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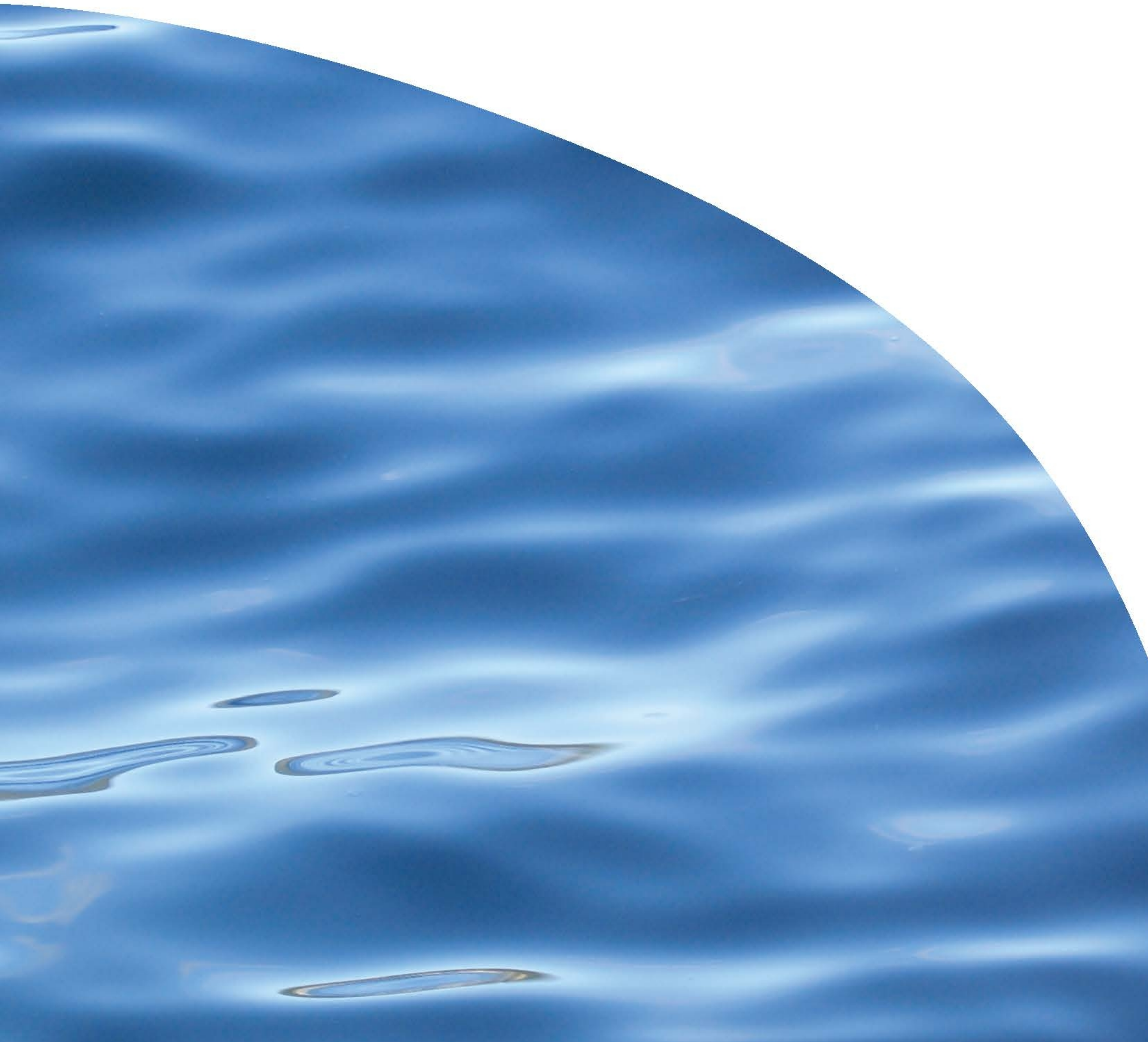
TOOLS AND INFRASTRUCTURE FOR MANAGING BIOSECURITY RISKS FROM VESSEL PATHWAYS IN THE TOP OF THE SOUTH REGION



TOOLS AND INFRASTRUCTURE FOR MANAGING BIOSECURITY RISKS FROM VESSEL PATHWAYS IN THE TOP OF THE SOUTH REGION

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Prepared for Nelson City Council and the Top of the South Marine Biosecurity Partnership via Envirolink Medium Advice Grant 1526–NLCC84 and direct contract No. 2900.

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EXECUTIVE SUMMARY

New Zealand's coastal environments are home to an increasing number of non-indigenous species (NIS) with shipping and boating identified as the most important pathways for movement of NIS into and within New Zealand. The Top of the South (TOS) region, encompassing the coastal areas administered by the Marlborough District Council, Nelson City Council and Tasman District Council, is visited by thousands of vessels from domestic and international origins every year. The TOS Marine Biosecurity Partnership (TOSMBP) formed in 2009 and comprising local and national regulatory bodies as well as other key stakeholders, is working towards reducing marine biosecurity risk in the region. Effective management of transport pathways that introduce or facilitate the spread of marine pests is critical to achieving the Partnership's aims. As such, the TOSMBP is considering the development of a Regional Pathway Management Plan under the amended Biosecurity Act 1993.

Cawthron Institute was contracted to collate information on: (i) risk pathways into and within the TOS region; (ii) current approaches to managing biosecurity risks from vessels; and (iii) existing and in-development treatment tools and other risk mitigation measures including their regional availability, and the feasibility and costs of their implementation. Associated environmental and health and safety risks and current regional requirements for resource consents in association with different treatment methods were also investigated. The project was funded via an Envirolink medium advice grant to Nelson City Council as well as direct top-up funds from the TOSMBP.

The TOS region, including its high-value natural areas (*e.g.* Abel Tasman and Marlborough Sounds), was found to be strongly connected via vessel movements to other regions throughout the country, as well as coastal locations globally. Based on vessel arrival data for the previous two years, Port Nelson has recent connections with all domestic sea ports except Gisborne. Domestic arrivals mainly comprise container, petrochemical, processed forestry, car carriers and cement vessels. The Port is also regularly visited by international vessels, including container ships and those associated with the commercial fishing industry. Picton also has connections with most other commercial sea ports in New Zealand. However, aside from connections to Wellington via frequent ferry movements, these are not as strong as Port Nelson's. The region also has six marinas that accommodate over 2000 recreational vessels, making it the largest vessel hub in the South Island. Collectively they receive > 300 vessel visits annually from regions outside of the TOS and internationally.

Numerous existing and in-development treatment tools and other risk mitigation measures to manage marine biofouling were identified. They include both land-based (*e.g.* manual removal with brushes and scrapers or mechanical removal via water-blasting) and in-water tools (*e.g.* rotary brush systems, high-pressure water jets, cavitational jets, and shrouding technologies such as wrapping). Over the past decade, the range of in-water cleaning/treatment technologies has increased considerably to meet a growing and changing demand, and due to advances in paint technologies. At present some of the emerging treatment technologies are not available in the TOS (*e.g.* cavitation, floating docks) or

nationally (*e.g.* ultrasonic methods). Floating dock systems, like that currently being trialled by Northland Regional Council, was identified as a promising avenue for treating biofouling on recreational vessels in the TOS, both as a pre-emptive maintenance measure and as a response option.

Numerous boat ramps, slipways and haul-out facilities were identified throughout the region, with Nelson and Picton/Waikawa being the largest providers. These facilities cater for small-to-medium craft (< 80 m) and most of them are available at short notice (*e.g.* during a pest response) throughout the year. At present, there are no land-based facilities for larger vessels (> 80 m) for either maintenance or treatment activities. The TOS was found to be well placed in terms of specialised diving services in the region. Of note is the considerable collective expertise in encapsulation methods, which has now been applied to wharf piles, marina pontoons and vessels up to 110 m in length.

At present resource consents are likely to be required for almost any of the in-water treatment technologies mentioned in this report. This can be problematic when trying to quickly deal with a high-risk vessel. Two options for minimising turnaround times were discussed with the TOS councils: the establishment of global resource consents for various treatment methods, and ways to reduce the processing time for individual resource consent applications. Views and perceptions of this vary between the TOS councils. Ongoing dialogue within and between all three councils (including both biosecurity and consenting personnel) is recommended throughout the development of pathway management approaches for the TOS.

Ongoing management of biofouling risks to the TOS region will be challenging. The recently introduced Craft Risk Management Standard is intended to improve the level of hygiene of vessels visiting from overseas. However, domestic pathway management will require a more co-ordinated and diverse approach. For domestic pathway management initiatives to be successful, we consider it critical for there to be co-ordination between regulatory authorities, including outside of the TOS.

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. Project background 1
1.2. Scope 2
1.3. Information sources 3
2. VESSEL RISK PATHWAYS INTO AND WITHIN THE TOP OF THE SOUTH REGION . 4
2.1. Types of vessels entering and operating within the Top of the South region 4
2.1.1. Maritime transport pathway 4
2.1.2. Mining and exploration pathway 5
2.1.3. Commercial fishing pathway 6
2.1.4. Marine aquaculture pathway 6
2.1.5. Sport and recreation pathway 7
2.1.6. Research and education pathway 8
2.2. Berthing and mooring facilities within the Top of the South 13
2.2.1. Vessel hubs 13
2.2.2. Other notable berthing facilities in the Top of the South region 24
2.2.3. Moorings outside of vessel hubs 25
2.2.4. Launching ramps 26
3. CURRENT APPROACHES TO MANAGING BIOSECURITY RISKS 30
3.1. Vessel hull maintenance 30
3.2. Legislation, codes of practice, facility agreements and other requirements 32
3.2.1. International Maritime Organisation biofouling guidelines 32
3.2.2. Classification societies 33
3.2.3. Biosecurity Act 1993 33
3.2.4. Craft Risk Management Standard for vessel biofouling 34
3.2.5. In-water cleaning guidelines 35
3.2.6. Resource Management Act 1991 35
3.2.7. National and regional pathway management plans 36
3.2.8. Marina berth agreements 36
3.2.9. Industry codes of practice 36
3.3. Inspections and surveillance 37
3.3.1. Active surveillance 37
3.3.2. Passive surveillance 37
3.4. Education/awareness 37
4. TREATMENT TOOLS AND TECHNOLOGIES 39
4.1. Land-based treatment options 41
4.1.1. Water-blasting 41
4.1.2. Manual removal 42
4.1.3. Desiccation 43
4.2. In-water treatment tools 43
4.2.1. Manual removal 43
4.2.2. Mechanical removal 44
4.2.3. Surface treatment 48
4.2.4. Shrouding technologies 49
5. REGIONAL AVAILABILITY OF TREATMENT TOOLS 54
5.1. Golden Bay 54

5.1.1. Waitapu Bay slipway and hardstand ... 54
5.1.2. Port Tarakohe vessel haul-out and storage ... 55
5.2. Motueka ... 55
5.2.1. Port Motueka slipways and vessel haul-out ... 55
5.2.2. Vessel haul-out and cleaning ... 56
5.3. Mapua ... 57
5.4. Nelson ... 57
5.4.1. Inspection grid ... 57
5.4.2. Vessel haul-out and cleaning ... 57
5.4.3. Nelson Slipway ... 59
5.4.4. Calwell Slipway ... 59
5.4.5. Commercial dive services ... 61
5.5. Havelock ... 63
5.5.1. Havelock Slipway ... 63
5.5.2. Vessel haul-out and cleaning ... 63
5.6. Picton ... 64
5.6.1. Slipway and vessel cleaning ... 64
5.6.2. Commercial dive services ... 65
5.7. Waikawa ... 65
5.7.1. Travel-lifts and contractors ... 65
5.7.2. Slipway and cleaning ... 67
6. CONSTRAINTS ON THE USE OF TREATMENT METHODS ... 71
6.1. Risks ... 71
6.2. Consent requirements ... 72
6.2.1. Background ... 72
6.2.2. Discharges associated with vessel cleaning or maintenance ... 74
6.2.3. Regional legislative context ... 75
6.2.4. Consultation with Top of the South councils regarding consenting requirements for vessel treatment ... 76
6.2.5. Overview of likely consent requirements ... 79
6.2.6. Potential avenues for streamlining the consent process ... 83
7. SUMMARY AND CONCLUSIONS ... 85
8. REFERENCES ... 87
9. APPENDICES ... 94

