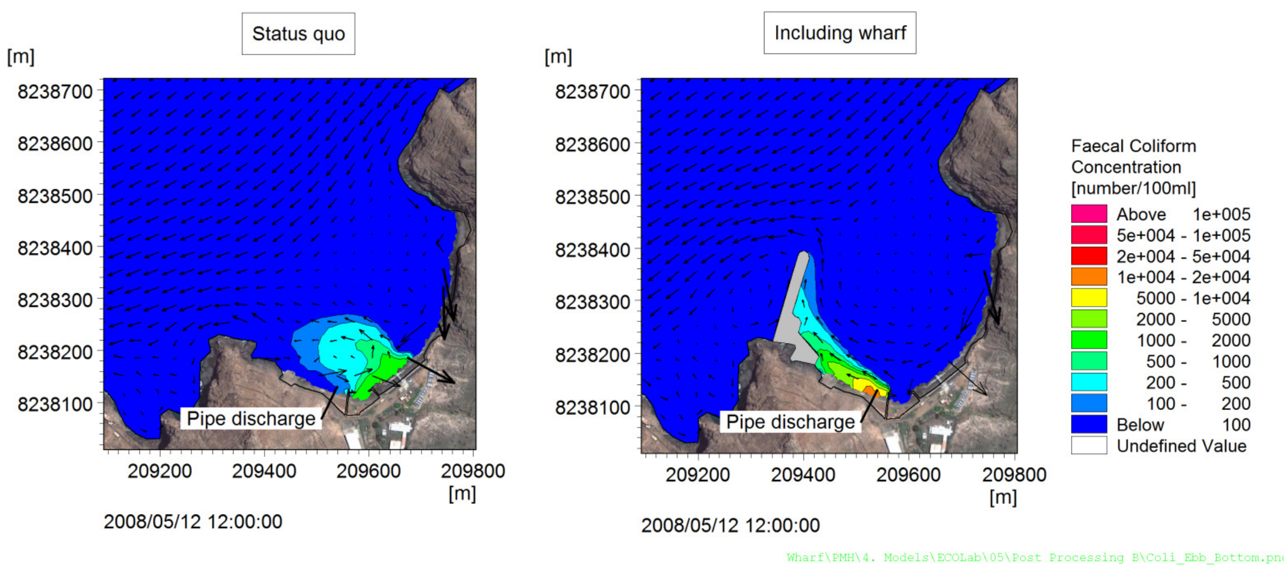


Figure 5-18: Discharge during ebb tide: bottom concentration



5.4.3.2 Maximum concentrations

Figure 5-19 and Figure 5-21 present the maximum near-surface and near-bottom concentrations of faecal coliforms reached in the 15-day simulation period. Each of the figures presents the status quo and the situation after construction of the wharf. Figure 5-20 and Figure 5-22 provide detail on the maximum coliform concentrations close to the swimming beach.

Figure 5-19: Maximum near-surface faecal coliforms

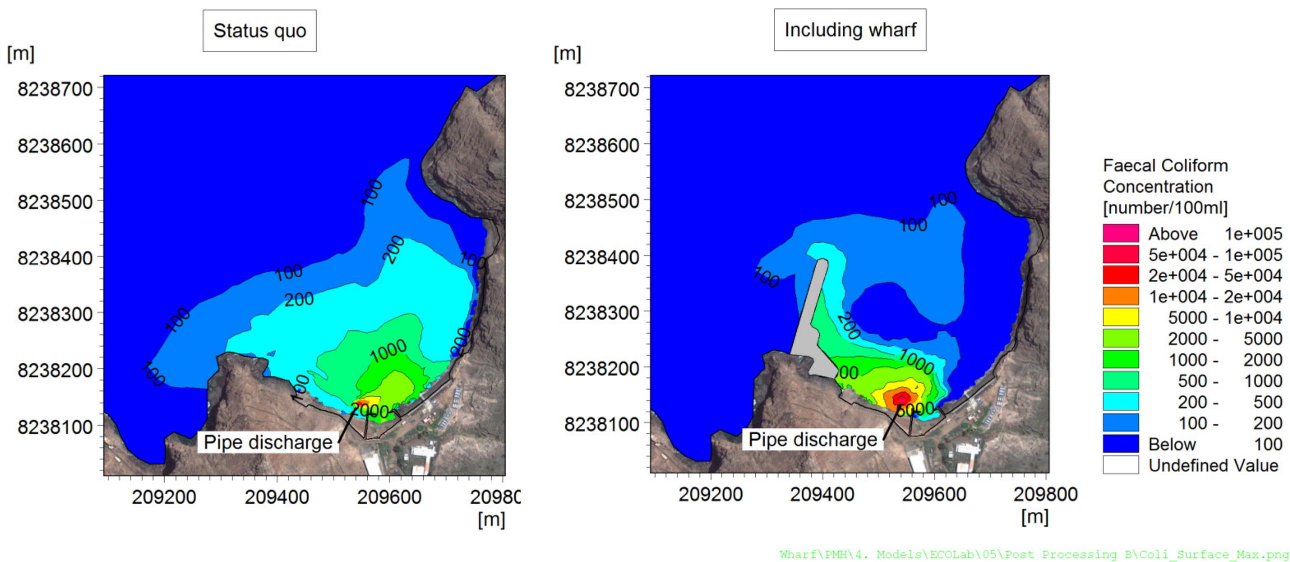
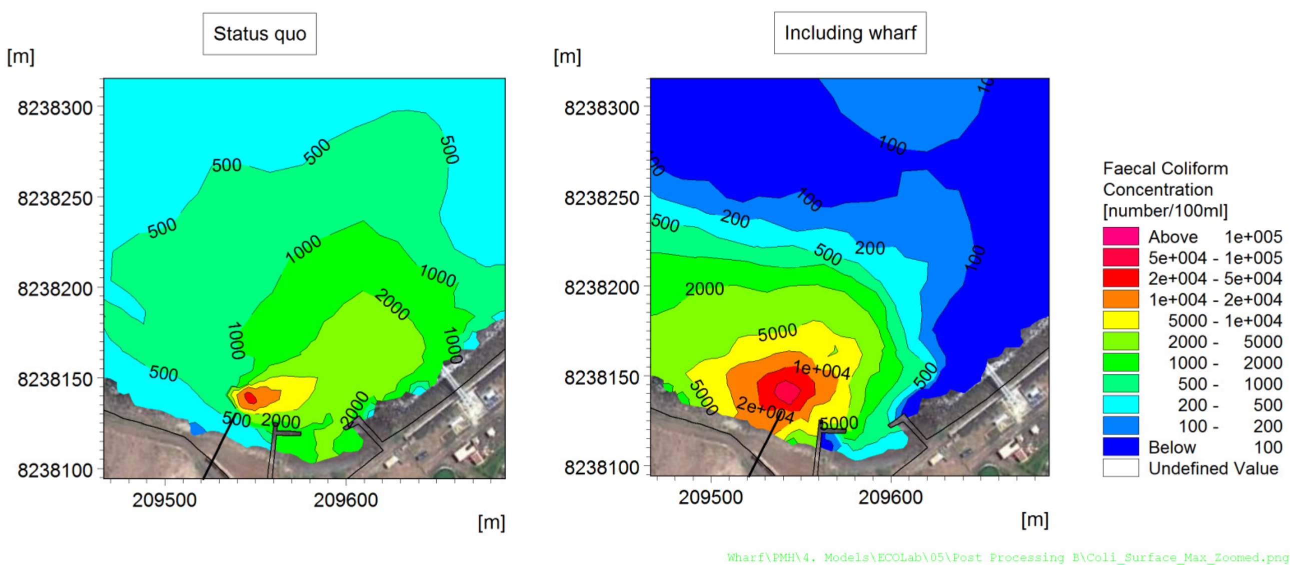


Figure 5-20: Maximum near-surface coliforms: swimming beach detail

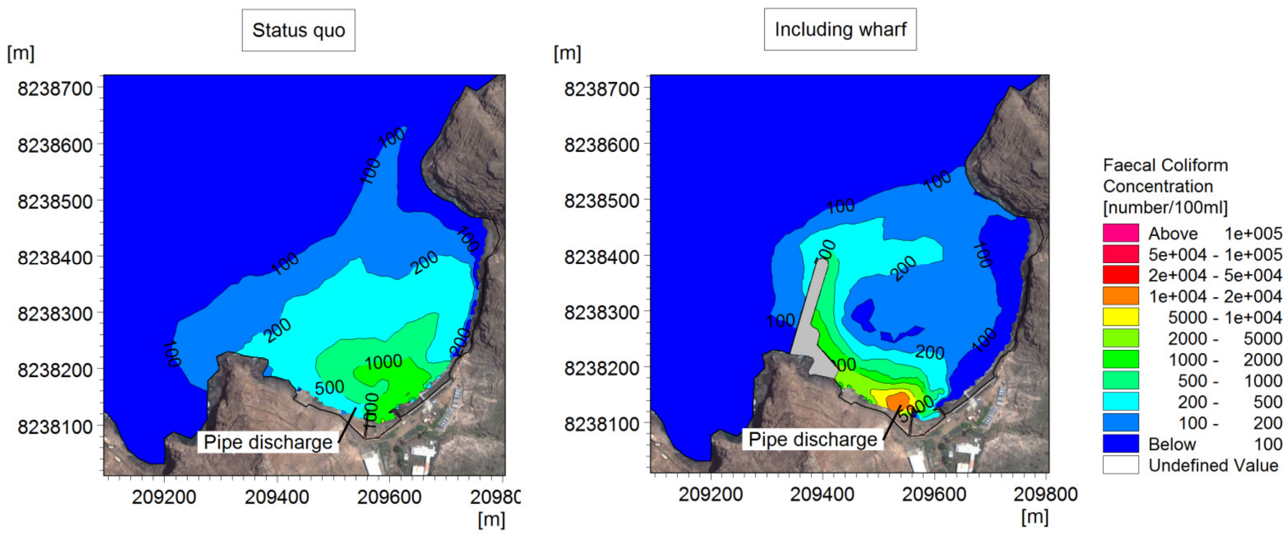


As seen in the typical transport patterns, the coliform concentrations at the surface are higher than those at the bottom. However, bottom concentrations are more widespread.

At the status quo, the maximum bay-wide concentration reached exceeds 100 coliforms per 100 ml, with a maximum concentration of over 20 000 coliforms per 100 ml reached at the discharge point. At the swimming beach, the maximum concentration exceeds 2 000 coliforms per 100 ml.

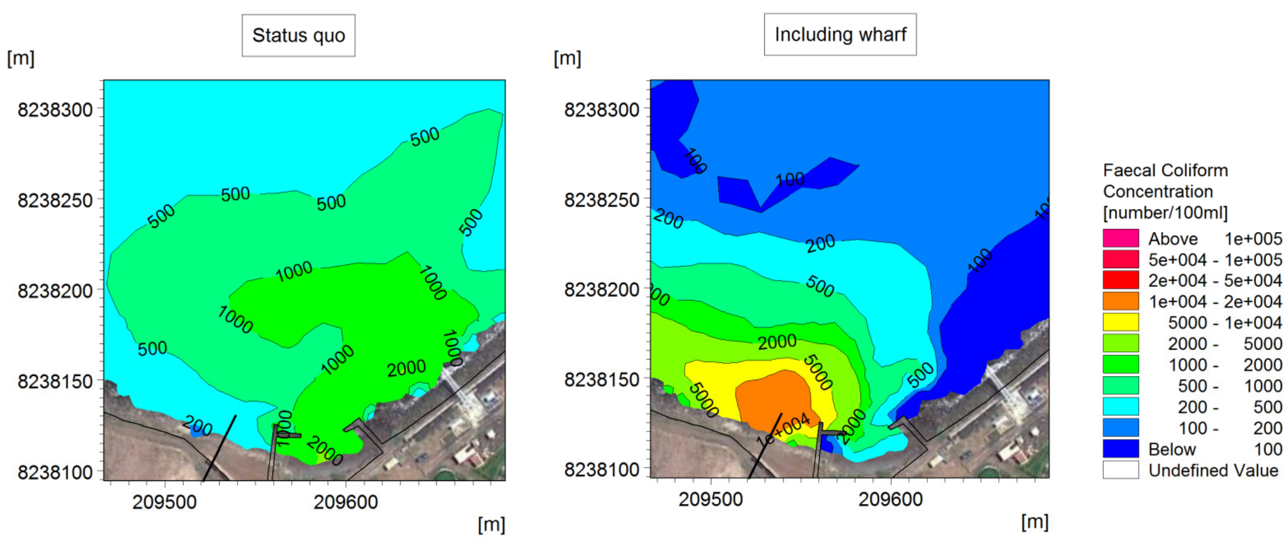
Following from the changes to the current circulation in the bay due to the proposed wharf, maximum concentrations exceeding 100 coliforms per 100 ml are confined to the south-western part of the bay. However, maximum concentrations at the discharge point are higher and reach a concentration of over 50 000 coliforms per 100 ml. Since the currents flow in the north-westerly direction at the discharge point, the maximum concentration reached at the swimming beach is approximately 1 000 coliforms per 100 ml, i.e. less than half the concentration for the status quo.

Figure 5-21: Maximum near-bottom faecal coliforms



Wharf\PMH\4. Models\ECOLab\05\Post Processing B\Coli_Bottom_Max.png

Figure 5-22: Maximum near-bottom coliforms: swimming beach detail



Wharf\PMH\4. Models\ECOLab\05\Post Processing B\Coli_Bottom_Max_Zoomed.png

5.4.3.3 Water quality guideline concentrations

In this section, the faecal coliform concentrations in Rupert's Bay are presented against published United Kingdom water quality guidelines for bathing (EEC, 1975). The following guideline faecal coliform concentrations are specified for marine water used for recreation:

- No more than 100 coliforms per 100 ml (80^{th} percentile of samples)
- No more than 2 000 coliforms per 100 ml (95^{th} percentile of samples)

In order to assess whether the above guidelines are exceeded in Rupert's Bay, this section presents the modelled 80^{th} and 95^{th} percentile concentrations of faecal coliforms. The 80^{th} and 95^{th} percentile concentrations were calculated from the half-hourly concentrations throughout the 15 day model simulation in each model element. Figure 5-23 and Figure 5-24 present the 80^{th} percentile of near-surface and near-bottom coliform concentrations. The yellow areas indicate where the guideline is exceeded.

Under the status quo, the guideline is exceeded at the swimming beach and along the coast directly north thereof. Following from the changes to the current circulation due to the proposed wharf, the 80^{th} percentile is no longer exceeded at the swimming beach, but is exceeded along the coast between the discharge point and the proposed wharf.

Figure 5-25 and Figure 5-26 present the 95^{th} percentile of near-surface and near-bottom coliform concentrations. The yellow areas indicate where the guideline of 2 000 coliforms per 100 ml is exceeded. At the status quo, the guideline is exceeded at the discharge point only near the surface. After the construction of the wharf, the guideline is expected to be exceeded both near the surface and near the bottom. In neither of the cases is the guideline exceeded at the swimming beach.