LIST OF FIGURES

Figure 1. Aerial view of Port Tarakohe, including the recreational marina. 13
Figure 2. Aerial view of Port Motueka, including the three marinas. 15
Figure 3. Aerial view of Port Nelson, including the recreational marina. 17
Figure 4. Aerial view of the port and marina at Havelock. 19
Figure 5. Pelorus Sound 'Mail Boat' routes departing from Havelock three times a week 20
Figure 6. Aerial view of the port facilities at Picton. 21
Figure 7. Aerial view of Picton marina. 23
Figure 8. Aerial view of Waikawa Marina. 24
Figure 9. A recreational yacht being water-blasted at the Nelson Marina travel-lift dock. 42
Figure 10. The Envirocart cleaning unit developed by Franmarine Underwater Services Pty Ltd 45
Figure 11. A proprietary floating dock ('FAB Dock') deployed around a recreational craft 51
Figure 12. Trials of a FAB Dock containment system utilising chlorine for the treatment of a 8 m yacht heavily fouled with *Sabella spallanzanii*. 53
Figure 13. Waitapu Bay slipway near the mouth of the Takaka River. 54
Figure 14. The 50–tonne capacity travel-lift in operation at Nelson marina. 58
Figure 15. The fishing vessel *Voyager P* being slipped at Calwell Slipway in Port Nelson 60
Figure 16. Two recreational yachts wrapped by Diving Services New Zealand Ltd. as part of the regional eradication and control programme for the sea squirt *Didemnum vexillum*. 62
Figure 17. Franklin's Boatyard in Waikawa Bay, Picton. 67

LIST OF TABLES

Table 1. Approaches and sources of data and information associated with the various project components. 3
Table 2. Vessel types moving into and within the Top of the South region, and the modes of infection by which they can transfer marine non-indigenous species (NIS). 9
Table 3. Estimated number of vessel arrivals (including repeat visits) from outside the Top of the South region over the past 12 months. 10
Table 4. Estimated number of different vessels (*i.e.* excluding repeat visits) entering from outside the Top of the South region over the past 12 months 11
Table 5. Estimated number of different vessels operating (almost exclusively) within the Top of the South region over the past 12 months 12
Table 6. Berthing facilities in Port Nelson 18
Table 7. Berthing facilities in the Port of Picton 22
Table 8. Boat ramps and launching lanes in the Tasman District, including details of ramp surface, tidal requirements for launching and fees payable for casual use...................... 27
Table 9. Boat ramps and launching lanes in the Marlborough District, including details of ramp surface, tidal requirements for launching and fees payable for casual use...................... 28
Table 10. Contact details for berthing and mooring facilities with the Top of the South region........ 29
Table 11. Summary of main antifouling coating types 31
Table 12. Summary of treatment or risk–reduction technologies available for vessel biofouling 40
Table 13. Regional treatment infrastructure including maximum vessel dimensions that can be accommodated, an indication of costs involved and vessel capacity of the facility.......... 68
Table 14. Contact details for regional treatment infrastructure facilities. 70
Table 15. Potential health and safety and environmental risks associated with the various treatment methods 72
Table 16. Consenting timeframes for decisions regarding in-water treatment of vessels in the Top of the South region. 79
Table 17. Possibility of biofouling ('contaminant') discharge associated with the in-water treatment technologies 81

LIST OF APPENDICES

Appendix 1. 'Modes of infection' (additional to vessel biofouling) by which vessels can transport non-indigenous species (NIS). ... 94
Appendix 2. Organisations, facilities and individuals contacted for specific information. ... 96
Appendix 3. Aquaculture vessels operating in the Top of the South region. ... 97
Appendix 4. Aquaculture vessels owned and operated by Sanford Ltd, and type of work and area of operation of each vessel. ... 98
Appendix 5. Summary of treatment or risk–reduction technologies available for vessel biofouling. Specific companies which can be contacted for each technology are indicated. ... 99
Appendix 6. Contact details for companies and facilities providing specific treatment or risk-reduction technologies for vessel biofouling. ... 100
Appendix 7. Nelson Hardstand Ltd. travel-lift, water-blast and hardstand charges as at 1 March 2015. ... 101
Appendix 8. Sounds Shipwright Services Ltd. slipping and hardstand charges as at 1 January 2015. ... 102
Appendix 9. Waikawa Marine Centre Travelift, water-blast and hardstand charges as at 1 October 2014. ... 103
Appendix 10. Information required by Tasman District Council to support resource consent applications relating to discharges in the Tasman area ... 104

1. INTRODUCTION

New Zealand's coastal environments are home to an increasing number of non-indigenous species (NIS) (Kospartov *et al.* 2008). NIS and other harmful marine organisms can be transported to New Zealand and spread along its coastline by a variety of means. Shipping and boating have been identified as the most important pathways for NIS into and within New Zealand (Inglis *et al.* 2010) and other global coastal regions (Eldredge & Carlton 2002; Hewitt & Campbell 2008). Ocean-going vessels can transport organisms or their reproductive propagules (*i.e*. larvae or spores) in ballast and bilge water, in sea chests and other hull recesses and as fouling communities attached to submerged parts of hulls (Fofonoff *et al.* 2003; Darbyson *et al.* 2009). Aquaculture operations and the aquarium trade represent further high-risk pathways (Forrest *et al.* 2007; Morrisey *et al.* 2011). Due to the relative importance of shipping as a transport mechanism, ports and marina facilities are often the sites where NIS become first established (Inglis 2001; Hayes *et al.* 2005). While international vessel arrivals are generally the source of initial introductions, the domestic shipping, boating and aquaculture networks provide a mechanism for the transport of NIS among New Zealand's coastal locations (Hayden *et al.* 2009).

The ecological and economic impacts of NIS in New Zealand can be minimised by restricting their distribution and by preventing spread into new coastal environments. In recent years, New Zealand has taken measures to reduce the risk of NIS arriving via international vessel movements. New Zealand is a signatory to the International Maritime Organization's (IMO) *International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004* (IMO 2005) and has already given effect to some of the Convention's provisions by implementing an Import Health Standard (IHS) under the Biosecurity Act 1993. In 2014, the Ministry for Primary Industries introduced a Craft Risk Management Standard (CRMS) that incorporates 'hull hygiene' and biofouling management requirements for vessels entering New Zealand territorial waters. The CRMS requires all vessels to complete a biofouling declaration prior to entering New Zealand and to arrive with a 'clean hull' in accordance with specified biofouling thresholds (MPI 2014). Currently there is no established, coordinated system in New Zealand to manage biosecurity risks posed by domestic vessel traffic. However, there is a growing national and regional interest in managing domestic pathway risks. Amendments to the Biosecurity Act 1993 in November 2012 have created opportunities for developing measures to better manage the spread of NIS in New Zealand (Sinner *et al.* 2013).

1.1. Project background

The three Top of the South (TOS) councils (Nelson City Council (NCC), Tasman District Council (TDC) and Marlborough District Council (MDC)), together with the Ministry for Primary Industries (MPI), are the key agencies that form the TOS Marine

Biosecurity Partnership (TOSMBP). This Partnership is working towards reducing marine biosecurity risk in the TOS, recognising that marine pests can significantly impact the region's 'values'. Effective management of transport pathways that introduce or facilitate the spread of marine pests is critical to achieving the aims of the TOSMBP. The principal pathways operating into and within the TOS include vessel movements (merchant ships, barges, fishing boats, tourism vessels, yachts, *etc*.), and aquaculture activities such as transfers of seed-stock and equipment.

The TOSMBP is considering the development of a Regional Pathway Management Plan under the amended Biosecurity Act 1993. It is unknown as yet whether a formal Pathway Plan will go ahead. As part of the development of such a plan, the councils need to be aware of existing and in-development treatment tools and other risk mitigation measures, their regional availability, and the feasibility and costs of their implementation. Cawthron Institute has been contracted, via an Envirolink grant to Nelson City Council and direct top-up funds from the TOSMBP, to collate this information.

1.2. Scope

This report describes the following:

1. **Risk pathways into and within the TOS region, focusing on vessels.** Aim: to describe the variety and frequency of vessel types that enter or operate within the TOS, and the main facilities they visit or reside in.
2. **Current approaches to managing biosecurity risks.** Aim: to describe current approaches to managing vessel biosecurity risks including the relevant legislation, codes of practice and facility agreements.
3. **Treatment or risk–reduction tools for vessels.** Aim: to describe currently available and in–development treatment tools for vessels, and comment on their effectiveness, applicability for different vessel types and shortcomings.
4. **Regional treatment infrastructure.** Aim: to collate information on the infrastructure available in the TOS for vessel treatment, including in-water and land-basedfacilities and operations, and including information on their suitability, availability and costs for different vessel types and sizes.
5. **Environmental risks, mitigation and consenting.** Aim: (i) to describe the potential environmental and health and safety risks associated with the different treatment methods; (ii) to examine current regional requirements for resource consents in association with different vessel treatment methods and explore potential options for streamlining consenting processes.

The focus of this assessment is on treatment of *biofouling risks* associated with vessel movements into and within the TOS region. In the context of vessels, the term biofouling is used to describe the accumulation of marine organisms on the submerged parts of their hulls. This includes general hull areas as well as so–called 'niche areas', which are locations that are recessed or protected from water drag or which are not adequately protected by an antifouling coating. Niche areas include sea-chests, dry-docking support strips, bow thrusters and tunnels, rudders, anodes, bilge keels and other structures (Bell *et al.* 2011). These structures generally contain the majority of biofouling on vessels (Coutts 1999; Inglis *et al.* 2010). Biofouling on vessels can facilitate the spread of NIS through reproductive activity while vessels are in port, via the removal of biofouling during in-water cleaning of the hull (if dislodged material is not effectively contained), and via natural sloughing of organisms from the hull.

Biofouling has been recognised as one of the greatest risks for the introduction and spread of marine NIS in the TOS region (Forrest *et al.* 2009; Brine *et al.* 2013). There are a number of additional ways in which vessels can transport NIS however (termed 'modes of infection'). This includes risks posed by the transport of ballast and bilge water, fishing gear, equipment and aquaculture stock, as well as dredge spoil and washings. These modes of infection are outside the scope of this current report, although descriptions of each have been provided in Appendix 1 for completeness.

1.3. Information sources

A range of methods was used to gather the information presented in this report. A breakdown of our approach is provided in Table 1. Literature sources are listed in the references section, and organisations, facilities and individuals contacted for specific information are identified in Appendix 2.

Table 1. Approaches and sources of data and information associated with the various project components.

Report section	Information sources
Vessel risk pathways into and within the TOS region	Scientific and grey literature, port and marina companies, fishing and boating associations
Current approaches for managing biosecurity risks associated with vessels	Scientific and grey literature, council websites and plans, national and international conventions, legislation and codes of practice
Treatment tools and technologies	Scientific and grey literature, treatment service providers, shipping and boating industries
Regional treatment infrastructure	Regional treatment service providers, councils, marina and port companies
Risks and consenting requirements	Scientific and grey literature, regional councils and plans, national legislation

2. VESSEL RISK PATHWAYS INTO AND WITHIN THE TOP OF THE SOUTH REGION

2.1. Types of vessels entering and operating within the Top of the South region

A wide range of vessels move into and within the TOS region, for recreational and commercial purposes (Table 2). For consistency, we have grouped vessels into the sectoral pathway classes defined during a recent MPI-funded project that examined the national policy and operational basis for pathway management (Sinner *et al.* 2013; Inglis *et al.* 2014). These pathways are defined and discussed below, along with some generic movement information at both national and regional scales. More detailed information on vessel traffic within specific vessel hubs is provided in Section 2.2 below (mooring and berthing facilities).

Estimated numbers of vessel arrivals (*i.e* including repeat visits) from outside the TOS region, as well as different vessels (*i.e* excluding repeat visits) entering, over the past 12 months are provided at the end of Section 2.1 (Table 3 and Table 4). In addition, estimated numbers of different vessels operating (almost exclusively) within the TOS region over the past 12 months are also provided (Table 5). These estimates are based on discussions with vessel operators in the region, records obtained from TOS ports and marinas, as well as documents available on the internet (*e.g.* annual reports for the various ports). Based on vessel arrival data for the previous 2 years, Port Nelson has recent connections with all 16 commercial sea ports except at Gisborne (Port Nelson Ltd. unpublished data). Picton also has connections with most other commercial sea ports in New Zealand; however, these connections are not as strong as Port Nelson's (Hayden *et al.* 2009).

2.1.1. Maritime transport pathway

The maritime transport pathway facilitates the transport of cargo and people by commercial shipping within New Zealand. This pathway includes domestic movements of all types of merchant vessels (container, cargo, bulk carriers, tankers, *etc*.), passenger vessels, barges and dredges, tug, tender and pilot vessels, marine safety and patrol vessels, passenger ferries, *etc*. (Table 2). New Zealand's domestic commercial fleet comprises only 15 vessels exceeding 45 m in length, five of which are the Cook Strait ferries. The majority of New Zealand's domestic maritime freight is transported by foreign-registered vessels. Approximately 800 individual vessels visit New Zealand's commercial ports each year and account for about 6,000 of the ~7,000 annual domestic port-to-port movements (Hayden *et al.* 2009; Inglis *et al.* 2014). This includes movements into the TOS region. Domestic bulk tankers transport petroleum products from Marsden Point (Northland) to a range of domestic ports including Nelson. Cement products are transported to the TOS from Whangarei and Westport. In addition, weekly and fortnightly domestic cargo lines (Maersk, MSC, Pacifica, Swires) link the port of Nelson to several other domestic ports including Lyttelton, New Plymouth, Onehunga and Wellington (Inglis *et al.* 2014). Of New Zealand's 16 commercial seaports, 12 also trade internationally (Rockpoint Corporate Finance 2009).

Specialised vessels such as towed barges and dredges usually undergo domestic movements according to the needs of individual projects such as port maintenance dredging operations (carried out regularly, often on an annual basis), capital dredging (for port expansion or deepening) or other construction activities. Maintenance dredging in New Zealand ports is generally undertaken by relatively small craft (hopper capacities of 500–1,000 m^3), several of which are based around New Zealand and contracted out for specific projects. Port Nelson and Port Marlborough, for example, use the *Kawatiri* for maintenance dredging. The requirement for regular maintenance dredging at Port Nelson means the port is frequently connected with both Westport and Gisborne. A number of smaller cutter suction, backhoe, clamshell and bucket dredges, hopper barges and tugs are based around the country and are used for domestic dredging and construction projects. Capital dredging for New Zealand ports requires the extraction of much larger quantities of seabed compared to maintenance dredging. This is usually carried out by contracting larger overseas dredges (Inglis *et al.* 2014).

Other commercial vessel types that transport goods or people within the TOS region include tug and pilot vessels, local ferries, water taxis (*e.g.* those linking Nelson and Picton to the Abel Tasman National Park and Marlborough Sounds regions), coastal patrol vessels and vessels supporting offshore exploration projects (*e.g.* Taranaki oil fields).

2.1.2. Mining and exploration pathway

Oil, gas and a range of minerals are prospected for and mined within New Zealand. The offshore industry operates a range of vessel types that are used at different stages of the life-cycle of production areas (exploration, field development, field production, product transport and decommissioning), each of which can be associated with biosecurity risks (IPIECA 2010). Common vessel types include different kinds of mobile offshore drilling unit(s) (MODU[s]), barges, heavy-lift vessels, dive/ROV vessels, pipe–laying vessels, floating production storage and offloading vessels (FPSO), tankers, general supply vessels and others (Table 2). Some of these vessels enter the TOS region on a regular basis. For example, heavy-lift vessels (HLVs) occasionally arrive from overseas and anchor in Admiralty Bay, where they float-on (load) or float-off (unload) MODUs. Port Nelson also regularly accommodates supply vessels for oil fields in the Taranaki basin; these vessels transport personnel, food and consumables to offshore rigs, or assist with offshore oil loading processes.

2.1.3. Commercial fishing pathway

New Zealand's domestic fishing industry is divided into different sectors (inshore finfish, inshore shellfish and seaweed, deep-water and middle-depth, and highly migratory species). More than 1,500 commercial fishing vessels are registered in New Zealand[1]. In 2007, the largest numbers of registered fishing vessels were domiciled in Auckland, Bluff, Nelson and Picton (Dodgshun *et al.* 2007). Fishing vessels spend varying amounts of time in port ranging from hours to weeks (Hayden *et al.* 2009), during which they may unload catch, provision, bunker, undertake repair and maintenance, change crews or wait out adverse weather conditions. Fishing vessels range from small wooden or steel craft of ~10m length to large vessels of > 100 m (Table 2). Domestic vessels fishing more than 50 nautical miles off the coast are required to be > 45 m in length (Maritime New Zealand 2015). Hayden *et al.* (2009) described the domestic movements of fishing vessels around New Zealand during 2000 to 2005. During those 5 years, there were 254 movements of large fishing vessels (> 99 gross tonnes) into Port Nelson. The majority of these vessels are likely to have returned to Nelson from sea as opposed to from other domestic ports. Smaller fishing vessels (< 99 gross tonnes) also visit Nelson and Picton on a regular basis or are based there permanently (Inglis *et al.* 2014).

2.1.4. Marine aquaculture pathway

Aquaculture is a growing industry for New Zealand. The industry has a goal of increasing annual sales to NZ$1 billion by 2025 and this is supported through New Zealand government's Aquaculture Strategy and Five-year Action Plan. Tasman and Golden bays and the Marlborough Sounds are among the country's main production regions. The dominant domestic crop is the green-lipped mussel (*Perna canaliculus*). Finfish species such as Chinook salmon (*Oncorhynchus tshawytscha*) are also produced but at significantly smaller scales and vessel pathways are largely intra-regional.

Vessels utilised by the aquaculture industry include mussel harvesters, seeding vessels, finfish transporters, barges and small launches (Inglis *et al.* 2014). Because of their small size, ranging from < 10 to approximately 30 m, vessels operating in the aquaculture industry do not carry ballast water (Table 2). See Appendix 3 for a list of aquaculture vessels operating in the TOS region. The movement of seed-stock and equipment is also an important vector with reference to aquaculture, however as discussed earlier this is beyond the scope of the current report.

Most aquaculture service vessels tend to operate within a single farming region (Forrest & Blakemore 2002) and frequent movements of locally-based vessels occur within the TOS region. However, inter-regional movements can occur, particularly for harvesting purposes. Recently, Gust *et al*. (2008) described two mussel harvesting

[1] http://www.fish.govt.nz/en–nz/Commercial/About+the+Fishing+Industry/default.htm

vessels that frequented the Port of Lyttelton, but which also service farms in the Marlborough Sounds. For between 1 and 4 months each year, these vessels made regular trips between farms around the Banks Peninsula region and the Port of Lyttelton. Outside of this period the vessels operated on mussel farms in Port Underwood, Pelorus Sound and Queen Charlotte Sound. Similarly, Sanford has a number of aquaculture vessels that work in different areas within the TOS region, as well as other regions. The vessel *Okiwi Spirit* predominantly operates within the Pelorus Sound area, however the vessel will also operate within the Queen Charlotte Sound, and Golden and Tasman bays. In addition, *Okiwi Spirit* will also operate out of Banks Peninsula, and on occasion Stewart Island (see Appendix 4).

2.1.5. Sport and recreation pathway

The transport vectors in the domestic sport and recreation pathway include predominantly movements of recreational vessels by sea or land. Other equipment, such as anchors and chains, surf boards, kayaks, fishing gear, live bait, catch and holding water, and diving equipment, may also be transported but are beyond the scope of this project to consider.

Recreational vessels include sailing and motor yachts and launches as well as trailered motor and sailing craft. Recreational vessels that move between New Zealand's coastal regions mostly comprise sailing and motor yachts and launches that are permanently moored in the water (Table 2). These vessels typically have a length of 8–20 m but super-yachts can reach > 100 m. The number of recreational vessels based in New Zealand is not known accurately because there is no required registration of non-commercial craft. However, a recent survey estimates that around 600,000 recreational craft are owned around New Zealand, of which 10% are permanently moored recreational motor and sailing yachts and launches (Colmar Brunton Ltd 2011).

The greatest recreational boating activity occurs during the summer period and the Marlborough Sounds, Nelson and Golden Bay regions are amongst the most popular sailing and boating destinations around the country (Inglis & Floerl 2002; Hayden *et al.* 2009). Domestic recreational vessels display a wide range of movement schedules. Sailing and motor yachts are known to undergo local, regional and long–distance domestic trips and voyages. A recent study showed that domestic recreational vessel movements effectively connect the marinas located along all of New Zealand's coastal locations (Floerl *et al.* 2009). However, many recreational vessels stay close to their homeport and some are only used infrequently. A recent study on boating habits in Canada and New Zealand found that only 25% of recreational boaters interviewed in Marlborough and Nelson had visited another domestic marina in the preceding 6 months - most voyages were to nearby local destinations (Lacoursière-Roussel *et al.* 2012).

New Zealand receives 500–800 international recreational vessels each year. The residency periods of these vessels within individual coastal marinas range from one day to several months (Floerl *et al.* 2008; Floerl *et al.* 2009). During 2002–2004, Nelson and Marlborough marinas received an estimated 480 and 1480 recreational vessel visits, respectively (Hayden *et al.* 2009). More recent data are presented in Section 2.2 for individual port and marina locations.

2.1.6. Research and education pathway

The research and education sector includes Crown Research Institutes, private research institutes, marine environmental consultancies, universities and polytechnics and commercial aquaria. Together, these institutions own several dozen research vessels of 4–70 m in length that operate locally or within a region (*e.g.* trailered research vessels) or more widely within New Zealand and internationally (*e.g.* NIWA's *Kaharoa* and *Tangaroa*) (Inglis *et al.* 2014). Several institutions within the TOS region own and operate trailered research vessels (≤ 7 m), including Cawthron Institute, NIWA and the Nelson Marlborough Institute of Technology.

Table 2. Vessel types moving into and within the Top of the South region, and the modes of infection by which they can transfer marine non-indigenous species (NIS).

Sector pathway	Vessel types	Approx. size range (length)	Modes of infection
Maritime transport	Merchant vessels (all cargoes), passenger vessels, ferries, dredges, barges, water taxis, patrol boats, harbour tugs, pilot boats and other non–trading vessels	10 to > 200 m	Ballast water, biofouling, sea chests, water for shipboard operations, fouled equipment
Mining and exploration	MODUs, barges, heavy-lift vessels, dive/ROV vessels, pipe–layers, FPSOs, tankers, support/supply vessels	25 to > 200 m	Ballast water, biofouling (vessels and equipment), sea chests, water for shipboard operations, dredge slurry water, fouled equipment
Commercial fishing	Seiners, trawlers, dredgers, long–liners, factory ships	10–100 m	Ballast water, biofouling (vessels and mobile fishing equipment), sea chests, water for shipboard operations, fouled gear and equipment, livestock and bait
Marine aquaculture	Harvesting vessels, seeding vessels, fish transporters, barges, water taxis, crew boats (see Appendix 3)	10–30 m	Biofouling (vessels and mobile farming equipment), water for shipboard operations, spat/seed movements, fouled culture gear and equipment
Sport and recreation	Sailing and motor yachts and launches, trailered motor boats and sailing dinghies	3–35 m, super-yachts up to 100 m	Biofouling, water for shipboard operations, fouled equipment
Research and education	Trailered and non–trailered research vessels	4–70 m	Biofouling, water for shipboard operations, fouled equipment

Note: MODU(s) = mobile offshore drilling unit(s), ROV(s) = remotely operated vehicle(s), FPSO = floating production storage and offloading vessels.

Table 3. Estimated number of vessel arrivals (including repeat visits) from outside the Top of the South region over the past 12 months. These estimates are based on discussions with vessel operators in the region, records obtained from Top of the South ports and marinas, as well as documents available on the internet (*e.g*. annual reports for the various ports).

Vessel type	**Number of visits**			
	0–10	**11–100**	**101–1,000**	**> 1,000**
MARITIME TRANSPORT				
Merchant vessels				●
Passenger vessels		●		
Ferries				●
Dredges	●			
Barges		●		
Water taxis	●			
Patrol boats	●			
Harbour tugs		●		
Pilot boats	●			
MINING & EXPLORATION				
MODUs	●			
Barges	●			
Heavy-lift vessels	●			
Dive/ROV vessels				
FPSO vessels	●			
Pipe–layers	●			
Tankers		●		
Support/supply vessels	●			
COMMERCIAL FISHING				
Seiners		●		
Trawlers			●	
Long–liners		●		
Factory ships			●	
MARINE AQUACULTURE				
Harvesting vessels	●			
Seeding vessels	●			
Fish transporters	●			
Barges: small (< 10 m)	●			
Barges: large (> 10 m)	●			
SPORT AND RECREATION				
Sailing and motor yachts			●	
Launches			●	
Trailered vessels				●
RESEARCH AND EDUCATION				
Trailered research vessels	●			
Non–trailered research vessels	●			

Note: MODU(s) = mobile offshore drilling unit(s), ROV(s) = remotely operated vehicle(s), FPSO = floating production storage and offloading vessels.