Figure 5-23: 80th percentile near-surface faecal coliforms

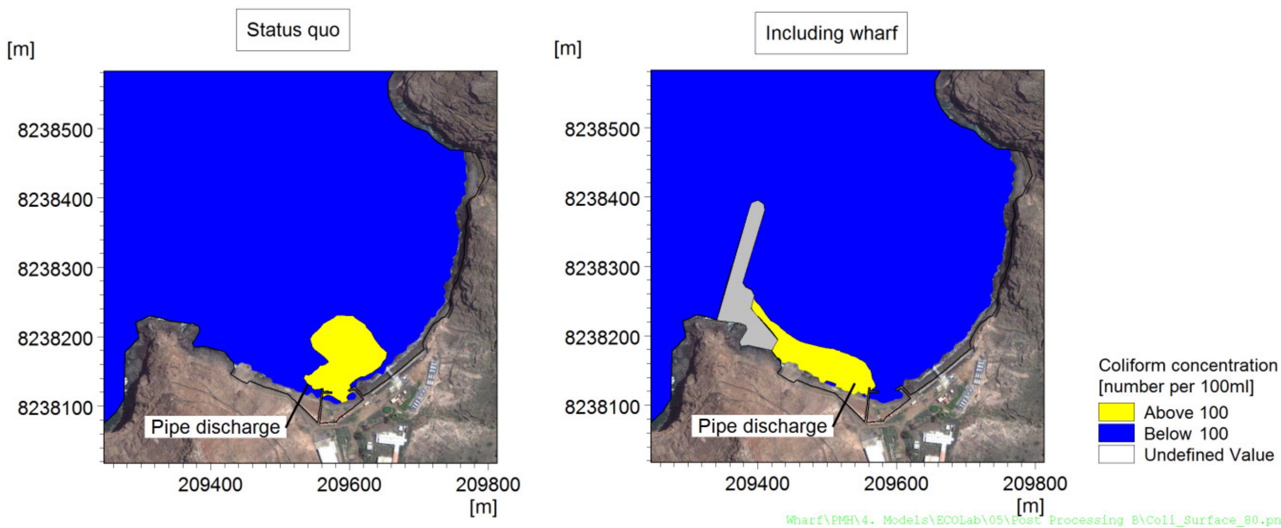


Figure 5-24: 80th percentile near-bottom faecal coliforms

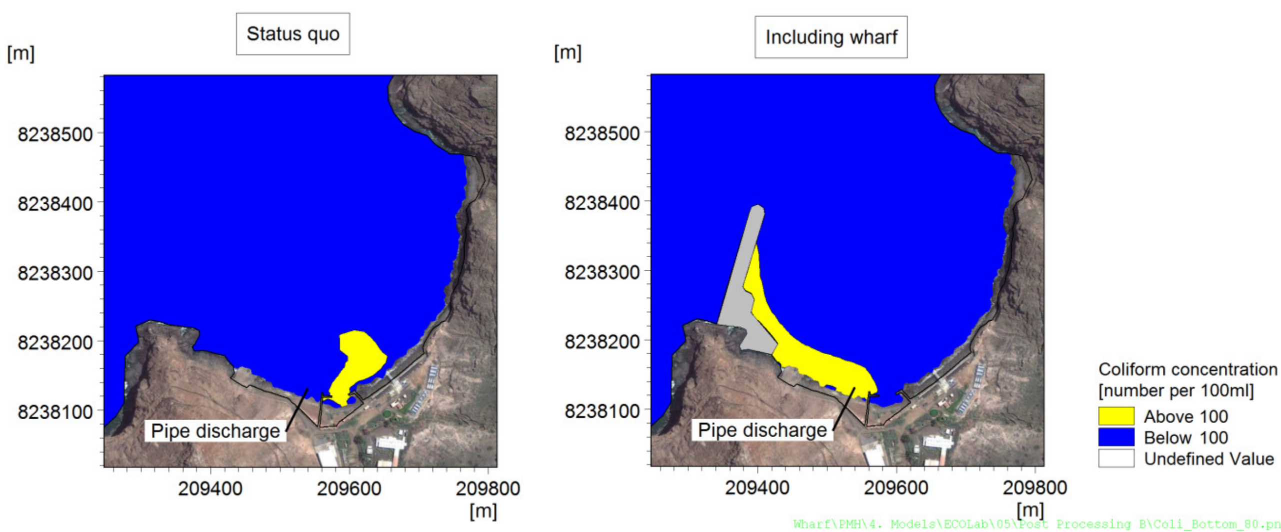


Figure 5-25: 95th percentile near-surface faecal coliforms

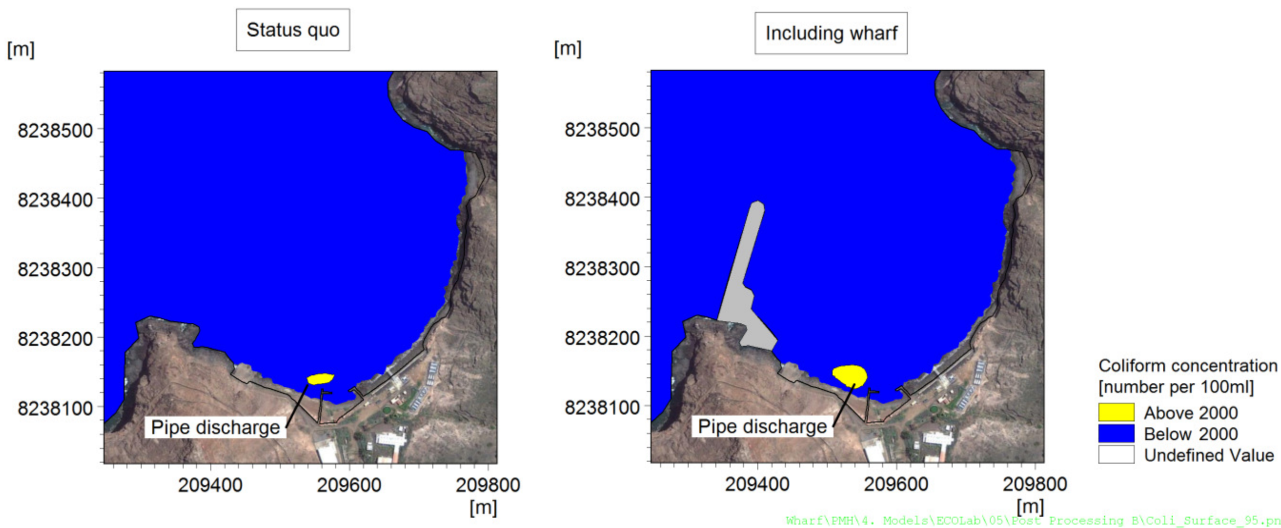
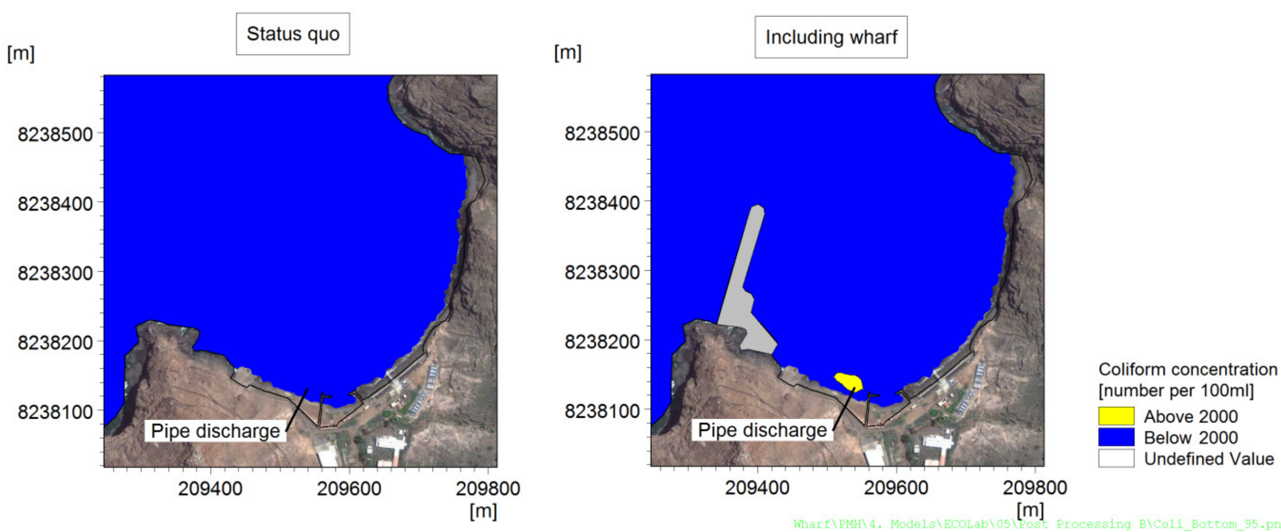


Figure 5-26: 95th percentile near-bottom faecal coliforms



6. CONCLUSIONS

A 3D hydrodynamic model was used to simulate the currents in Rupert's Bay due to tides, winds and waves. The impact of the proposed wharf on the water circulation in the bay was investigated by including the wharf in the model.

Results of this analysis indicate that the wharf will result in the partial deflection of tidal currents from Rupert's Bay. Mean current speeds show a minor reduction in the lee and outside the wharf structure. The wharf causes significant wave sheltering in the south-western region of Rupert's Bay. This sheltering reduces the wave-driven currents in the lee of the wharf such that the existing rip current is translated and deflected to flow toward the wharf and ultimately follows the wharf offshore.

Water quality modelling was performed to determine the impact of the proposed wharf on the dispersion of faecal coliforms from a sewage discharge into Rupert's Bay. The changed current patterns due to the construction of the wharf were found to change the transport of faecal coliforms in the bay. Although there is uncertainty in both the flow rate and the sewage quality of the discharge, which implies a corresponding uncertainty in the modelled faecal coliform concentrations, the model results indicate that the water quality guidelines for sewage contamination are exceeded within Rupert's Bay.

At the status quo, the water quality guideline 80th percentile coliform concentration is exceeded in a region from the discharge point to the swimming beach. The guideline 95th percentile concentration is only exceeded in a small area surrounding the discharge point.

Following construction of the wharf, the 80th percentile guideline is exceeded in the region between the discharge point and the wharf, but no longer at the swimming beach. The 95th percentile guideline concentration remains confined to a small area surrounding the discharge point.

In summary, the impact of the wharf is a minor reduction in water circulation in Rupert's Bay and a moderate increase in the faecal coliform concentrations in the south-western corner of the bay. However, the change in the current direction caused by the wharf tends to transport the sewage away from the swimming beach, thus resulting in a moderate improvement in the water quality at the swimming beach compared to the status quo.

7. REFERENCES

Alberta Environmental Protection, 1997. *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems,* Alberta: Alberta Environmental Protection.

ASCE, 2007. *Gravity Sanitary Sewer Design and Construction: ASCE Manuals and Reports on Engineering Practice No. 6: WEF Manual of Practice No. FD-5.* 2nd ed. Virginia: ASCE.

DHI, 2012a. *MIKE by DHI Flow Flexible Mesh Model, User Guide,* Copenhagen, Denmark: Danish Hydraulics Institute.

DHI, 2012b. *MIKE by DHI Flow Flexible Mesh, Scientific Documentation,* Copenhagen, Denmark: Danish Hydraulics Institute.

DHI, 2012c. *MIKE by DHI, Spectral Waves FM Module, User Guide,* Copenhagen, Denmark: Danish Hydraulics Institute.

DHI, 2012d. *MIKE by DHI, Spectral Waves FM Module, Scientific Documentation,* Copenhagen, Denmark: Danish Hydraulics Institute.

DHI, 2012e. *MIKE by DHI ECOLAB, User Guide,* Copenhagen: Danish Hydraulics Institute.

DHI, 2012f. *MIKE by DHI, ECOLAB, Scientific Documentation,* Copenhagen: Danish Hydraulics Institute.

DHI, 2012g. *MIKE by DHI, Water Quality Templates, Scientific Description,* Copenhagen: Danish Hydraulics Institute.

EEC, 1975. *Council Directive of 8 December 1975 concerning the quality of bathing water (76/160/EEC).* Official Journal of the European Communities: European Economic Community.

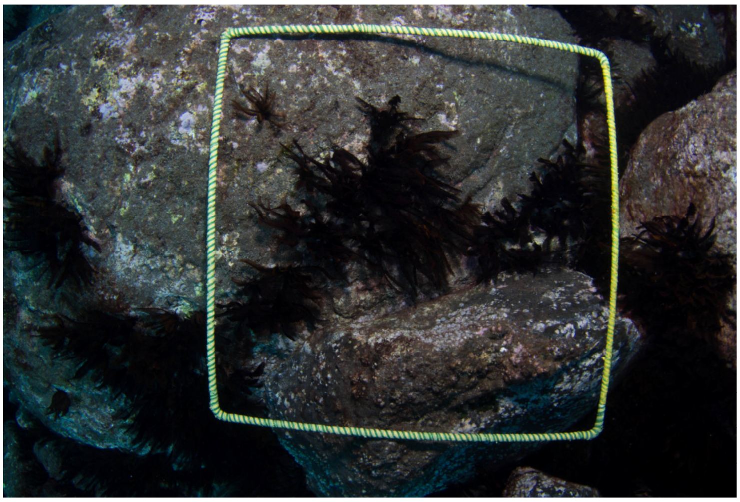
Henze, M., 2008. *Biological Wastewater Treatment: Principles, Modelling and Design.* 1st ed. London: IWA Publishing.

PRDW, 2013a. *St. Helena Island, Rupert's Bay Permanent Wharf - Phase 2, Coastal Processes Report. Report No. 1097/02/02,* Cape Town: PRDW.

Tritan, 2006. *Geophysical Survey and Data Quality Report of the Rupert's Bay Bathymetric, Side-Scan Sonar and 'Pinger' Seismic Survey, St. Helena. Report No. FR-2007-5633,* Cape Town: Tritan Survey cc.

Tritan, 2012. *Survey Report, St. Helena Airport Project, Site Visit - 30th December 2011 to 23rd January 2013.,* Cape Town: Tritan Survey cc.

UK Hydrographic Office, 2002. *Admiralty Sailing Directions, Africa Pilot, Volume II.* 13th ed. Taunton, England: United Kingdom Hydrographic Office.



Marine Ecology Survey
at Rupert's Bay, St Helena
in conjunction with the Air Access Project

Prepared by:
Mrs E Clingham and Dr. J Brown
Marine Conservation Officer and Marine Darwin Project Manager
Marine Section
Environmental Management Directorate
St Helena Island
26 March 2013

Contents

1. BACKGROUND

The Marine section of the Environmental Management Directorate (EMD) conducted a marine ecology survey of Rupert's Bay, within the area of the *newly* proposed jetty as part of the air access project.