Table 4. Estimated number of different vessels (*i.e.* excluding repeat visits) entering from outside the Top of the South region over the past 12 months. These estimates are based on discussions with vessel operators in the region, records obtained from Top of the South ports and marinas, as well as documents available on the internet (*e.g*. annual reports for the various ports).

Vessel type	Number of vessels		
	0–10	11–50	> 50
MARITIME TRANSPORT			
Merchant vessels			●
Passenger vessels		●	
Ferries	●		
Dredges	●		
Barges	●		
Water taxis	●		
Patrol boats	●		
Harbour tugs	●		
Pilot boats	●		
MINING & EXPLORATION			
MODUs	●		
Barges	●		
Heavy-lift vessels	●		
Dive/ROV vessels	●		
FPSO vessels	●		
Pipe–layers	●		
Tankers	●		
Support/supply vessels	●		
COMMERCIAL FISHING			
Seiners	●		
Trawlers		●	
Long–liners	●		
Factory ships	●		
MARINE AQUACULTURE			
Harvesting vessels	●		
Seeding vessels	●		
Fish transporters	●		
Barges: small (< 10 m)	●		
Barges: large (> 10 m)	●		
SPORT AND RECREATION			
Sailing and motor yachts			●
Launches			●
Trailered vessels			●
RESEARCH AND EDUCATION			
Trailered research vessels	●		
Non–trailered research vessels	●		

Note: MODU(s) = mobile offshore drilling unit(s), ROV(s) = remotely operated vehicle(s), FPSO = floating production storage and offloading vessels.

Table 5. Estimated number of different vessels operating (almost exclusively) within the Top of the South region over the past 12 months. These estimates are based on discussions with vessel operators in the region, records obtained from Top of the South ports and marinas, as well as documents available on the internet (*e.g.* annual reports for the various ports).

Vessel type	**Number of vessels**		
	0–10	**11–50**	**>50**
MARITIME TRANSPORT			
Merchant vessels	●		
Passenger vessels		●	
Ferries	●		
Dredges	●		
Barges		●	
Water taxis		●	
Patrol boats	●		
Harbour tugs	●		
Pilot boats	●		
MINING & EXPLORATION			
MODUs	●		
Barges	●		
Heavy-lift vessels	●		
Dive/ROV vessels	●		
FPSO vessels	●		
Pipe–layers	●		
Tankers	●		
Support/supply vessels	●		
COMMERCIAL FISHING			
Seiners	●		
Trawlers		●	
Long–liners	●		
Factory ships	●		
MARINE AQUACULTURE			
Harvesting vessels	●		
Seeding vessels	●		
Fish transporters	●		
Barges: small (< 10 m)	●		
Barges: large (> 10 m)	●		
SPORT AND RECREATION			
Sailing and motor yachts			●
Launches			●
Trailered vessels			●
RESEARCH AND EDUCATION			
Trailered research vessels	●		
Non–trailered research vessels	●		

Note: MODU(s) = mobile offshore drilling unit(s), ROV(s) = remotely operated vehicle(s), FPSO = floating production storage and offloading vessels.

2.2. Berthing and mooring facilities within the Top of the South

Commercial ports and marinas that are either first-entry points for international vessels and/or domestic shipping hubs are often locations where NIS first establish (Morrisey & Miller 2008). In the TOS region this includes the ports of Tarakohe, Motueka, Nelson, Havelock and Picton, as well as recreational marinas at Tarakohe, Motueka, Nelson, Havelock, Picton and Waikawa. Information on major berthing and mooring facilities at each location is presented below, as well as approximate traffic volumes for vessels arriving from other regions in New Zealand and internationally. Information on additional points of entry to the TOS region, such as swing moorings, jetties and launching ramps, is also provided. Contact details for all facilities listed are provided at the end of the section, in Table 10.

2.2.1. Vessel hubs

Port Tarakohe

Port Tarakohe (also known as Port Golden Bay) is located on the south–eastern shore of Golden Bay (40° 49' 22.4"S, 172° 53' 52.5"E) and is owned and operated by Tasman District Council. The port is predominantly used by mussel farmers, scallop fishermen and recreational boaters. There is one heavy-duty concrete wharf (120 x 25 m) that can accommodate vessels up to 140 m length. There is also a smaller wooden wharf adjacent (70 m × 10 m), although this has been condemned. Water depth within the channel on wharf approach and alongside the main wharf is 4 m at low tide. Vessels wishing to berth in Tarakohe Harbour are required to contact the Harbour Manager prior to entry (see Table 10).

Figure 1. Aerial view of Port Tarakohe, including the recreational marina.

Traffic volumes for Port Tarakohe include a mixture of vessels based at the port and those visiting from other regions in New Zealand. The port does not receive international vessels directly as it does not have customs clearance. Most of the local vessels are fishing boats or mussel harvesters servicing farms within Golden and Tasman Bays. As at February 2015, there were seven fishing boats permanently residing within the port as well as several others landing their product from throughout New Zealand. It is estimated that 20 external fishing boats will visit Port Tarakohe within a year (pers. comm. A. Kilgour, Tarakohe Harbour Manager).

With reference to vessels associated with the mussel industry, there are eight permanent mussel harvesters within the port that operate daily. In addition, there are 10 mussel harvesting vessels from five companies based in the Marlborough Sounds that come to work at the Golden and Tasman Bay farms when required. These vessels can be in port from 1 day to 1 month, and on many occasions throughout the year. Port Tarakohe has also had three visits in the past year from support vessels working on the Taranaki oil fields. These vessels call into the port for supplies and recreation and stay two or three days. The vessels are between 50 – 70 m in length. There have also been three cruise liner visits to the port in the past year, which anchored outside of the harbour and tendered passengers to the shore. The small cargo freighter *M.V. Anatoki* (50 m in length) visits monthly as part of a scheduled service distributing dolomite throughout New Zealand ports. Other ports of call for this vessel include Wanganui, New Plymouth, Auckland, Tauranga, Timaru and Bluff (pers. comm. A. Kilgour, Tarakohe Harbour Manager).

Tarakohe Marina

The recreational marina at Tarakohe is owned by Tasman District Council. It has 62 berths, 41 of which are floating berths and 21 are pile berths (Figure 1). There are also 20 fixed moorings within the harbour limits (10 each in the inner and outer harbour). The inner seawall on the west side was extended by 70 m in 2008, with plans to increase the number of marina berths by 150–180 over the next several years discussed. Existing marina berths can accommodate vessels from 10 to 30 m length and 2.5 to 3.5 m draft. There is a substantial hard stand area adjacent the Pohara Boat Club on the western side of the port.

Occupancy rates for the marina are very high; as at February 2015, there were approximately 60 vessels berthed within the marina and a further 20 on moorings. It is estimated that ~100 recreational craft visit the marina from other regions in New Zealand during a year; including the North Island, Marlborough Sounds, West Coast, Milford Sound and Canterbury (pers. comm. A. Kilgour, Tarakohe Harbour Manager). The port does not have customs clearance so any recreational craft visiting from overseas will have entered New Zealand at a different location. A large number of recreational trailer boats are also launched at the boat ramp within the harbour. Approximately 4,000 boats access the boat ramp through the controlled barrier arm during a typical year; a large proportion of these come from visitors on holiday within the bay (pers. comm. A. Kilgour, Tarakohe Harbour Manager).

Port Motueka

Port Motueka is located 3 km south-east of Motueka township (41° 08' 11.8"S, 173° 01' 21.9"E). The inner harbour is a tidal lagoon of some 1,000 ha with the port at the entrance to the harbour (Figure 2). The main wharf is owned and operated by Talley's Group Ltd; other facilities are owned by Tasman District Council. The main wharf is 150 m long and has the capacity to berth large vessels; however, the port is restricted by a shallow draft entrance which limits the vessels to a small fleet of fishing vessels currently operating out of the port. Larger fishing vessels berth and unload catch in Port Nelson.

Figure 2. Aerial view of Port Motueka, including the three marinas.

Traffic volumes are very low at Port Motueka, mainly because of the restricted depth at the entrance. There are currently nine fishing vessels permanently based at the port, all of which are owned and operated by the Talley's Group. These vessels also frequent the ports of Tarakohe, Westport and Greymouth. They have all dredged for scallops in the past in the Marlborough Sounds and Golden Bay when these growing areas are open for harvesting. During the past 12 months there has been one other vessel (*FV Jay Penelope*) berthed at the Talley's Group wharf; this vessel was predominantly operating out of Westport, Greymouth, Picton and Tarakohe, and was berthed in Motueka over the Christmas 2014 period. There have also been short visits from a vessel that completes work on mussel farms in Tasman Bay; this vessel travels to most parts of New Zealand completing marine farm work. Abel Tasman shuttles also operate 2–3 smaller vessels in and out of Port Motueka when the tides are suitable or vessel maintenance is required (pers. comm. B. Gardiner, Talley's Group).

Motueka Marinas

There are three separate marinas, two boat ramps and two slipways in Motueka, all owned and operated by local clubs or associations. The three marinas are owned and operated by the Motueka Power Boat Club, the Motueka Yacht and Cruising Club and the Motueka Peninsula Marine Society (Figure 2).

The Motueka Power Boat Club's marina currently has 40 berths, although the organisation has resource consent to increase the total number to 87 in the future. Berth sizes range from 8 to 18 m. The committee of the club is also working with the council to obtain consents for an extended hard stand area on the western side of the channel for the storage of trailer boats and the haul-out and maintenance of larger vessels in the area. The Motueka Yacht and Cruising Club maintain the central marina within the harbour, also comprising nearly 40 berths. Maximum vessel size that can be accommodated at this marina is 12 m. The club has a haul-out facility for members wishing to work on their boats. The Motueka Peninsula Marine Society operates the marina closest to the harbour entrance. There are also approximately 40 berths at this marina.

Motueka's three marinas have a relatively high rate of occupancy with most available berths occupied by local vessels. The marinas receive some visitors from other regions however this is quite limited within a typical year. For instance, less than 10 vessels visit the Motueka Yacht and Cruising Club marina from other regions each year (pers. comm. P. Dodgshun, Motueka Yacht and Cruising Club). As with Tarakohe, the port does not have customs clearance so any recreational craft visiting from overseas will have entered New Zealand at a different location.

Port Nelson

Port Nelson is the largest fishing port in Australasia, and is jointly owned by Nelson City Council and Tasman District Council. The port is located 2 km north of Nelson township (41° 15' 49.8"S, 173° 16' 41.3"E), and comprises infrastructure operated by Port Nelson Ltd. as well as several independent fishing companies, including two of New Zealand's largest operators, Amaltal and Sealord Group (Figure 3). The port has five main shipping wharves; two heavy-duty wharves (Main Wharf and Brunt Quay) and three multi-purpose berths (McGlashen Quay, Kingsford Quay and the Coastal Berth). There are also three designated lay-up berths for ship repair work and refitting as well as several other smaller wharves and facilities designated for use by fishing fleets. In addition to the commercial wharves, there is a super–yacht pontoon positioned off Wakefield Quay that can take vessels up to 130 m length. The pontoon itself is only 30 m in length, although the adjoining Coastal Berth gives an additional

85 m of mooring length. Detailed berthing facilities, including berth length and maximum vessel draft and beam, are listed below (Table 6).

Figure 3. Aerial view of Port Nelson, including the recreational marina.

Port Nelson received a total of 1,713 vessel arrivals during the 2013-2014 financial year, up from 1614 during the previous year (Port Nelson Ltd., unpublished data). Of these vessels' arrivals, 786 were vessels ≥ 100 gross tonnes (Port Nelson Ltd. 2014). The Port received 192 international vessel visits during this period; vessels arrived from Australia, Malaysia, China, Qatar, New Caledonia, Japan, Thailand and Taiwan. There were 619 vessel arrivals direct from another New Zealand commercial port (includes vessels < 100 gross tonnes) during the 2013–2104 financial year; of these arrivals, 300 were form the Port of Lyttelton, the majority of which were container vessels. The remainder of the domestic arrivals were made up of petrochemical, processed forestry, car carriers and cement vessels. There were 32 arrivals to the super–yacht berth during the same period, yachts and launches arrived from Wellington, Auckland, Picton and directly from sea. In addition, three separate cruise vessels and three navy vessels visited the port (Port Nelson Ltd., unpubl. data).

Table 6. Berthing facilities in Port Nelson (modified from Inglis *et al.* 2006a).

Berth	Section	Purpose	Length of berth (m)	Maximum draft (m)
Coastal berth + pontoon		Multipurpose, super yacht lay-up	85 + 30	5
Main Wharf	North	Discharge point for petroleum products	160	9
	South	Heavy–duty cargo berth	119	10.5
Brunt Quay		Heavy–duty cargo berth	196	10.3
McGlashen Quay	North	General and break–bulk cargoes	155	9.2
	South	Bitumen and methanol discharge	200	9.2
Kingsford Quay		Break bulk, general cargoes, logs	174	9.5
	East	Break bulk, general cargoes, logs, vessel lay-up	85	6.5
Lay-up Berth	1	Lay-up, fish unloading	85	8
	2	Lay-up, fish unloading	65	6.5
	3	Lay-up, fish unloading	105	5.5
McKellar Quay (Sealord)	East	Independently operated fishing vessels	129	7
	Centre	Independently operated fishing vessels	65	6
	West	Independently operated fishing vessels	50	6
Dog Leg		Independently operated fishing vessels	43	3.5
Amaltal Fishing Co.		Independently operated fishing vessels	130	7
Donker Marine		Independently operated fishing vessels	70	4.5

Nelson Marina

There is a recreational marina east of the port in Dixon Basin which is operated by Nelmac on behalf of Nelson City Council (see Figure 3). The marina currently has 519 pontoon berths plus approximately 36 pole berths, all of which can accommodate vessels up to 20 m length. Some of the marina berths can also accommodate vessels > 20 m length (*i.e.* berths at the end of the jetties). In addition to permanently allocated berths, there are 30 visitor berths within the marina (all of F jetty is allocated to visiting vessels). At present the marina is operating at 97% occupancy (pers. comm. P. Jonkers, Nelmac) with a wait list in operation for the permanent berths. While there are a few of the smallest berths available (8 m), no larger berths are currently free. Approximately 120 vessels visit Nelson marina from other regions in New Zealand or from overseas each year (pers. comm. P. Jonkers, Nelmac).

Port Havelock

The Port of Havelock is located at the south-western edge of the Pelorus Sound (41°16' 50.6"S, 173° 46' 15.9"E). There are two commercial wharf areas within the port, located at either end of the marina. The Main Wharf is located at the northern end of the harbour, nearest the entrance, comprising two heavy–duty concrete wharves (40–50 m length). At the inner most part of the harbour there is a substantial sheet pile wharf (~70 m length) serving as a berth for larger vessels visiting the harbour. There is a maintenance berth and commercial haul-out ramp alongside the sheet pile wharf. Both wharf areas service a number of aquaculture companies (Sanford Ltd. have a mussel processing factory at the port) as well as a range of other commercial and domestic users (pers. comm. P. Mitchell, Port Marlborough Ltd.).

Figure 4. Aerial view of the port and marina at Havelock.

Havelock is the centre for much of the New Zealand green–lipped mussel industry. As such the port is the base for a number of vessels servicing this industry, as well as several oyster and salmon farms that operate within the Pelorus Sound. The port also houses a number of water taxis, small tourism vessels and fishing boats. There is a regular 'mail boat' run on the *Pelorus Express* which departs from Havelock three times a week. This boat services the remote communities in the Pelorus Sounds as well as operating as a passenger cruise vessel (see Figure 5 for routes). Traffic movements are largely restricted to domestic vessels returning to the port each day. There are not believed to be many visits from vessels from other regions in New Zealand. The port does not have customs clearance (pers. comm. P. Mitchell, Port Marlborough Ltd.).

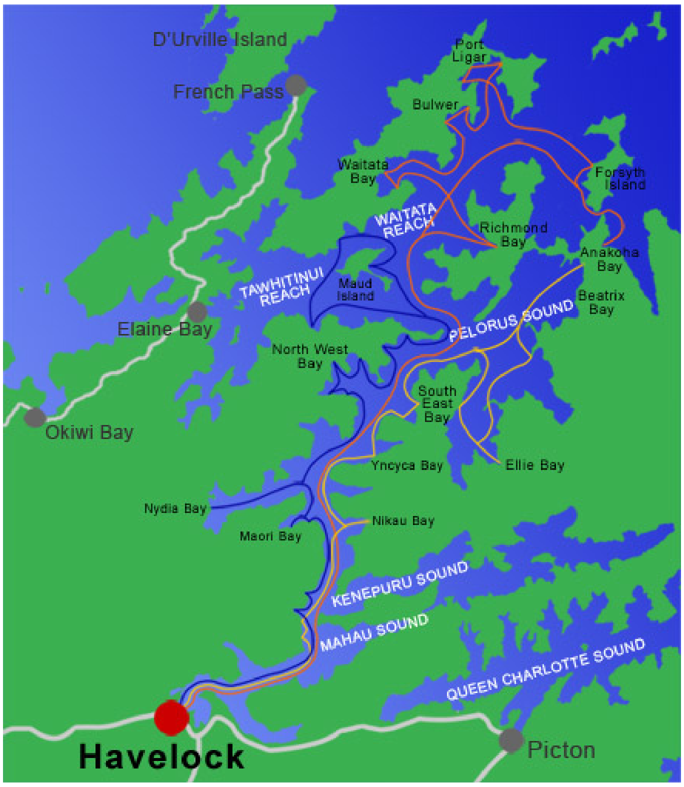

Figure 5. Pelorus Sound 'Mail Boat' routes departing from Havelock three times a week. Blue line = western route (Tuesday), Yellow line = Eastern route (Thursday), and Orange line = Outer Sounds route (Friday). Map sourced from: http://www.themailboat.co.nz/mailruns.html

Havelock Marina

Havelock Marina is located at the head of the Pelorus Sound. It has 366 berths and can accommodate vessels from 10 m to 30 m length (Figure 4). The minimum marina depth is 2.5 m. The marina accommodates a mix of both recreational and commercial vessels including charter boats and marine farming vessels. The three inner most jetties (J6–8; see Figure 4) house the larger vessels while smaller recreational craft are berthed at the jetties nearer the harbour entrance. Havelock marina had average berth occupancy of 71% during the 2013–2014 financial year (Port Marlborough Ltd. 2014). The marina does not have customs clearance and does not get many visits from vessels outside of the TOS region (pers. comm. P. Mitchell, Port Marlborough Ltd.).

Picton (Port Marlborough)

The head of Picton Harbour (41° 17' 06.2"S, 174° 00' 11.7"E) is divided into two bays by Kaipupu Point, with the port of Picton operating facilities in both bays (Figure 6). Picton is the South Island terminal port for New Zealand's inter–island passenger and freight ferries.

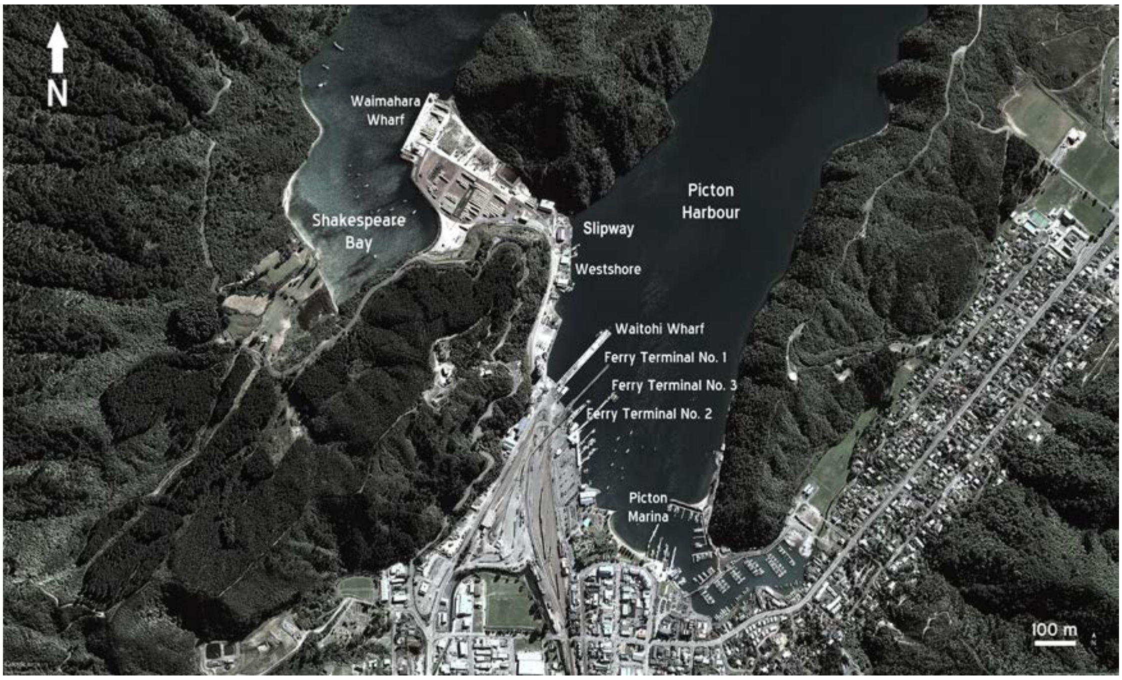

Figure 6. Aerial view of the port facilities at Picton.

There are four main wharves located in Picton, including three ferry terminal berths (serving both road and rail traffic) and the Waitohi Wharf. Waitohi Wharf is a general-purpose finger wharf providing berths and facilities for overseas and coastal cargo vessels. The wharf also serves as the berth for passenger cruise ships, accommodating vessels up to 245 m long and 8.5 m draft. The newer Westshore berth is located further towards Kaipupu Point and provides berth space for commercial fishing vessels (max. vessel dimensions 210 m length and 8 m draft). Infrastructure between the two shipping wharfs includes a recently developed sheetpile wharf, jetties and a slipway. South of the main wharf, towards the town centre, there are several wharves for water taxis, commercial launches, vessels at anchor, and large visiting recreational vessels. A float–plane tourism operation also operates from this area.

In addition to infrastructure at Picton, Port Marlborough also operates a newer deep–water port facility in Shakespeare Bay to the west. The 200 m long Waimahara Wharf is designed as a multi–purpose berth for timber, logs and coal. With a depth of 15.3 m at low tide, the wharf provides deep–water access and can accommodate cargo vessels up to 13.5 m draft and cruise ships up to 320 m long. The Port at Shakespeare Bay is the deepest export port in New Zealand and does not require dredging. This is particularly important for ship exports as elsewhere in New Zealand depth can limit shiploads. For example, logging ships initially loaded in Nelson often 'top-up' their load in Picton as the Port at Nelson is not deep enough to support maximum shiploads (Boffa Miskel, 2007).

Detailed berthing facilities, including length and maximum vessel draft and beam, for the Port of Picton are listed below (Table 7).

Table 7. Berthing facilities in the Port of Picton (modified from Inglis *et al.* 2006)

Berth	Berth No.	Purpose	Length of berth (m)	Maximum draft (m)
Inter–island ferry terminal	1	Road and rail–carrying conventional ferries	120	7.5
	2	Road and rail–carrying conventional ferries	160	7.5
	3	Vehicle–carrying conventional ferries	140	7.5
Waitohi Wharf	East	General–purpose finger wharf, cargo berths, overseas and coastal vessels, Cook Strait roll on–roll off vessels, fishing vessels	210	10.3
	West	General–purpose finger wharf, cargo berths, overseas and coastal vessels, Cook Strait roll on–roll off vessels, fishing vessels	210	10.3
Westshore		Commercial fishing vessels	30	2.5
Waimahara Wharf (Shakespeare Bay)		Multi–purpose berth for timber, logs and coal	200	15.3

The total number of vessel visits (≥ 500 gross tonnes) to Port Marlborough during the 2013–2014 financial year was 3,443 (Port Marlborough Ltd. 2014). The vast majority of these vessel visits (96%) are return visits by the interisland ferries operating between Picton and Wellington. Once the ferry services to Wellington are excluded, the port of Picton has relatively light connections but to most commercial sea ports in New Zealand (Hayden *et al.* 2009). During 2013-2014, 91 vessels ≥ 500 gross tonnes (excluding the ferry services) visited the port. The main cargoes transported through Picton are logs, salt, cement and fish (Port Marlborough Ltd. 2014). There were 19 cruise vessel visits to Picton during 2013–2014, down slightly from 22 and 20 during the two previous years. Cruise vessel visits will be considerably higher for the current year however, with 33 visits scheduled for the current summer (57% increase). There are a number of barging companies who operate out of Picton (largely based within the Westshore development), servicing the outer regions of the Queen Charlotte Sound. These companies carry out construction including building fixed structures such as jetties and mooring installations, as well as transporting supplies such as aquaculture feed.