Basil Reid dive contractors had already marked the outline of the proposed jetty with blue buoys. Within the marked area the survey team were able to conduct an exploration dive to decide the best locations for marine ecology and habitat surveys to fully represent the area of proposed development.

From this exploratory dive it was decided that there was a need to conduct surveys at three different sites within the area, two surveys would be required along the length of the proposed jetty and the other would be done parallel to shore.

The survey methodology used to conduct these surveys is slightly different to the surveys conducted by the marine section in 2006. The new survey methods are more comprehensive than the method used previously as it covers all fish and inveterate life within a larger belt survey area. The methodology used to conduct surveys is outlined below.

2. SURVEY LOCATIONS AND METHODOLOGY

2.1 Survey location details:

Location Lat 15^{o} 9' 17" N Long 5^{o}7' 15" W	**Details of location**	**Survey Code**	**Data collectors** **Marine Ecology Surveys**	**Quadrant photographer**
Rupert's Bay	1st survey parallel to length of jetty	130325 Q1	Leeann Henry (LH) and Annalea Beard (AB)	Steve Brown
Rupert's Bay	2nd survey parallel to length of jetty	130325 Q2	Leeann Henry (LH) and Annalea Beard (AB)	Elizabeth Clingham
Rupert's Bay	3rd survey parallel to shore	130325 Q3	Elizabeth Clingham (EC) and Judith Brown (JB)	Annalea Beard, Leeann Henry and Steve Brown

2.2 Methodology

A fifty metre transect line was laid down from a pre-defined position on the seabed. The dive team consisted of three people (two data collectors and a camera man). On the first count along the transact line two divers record all invertebrate and benthic (bottom dwelling) fish species in a one metre belt either side of the transect tape for the full fifty metres. The cameraman follows a few metres behind the data collectors and takes photographs of a 0.5m^2 quadrat placed on the seabed every two meters along the transect line. Photographs are alternated from one side of the transect line to the other. Photo quadrats will be analysed later for determination of habitat (percentage cover) and any small immobile species. Upon completion of the invertebrate/benthic species count the recording sheets were turned over and the second survey commenced. During the return swim along the 50m transect line all other fish species within a 5m belt either side of the transect line were counted. At the end of the dive all surveyors complete a predefined JNCC habitat classification form (see appendix 1 for guidance notes on habitat form).

3. DATA COLLECTED

3.1 Marine ecology data

Table 1: All invertebrate and benthic fish species in a 50m^2 survey

Date:	25/03/2013	25/03/2013	25/03/2013	25/03/2013	25/03/2013	25/03/2013
Site code:	Q1	Q1	Q2	Q2	Q3	Q3
Site	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay
Surveyors:	AB	LH	AB	LH	JB	EC
Start Depth:	11.4	10.2	12.3	12.8	9.6	6.9
End Depth	12.4	12.2	13	13.6	7.8	10.3
Habitat	Sand	Sand	Sand	Sand	Bedrock & large/small boulders	Bedrock & large boulders
Brown moray					1	
Redlip blenny					5	5
Textile blenny						
Auxillary-spot cardinalfish						1
Diamond lizardfish					1	
St Helena flounder			1	1		
Red spotted hawkfish					1	2
8-armed starfish					1	3
Pencil urchin –long spine					24	10
Pencil urchin –short spine					5	1
Black longspined urchin					40	43
Black short spine urchin						12
Hermit crab stripey legs					2	2
Spray crab					2	
Fireworm (*Hermodice*)					11	3
Parchment worm	3					
Whelk (*Monoplex* sp.)						10
Cowrie shell						2

Table 2: All other fish species in a 250m^2 survey (A=adult, J= juvenile)

Date:	25/03/2013	25/03/2013	25/03/2013	25/03/2013	25/03/2013	25/03/2013
Site code:	Q1	Q1	Q2	Q2	Q3	Q3
Site	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay	Rupert's Bay
Surveyors:	AB	LH	AB	LH	JB	EC
Start Depth:	11.4	10.2	12.3	12.8	9.6	6.9
End Depth	12.4	12.2	13	13.6	7.8	10.3
Habitat	Sand	Sand	Sand	Sand	Bedrock & large/small boulders	Bedrock & large boulders
Black triggerfish/durgon						
Ocean triggerfish						
Sea Chub						3
Pompano	1	1				12
Stonebrass Scad (yellow tail)	46	200				
Ocean surgeonfish					9	23
Hedgehog butterflyfish					1	1
St Helena butterflyfish	10	25			5	200
Brown chromis					80	200
St Helena Gregory A			1		135	40
St Helena Gregory J			3	3	4	
Sergeant major	2					
Sea bream					3	3
Trumpetfish					5	7
St Helena pufferfish			1	1		3
St Helena wrasse A					8	23
St Helena wrasse J					3	7
Island hogfish A					2	5
Island hogfish J						
St Helena Parrotfish					6	9
Rockhind						1
Squirrelfish					2	

3.2 Marine habitat data

(See appendix 1 for JNCC guidance notes for completion of forms).

Q1 & Q2

130325 Q1 & Q2

Survey no.
Site no.
Field site no.

MARINE NATURE CONSERVATION REVIEW

SUBLITTORAL HABITAT (DETAILED)

JOINT NATURE CONSERVATION COMMITTEE

Site name: Ruperts Bay

Hab. no.	Position within site (extensive sites only)	No. of cores	Sieved vol. (l)	Infaunal sample no.	Granul. sample no.

SURVEYORS

AB, LH, JB, SB, EC

m	DEPTH LIMITS
10	Upper (from sea level)
14	Lower "
	Upper (from chart datum)
	Lower "

✓	DEPTH BAND
	0-5 m
	5-10 m
✓	10-20 m
	20-30 m
	30-50 m
	>50 m

✓	ZONE
	Sublittoral fringe
	Infralittoral
	- upper
	- lower
	Circalittoral
✓	- upper
	- lower
	Not applicable

✓	EXTENT OF RECORD
	Multiple habitats (whole area)
✓	Zone / depth band
	Restricted feature

SURVEY QUALITY

Flora	Fauna	
✓	✓	Thorough
		Adequate
		Incomplete

%	SUBSTRATUM	
	Bedrock	
	Boulders	
	- very large	>1024 mm
	- large	512-1024 mm
1	- small	256-512 mm
	Cobbles	64-256 mm
	Pebbles	16-64 mm
	Gravel	4-16 mm
	- stone	
	- shell	
	- dead maerl	
	- live maerl	
	Sand	
	- coarse	1-4 mm
5	- medium	0.25-1 mm
93	- fine	0.063-0.25 mm
	Mud	<0.063 mm
	Shells (empty)	
	Artificial	
1	- metal	
	- concrete	
	- wood	
	Trees / branches	
	Algae	
	....	
100	Total	

%	INCLINATION	
	Overhangs	
	Vertical faces	(80-100°)
	Very steep faces	(40-80°)
100	Upper faces	(0-40°)
	Underboulders	
100	Total	

1-5	FEATURES - ROCK	
	Surface relief	(even-rugged)
	Texture(smooth-pitted)	
	Stability	(stable-mobile)
	Scour	(none-scoured)
	Silt	(none-silted)
	Fissures >10mm	(none-many)
	Crevices <10mm	(none-many)
	Boulder/cobble/pebble shape	(rounded-angular)

✓	
	Gully
	Cave
	Tunnel
	Rockmill
	Boulder/cobble - on rock
✓	Boulder/cobble - on sediment
	Boulder holes
	Sediment on rock

✓	MODIFIERS	
	Freshwater runoff	
✓	Wave exposure	- wave surged
		- sheltered
	Tidal streams	- accelerated
		- decelerated
	Grazing	
	Shading	
	Pollution	

1-5	FEATURES - SEDIMENT	
2	Surface relief	(even-uneven)
4	Firmness	(firm-soft)
4	Stability	(stable-mobile)
2	Sorting	(well-poor)

✓	
	Mounds / casts
✓	Burrows / holes
✓	Tubes
	Algal mat
	Waves / dunes (>10 cm high)
✓	Ripples(<10 cm high)
	Subsurface black layer
	Subsurface coarse layer
✓	Subsurface clay / mud
	Surface silt / flocculent

1-5	ASSESSMENT	
4	Representativeness(atyp/tran/typ)	
5	Naturalness	(unnat.-nat.)
5	Extent	(limit.-exten.)
2	Species richness	(low-high)
2	Abundance/biomass(low-high)	

MAIN COVER OR CHARACTERISING SPECIES / TAXA

Abund.	Species / taxon
3	Bluntnose lizard fish.
1	Bastard cavelly Pilot
1	Pompano
2	cunning fish.
2	Flouders
1	old wife
1	spotted moray
1	St Helena pufferfish.
1	crowper
1	feather stars
2	blennys (Gold spotted Gobys)
1	Tube worms
1	Devil worms.

Q3

130325 Q3

MARINE NATURE CONSERVATION REVIEW
SUBLITTORAL HABITAT (DETAILED)

JOINT NATURE CONSERVATION COMMITTEE

Survey no.
Site no.
Field site no.

Site name: Ruperts Bay

Hab. no.	Position within site (extensive sites only)	No. of cores	Sieved vol. (l)	Infaunal sample no.	Granul. sample no.

	SURVEYORS
	AB, LH, JB, SB, EC

m	DEPTH LIMITS
6.4	Upper (from sea level)
16	Lower "
	Upper (from chart datum)
	Lower "

✓	DEPTH BAND
	0-5 m
✓	5-10 m
	10-20 m
	20-30 m
	30-50 m
	>50 m

✓	ZONE
	Sublittoral fringe
	Infralittoral
	- upper
	- lower
	Circalittoral
✓	- upper
	- lower
	Not applicable

✓	EXTENT OF RECORD
	Multiple habitats (whole area)
✓	Zone / depth band
	Restricted feature

Flora	Fauna	SURVEY QUALITY
	✓	Thorough
✓		Adequate
		Incomplete

%	SUBSTRATUM	
50	Bedrock	
	Boulders	
25	- very large	>1024 mm
20	- large	512-1024 mm
3	- small	256-512 mm
	Cobbles	64-256 mm
	Pebbles	16-64 mm
	Gravel	4-16 mm
	- stone	
	- shell	
	- dead maerl	
	- live maerl	
	Sand	
2	- coarse	1-4 mm
	- medium	0.25-1 mm
	- fine	0.063-0.25 mm
	Mud	<0.063 mm
	Shells (empty)	
	Artificial	
	- metal	
	- concrete	
	- wood	
	Trees / branches	
	Algae	
	....	
100	Total	

%	INCLINATION	
	Overhangs	
20	Vertical faces	(80-100°)
80	Very steep faces	(40-80°)
	Upper faces	(0-40°)
	Underboulders	
100	Total	

1-5	FEATURES - ROCK	
3	Surface relief	(even-rugged)
4	Texture(smooth-pitted)	
1	Stability	(stable-mobile)
2	Scour	(none-scoured)
1	Silt	(none-silted)
1	Fissures >10mm	(none-many)
1	Crevices <10mm	(none-many)
4	Boulder/cobble/pebble shape	(rounded-angular)

✓	
	Gully
	Cave
	Tunnel
	Rockmill
✓	Boulder/cobble - on rock
	Boulder/cobble - on sediment
✓	Boulder holes
	Sediment on rock

✓	MODIFIERS	
	Freshwater runoff	
✓	Wave exposure	- wave surged
		- sheltered
	Tidal streams	- accelerated
		- decelerated
	Grazing	
	Shading	
	Pollution	

1-5	FEATURES - SEDIMENT	
	Surface relief	(even-uneven)
	Firmness	(firm-soft)
	Stability	(stable-mobile)
	Sorting	(well-poor)

✓	
	Mounds / casts
	Burrows / holes
	Tubes
	Algal mat
	Waves / dunes (>10 cm high)
	Ripples(<10 cm high)
	Subsurface black layer
	Subsurface coarse layer
	Subsurface clay / mud
	Surface silt / flocculent

1-5	ASSESSMENT	
4	Representativeness(atyp/tran/typ)	
5	Naturalness	(unnat.-nat.)
3	Extent	(limit.-exten.)
4	Species richness	(low-high)
4	Abundance/biomass(low-high)	

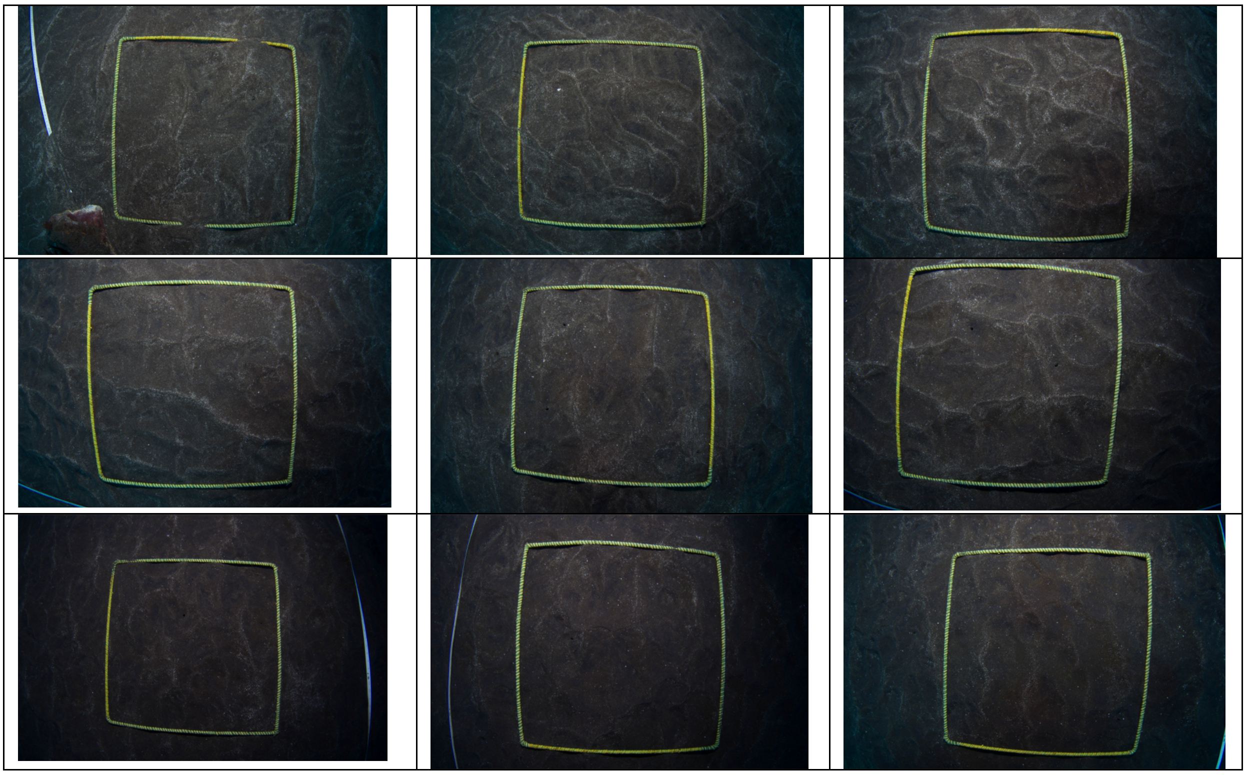
MAIN COVER OR CHARACTERISING SPECIES / TAXA

Abund.	Species / taxon
4	feather stars
2	whelks
4	long spined sea urchins
3	Black sea urchin
3	Pencil urchin long spined.
2	short spinned pencil urchin.
1	Purple star fish.
3	pompano
2	Cavelly Jack.
1	limpets
1	helmet shell
1	trigger fish.
4	Greenfish.
4	Cunning fish.
4	Bastard Cavelley pilot
3	Hogfish.
3	Parrotfish.
13	St Helena pufferfish.
1	Box fish (Cow fish)
1	lizard fish
3	trumpet fish.