Picton Marina

Picton Marina is located adjacent to the Port of Picton (41° 17' 19.8"S, 174° 00' 37.9"E) and has 254 berths that include pile and floating pontoon berths (Figure 7). Berths range in size from 10 m to 35 m, and are fully serviced with power and water. In addition to the marina facilities, five town wharves at the entrance of the marina cater to a number of water taxi companies and other small commercial vessels. There is a visitor's jetty for short–stay visiting craft at the marina entrance. Picton marina had an average berth occupancy of 97% during the 2013–2014 financial year (Port Marlborough Ltd. 2014).

Figure 7. Aerial view of Picton marina. The location of main wharf and jetty structures is included. Note the new Jetty 10 (J10) is not pictured (situated closest to boat ramp).

Approximately 60 vessels visit Picton Marina from other regions in New Zealand or from overseas each year. The majority of visits are during the summer months, with few visits during winter (pers. comm. Port Marlborough Ltd.). The marina itself does not have customs clearance so any recreational craft visiting from overseas will have entered New Zealand at a different location, or alternatively clear customs in the port area.

Waikawa Marina

Waikawa Marina is also located within Queen Charlotte Sound and is approximately 5 minutes' drive from Picton town ship (41° 16' 02.5"S, 174° 02' 12.9"E). The marina has 600 berths for vessels from 8 to 20 m. There are also 70 lock–up boat sheds present nearby. Waikawa marina had average berth occupancy of 93% during the 2013–2014 financial year (Port Marlborough Ltd. 2014).

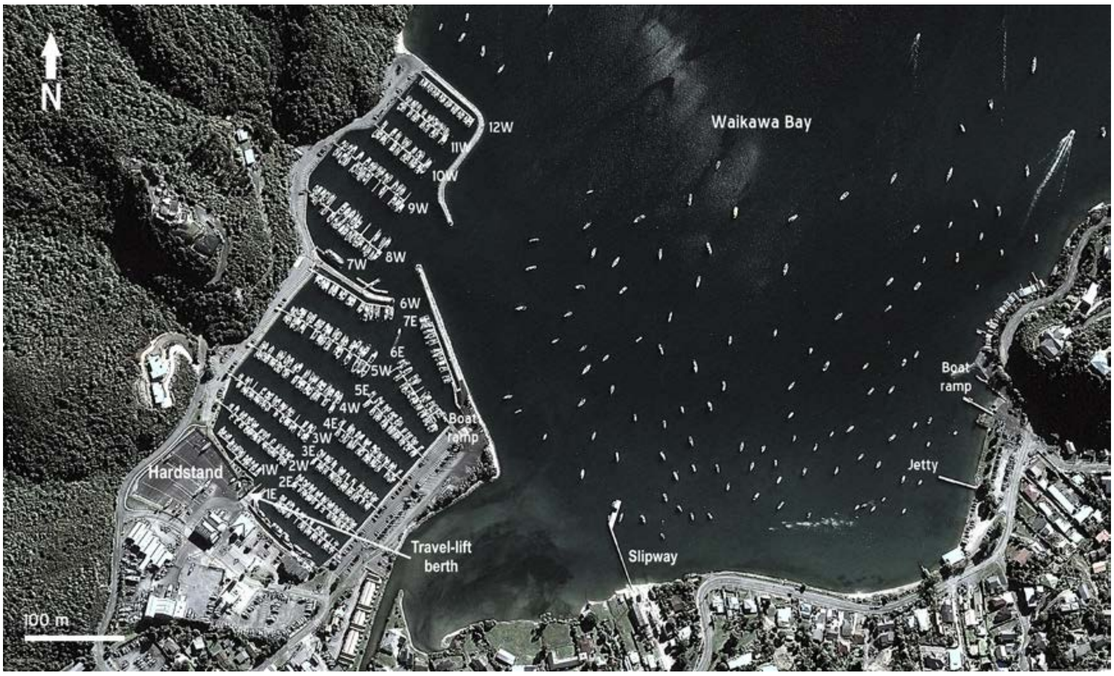

Figure 8. Aerial view of Waikawa Marina.

The marina does not have customs clearance and most vessels from outside of the TOS region will berth at Picton marina due to proximity to town facilities and attractions (pers. comm. B. Carver, Port Marlborough Ltd.).

2.2.2. Other notable berthing facilities in the Top of the South region

Riwaka Wharf

This wharf is operated by Tasman District Council as part of the roading network. There is a sealed boat ramp for small trailer boats at the end of Green Tree Road. No wharf fees are applicable at the Riwaka Wharf although maximum duration of stay allowed is 7 days. The water around the wharf is shallow – vessels lying alongside are likely to settle on the bottom at low tide.

Mapua Wharf

Mapua Wharf is owned by Tasman District Council. Along with the main wharf there is an attached floating pontoon jetty. Maximum vessel length is 10 m at this jetty and no overnight berthing alongside is permitted. In addition to the main wharf, the Mapua Boat Club Inc. administers some casual moorings at Mapua.

2.2.3. Moorings outside of vessel hubs

In addition to vessel hubs such as ports and marinas, the TOS has a considerable number of moorings and jetties frequently visited by vessels from other regions. The number of moorings varies considerably between the three districts. As at February 2015, the Tasman District Council has 263 swing moorings and 96 fixed moorings or jetties recorded within their jurisdiction (pers. comm. Ros Squire, TDC). Nelson City Council has 60 swing moorings on record, predominantly located within the Nelson Haven (pers. comm. Kathy Mardon, NCC). Marlborough District Council has ~3100 swing moorings on record throughout the Marlborough Sounds area[2] (pers. comm. MDC duty planner), with these numbers reflecting the considerable amount of coastline this regional council is responsible for (~1/5 of New Zealand's coastline).

Recreational craft visit the TOS from other regions in New Zealand, often berthing at yacht and cruising club moorings and not visiting coastal facilities such as regional marinas. Vessel traffic is believed to be largely from the Wellington region, likely due to its proximity and its regularly organised boating club outings. The two main yacht clubs in the Wellington region are the Mana Cruising Club and the Lowry Bay Yacht Club based at Seaview Marina. Traffic is higher from the coast north of Wellington due to proximity; faster motor launches can make the journey to the Marlborough Sounds in ~40 minutes and sailing yachts ~3 hours (depending on conditions in Cook Strait). Up to 200 recreational craft are believed to travel to the TOS region from Mana marina within a typical year (pers. comm. P. Heart, Mana Marina Manager). Most vessels travel to the Marlborough Sounds, although 20–30 vessels will go further to the Abel Tasman National Park area. Most trips will take place during the summer months. It is estimated that < 100 yachts will visit the TOS from the Lowry Bay club, generally travelling over together in groups of ~10 several times a year. These yachts will usually visit either the Marlborough Sounds or Torrent Bay in the Abel Tasman National Park (pers. comm. M. Lissette, Lowry Bay Yacht Club).

[2] see http://maps.marlborough.govt.nz/viewer/?webmap=8e37220979944bce8ae2e99c58e84453&s=moorings

2.2.4. Launching ramps

Tasman District

There is a considerable number of boat launching ramps within the Tasman District, from Westhaven Inlet on the West Coast through to Rabbit Island within Tasman Bay. Conditions range from unsealed launching slopes through to sealed concrete or asphalt ramps with toilets, trailer parking and boat wash–down facilities. Most of the smaller public access ramps are free to use, however there is generally a charge to cover maintenance for casual use of the larger facilities. A full list of boat launching ramps in the Tasman District is provided in Table 8.

Table 8. Boat ramps and launching lanes in the Tasman District, including details of ramp surface, tidal requirements for launching and fees payable for casual use.

Location	Launching ramp features	Fee to use?
Best Island	Subject to significant tidal effects.	No
Rough Island (at Hunter Brown Reserve)	Subject to significant tidal effects.	No
Rabbit Island (access from Boat Ramp Road)	Sealed with concrete or asphalt	No
Mapua (at the wharf)	Sealed with concrete or asphalt.	Yes
Mapua (Grossi Point)	Subject to significant tidal effects.	No
Kina (at Baigent's Reserve)	Subject to significant tidal effects.	No
Motueka (at Motueka Power Boat Club marina)	Sealed with concrete or asphalt.	Yes
Riwaka (end of Green Tree Road)	Sealed with concrete or asphalt. Subject to significant tidal effects.	No
Tapu Bay reserve	Subject to significant tidal effects.	No
Stephens Bay	Unsealed.	No
Kaiteriteri	Sealed with concrete or asphalt. Subject to significant tidal effects.	Yes
Otuwhero Estuary	Sealed with concrete or asphalt. Subject to significant tidal effects.	No
Marahau Beach	Sealed with concrete or asphalt. Subject to significant tidal effects.	No
Awaroa Inlet (at end of road)	Subject to significant tidal effects.	No
Totaranui (at beach)	Sealed with concrete or asphalt.	No
Totaranui (at estuary)	Sealed with concrete or asphalt. Subject to significant tidal effects.	No
Tata Beach	Sealed with concrete or asphalt.	No
Tarakohe	Sealed with concrete or asphalt.	Yes
Port Waitapu	Subject to significant tidal effects.	No
Rangihaeata	Subject to significant tidal effects.	No
Paton Rock	Unsealed surface.	No
Onekaka	Subject to significant tidal effects.	No
Milnthorpe	Unsealed surface.	No
Collingwood	Sealed with concrete or asphalt.	Yes
Pakawau (at the motor camp)	Unsealed surface.	No
Puponga	Subject to significant tidal effects.	No
Westhaven Inlet (at Dry Road)	Subject to significant tidal effects.	No
Westhaven Inlet (at Mangarakau Wharf)	Sealed with concrete or asphalt.	No

Nelson City

The Nelson marina has a public boat ramp at Akersten Street. The ramp is designed for the launching of small recreational craft. The cost of casual use is $5 per launch. There is also a restricted access boat ramp within the marina accessed from Vickerman Street. Additional public boat ramps are located on the Monaco peninsula and on Wakefield Quay (non–trailered craft only).

Marlborough District

The Marlborough District also has a considerable number of public access boat launching ramps. Similar to the Tasman District, conditions range from unsealed launching slopes through to sealed concrete or asphalt ramps with toilets, trailer parking and boat wash–down facilities. Most of the smaller public access ramps are free to use, however there is generally a charge to cover maintenance for casual use of the larger facilities. A full list of boat launching ramps in the Marlborough District is provided in Table 9.

Table 9. Boat ramps and launching lanes in the Marlborough District, including details of ramp surface, tidal requirements for launching and fees payable for casual use.

Location	Launching ramp features	Fee to use?
Cissy's Bay ramp	Beach access, tidal, good parking, no facilities.	No
Duncan's Bay ramp	Dual access concrete boat ramp, good parking, no facilities.	No
Penzance boat ramp	Beach launching, good parking, tidal, no facilities.	No
Tennyson Inlet boat ramps		No
Anakiwa boat access	Beach access, tidal, good parking, no facilities.	No
Momorangi Bay boat access	Beach access, tidal, good parking, no facilities.	No
French Pass boat ramp	Single access concrete boat ramp, limited parking, toilets, jetty, fuel, camping ground.	No
Okiwi Bay boat ramp	Single access concrete boat ramp, limited parking, toilets, camping ground.	No
Elaine Bay boat ramp	Follow metal track onto beach, launching off bar into channel, good parking, jetty, fuel.	No
Picton boat ramp	Four lane concrete boat ramp, good parking, jetty, toilet facilities.	Yes
Waikawa boat ramps	Dual access concrete boat ramp, good parking, toilet facilities.	Yes
Havelock boat ramp	Dual access concrete boat ramp, jetty, all tide, good parking.	Yes
Ohingaroa Reserve boat ramp	Beach launching, good parking, tidal, no facilities.	No

Table 10. Contact details for berthing and mooring facilities with the Top of the South region.