3 Snitty trooper
1 berhellina
1 8 armed starfish
1 hardback soliders
1 Softback soliders
1 Grouper
1 ~~common~~ Brown moray eel
1 Hedgehog butterfly fish
2 Devilfish
1 Spray crab
3 fireworms
4 Cavelly Pilots
3 old wife
3 Yellow tail

3.3 Quadrat photographs

Q1



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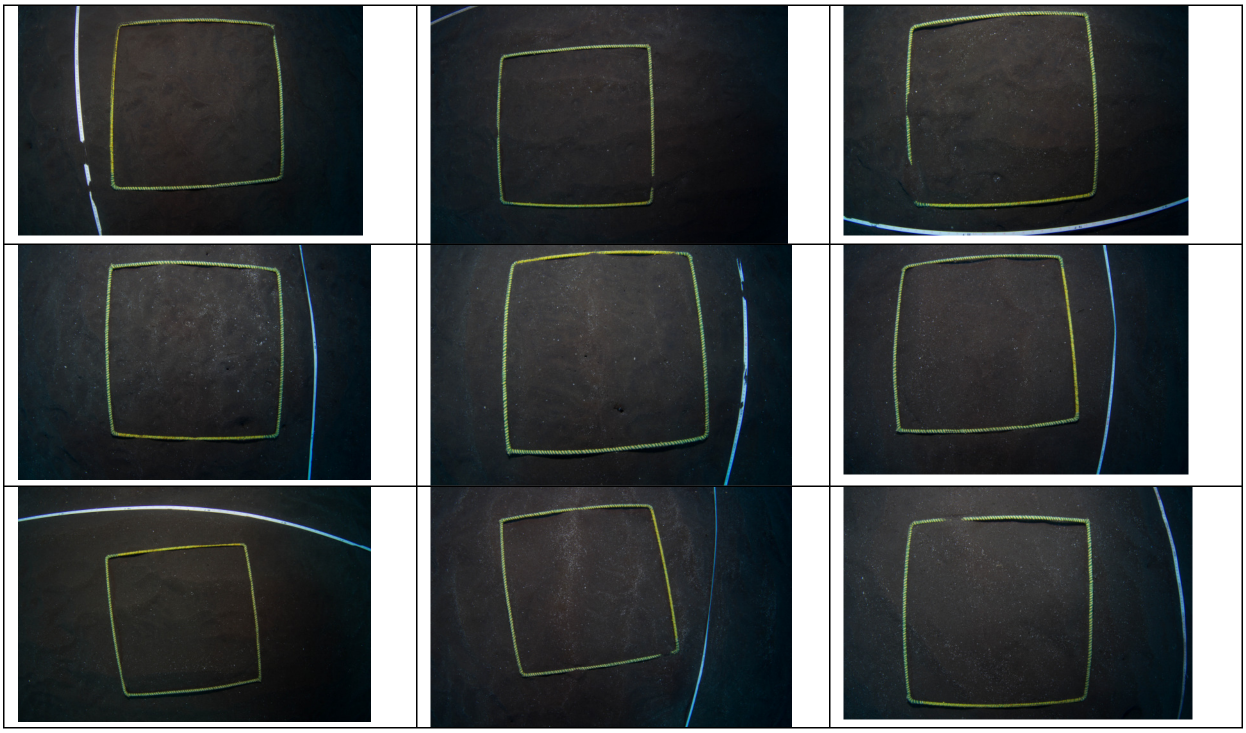
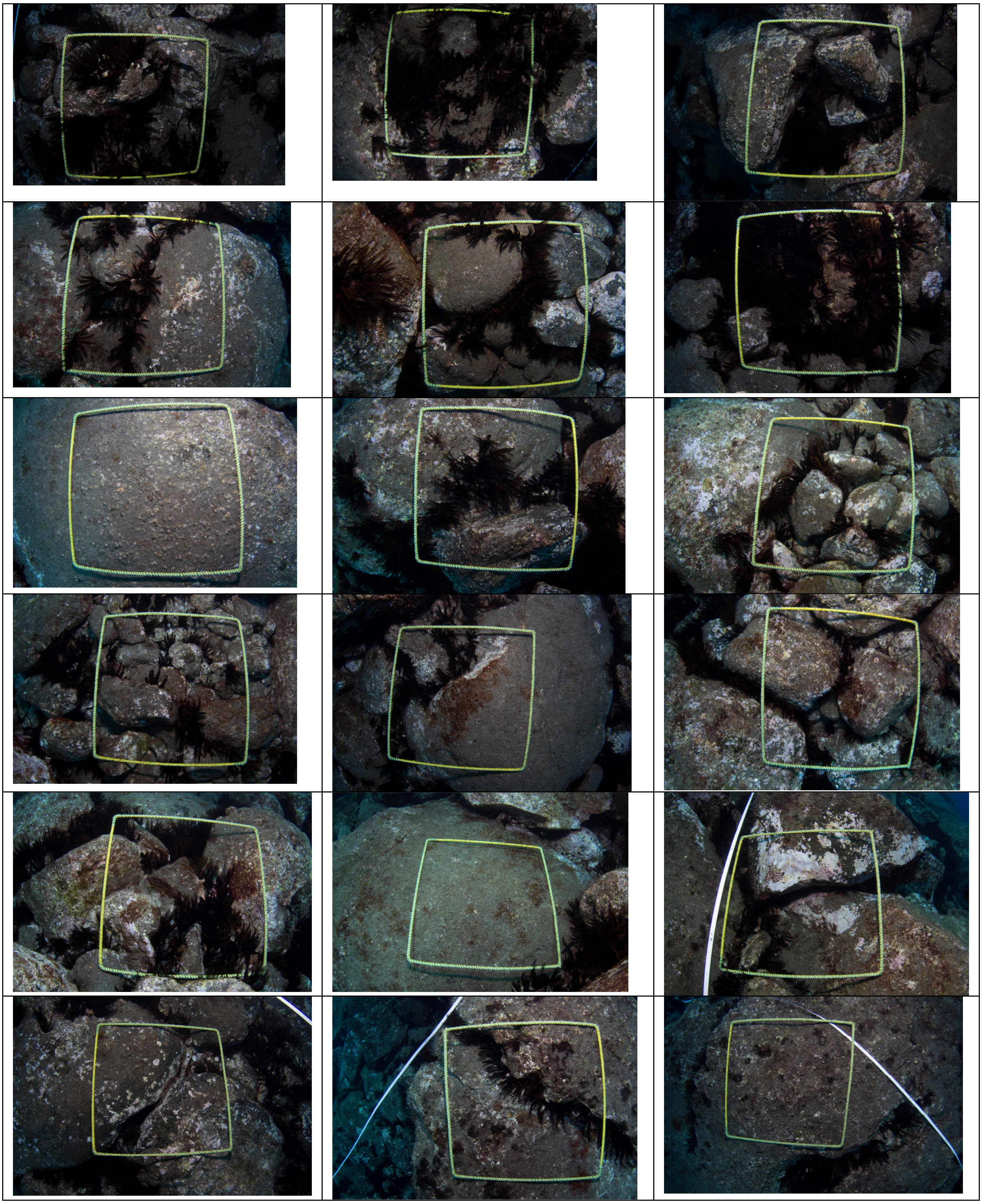
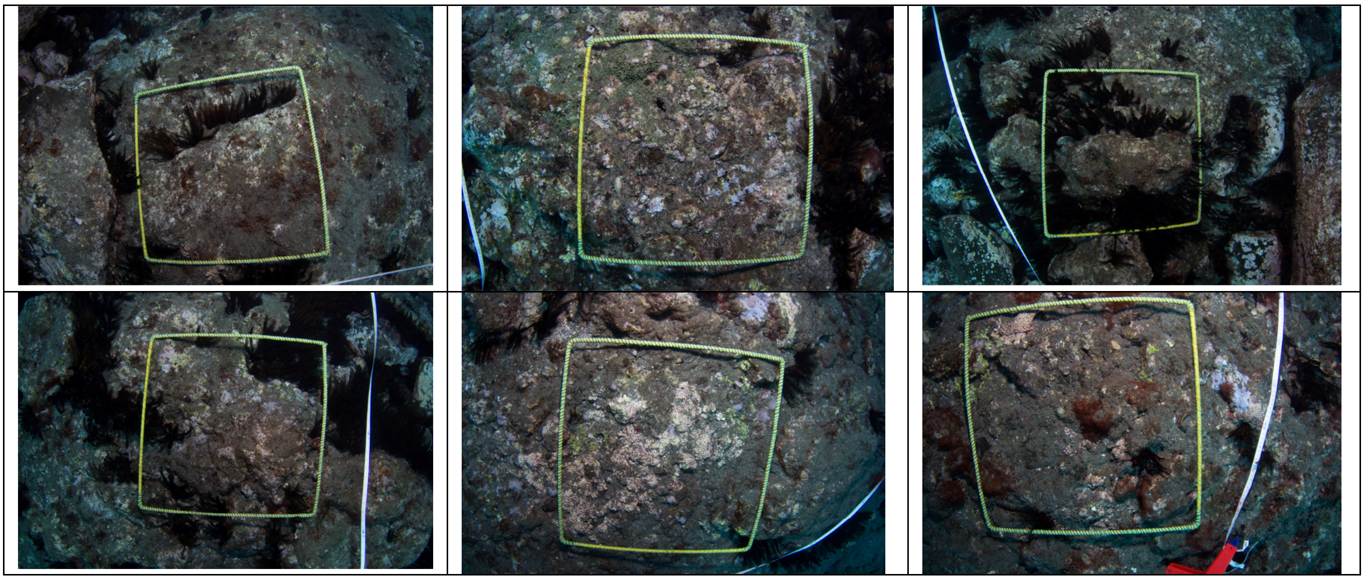


Q3





4. TURTLE SIGHTINGS

No dedicated turtle survey was conducted however a green turtle was noted swimming alongside the survey team during the exploratory dive on 21 March 2013. Historical data (since 1999) on turtle presence in Rupert's Bay has also been collected from marine sightings with 16 reports of green turtles, 84 reports of hawksbill turtles, 15 unidentified turtles and 1 report of a leatherback turtle (Table 3).

Table 3: Historical turtle sightings in Rupert's Bay

Date	Type of Sighting	Species Common Name	Location Description	Time	Range of Individuals Seen	Approximate Number of Adults
29/09/2011	Turtle	Hawksbill Turtle			1	
29/09/2011	Turtle	Hawksbill Turtle		11:00	1	
07/06/2011	Turtle	Hawksbill Turtle		13:00	1	
06/06/2011	Turtle	Hawksbill Turtle		14:00	1	
30/03/2011	Turtle	Hawksbill Turtle	Near the landing platform.	14:15	1	1
12/02/2011	Turtle	Hawksbill Turtle		13:30	1	
31/08/2010	Turtle	Hawksbill Turtle	Ruperts Bay	14:30	1	1
29/04/2010	Turtle	Green Turtle	Ruperts Bay	15:00	1	1
29/04/2010	Turtle	Green Turtle	Ruperts Bay	15:00	1	1
28/04/2010	Turtle	Hawksbill Turtle	Ruperts Bay	15:00	1	1
10/04/2010	Turtle	Hawksbill Turtle	Ruperts Bay	12:00	1	1
03/09/2009	Turtle	Hawksbill Turtle	Ruperts Bay	13:35	1	1
12/08/2009	Turtle	Hawksbill Turtle	Ruperts Bay	15:30	1	1
05/08/2009	Turtle	Hawksbill Turtle	Ruperts Bay	14:50	1	1
15/06/2009	Turtle	Hawksbill Turtle	Ruperts Bay	14:00	1	1
04/06/2009	Turtle	Hawksbill Turtle	Ruperts Bay	14:00	1	1
15/05/2009	Turtle	Hawksbill Turtle	Ruperts Bay	17:00	1	1
13/05/2009	Turtle	Hawksbill Turtle	Ruperts Bay	13:30	02-Apr	2
10/05/2009	Turtle	Hawksbill Turtle	Ruperts Bay	15:00	1	1
05/05/2009	Turtle	Hawksbill Turtle	Ruperts Bay	13:20	1	1
29/04/2009	Turtle	Hawksbill Turtle	Ruperts Bay	13:05	1	1
14/04/2009	Turtle	Hawksbill Turtle	Ruperts Bay	13:40	1	1
20/01/2009	Turtle	Hawksbill Turtle	Ruperts Bay	14:15	1	1
16/12/2008	Turtle	Hawksbill Turtle	Ruperts Bay	13:30	1	1
10/11/2008	Turtle	Hawksbill Turtle	Ruperts Bay	14:45	1	1
01/10/2008	Turtle	Hawksbill Turtle	Ruperts Bay	14:00	1	1
11/06/2008	Turtle	Hawksbill Turtle	Ruperts Bay	09:50	1	1
20/04/2008	Turtle	Green Turtle	15°54.814'S 005°42.776'W	09:28	1	1
04/04/2008	Turtle	Hawksbill Turtle	Ruperts Bay	14:15	1	1

02/04/2008	Turtle	Hawksbill Turtle	Ruperts Bay	12:50	1	1
29/12/2007	Turtle	Hawksbill Turtle	Ruperts Bay	12:45	1	1
20/11/2007	Turtle	Hawksbill Turtle	Ruperts Bay	15:05	1	1
09/11/2007	Turtle	Hawksbill Turtle	Ruperts Bay	09:50	1	1
09/11/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:30	1	
05/11/2006	Turtle	Hawksbill Turtle	Ruperts Bay	02:00	02-Apr	2
26/10/2006	Turtle	Hawksbill Turtle	Ruperts Bay Sheers	14:44	1	
24/10/2006	Turtle	Hawksbill Turtle	Ruperts Bay	17:15	02-Apr	2
11/10/2006	Turtle	Hawksbill Turtle	Ruperts Bay	14:35	1	
11/09/2006	Turtle	Hawksbill Turtle	Ruperts Bay	12:15	1	
02/09/2006	Turtle	Unknown	Ruperts Bay		1	
13/08/2006	Turtle	Hawksbill Turtle	Ruperts Bay	16:00	02-Apr	2
13/08/2006	Turtle	Unknown	Ruperts Bay	15:45	1	
02/08/2006	Turtle	Hawksbill Turtle	Ruperts Bay		1	
31/07/2006	Turtle	Hawksbill Turtle	Ruperts Bay	15:05	1	
26/07/2006	Turtle	Hawksbill Turtle	Ruperts Bay		1	
05/07/2006	Turtle	Hawksbill Turtle	Ruperts Bay	15:10	1	
27/06/2006	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	2
19/06/2006	Turtle	Hawksbill Turtle	Ruperts Bay	15:00	1	
07/06/2006	Turtle	Green Turtle	Ruperts Bay		1	
25/05/2006	Turtle	Hawksbill Turtle	Ruperts Bay	14:30	1	
22/05/2006	Turtle	Hawksbill Turtle	Ruperts Bay		1	
09/05/2006	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)	10:10	1	
06/05/2006	Turtle	Hawksbill Turtle	Ruperts Bay	15:15	1	
03/05/2006	Turtle	Hawksbill Turtle	Ruperts Bay		1	
02/05/2006	Turtle	Hawksbill Turtle	Ruperts Bay	16:30	1	
28/04/2006	Turtle	Hawksbill Turtle	Ruperts Bay		1	
22/04/2006	Turtle	Hawksbill Turtle	Ruperts Bay	14:00	02-Apr	4
20/04/2006	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	4
04/04/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:50	1	
03/04/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:00	1	
30/03/2006	Turtle	Green Turtle	Ruperts Bay	13:45	1	
27/03/2006	Turtle	Green Turtle	Ruperts Bay		1	
23/03/2006	Turtle	Green Turtle	Ruperts Bay	13:15	1	
23/03/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:15	1	
21/03/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:00	02-Apr	2
18/03/2006	Turtle	Hawksbill Turtle	Ruperts Bay	15:00	1	
17/03/2006	Turtle	Unknown	Ruperts Bay		02-Apr	2
14/03/2006	Turtle	Hawksbill Turtle	Ruperts Bay	17:00	1	
13/03/2006	Turtle	Hawksbill Turtle	Ruperts Bay	11:10	1	
25/01/2006	Turtle	Green Turtle	Ruperts Bay	15:20	1	
24/01/2006	Turtle	Green Turtle	Ruperts Bay		1	
19/01/2006	Turtle	Hawksbill Turtle	Ruperts Bay	14:45	1	
18/01/2006	Turtle	Green Turtle	Ruperts Bay	14:00	1	

18/01/2006	Turtle	Unknown	Ruperts Bay		1	1
12/01/2006	Turtle	Hawksbill Turtle	Ruperts Bay	13:25	1	
06/01/2006	Turtle	Green Turtle	Ruperts Bay		1	
03/01/2006	Turtle	Unknown	Ruperts Bay	15:00	1	
12/12/2005	Turtle	Hawksbill Turtle	Ruperts Bay	10:30	1	
13/09/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
12/09/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
26/08/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
08/08/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
21/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
20/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
19/06/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
19/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
18/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
17/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
16/06/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
05/06/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
05/06/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
04/06/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
03/06/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
29/05/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
27/05/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
26/05/2005	Turtle	Hawksbill Turtle	Ruperts Bay		1	
20/05/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
25/03/2005	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	4
19/03/2005	Turtle	Hawksbill Turtle	Ruperts (landing Jetty)		1	
28/02/2005	Turtle	Unknown	Ruperts Bay		1	
24/02/2005	Turtle	Hawksbill Turtle	Ruperts Bay	06:00	1	
24/02/2005	Turtle	Green Turtle	Ruperts Bay	06:00	1	
20/02/2005	Turtle	Green Turtle	Ruperts Bay		1	
06/02/2005	Turtle	Green Turtle	Ruperts Bay		1	
06/02/2005	Turtle	Leatherback Turtle	Ruperts Bay		1	
06/02/2005	Turtle	Hawksbill Turtle	Ruperts Bay	18:00	1	
05/02/2005	Turtle	Unknown	Ruperts Bay		1	
02/02/2005	Turtle	Hawksbill Turtle	Ruperts Bay	18:00	02-Apr	2
31/01/2005	Turtle	Green Turtle	Ruperts Bay	12:30	1	
28/01/2005	Turtle	Unknown	Ruperts Bay		02-Apr	2
18/01/2005	Turtle	Unknown	Ruperts Bay		1	
24/12/2004	Turtle	Unknown	Ruperts Bay		1	
12/11/2004	Turtle	Unknown	Ruperts Bay	17:00	1	
10/11/2004	Turtle	Hawksbill Turtle	Ruperts Bay		1	
27/09/2004	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	2
22/09/2004	Turtle	Hawksbill Turtle	Ruperts Bay	08:00	1	

20/09/2004	Turtle	Hawksbill Turtle	Ruperts Bay	15:30	1	
15/09/2004	Turtle	Hawksbill Turtle	Ruperts Bay		1	
29/06/2004	Turtle	Hawksbill Turtle	Ruperts Bay		1	
08/05/2004	Turtle	Unknown	Ruperts Bay		21-30	
28/06/1999	Turtle	Hawksbill Turtle	Ruperts Bay		1	
12/06/1999	Turtle	Unknown	Ruperts Bay		05-Oct	6
30/04/1999	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	
06/04/1999	Turtle	Hawksbill Turtle	Ruperts Bay		02-Apr	4
26/03/1999	Turtle	Unknown	Ruperts Bay		1	
13/03/1999	Turtle	Unknown	Ruperts Bay		1	
17/02/1999	Turtle	Green Turtle	Ruperts Bay		02-Apr	2

5. Discussion

The marine ecology surveys from Ruperts Bay show that there is a low diversity of both the fish and invertebrate fauna found on the sand areas where the proposed jetty will be situated. There were numerous worm holes seen within the sand habitat and these surveys did not cover any of the infauna species which will be impacted by disturbance of the sediments. However, the proposed impacted habitat area is small compared with the size of the sand habitat in the bay. This survey also did not examine any impacts from movements of sediments due to construction of a large jetty in the mouth of the bay.

There was a greater species richness and diversity within the rock habitat close inshore, including some endemic species. The proposed jetty will impact these species, however as this is a relatively small area and this is not a rare habitat type the impact should be minimal.

From the historical marine sightings there have been frequent turtle sightings in the Ruperts Bay area. Although this is not a breeding area for this species mitigation measures should be put in place to ensure no plastic litter is discarded during the construction (and post construction) which can cause potential harm to turtles.

Appendix I – JNCC guidance notes for completion of marine habitat forms.

Habitat forms

The front page of these forms is for a description of the main characteristics, physical and biological, of each separate habitat investigated. Species present are noted on the remaining pages. The **intermediate** forms allow for up to three habitat records to be made per form.

Because the **littoral** and **sublittoral** versions and the **intermediate** and **detailed** versions are all similar in format and content, details for all versions are given together here. Some categories may not therefore appear on particular forms.

At the top of each set of boxes the type of information required is shown:

✓	=	tick one only
✓✓	=	tick as many as apply
1-5	=	score as appropriate
%	=	give estimated percentage of the total encountered
Abund.	=	give abundance of taxon on the MNCR SACFOR abundance scale (Superabundant, Abundant, Common, Frequent, Occasional, Rare)

GENERAL DETAILS

Survey no., Site no., Field site no. - As on the associated site form.

Site name - As on the associated site form.

Habitat number - A sequential number allocated to each habitat within the site. Habitat numbers should run from the highest or shallowest habitat (= 1) to the lowest or deepest.

Position within site - For most sites, this section will not have to be completed as the position on the site form will be sufficiently accurate. However, it should be completed where the site covers a large area, such as an extensive sediment flat and the location of the habitat or station is significantly different to the central site location on the site form.

Number of cores - Give the number of infaunal core samples taken.

Sieved volume - Note the volume in litres of sediment left after sieving (to assist later in drawing up contracts for sample sorting).

Replicate number - For remotely collected grab and dredge samples several replicates may be taken. For each the sieved volume, sample numbers and position should be noted, although they each have the same habitat number.

Sample volume - For remotely collected grab and dredge samples note the volume in litres of sediment collected (i.e. before sieving).

Infaunal sample number - Note the number code put on any label/Dymo tape with the sample. The following convention is recommended: Survey no. or a letter code for survey/Field Site no./Habitat no., e.g. 346.14.2 or MB14.2 where MB indicates survey area (in this case Morecambe Bay).

Granulometry sample number - Note the number code put on any label/Dymo tape with the sample. Use the SAME NUMBER as the infaunal sample + GS, e.g. 346.14.2GS.

SURVEYORS - Enter names of the survey staff (which may be a subset of those surveying the whole site).

HEIGHT/DEPTH LIMITS - Enter the upper and lower height or depth limits relative to sea level and relative to chart datum after correction.

HEIGHT BAND/DEPTH BAND - The appropriate height or depth band should be indicated (essential for sediment shores and all sublittoral habitats).

ZONE - These are primarily related to rocky habitats or those where algae grow (*e.g.* stable shallow sublittoral sediments).

Separate habitat records should be made for each zone. Avoid making records which span zones, especially where they cross the main zones, such as between Infralittoral and Circalittoral or Littoral fringe and Eulittoral. Additionally, records may be made for sub-habitats within a zone if appropriate (e.g. rockpools in the mid eulittoral) but note here the zone applicable.

The zones are defined below:

Supralittoral - colonised by yellow and grey lichens, above the *Littorina* populations but generally below flowering plants.

Upper littoral fringe - this is the splash zone above High Water of Spring Tides with a dense band of the black lichen by *Verrucaria maura. Littorina saxatilis* and *Littorina neritoides* often present. May include salt marsh species on shale/pebbles in shelter.

Lower littoral fringe - the *Pelvetia* (in shelter) or *Porphyra* (exposed) belt. With patchy *Verrucaria maura, Verrucaria mucosa* and *Lichina pygmaea* present above the main barnacle population. May also include salt marsh species on shale/pebbles in shelter.

Upper eulittoral - barnacles and limpets present in quantity or with dense *Fucus spiralis* in sheltered locations.

Mid eulittoral - barnacle-limpet dominated, sometimes mussels or dominated by *Fucus vesiculosus* and *Ascophyllum nodosum* in sheltered locations. *Mastocarpus stellatus* and *Palmaria palmata* patchy in lower part. Usually quite a wide belt.

Lower eulittoral - *Fucus serratus, Mastocarpus stellatus, Himanthalia elongata* or *Palmaria palmata* variously dominant; barnacles sparse.

Sublittoral fringe - dominated by *Alaria esculenta* (very exposed), *Laminaria digitata* (exposed to sheltered) or *Laminaria saccharina* (very sheltered) with encrusting coralline algae; barnacles sparse.

Upper infralittoral - dense forest of kelp.

Lower infralittoral - sparse kelp park, dominated by foliose algae except where grazed. May lack kelp.

Upper circalittoral - dominated by animals, lacking kelp but with sparse foliose algae except where grazed.

Lower circalittoral - dominated by animals with no foliose algae but encrusting coralline algae.

EXTENT OF RECORD - Tick zone/height or depth band except where the record is from a restricted feature (such as a rockpool, isolated patch of sediment or rock outcrop) or where several habitats have been recorded together (e.g. where a rapid record is made of a whole shore).

SURVEY QUALITY - Indicate the quality of records obtained from both fauna and flora.

Thorough - suggests that all conspicuous species have been recorded.

Adequate - indicates that a high proportion of conspicuous species were recorded (a few more would be found given extra time) or that you feel your expertise is such that some species may have been overlooked but you were able to record thoroughly within the habitat.

Inadequate - implies that insufficient time was spent recording the habitat or that your expertise in fauna or flora was poor.

Do not over-estimate your abilities; inadequately recorded records should be labelled as such and can be screened out of analytical procedures if necessary.

SUBSTRATUM - Give the percentage of each different substratum present in the habitat as whole (i.e. from where this particular record is made). For sediments estimate the proportion of each grain size category (which should be backed up by a sample taken for granulometric analysis). The total should add up to 100%.

Where species are recorded as epibiota on fucoid fronds or kelp stipes do not record the fucoid or kelp as part of the substratum - the habitat is rock.

INCLINATION - This category gives an indication of the variation in inclination of the substrata within the record. Record the relative quantity of each category as a proportion of 100%.

FEATURES - Record the particular features of the habitat as a tick (rockpool, ripples, etc.) or on a 1-5 scale as indicated. Where categories are scored, an indication of the extremes of the scale are given below and recorders should interpolate between these for each record.

The categories given here indicate the range of features which should be used to aid description of the habitat, and which in some cases may be better described in words than as a 1-5 score.

FEATURES -ROCK

Surface relief - overall relief of the habitat from **very even** (unbroken bedrock with uniform inclination) to **very rugged** (highly broken slope with wide range of surfaces, possibly with gullies or rockpools breaking up the overall inclination considerably).

Texture - an indication of the smoothness of the rock type from **very smooth** (a hard and well worn rock such as granite or well rounded cobbles) to **highly pitted** (a highly pitted or bored rock such as some limestone, or very fragmentary and jagged rock such as shale).

Stability - an indication of the stability of the rock, and related to wave action, from **very stable** (bedrock; boulders which are never moved by wave action) to **highly mobile** (frequently turned pebbles, cobble or even boulders, where colonisation is considerably affected because of such movement).

Scour - an indication of scour by sand (not abrasion from mobility of rocks - see above), from **none** (no scour present) to **highly scoured** (very highly scoured by sand - rocks likely to be smooth and without colonisation).

Silt - the amount of silt settled on the rocks, from **none** (very clean rock surfaces) to **highly silted** (thick layer of silt on all surfaces). Where sand deposits on rocks from wave action note under the tick-boxes of this section.

Fissures - the amount of fissures (over 10 mm wide) present, from **none** to **very many** (accounts for high proportion of habitat).

Crevices - the amount of crevices (less than 10 mm wide) present, from **none** to **very many** (accounts for high proportion of habitat).

Rockpools - the amount of rockpool present, from **none** to **very many** (accounts for high proportion of habitat).

Boulder, cobble, pebble shape - from **highly rounded** (very rounded boulders, cobbles or pebbles) to **very angular** (highly angular boulders, cobbles or pebbles, e.g. slates).

FEATURES - SEDIMENT

Surface relief - overall relief of the habitat, from **very even** (surface completely uniform) to **highly uneven** (surface perhaps with numerous mounds or drainage channels).

Firmness - an indication of the degree of softness or compactness of the sediment, on the scale (with littoral and sublittoral guides): 1 **very firm** (no indentation when walked on; difficult to dig with fingers), 2 (make a slight indentation; fingers only in), 3 (sink ankle deep; hand in), 4 (sink knee deep; can penetrate up to elbow) to 5 **very soft** (sink thigh deep; whole arm in).

Stability - from **highly stable** (movement of sediment very unlikely) to **highly mobile** (sediment constantly being moved).