Facility	Contact person	Address	Phone	Email
Port Tarakohe (Port Golden Bay)	Allan Kilgour (Harbour Manager)	995 Abel Tasman Drive, Takaka 7142	(03) 525 8174 027 446 3891	port.tarakohe@ tasman.govt.nz
Port Motueka	Talley's Group Ltd.	Ward Street Motueka 7120	(03) 528 2800	inquiries@talleys.co.nz
Port Nelson Ltd.		10 Low Street, Port Nelson, Nelson 7010	(03) 548 2099	info@portnelson.co.nz
Port Havelock (Port Marlborough Ltd.)	Pete Mitchell (Marina Manager)	Inglis Street, Havelock 7100	(03) 574 2366	havelock@ msmarinas.co.nz
Port of Picton (Port Marlborough Ltd.)		14 Auckland Street, Picton 7220	(03) 520 3399	reception@ pmnz.co.nz
Port Tarakohe (Port Golden Bay) Marina	Allan Kilgour (Harbour Manager)	995 Abel Tasman Drive, Takaka 7142	(03) 525 8174 027 446 3891	port.tarakohe@ tasman.govt.nz
Motueka Power Boat Club	Alan Nobal (Marina Supervisor)	PO Box 41, Motueka 7143	027 663 3995	
Motueka Yacht and Cruising Club	Peter Dodgshun (Marina Custodian)	2 Ward Street, Port Motueka, Motueka 7120	(03) 528 7291 027 606 3291	
Nelson Marina	Paul Jonkers (Marina Manager)	Cross Quay, Port Nelson, Nelson 7010	(03) 546 7768 027 246 5535	marina@nelmac.co.nz
Havelock Marina	Pete Mitchell (Marina Manager)	Inglis St, Havelock, Marlborough 7100	(03) 574 2366	havelock@ msmarinas.co.nz
Picton Marina	Dave Mahony (Marina Manager)	Waikawa Road, Picton 7220	(03) 520 3390	picton@ msmarinas.co.nz
Waikawa Marina	Brian Carver (Marina Manager)	Beach Road, Waikawa 7220	(03) 520 3395	waikawa@ msmarinas.co.nz

3. CURRENT APPROACHES TO MANAGING BIOSECURITY RISKS

3.1. Vessel hull maintenance

Periodic hull maintenance, in particular biofouling removal and the application of antifouling paint, is an important risk mitigation measure to reduce the spread of NIS associated with vessel traffic. For most vessel types, the main driver for biofouling removal is improved performance and economy, as marine growth can substantially increase drag and accelerate corrosion. Regular cleaning can also extend the in-service period of the antifouling paint (Tribou and Swain 2010). Until recently, biosecurity benefit has typically been a secondary consideration. Fouling removal can take place on–land or in-water using a range of tools and facilities (see sections 4 and 5). When undertaken on land, antifouling paints can also be re–applied. There is a range of antifouling paints on the market, and the choice of which one to use is largely based on the operational profile of the vessel (Table 11).

Most antifouling coatings contain biocides, with copper-based paints the most common by far. Biocidal compounds in paints (including copper) have been under increased scrutiny and restrictions on their use have been put in place. For example, mercury, arsenic and organotins are now deemed unacceptable due to adverse environmental or human health risks (Thomas & Brooks 2010). As a consequence, non–toxic (*i.e* no biocide present) coatings are becoming more common, and include approaches based on natural compounds (including secondary metabolites) and surface properties (Yebra *et al.* 2004, Qian *et al.* 2010, Scardino & de Nys 2011). The frequency of antifouling paint renewal varies with paint–type and the operational profile of the vessel (Table 11) For example, hard contact leaching paints require removal and reapplication more frequently (typically within 18 months) than a self-polishing co-polymer coating (ca. 5 years). For recreational vessels (*i.e* motorised and sailing craft), antifouling effectiveness may be exceeded before repainting occurs.

In terms of application, paint coatings on recreational vessels are commonly applied by amateurs (*e.g.* the vessel owner) with paint sourced from retailers. By contrast, commercial vessels are normally painted by professionals in shipyards (*e.g.* fishing vessels, mussel harvesters) or in a dry-dock (*e.g.* merchant ships, cruise ships, large ferries).

Table 11. Summary of main antifouling coating types. Some developing approaches (*e.g.* non–toxic coatings) are not presented here, but a summary can be found in Qian *et al.* (2010).

Paint type	Description	Suitability	Typical in–service period[1]
BIOCIDAL			
Ablative	Water movement over the paint surface wears down the outer layers and exposes fresh biocide.	Not suitable for vessels that sit idle for extended periods as it requires water movement to wear away the ‘spent’ outer layer of paint.	Effective for periods up to 36 months.
Self–polishing copolymer	Much tougher than ablative paints. Polishing rates can be varied to suit operating speeds and activity.	Fast–polishing (*i.e* soft) coatings are applied to slow or infrequently used vessels, while slow–polishing (*i.e* hard) coatings are applied to fast or high activity vessels.	Can be effective for > 5 years.
Hard (contact leaching)	A very hard (*i.e* durable), smooth, low maintenance between paint applications. Releases the biocide constantly (initially from the surface, then from deeper via ‘microchannels’). Release rates decrease exponentially with time.	Used on fast powerboats and large commercial vessels.	Effective life rarely exceeds 18 months
NON–TOXIC			
Fouling release	Do not contain biocides (coatings are now mainly silicon–based). Adhesion strength of fouling is reduced due to the surface properties (analogous to a non–stick frying pan). Fouling removal occurs when the vessel moves through the water or during in-water cleaning.	Not suitable for all vessel types, as sufficient speed is required to remove all biofouling species. Some of the Cook Strait ferries use fouling release paints.	Can be effective for > 5 years.

[1] If coatings used according to manufacturers recommendations

Antifouling paints are seldom 100% effective in preventing marine growth from forming on the hull, especially if vessels are stationary for extended periods (Hopkins & Forrest 2010). This is particularly true for ablative paints, which require continual 'sloughing' of outer layers where biocides have become depleted. For vessels that accumulate biofouling between antifouling applications (known as the in-service period), in-water cleaning can be an effective option to rejuvenate the coating. As with land-based methods, a range of tools are used, depending on the size of the vessel and type of antifouling coating present (see Section 4.2 for a summary). For example, fouling removal on oil rigs is often achieved by using high pressure water blasters, whereas a soft cloth or mesh bag is typically used on a recreational yacht.

The frequency of in-water cleaning also varies considerably between vessel types. For example, a recreational yacht owner may undertake in-water cleaning on a weekly–to–monthly basis, particularly if it is a racing yacht. By contrast, a merchant vessel may be cleaned every 12–18 months, and this may be limited to only areas where biofouling is present. In practice, all in-water cleaning is restricted by rules in Coastal Plans and most instances of in-water cleaning are done outside of these rules.

3.2. Legislation, codes of practice, facility agreements and other requirements

The biosecurity regime in New Zealand is governed primarily by the Biosecurity Act 1993 (BSA). The Resource Management Act 1991 (RMA) and the New Zealand Coastal Policy Statement (NZCPS) also play significant roles in the management of harmful marine organisms. Other legislation and regulations with relevant provisions include the Fisheries Act 1996, the Local Government Act 2002, the Maritime Transport Act 1994, the Resource Management (Marine Pollution) Regulations 1998 and the Hazardous Substances and New Organisms Act 1996 (HSNO Act). Sinner *et al.* (2013) provide a comprehensive assessment of the statutory framework in place to manage marine pests in New Zealand, including detailed a description of the legislation listed above.

Here we summarise key legislation relevant to managing vessel biofouling in the TOS, as well as describe codes of practice, guidelines and facility agreements in place that collectively aim to improve vessel biofouling best management practices.

3.2.1. International Maritime Organisation biofouling guidelines

The International Maritime Organisation (IMO) is the United Nations specialised agency with responsibility for developing and maintaining a comprehensive regulatory framework for international shipping. In 2011, the Marine Environmental Protection

Committee of the IMO adopted detailed guidelines for management of biofouling[3]. The guidelines recommend measures that vessel operators can take to minimise the risks of transporting biofouling, including guidance on appropriate choice and maintenance of antifouling systems for vessels and operational practices to reduce the development of biofouling. A central feature is maintenance of a biofouling management plan (BMP) and record book for the vessel that details how biofouling is managed. Although the guidelines are voluntary, the IMO has requested Member States to take 'urgent action' to apply them, including disseminating the guidelines to the shipping industry and other affected parties. While the 2011 guidelines target commercial vessels, the IMO has subsequently released a shorter guidance document for recreational vessels.

3.2.2. Classification societies

A classification society is a non–governmental organisation that establishes and maintains technical standards for the construction and operation of ships and offshore structures. For commercial vessels over 400 GT, it is necessary to hold an antifouling certificate to prove that the paint used does not contain organotin compounds[4]. All ships with a length of or above 24 m but with a tonnage < 400 GT must hold an antifouling declaration. Contrary to the certificate, the declaration is not associated with a requirement for survey and certification by a recognised classification society.

To remain in class, vessels are required to undergo periodic surveys by suitably qualified inspectors; in the TOS region, Diving Services New Zealand Ltd. undertakes such inspections. Biofouling presence is recorded, but this is primarily to assess whether the antifouling systems are effective.

3.2.3. Biosecurity Act 1993

The Biosecurity Act 1993 (BSA)[5] is the key legislation for managing marine pests in New Zealand. Key provisions and regulatory mechanisms available under the BSA to manage marine pests include:

- national policy direction
- national and regional pest management plans
- national and regional pathway management plans
- government–industry agreements
- craft risk management standards
- controlled area restrictions

[3] *Guidelines For the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*. The original 2011 version and MEPC decision 207(62) can be found at http://www.imo.org/blast/blastDataHelper.asp?data_id=30766&filename=207%2862%29.pdf. A revised edition was published in 2012.

[4] The organotin compounds are harmful to the environment and have been made illegal through the International Convention on the Control of Harmful Anti–fouling Systems on Ships (the AFS Convention).

[5] Biosecurity Act 1993: http://www.legislation.govt.nz/

- small–scale management programmes
- unwanted organism declarations

The statutory provisions enabling pathway management plans (see Section 3.2.7 below) and government–industry agreements were added by amendments to the BSA in late 2012. During marine response activities, the BSA can also be used to direct vessel owners to comply with instructions from response staff (termed a Notice of Direction), such as removing the vessel to land or treating/removing biofouling present. To our knowledge, these powers of the BSA have never been used in New Zealand during a marine response.

3.2.4. Craft Risk Management Standard for vessel biofouling

Until recently, hull fouling was a largely unmanaged pathway for marine species translocations into and within New Zealand. The recently finalised Craft Risk Management Standard for biofouling (CRMS) requires all vessels to complete a biofouling declaration prior to entering New Zealand and to arrive with a ‘clean hull’ in accordance with specified biofouling thresholds. There are two different thresholds: ‘long–stay vessels’ (vessels staying in New Zealand for > 20 days) are not allowed to arrive with more than a slime layer and goose barnacles on their entire submerged hull surface. ‘Short–stay vessels’ (vessels staying ≤ 20 days) are allowed to have more fouling, but it is restricted to macroalgae and very low abundance of one type of sessile animal biofouling such as barnacles, tubeworms or bryozoans.

The CRMS has a 4-year voluntary lead-in period and will enter into force in May 2018. The lead-in period is intended to allow for the development and implementation of improved biofouling management technologies and practices within the shipping industry.

The CRMS can also be met via one of the following acceptable measures.

1. Complete hull clean within 30 days prior to arriving to New Zealand or within 24 hours following arrival.
2. Continual maintenance using best practice (application of appropriate antifouling coatings; operation of marine growth prevention systems in sea-chests; in-water inspections with biofouling removal as required). Following the IMO Biofouling Guidelines is recognised as an example of best practice.
3. Application of approved treatments for hull areas with biofouling. However, to date no approved treatments are listed on the MPI website.

As an alternative to the acceptable measures listed above, vessel operators can submit a Craft Risk Management Plan for MPI approval that outlines the steps to be taken to reduce biosecurity risk to an equivalent degree as meeting the above requirements of the CRMS.

With the adoption of improved biofouling management practices by various vessel owners/operators, in response to the CRMS, we anticipate considerable benefit to New Zealand and the TOS region. In particular, we would expect a reduction in the rate of new NIS introductions (assuming vessel traffic levels remain constant). A consideration for the TOS region, however, is that when the CRMS becomes mandatory in 2018, international vessels not meeting the strict hull hygiene requirements will require local options for treatment and mitigation. As outlined in Section 7 below, such facilities may exist for smaller craft (*e.g.* recreational yachts and vessels < 25 m), however there is a shortage of capacity to manage larger vessels.