Sorting - an indication of the uniformity of the particle size, from **very well sorted** (sediment composed of a single grain size) to **very poorly sorted** (sediment with wide range of grain sizes).

Black layer - an indication of the depth of the anoxic layer, on the scale: 1 = not visible, 2>20 cm below surface, 3=5-20 cm below surface, 4=1-5 cm below surface, 5=<1 cm below surface.

MODIFIERS - Tick if any of these are affecting the habitat. This category indicates in particular if conditions for this habitat record are different to the overall conditions as noted on the Site form (e.g. salinity, wave exposure or tidal streams):

Freshwater runoff - where small streams run over the shore or a freshwater surface layer develops and may affect the species present.

Wave exposure - wave surged - surge gullies in the sublittoral fringe often lack *Alaria esculenta* or kelps. Lower shore habitats on steep and vertical rocky shores are often subject to increased wave action compared to the upper shore.

- sheltered - localised protection from the predominant wave action.

Tidal stream - accelerated - from that indicated on the Site Record. Occasionally rock outcrops or wrecks which protrude into the water column experience stronger currents than the surrounding seabed.

- decelerated - habitats, particularly in the littoral zone and kelp forest probably experience markedly reduced tidal streams compared with that offshore (which is the likely source of tidal stream data from charts and coastal pilots) or on the lower shore of sealoch narrows. If a habitat is specifically subject to slower tidal streams by way of shelter from headlands, gullies etc. note it here.

Grazing - where grazing has eliminated the algae used to characterise the zone, e.g. where *Echinus* completely grazes the foliose algae below kelp forests on North Sea coasts.

Shading - shaded surfaces on the shore or in the shallow sublittoral.

Pollution - where pollution has or may have a significant modifying effect on the habitat.

ASSESSMENT - Give your on-site assessment of the quality of the habitat. This assessment will rely upon the personal experience of the recorder both within the region being surveyed and of the biotope in question. **Inexperienced recorders may feel unable to**

complete this section. The assessment should act as a guide to the survey reporter of the conservation value of the biotope, although a wide variety of other data will also be taken into account in any final evaluation.

Representativeness - The degree to which the biotope at the site is representative, both physically and biologically, of the biotope in the region (MNCR sector) as a whole, on the scale:

5 **Highly typical** - conforms very closely to the defined biotope (in its most natural state) in habitat characteristics and contains a high proportion of species typical of or highly preferential to the habitat.

4 **Typical** - conforms closely to the defined biotope in habitat characteristics and contains most species typical of the habitat.

3 **Transitional** representative of the region but intermediate between one biotope and another

2 **Atypical** - differs slightly in habitat and species characteristics to the defined biotope, but not considered transitional to another biotope.

1 **Highly atypical** - markedly different in either habitat or species characteristics to the defined biotope, but not considered a separate biotope. May contain different dominant species or rare/scare species in very high densities.

Naturalness - The degree to which the habitat is affected by man, either through change in the substrata, pollution or disturbance or the introduction of non-native species which affect the natural community composition. Scale:

5 **Highly natural** - Substrata wholly natural, likely to be virtually free from pollution or disturbance and no non-native species present.

4 **Natural** - Substrata wholly natural, no evidence of pollution or disturbance (whilst recognising diffuse pollutants and activities such as fishing/potting may have some effect), only one or two non-native species present at most which do not appear to have an effect on community structure.

3 **Semi-natural** - Substrata not fully natural or pollution / disturbance possible (no obvious effects) or a few non-native species present.

2 **Unnatural** - Substrata mostly artificial, or some evidence of pollution or disturbance or high proportion of non-native species.

1 **Highly unnatural** - Substrata artificial, or habitat heavily polluted or disturbed or non-native species present which have a significant effect on community structure.

Extent - The extent by area of the habitat, based on actual evidence in the field or reasonable judgement from information on charts or maps. Scale:

5 **Very extensive**	>10,001 m^2
4 **Extensive**	1001-10,000 m^2
3 **Moderately extensive**	101-1000 m^2
2 **Limited**	11-100 m^2
1 **Very limited**	0-10 m^2

Species richness - An indication of the number of different species present compared with the average **for that community in the region** (i.e. an exposed sandy beach which would not normally have a rich biota because of the mobile nature of the sediment should not be compared with more stable shores which are usually much richer). Score as follows:

5 Very high

4 High

3 Moderate

2 Low

1 Very low

Abundance/biomass - relates to the biomass or quantity of fauna and flora present. Score as follows:

5 Very high

4 High

3 Moderate

2 Low

1 Very low

MAIN COVER OR CHARACTERISING SPECIES / TAXA - List the species or higher taxa which best characterised that particular habitat, and note their abundance (abundances are not entered to the database but are important in later interpretation of the record). Do not list species simply because they were very common, but only if they are good indicators of the habitat type. Taxa given here (except higher taxa specified individually in the species list) must not be omitted from the main species checklist.

BIOTOPE NAME - This should be a succinct (<60 character) description of the biotope including the key features of the substrata, the biological zone or height/depth band and the type of community. Modifiers (e.g. tidal stream strengths) should be included in the biotope name if they distinguish this biotope from another.

e.g. Overhanging, infralittoral bedrock

Boulders and cobbles on mud at 11-17 m

Lower eulittoral *Sabellaria* reefs

Tide-swept cobbles and pebbles at 24-28 m

BIOTOPE DESCRIPTION - This is a 'sketch in words' to describe the main characteristics of the biotope and can include features not included in the checklist, or mentioned in the biotope name. An example is given below:

"A gently sloping plain of sandy mud with patches of empty shells, supporting a diverse community of epifaunal and burrowing species, with *Pecten maximus* and *Virgularia mirabilis* particularly conspicuous."

In your description try to give a clear pen picture of the habitat and the spatial arrangement of the main cover taxa or predominant infaunal groups. Also note any rare or unusual features or species or if the biotope is in any way atypical.

MNCR CLASSIFICATION CODE - your on-site match of the record to the MNCR classification of biotopes (ensure the version of the classification is noted on the site form).

When assigning field records to a particular biotope the following annotations can be used against the biotope code:

BASIL READ

ST HELENA ISLAND

RUPERT'S BAY PERMANENT WHARF - PHASE 2

SHIPPING RISKS EIA STUDY

REPORT NO. : 1097/03/02 REV B

MAY 2013

PRESTEDGE RETIEF DRESNER WIJNBERG (PTY) LTD
CONSULTING PORT AND COASTAL ENGINEERS

Rupert's Bay Permanent Wharf – Phase 2: Shipping Risks EIA Study Report No. 1097/03/02 Rev A					
Revision	**Date**	**Author**	**Checked**	**Status**	**Approved**
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B	27 May 2013	JB	SRP	For Issue	
Keywords: Rupert's Bay, Permanent Wharf, Shipping Risks					

BASIL READ

ST HELENA ISLAND

RUPERT'S BAY PERMANENT WHARF - PHASE 2

SHIPPING RISKS EIA STUDY

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1. INTRODUCTION

The construction of a new airport on the island of St Helena will require the existing port facilities on the island to be upgraded to allow both the landing of contractor's equipment and supplies during construction, and the provision of permanent facilities for handling bulk cargo, petroleum products, general cargoes and containers in the medium to long-term. The site selected for this facility is Rupert's Bay on the North West coast of the island.

The South African Institute for Environmental Assessment (SAIEA) has been appointed to conduct an EIA study of the proposed facility in Rupert’s Bay. A number of specialists have been requested to undertake specific component studies of the EIA. The specialist study reported here addresses the shipping risks associated to the provision of a permanent wharf structure at Rupert’s Bay, St Helena Island.

This increase in traffic volumes associated to the proposed development will give rise to the probability of an increase in shipping risk within the bay. The result of increased shipping risk which has the most significant effect on the environment is marine pollution, particularly in the form of marine product spills. The sources of marine product spills and the possible mitigation measures that can be put in place (for both the Permanent Wharf Structure (PWS) and the Bulk Fuel Installation (BFI)) will be discussed as an objective of this report.

1.1 Report Structure

This report consists of eight sections including the current section. Section 2 describes the layout of the proposed Permanent Wharf Structure and the Bulk Fuel Installation in Rupert’s Bay, whilst Section 3 provides the site conditions in Rupert’s Bay. Vessel navigation and manoeuvring requirements are discussed in Section 4. Section 5 provides a description of the vessel operations at the PWS and BFI. Section 6 discusses the shipping risks and the associated impacts. Section 7 discusses the mitigation measures that can be implemented in Rupert’s Bay for the safe operation of the facility. Section 8 provides the conclusions and any recommendations of the study.

2. LAYOUT

2.1 General Layout

The design of the general layout has aimed to provide the most cost effective permanent wharf solution while maintaining safety and the efficiency of navigation and ship operations. The layout design has as far as reasonably practical aimed to meet the following requirements:

- Sympathetically reflect the coastal landscape
- Avoid any land uptake
- Avoid adverse impacts on Rupert's beach and the amenity area
- Avoid disturbance of the Boer prisoner of war desalination chimney
- Minimise direct effects on Rupert's lines (the fortification wall)
- Minimise adverse effects on the marine and coastal ecology

The general arrangement of the proposed permanent wharf facility is illustrated in the navigation layout within the Appendix A. A basic description of the permanent wharf layout and the Bulk Fuel Installation will be discussed below. Further detail of the proposed structure can be found in the preliminary design report (PRDW, 2013a).

2.2 Permanent Wharf Layout

The proposed Rupert's Bay Permanent Wharf requires the construction of the following quay structures:

- Main Berth 97.5 m long with 16.6 m wide Ro-Ro Ramp, 7.0 m minimum berth depth
- Lighter Berth 43 m long, 3.0 m minimum berth depth
- Rigid Inflatable Boat (RIB) Ramp adjacent to the existing fisherman's wharf

2.2.1 Main Berth Design

The preferred quay structure for the main berth is a pre-cast reinforced concrete hollow block design placed in a vertical stack. The base block will be placed on a 1.0 m thick stone foundation bed screeded to a level of -8.0 m CD and the precast concrete blocks are stacked on top of each other to a level of +1.6 m CD. The blockwall is also filled with crushed stone and tied together longitudinally with an insitu cast reinforced concrete capping to a level of +3 m CD. The capping is profiled to meet the ramp gradient requirements.

2.2.2 Lighter Berth Design

The Lighter Berth has been designed using smaller precast concrete hollow blocks than the main berth, due to the shallower water depth and lower height requirement. The same block interlocking principles have however been retained. No provisions (in terms of a reduced cope levels or access stairs) have been made for passenger embarkation/disembarkation at the quay, at this stage.

2.2.3 RIB Boat Ramp Design

The proposed ramp for the RIB Sea Rescue vessel is designed with a 1:8 slope allowing the launch and recovery of the boat by a vehicle with a boat trailer. The proposed structure will consist of a 1 to 300 kg core rock slope extending from the existing boat ramp to a level of -2.0 m CD. All concrete ramp surfaces will have a roughened finish to ensure tyre traction. No provisions for a jetty structure adjacent to the ramp have been made. All loading/unloading of personnel or equipment, not launched with the boat, will take place at the existing wharf structure or at the new lighter berth.

2.3 Bulk Fuel Installation Relocation

It is necessary as part of the design of the permanent wharf structure to relocate the hose gantry and mooring buoy system for the Bulk Fuel Installation (BFI).

The mooring buoy which presently comprises three anchor legs will be relocated approximately 75 m seaward of the breakwater head. The mooring legs will be consolidated into two mooring legs anchored to the sea-bed by gravity anchors. Two additional mooring buoys will be installed perpendicular to the stern of the tanker in order to ensure that sufficient lateral support is provided to the mooring system.

As is the case with the existing installation, the floating hose connection will be made on the port side manifold of the tanker. The arrangement of the mooring for the relocated BFI is illustrated in the layout in Appendix A. The relocation of the BFI will allow both the bulk fuel terminal and the proposed wharf structure to operate independently and will reduce the navigation risk to both terminals.

3. SITE CONDITIONS

This section provides a brief summary of the site conditions at Rupert's Bay. A more detailed description of the met-ocean site conditions can be found within the Coastal Processes Report (PRDW, 2013b).

3.1 Design Wave Conditions

The wave climate of St Helena is strongly influenced by the South East trade winds. Rupert's Bay is located on the lee shore of the island. Regional wave modelling has been performed using offshore hindcast wave data to determine the nearshore wave climate within Rupert's Bay. Calibration has been performed by comparing the simulated waves to measured waves. An Extreme Value Analysis of the modelled nearshore conditions was subsequently performed on the modelled conditions, to determine the design wave conditions for the marine infrastructure. A summary of these results are shown in Table 3-1.

Table 3-1: Design Waves

Parameter	Extreme	Operational
Return period [yr]	1000	1
H_{mo} [m]	4.6	1.6
Tp [s]	16	16

3.2 Currents

The current speeds in Rupert's Bay are considered very low, with the highest current speed of 0.25 m/s measured between December 2006 and September 2012 being. An investigation into the mechanism forcing the currents revealed that the currents in Rupert's Bay include a tidal forcing, as observed in the oscillation of current direction with the tide.

3.3 Wind

Winds on St. Helena Island blow almost constantly from the SE with an average wind speed of 6.5 m/s. Due to the topography of the valley leading down to Rupert's Bay, winds are expected to follow the path of the valley, which roughly runs in a SE-NW orientation. A slight seasonality was observed in the wind data with winds in the months of spring and winter being slightly stronger than those in autumn and summer. The extreme wind conditions are presented in Table 3-2.

Table 3-2: Extreme Wind Conditions

Return Period [years]	Wind Speed [m/s]
1	14.9
10	17.7
50	19.8
100	20.7

4. VESSEL NAVIGATION AND MANOEUVRING

4.1 Design Vessels

The design vessel considered for the Permanent Wharf Structure includes a 5 500 DWT multipurpose container vessel. The characteristics of this vessel are shown in Table 4-1.

Table 4-1: 5 500 DWT Design Vessel Parameters

Parameters	Value
Dead weight	5 550 t
Displacement	6 300 t
Length overall (Loa)	105.23 m
Length Between Perpendiculars	99.98 m
Beam	15.2 m
Laden Draft	6.2 m
Depth	7.9 m
Block Coefficient	0.67
Main Engine Thrust	1 920 kW
Bow Thruster	300 kW
Lateral Windage	440 m^2

The design vessel for the BFI considers Handy Size tankers which provide fuel supply to the Island. The main physical characteristics of the design vessel for the BFI are shown in Table 4-2.

Table 4-2: Design Vessel Characteristics – BFI

Parameters	Value
Length overall	170 m
Beam	25.6 m
Laden Draft	10.96 m

4.2 Vessel Navigation Areas

A brief description of the vessel navigation areas will be presented in this section. Further detail of the navigation areas can be found in the preliminary design report (PRDW, 2013a).

4.2.1 Vessel Navigation - Permanent Wharf Structure

The vessel navigating area required for access to the permanent wharf structure comprises a navigation channel with a minimum approach channel width of +/80 m and a channel depth of approximately -9.1 m CD. An access channel leads to the berth with a minimum channel width requirement of +/- 60 m and a minimum channel depth of -7.9 m CD. The minimum depth alongside the berth will be designed at -7.0 m CD in order to accommodate the design vessel. A turning circle intersects the approach and access channels. The minimum diameter required for the turning circle is 210 m and is provided for between the head of the proposed breakwater and the headland to the north of Rupert's Bay.

4.2.2 Vessel Navigation - BFI

The vessel navigating area required for access to the bulk fuel installation is considered to be more than sufficient as it lies to seaward of the -17 m CD contour and is free of navigational constraints.

4.3 Vessel Manoeuvring Operations

4.3.1 Manoeuvring Operations – Permanent Wharf Structure

Manoeuvring operations for the Permanent Wharf Structure consider both the arrival and sailing manoeuvres in Rupert's Bay with the 5 500 DWT design vessel to and from the proposed berth port side alongside. It is assumed that all vessels using the proposed wharf will be required to self-berth without the aid of tugs and a pilot. It should be noted that a bow thruster is considered essential when navigating without tug assistance.

The arriving vessel, in most cases, will either be fully laden or in a nearly fully laden condition. The manoeuvre will consist of transiting the approach channel, turning to port within the turning circle and backing into the berth port side alongside. The vessel will be effectively turning 'short round' which implies short bursts of both forward and astern engine thrust in order to manoeuvre the vessel round within a limited manoeuvring area. The vessels engine, rudder and bow thruster will be controlled in order to manoeuvre the vessel into the berth. A typical vessel arrival manoeuvre on to the permanent wharf structure is illustrated in Figure 4-1.

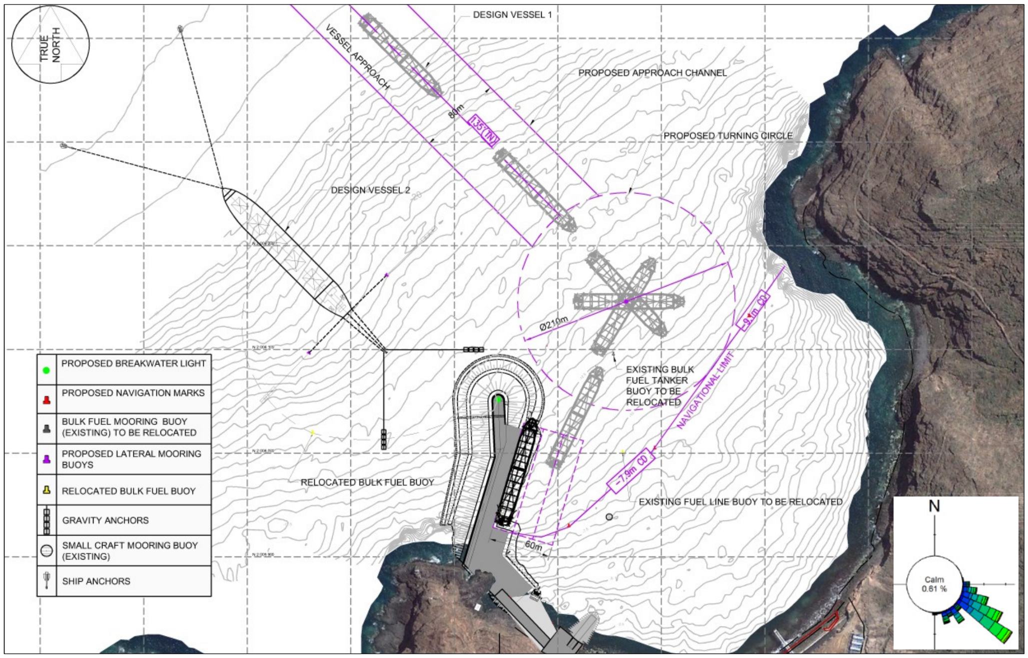

Figure 4-1: Typical Vessel Arrival Manoeuvre on to the Permanent Wharf Structure

Sailing manoeuvres will be more easily executed as the vessel will be able to sail directly from the berth as it will have turned around prior to berthing. In all likelihood the vessel will spring-off the berth. This is described as manoeuvring ahead with the vessel's engine against the forward spring in order to kick the stern of the vessel out. This may be accelerated by using the vessels engines moving ahead briefly against a port rudder.

Once the vessels stern is clear of the berth, the vessel will slowly manoeuvre towards the centre of the turning circle. This will ensure that it sufficiently and safely clears both the quay and the breakwater structures during the manoeuvre. Once the vessel is clear of the breakwater it will commence a turn to port in order to depart Rupert's Bay.

4.4 Bulk Fuel Installation Manoeuvres

4.4.1 Manoeuvring Operation - BFI

The manoeuvre of the tanker on to the buoy mooring system will be similar to that of the existing operation with the exception that it will now be relocated to a position with a greater water depth, effectively removing the operation from inside Rupert's Bay to the area immediately outside the bay.

The arriving tanker will approach Rupert's Bay towards a position where first the starboard anchor can be let-go and then the port anchor will be let-go. Once the anchors have been deployed in the correct positions (approximately 500 m from the breakwater), the vessel will then swing around in order to moor the vessel's stern to the mooring buoy. The stern of the tanker will be moored approximately 50 m from the mooring buoy using four stern lines from the vessel. The vessel will then moor breast lines to the breasting mooring buoys in order to provide lateral positioning within the mooring. A typical vessel arrival manoeuvre on to the BFI is illustrated in Figure 4-2.

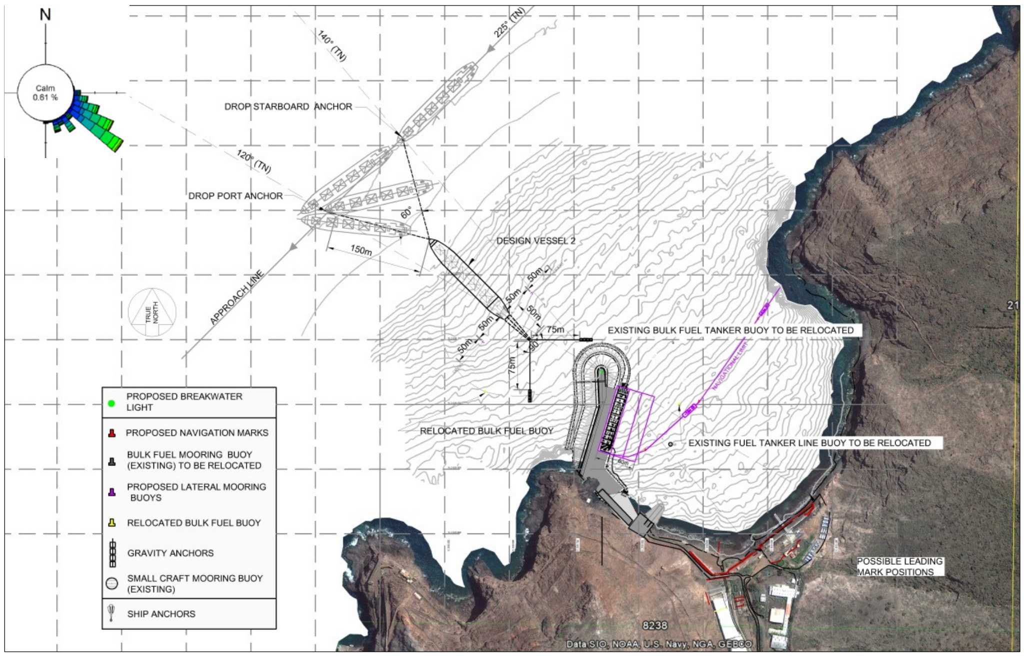

Figure 4-2: Typical BFI Vessel Arrival Manoeuvre

5. VESSEL OPERATIONS

5.1 Vessel Operations - Permanent Wharf Structure

The vessels that will make use of the permanent wharf structure will predominantly be Multipurpose General Cargo vessels, Geared Container vessels or Ro-Ro vessels. It is envisaged that the general cargo and geared container vessels will have similar physical characteristics as the design vessel shown in Table 4-1. The Ro-Ro vessels will be similar in design to a landing craft such as the 'NP Glory 4' being used by Basil Reed to discharge construction equipment at St. Helena Island. Figure 5-1 shows the 'NP Glory 4' preparing to berth at the temporary facility at St Helena Island.

Figure 5-1: Landing Craft - NP Glory 4

It is anticipated that the majority of cargoes will be general cargo such as break-bulk, containerised and neo-bulk cargoes. The break-bulk will comprise miscellaneous goods in small packages, bags or boxes. The neo-bulk will comprise goods shipped packaged and transferred as units. Automobiles, bundled steel products, lumber in stacks and heavy machinery such as construction machinery are examples of neo-bulk. The containerised cargoes will be higher value miscellaneous goods shipped in standard International Organisation for Standardisation (ISO) containers. The multipurpose general cargo or geared container vessels that will call at the terminal will have ship's cranes or derricks for the discharge of containers or non-containerised cargoes. There is limited quay space available so cargo will have to be cleared from the terminal apron to the storage yard quickly in order to facilitate an efficient operation. The standard method of transfer for virtually all the cargo types is by tractor/trailer combinations. The trailers should be of a size normally associated to container operations, but with a lower profile design and equipped for easy coupling and uncoupling.

5.2 Vessel Operations - BFI

The bulk fuel installation imports, stores and wholesales all St Helena's diesel and petrol supply. The vessels that will predominantly call at the BFI will be tankers for the discharge of petrol and diesel oil using the vessel's own pumping systems on board. The berth for the tankers is more commonly known as a conventional buoy mooring (CBM). CBM's are offshore marine berths in which the vessel's bow is held in position by the vessel's own anchors. The advantage of a CBM is that it provides the least amount of obstruction during berthing operations as there are fewer mooring buoys (as compared to an all-buoy mooring) to impede the safe passage of the vessel.

Three mooring buoys will be installed to provide mooring points for the vessel's stern. The vessel's own mooring lines will run from the vessel's stern to the buoys in order to provide a secure mooring. The CBM mooring design is similar to the existing CBM mooring design with the exception that two additional lateral mooring buoys will be installed. The original BFI design vessel was smaller than the vessels that are currently using the CBM, thus additional lateral mooring buoys have been provided for.

The safe connection and disconnection of the floating fuel hose is an integrated activity between the tanker and terminal and will involve varying levels of support from both shipboard personnel and terminal operations personal. The hose connection will be made on the port side of the tanker at the vessel's manifold. The floating hose is supported on the landward side by a hose gantry system that will ensure the controlled release of the hose string. The pumping rate from ship to shore is governed by the capacity of the ship's pumps and the diameter of the fuel hose. The fuel hose size which would accommodate the discharge of Handy Size tankers is approximately 8" to 12" in diameter.

The 'Jo Acer' is a tanker that has been providing import diesel oil and petroleum to the Island of St. Helena. The 'Jo Acer' has a pump capacity of 220 m^3/hr to 330 m^3/hr. Figure 5-2 illustrates the tanker 'Jo Acer' on the buoy mooring with the hose gantry in the foreground and the hose string on the water surface making the connection at the manifold of the vessel.

Figure 5-2: Tanker - Jo Acer

The main concern for the liquid bulk terminal operation is safety. The commodities are flammable and are a pollution risk both during the discharge and storage. Due to the hazardous nature of these commodities, it is typically required to separate liquid bulk berths, jetties or buoy moorings from other port facilities. The offshore buoy mooring will more than adequately comply with this general requirement.

6. RISK IDENTIFICATION

The potential increase in the number of vessels associated with the proposed development at Rupert's Bay and the potential increase in liquid bulk requirements (contributable to the proposed airport on the Island) will add to the volume of maritime traffic in the area. This increase in vessel traffic will give rise to the probability of an increase in shipping risk within the bay. The most significant effect on the environment of an increase in shipping risk is an increase in marine pollution. The main source of marine pollution relevant to the study area is marine product spills. The nature and risk of marine product spills will be discussed in this section.

6.1 Nature and Risk of Marine Product Spills

The risk of marine product spills in Rupert's Bay could arise from the following activities:

- Bunker Fuel Spills - Permanent Wharf Structure/BFI
- Cargo Spills - BFI
- Bunker Fuel Transfer Spills - Lighter Berth/Permanent Wharf Structure

6.1.1 Bunker Fuel Spills – Permanent Wharf Structure/BFI

Bunker fuel spills refer to a rupture of a tank of a vessel that is designated for the carriage of fuel (bunkers) for its own propulsion. Vessel bunkers make up a variety of marine products including light distillates such as Marine Diesel Oil (MDO) to heavier bunker fuels such as Heavy Fuel Oil (HFO). In order to determine the potential oil spill volumes for each design vessel, the bunker capacity of both HFO and MDO have to be determined. Average bunker capacities can be calculated at approximately 3.3% of the vessel's Deadweight (DWT) tonnage (Michel and Winslow, 2000). The approximate bunker capacities for the design vessels are shown in Table 6-1 below.

Table 6-1: Bunker Capacity – Design Vessels

Description	Design Vessel BFI	Design Vessel Permanent Wharf
DWT (t)	30 000	5 500
HFO (m^3)	1 300	210
MDO (m^3)	130	70

The potential oil spill volume from a vessel in an oil spill event will depend on factors such as the cause of the leak, location of the damage and size of the tank rupture. The main properties which affect the fate of spilled oil at sea are specific gravity, volatility (distillation characteristics), viscosity (resistance to flow) and pour point (the temperature below which it will not flow). There are two common grades of heavy fuel oil supplied to merchant vessels: IFO 180 and IFO 380, which have maximum viscosities of 180 Centistokes (cSt) and 380 cSt at 50°C respectively. MDO has a lower viscosity up to 12 cSt at 40°C. Typical marine bunker fuel oil characteristics are shown in Table 6-2 below.

Table 6-2: Typical Marine Bunker Fuel Oil Characteristics

Type	Density (g/cm³)	API* Gravity	Water Content (%)
MDO	0.83	39.0°	0
HFO	0.97	39.0°	30

*API – American Petroleum Institute Scale

Bunker fuel spills associated to vessels calling at the permanent wharf structure or BFI would most likely occur in cases where the vessel has suffered one of the following incidents:

- Vessel Grounding
- Vessel Collision
- Vessel Contact

These incidents will be discussed in more detail in the sections that follow.

<u>Bunker Fuel Spill - Vessel Grounding</u>

The risk of a vessel grounding incident may result from the following conditions:

- Where the vessel's draught exceeds the available depth of water
- When the vessel departs from the designated manoeuvring area

Oil spill incidents from vessel groundings are judged to be very low frequency, but high severity incidents. The low frequency is attributable to the short time period that these vessels are in contact with areas where there is a risk of the vessel's draught exceeding the available depth of water. Human error, navigational error, steering failure, electrical failures and/or loss of engine power would be the main causal factors for such incidents. Additionally, deteriorating weather conditions will affect the likelihood of grounding. In the case of vessel grounding it can be assumed that there will be a 50% outflow of bunker oil resulting from a bunker spill from a ruptured tank (Michel, Winslow, 2000), but the probability of the incident occurring is low.

Bunker Fuel Spill - Vessel Collision

Vessel collisions include the potential damage sustained by the design vessels due to collisions with other traffic vessels. It is assumed that vessel manoeuvring operations in Rupert's Bay will not occur simultaneously at both the PWS and the BFI. Therefore the risk of vessel collision and the resultant oil spill is considered low.

Bunker Fuel Spill - Vessel Contact

Vessel contact refers to the damage sustained by a vessel in contact with a hard structure such as the quay structure. Human error, navigation error and severe weather conditions are causal factors for vessel contact. The potential consequence of this type of incident is the possible breach of the design vessel's wing fuel tanks as a result of contact with the quay structure. Smaller vessels such as the design vessels tend to carry their bunker fuel oil in double bottom tanks (Michel, Winslow, 2000). The risk of a bunker fuel oil spill from a wing tank rupture due to vessel contact at the permanent wharf can therefore be considered low.

6.1.2 Cargo Spills – BFI

Cargo spills specifically refer to the volume of HFO and MDO transported to Rupert's Bay for import (discharge) to the Island's storage tanks. The cargo carrying capacity of the 'Jo Acer' (refer to section 5.2) is 35 136 m^3. The tank capacities range from a minimum tank capacity of approximately 400 m^3 to a maximum tank capacity of 2 500 m^3. The volume of product that the vessel carries at any one time would depend on the port rotation of the vessel. Cargo spills associated to vessels calling at the BFI would most likely only occur in cases where the vessel has suffered one of the following incidents:

- Vessel Grounding
- Vessel Collision
- Vessel Contact
- Hose Failure/Manifold Leak during Product Transfer Operations

These incidents will be discussed in more detail in the subsequent sections.

Cargo Spills - Vessel Grounding

Cargo spill incidents from vessel groundings are judged to be very low frequency, but potentially high severity incidents, depending on the volume of product the tanker is carrying when the incident occurs. It has been proposed in the current design that the BFI be relocated in deeper water seaward of the -17.0 m CD contour. This relocation will reduce the probability of vessel grounding and therefore will reduce the risk of a cargo spill. The IMO MARPOL convention (International Maritime Organisation convention on the prevention of Marine Pollution by vessels) requirements for double hull tankers will additionally further reduce the likelihood that a product tank is ruptured during a grounding incident. This is provided that the vessel grounding incident is a low energy grounding incident.

Cargo Spills - Vessel Collision

It is assumed that vessel manoeuvring operations in Rupert’s Bay will not occur simultaneously at both the PWS and the BFI. Therefore the risk of vessel collision and the resultant cargo spill can be considered low.

Cargo Spills - Vessel Contact

Vessel contact refers to the damage sustained by the tanker in contact with fixed structures such as the quay structure. As the tankers will be mooring to a CBM and will not be in close proximity to a quay structure, the risk of a cargo spill due to vessel contact is considered low. There is a potential risk of contact with a mooring buoy while mooring within the buoy field. Vessel contact with the breakwater structure is also a potential risk as the CBM is located close to the breakwater structure.

Cargo Spills – Transfer Operations

Cargo spills occurring during cargo transfer operations can occur as a result of a rupture of the floating hose or a leak at either the vessel or shore manifolds. It is assumed that the operation will be daylight-only operation so that a visual watch on the floating hose and manifolds can be maintained at all times. This will reduce the likelihood of a significant cargo spill as the system can be shut-down immediately on sighting a hose rupture or manifold leak. A small volume cargo spill will occur relative to the size of the cargo hose (8” to 12” diameter) and the duration prior to an emergency shut-down of the system.

6.1.3 Bunker Fuel Transfer Spills - Lighter Berth/Permanent Wharf Structure

Bunker fuel transfer spills refer to the volume of MDO transferred to small recreational or fishing vessels at the lighter berth or the permanent wharf structure. The volumes pumped during any transfer operation will range from approximately 100 litres (sailing vessel) to a maximum of 40 m^3 (small tug or large fishing vessel). The volumes of bunker fuel transferred can be considered small and providing good operational procedures are in place, the consequences of a spill can be kept to a minimum.

7. MITIGATION

Potential measures to mitigate the risks and impacts identified in Section 6 will be discussed in this section.

7.1 Vessel Navigation – Permanent Wharf and BFI

Adopting a single shipping practice in the bay, i.e. allowing only one vessel manoeuvring operation at a time, will ensure that the risk of vessel collisions are kept to a minimum. A collision may occur with a small vessel (e.g. a fishing boat, sailing boat or other small craft). In this case, the small vessel will sustain most of the damage and it is not envisaged that either design vessel would experience significant damage to the extent that a ballast, cargo or bunker tank is ruptured. A potential loss of life or injury to personnel on the smaller craft is apparent, but this is not within the scope of this report. A 250 m wide exclusion zone around the CBM facility could be declared in order to reduce potential vessel contact from traffic vessels.

Navigation aids are in general required to reduce marine risk. This is done by permanently demarcating specific navigation areas such as navigation channels as well as locations that may cause an obstruction to navigation within the port and approaches. A preliminary assessment of the required aids to navigation for the permanent wharf structure has been completed. The required navigation marks for the permanent wharf structure include three lateral marks and a breakwater light. This will assist vessels berthing and sailing from the permanent wharf structure from potential groundings as the navigation area will be appropriately demarcated.

It is recommended that two masts in transit with the breakwater light be installed so as to assist tankers with reference marks to 'let-go' the vessel's anchors for manoeuvring on to the BFI. This will ensure that vessels mooring on to the CBM will have reference marks to continuously monitor the vessels position in order to avoid potential vessel groundings and contact with the breakwater structure.

The greatest risk for vessel manoeuvring would be the overrun of the vessel beyond the navigational limit within Rupert's Bay. The proposed lateral marks will demarcate the navigational limit, but navigation, human or a technical error my still result in the vessel breaching this area and consequently grounding.

The Aids to Navigation recommended should adhere to the most recent guidelines of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

7.2 Vessel Manoeuvring Operations – Permanent Wharf and BFI

Presently a mooring launch provides berthing assistance to tankers mooring to the BFI in Rupert's Bay. It is assumed that this operation will continue and that no additional berthing or manoeuvring assistance craft will be required for the operation of the BFI. The assistance provided by the mooring launch will ensure that the vessel can safely moor to the mooring buoys and avoid potential vessel contact with the buoys. The mooring buoys are anchored by means of anchor chains and a gravity anchor which makes them flexible in their anchored rest position. This reduces the likelihood of vessel contact with a mooring buoy. The material of the buoy should be designed to ensure minimal damage to the vessels hull should there be any vessel contact.

The operational navigational limitations of manoeuvring on the permanent wharf structure without the assistance of tugs as well as manoeuvring and dwelling on a CBM need to be strongly enforced by the local port authority in order to ensure that the risk of vessel contact is reduced to an acceptable margin.

Tankers should be restricted to only performing manoeuvring operations on the BFI during daylight hours in order to reduce navigation risk and the potential for vessel contact.

7.3 Product Transfer Operation –BFI

Product transfer operations should only be carried out during daylight hours in order to reduce the risk of a product spill not being sighted. Should the hose string be well illuminated or divers used to monitor the status of the hose, the product transfer operation could operate on a 24-hour basis. The suitability of this would need to be further assessed. The probability of a product transfer leak can be considered high, but the volume resulting from a cargo spill incident (should breakaway couplings be fitted) will only be the volume contained within a single hose section.

7.4 Bulk Fuel Installation Design

The BFI will be relocated further seaward than the existing position within Rupert's Bay. The position of the relocated BFI is seaward of the -17 m CD contour and is approximately 150 m from the approach channel of vessels proceeding to the permanent wharf structure. An additional two mooring legs are to be installed to more adequately moor the vessels that call at the BFI. These measures should significantly reduce navigational and operational risk for the BFI as compared to the existing facility.

7.5 Oil Spill Response Plan

The aim of oil spill response plan is to efficiently provide sufficient suitable equipment to prevent oil from impacting sensitive marine and coastal environments. The oil spill response equipment that would be required to contain and recover a potential oil spill in Rupert's Bay is briefly described in the sections below.

7.5.1 Containment Booms

The main functions of a containment boom are to protect sensitive marine areas and to contain a product spill (at the source if possible). The operating environment at the permanent wharf structure can be considered as protected waters which will make the deployment of containment booms very efficient. Containment booms will be particularly effective for bunker transfer spills occurring during bunkering operations, as the speed of deployment can be instantaneous. Specifically in cases where the deployment of booms for a bunkering operation becomes a mandatory procedure or the booms are in close proximity to the bunkering operation.

7.5.2 Skimmers

Once oil from an oil spill is contained, it will require an oil skimmer in order to recover it. The main function of an oil skimmer device is to recover floating oil from or near the surface of the water. The principle uses the oil's ability to adhere to certain types of materials for e.g. polypropylene, PVC and aluminium. The aim is to let the floating oil adhere to a moving surface and then scrape or squeeze it off into a sump. The skimmer may be a rotating disc, drum, brush, an endless band, mop rope or bristle type. In most cases this will require a specialised vessel with this capability.

7.5.3 Oil Pollution Response Vessel

A dedicated oil pollution response vessel is highly recommended in order to prevent oil from an oil spill from impacting sensitive marine and coastal environments. This could be considered as vessel volumes to the Island increase.

7.6 Vessel Vetting

The 1992 amendments to the MARPOL Convention require double-hull cargo tanks on all tankers built after July 1996. The double hull solution for liquid bulk vessels is now well established and all new tankers are built with double hulls as specified in the MARPOL Convention. The introduction of double hull tankers prevents oil spills in about 75 % of all groundings according to the IMO MARPOL accident statistics. There are, however, no restrictions on the designs of vessel and more specifically, conventional vessel fuel tanks and subsequently most vessels have been constructed with single-hull fuel tanks. The tank configuration, total bunker capacity and the average volume of bunkers carried by arriving vessels are factors that will influence the oil spill volumes in the event of a casualty within the study area. Although there is no legislation that directly deals with tank configuration on vessels with respect to restricting oil spill volumes, a vetting system can influence the selection of vessels and thus the factors that influence potential oil spill volumes.

Ship vetting is a detailed assessment of a vessel with respect to its quality and that of its owner, operator and/or manager from its inception to its current status. Ship vetting enables a charterer to optimise vessel selection by matching available vessels to the operational requirements of the voyage and therefore maximise efficiency.

7.7 Port and Safety Regulations

General and specific port safety guidelines, rules and regulations should be regularly reviewed and updated, taking into account international best practice. International safety and security procedures (ISPS Code) and best practice for tanker operations should be applied.

7.8 Personnel Training

With proper training and safety instructions and measures, the human cause of such incidents can be reduced as much as possible. Personnel training include both training for operational personnel engaged in terminal operations and training for shipboard personnel. Training for shipboard personnel could include ship simulation training to ensure that vessels crew are competent with the type of vessel manoeuvring required for both the Permanent Wharf Structure and the BFI.

7.9 Summary of Mitigation Measures

A summary of mitigation measures against identified risks is shown in Table 7-1.

Table 7-1: Summary of Mitigation Measures

Risk	Causal Factors	Mitigation Measures
Vessel Grounding	Main engine failure, steering gear failure, electrical failure, navigational error, severe weather, current and tidal variations, insufficient aids to navigation, poor quality vessels, master unfamiliarity with area.	• Personnel training • Pollution response plan • Ship vetting systems in place • Aids to navigation marks demarcating navigation limit • Design criteria for BFI and Permanent wharf structure • Adherence to operational limiting conditions and port and safety regulations.
Vessel Contact	Human error, main engine failure, severe weather, current and tidal variations, unfamiliarity with vessel manoeuvring capabilities.	• Personnel training • Pollution response plan • Aids to navigation marks demarcating reference marks • Adherence to operational limiting conditions and port and safety regulations.
Vessel Collision	Human error, main engine failure, steering gear failure, electrical failure, navigational error, severe weather, current and tidal variations, Vessel traffic volume.	• Personnel training • Pollution response plan • Exclusion zone around CBM • Adherence to port and safety regulations.
Hose Failure/Manifold Leak	Human error, Mechanical failure.	• Personnel training • Pollution response plan • Adherence to port and safety regulations/procedures • Marine breakaway couplings.

8. CONCLUSIONS AND RECOMMENDATIONS

This increase in traffic volumes associated to the proposed development will give rise to the probability of an increase in shipping risk within the bay. The most significant effect, on the environment, of an increase in shipping risk is an increase in marine pollution. The main source of marine pollution relevant to the study area is a marine product spill. The sources of marine product spills include:

- Bunker Fuel Spills occurring at the Permanent Wharf Structure (PWS) or Bulk Fuel Installation (BFI)
- Cargo Spills by tankers at the BFI
- Bunker Fuel Transfer Spills by small vessels bunkering at the Lighter Berth or PWS

Marine product spills associated to vessels calling at the PWS or BFI would most likely only occur in cases where the vessel has suffered one of the following incidents:

- Vessel grounding
- Vessel collision
- Vessel contact
- Hose failure/manifold leak during product transfer

The most significant shipping risk will be contributable to vessel grounding at the Permanent Wharf Structure (refer to Section 6.1.1) while the most probable risk would be contributable to a hose failure or manifold leak during a product transfer operation at the BFI (refer to Section 6.1.2).

Mitigation measures to prevent a marine product spill (refer to Table 7-1) include:

- Personnel training
- Pollution response plan
- Ship vetting systems
- Aids to navigation marks
- Design criteria for BFI and Permanent wharf structure
- Adherence to operational limiting conditions and port and safety regulations/procedures
- Exclusion zone around CBM
- Marine breakaway couplings

9. REFERENCES

(Michel, Winslow, 2000)	Cargo Ship Bunker Tanks: Designing to Mitigate Oil Spillage. Marine Technology, vol 37, no. 4, October 2000
(PIANC, 1985)	"Underkeel Clearance for Large Ships in Maritime Fairways with Hard Bottom", Supplement to PIANC Bulletin No. 51, 1985
(PIANC, 1997)	"Approach Channels, A Guide for Design", Final Report of the Joint PIANC-IAPH Working Group II-30 in cooperation with IMPA and IALA, June 1997
(PRDW, 2013a)	"St Helena Island: Rupert's Bay Permanent Wharf - Phase 2: Preliminary Design Report", Report No. 1097/02/04, PRDW, 2013
(PRDW, 2013b)	"St Helena Island: Rupert's Bay Permanent Wharf - Phase 2: Coastal Processes Report", Report No. 1097/02/02, PRDW, 2013
(Thoresen, 2010)	"Port Designer's Handbook". *2nd ed*. London: Thomas Telford Limited, Thoresen, 2010

APPENDIX A