3.2.5. In-water cleaning guidelines

The Anti–fouling and In-water Cleaning Guidelines were released by the Commonwealth of Australia (COA) in June 2013, and replaced the 1997 *ANZECC Code of Practice for Anti–Fouling and In-water Hull Cleaning and Maintenance*. Whereas ANZECC in 1997 largely discouraged in-water cleaning, the 2013 guidelines enable in-water cleaning under certain circumstances. The guidelines were developed through an extensive process of stakeholder consultation, and are endorsed by the Australian government and MPI. The guidelines have no statutory effect in New Zealand but can be used as the basis for the development of CoPs, RMA rules or measures under biosecurity instruments such as pathway management plans.

The guidelines recommend best-practice approaches for the application, maintenance, removal and disposal of antifouling coatings, and the management of biofouling and invasive aquatic species on vessels and movable structures in Australia and New Zealand. The guidelines also contain a decision-support tool that uses risk factors (*e.g.* paint coating type, age, biofouling size and origin) to assist decision-makers about appropriate in-water cleaning practices. A copy of these guidelines can be obtained online[6].

3.2.6. Resource Management Act 1991

The Resource Management Act 1991 (RMA) can be used to manage vectors and pathways in the TOS region. For example, a condition in a resource consent for drilling rigs being offloaded (from a heavy-lift vessel) in Admiralty Bay was required to meet the new biofouling standard (CRMS, see above). This condition also applied to the heavy-lift vessel and the supply vessels used to tow the rigs up to the Taranaki Basin.

Resource consents issued for swing moorings in the NCC jurisdiction include conditions that require that mooring fittings are inspected biennially by a suitably qualified and experienced inspector. In addition to being structurally sound, correctly

[6] http://www.agriculture.gov.au/Style%20Library/Images/DAFF/__data/assets/pdffile/0020/2330570/antifouling–guidelines–june–2013.pdf

positioned and labelled, and of the configuration specified, they are also required to be ‘free from invasive marine organisms in the opinion of Council’s Monitoring Officer’. Swing mooring consents issued by TDC and MDC also require regular inspections, however there are presently no conditions relating to invasive species or biofouling accumulation. In addition to consent conditions, at least one council (Auckland) has proposed regional rules for the management of biofouling risks resulting from hull fouling and in-water cleaning.

3.2.7. National and regional pathway management plans

Amendments to the BSA in 2012 have enabled MPI and regional councils to develop national or regional pathway management plans, respectively. These plans provide a non–RMA regulatory mechanism that can be used to manage biosecurity risk from vessel biofouling and in-water cleaning. Currently, MPI are working with regional councils to foster cooperation on the development of pathway management plans, or pathway–based management approaches. While some councils are considering regional pathway management plans, no plans have yet been formally proposed, but several councils (Southland, Tasman, Nelson, Marlborough and Northland) are actively implementing approaches to manage high-risk vessels.

3.2.8. Marina berth agreements

None of the six main marinas in the TOS region (Picton, Waikawa, Havelock, Nelson, Motueka and Tarakohe) have rules that relate specifically to marine biosecurity, or identify ‘acceptable’ levels of biofouling accumulation for vessels using the facilities. The Nelson Marina is currently re-drafting their berth agreement, which will include rules relating to seaworthiness and acceptable levels of fouling (pers. comm. P. Jonkers, Nelmac).

3.2.9. Industry codes of practice

There are codes of practice (COP) in place for the mussel, oyster, and salmon industries, although these are currently being reviewed and updated. Aquaculture New Zealand administers the COP that provide guidance on day–to–day practices to reduce the risk of spreading harmful marine organisms, as well as directions for best practice during emergency biosecurity events. For vessels, the COP generally encourage regular hull cleaning and application of antifouling paints (at appropriate facilities). Interestingly, an online search for rules or guidance relating to vessel biofouling (or marine biosecurity more generally) on boating club webpages (TOS only) revealed nothing.

3.3. Inspections and surveillance

3.3.1. Active surveillance

Since 2002 the government has funded a national port surveillance programme (*Marine High-risk Site Surveillance*) that searches for several high-risk target species (some of which are designated as unwanted organisms under the Biosecurity Act 1993) that have the potential to threaten New Zealand's marine environment and economy. The current target list includes five primary species (not yet established in New Zealand) and four secondary species (already established in New Zealand) (Morrisey *et al.* 2014). Biannual surveys are carried out in and around 11 of the country's main shipping ports (Whangarei, Auckland, Tauranga, Taranaki, Wellington, Nelson, Lyttelton, Otago and Bluff) and marinas (Opua, Picton/Havelock). The objective of this programme is to detect new incursions at low abundances to maximise the chances for successful eradication or control measures.

Surveillance work has also been undertaken in the TOS region (mainly Marlborough) following recent incursions by *Didemnum vexillum*, *Styela clava* and *Sabella spallanzanii*. This has involved the inspection of vessels, marina and port infrastructure (piles and pontoons), moorings, marine farm structures, and natural habitats by divers. In terms of vessel inspections, councils in the TOS region have previously targeted 'high risk' vessels that have arrived from outside of the region. These inspections are typically ad–hoc and rely on advanced warning of the vessels' arrival.

3.3.2. Passive surveillance

Passive surveillance is a major component of any biosecurity system and has been responsible for the detection of several high profile marine pests in the region. For example, during routine maintenance on a domestic cargo vessel in Nelson, a commercial diver discovered Mediterranean fan worms (*Sabella spallanzanii*) inside a sea chest. Given their time on or near the water and working with vessels, commercial divers, marine farm contractors, water taxis, harbour masters, marina operators, slipway and haul-out workers, and marine scientists are a valuable passive surveillance resource. Recreational boaties and divers also extend the network of passive surveillance beyond invasion hotspots (*e.g.* marinas and ports) to less 'industrial' areas where invasions can also occur (*e.g.* marine reserves).

3.4. Education/awareness

In recognition of the importance of recreational vessels, MPI has developed 'Clean Boats-Living Seas', a boatie's guide to marine biosecurity. This booklet encourages boaters to keep their hulls clean (to not exceed slime layer biofouling) and be on the look-out for target pests or unusual species. Another initiative is New Zealand's Clean

Boating Programme (www.cleanboating.org.nz) developed by the New Zealand Marina Operators Association, part of which provides guidance on hull biofouling and cleaning.

The TOS Partnership has undertaken a range of initiatives to raise marine biosecurity awareness in the region, including close liaison with key facility operators (*e.g.* marinas, slipways, ports) and potential vectors of spread (*e.g.* recreational vessels, industry), feature articles in the TOS newsletter and the provision of information on the webpage.

Research organisations in the region (particularly NIWA and Cawthron) also have a strong presence in the marine community, and actively liaise with the public and clients in the region regarding biosecurity issues. A large touch-tank with local common biofouling species, along with preserved samples of high profile pests, featured at a recent open day at Cawthron.

4. TREATMENT TOOLS AND TECHNOLOGIES

The impacts of marine NIS on environmental and economic values has led to an increased demand for treatment tools to mitigate their spread. Control options generally involve treatments for the reduction or removal of biomass and have varying levels of success. Information for a range of land-based and in-water treatment tools is provided below. Information is initially summarised (Table 12), including details of vessel suitability and target applications for each technology. The availability of treatment technologies in the Top of the South region, as well as those only available nationally, is indicated. Specific companies which can be contacted for each technology, and their contact details, are included in Appendix 5 and Appendix 6.

Specific information about each treatment or risk-reduction tool can be found in a number of previously published reports and papers (*e.g.* Bohlander 2009, Piola *et al.* 2009, Floerl *et al.* 2010, Inglis *et al.* 2012, Morrisey & Woods 2014). The first four of these resources are included as an electronic appendix to this report, while Morrisey and Woods (2014), currently in draft format, can be obtained from MPI (enquiries to Dr. Eugene Georgiades, Senior Adviser, Biosecurity Risk Analysis - Animals and Aquatic). References and page numbers for specific information are given where possible.

Table 12. Summary of treatment or risk–reduction technologies available for vessel biofouling. Vessel suitability and target applications for each technology are specified. Treatments shaded orange are currently available in the Top of the South region, while treatments shaded blue are available nationally. Although discussed in text, ultrasonic treatments are not included as this tool is still in development.

Treatment method	Land based	In-water	Vessel suitability	Target application
Manual removal				
Hand-picking	●	●	Recreational and light commercial vessels	Isolated patches of fouling
Hand–removal with brushes, scrapers and pads	●	●	Recreational and light commercial vessels	Isolated patches of fouling
Desiccation	●		Smaller vessels not restricted by time in port	All hull surfaces, sea chests and external structures
Mechanical removal				
Rotary brush / pad (hand-held devices)		●	Small commercial vessels and/or small patches of fouling	Continuous sections of hull
Rotary brush / pad (diver-operated brush carts)		●	Merchant shipping vessels	Continuous sections of hull
Rotary brush / pad (robots and ROVs)		●	Merchant shipping vessels	Continuous sections of hull
Rotary brush / pad (contactless)[1]		●	Merchant shipping vessels	Continuous sections of hull
High-pressure water jet (hand tools)	●	●	Recreational and light commercial vessels	Hull sections, sea chests if gratings removed, isolated patches of fouling
High-pressure water jet (carts and ROVs)[2]		●	Merchant shipping vessels	Continuous sections of hull
Cavitational jet (self–propelled, diver-operated carts and hand-held pistols)[1]		●	Merchant shipping vessels	Continuous sections of hull
Vacuum systems[3]		●	Light commercial vessels	Isolated patches of fouling
Surface treatment				
Hot water / heat / steam		●	Merchant shipping vessels	
Shrouding technologies				
Wrapping		●	No length restrictions	All hull surfaces including niche areas
Floating docks		●	At present restricted to vessels < 20 m length	All hull surfaces including niche areas
Shrouding with toxicant		●	All vessels that can be wrapped	All hull surfaces including niche areas
Shrouding with manual or mechanical cleaning		●	Safety considerations will likely restrict to < 20 m length	All hull surfaces including niche areas

[1] This cleaning method has been specifically designed to minimise damage to paint coatings
[2] Two Norwegian systems (ECOsubsea and CleanROV) are designed to treat early-stage biofouling assemblages (*e.g.* slime layers) without causing damage to underlying antifouling coatings
[3] Vacuum systems are generally used in conjunction with other removal systems/devices (*e.g.* hand–picking, mechanical removal)

4.1. Land-based treatment options

Vessels can be removed from the water on trailers at launching ramps, as well as using travel-lift, slipway and dry-dock facilities. Large vessels (>80 m length) are commonly treated in dry-docks; these are narrow basins that can be flooded to allow a vessel to be floated in. The basin is then drained of water to provide a dry working platform. Smaller vessels are removed from the water using patent slips or marine railways. These use a wheeled cradle to winch the vessel from the water up the incline of a slipway. Maintenance of the vessel is then undertaken on the slipway or nearby. Smaller vessels such as recreational yachts are generally removed from the water using travel or cradle–lifts which use straps under the hull as slings to support the weight of the vessel. Hydraulic hoists raise and lower the vessel, with travel-lifts able to move and steer under their own power. In the yard, vessels are supported by boat stands and bilge blocks. Smaller vessels can also be cleaned on tidal grids, careening bays or by beaching at high tide, although relevant consents are likely to be required (see Section 6.2).

4.1.1. Water-blasting

Water-blasting is the most common above–water cleaning method for vessels, and is often undertaken prior to further maintenance or replacement of the antifouling coating. Water is sprayed under pressure from a lance (generally up to 8,000 psi), with the power of the water blast varied depending on the type of antifouling coating present on the hull (*e.g.* silicone based paints require gentler treatment) and the type and extent of biofouling present. Specific information on water blasting as a vessel treatment tool can be found in Piola *et al.* 2009, page 215; and Inglis *et al.* (2012), page 81.

Water-blasting can be used on a range of vessel types, including smaller recreational craft and larger commercial vessels. Depending on the size of the vessel and amount of biofouling present, it can take just a few hours to haul-out and clean a recreational vessel using water-blasting (Floerl *et al.* 2010). Larger vessels may need to be on the slipway or in dry-dock for several days. Water-blasting can treat most modes of infection, including hull biofouling, sea chests (if grating is removed), and biofouling on mobile structures. Water-blasting can be less effective for removing biofouling from complex or recessed areas such as seawater inlet pipes and gratings (Inglis *et al.* 2012). Correct disposal of waste is important when colonial organisms such as ascidians and bryozoans are present on vessel hulls. Fragmentation of these organisms may enhance local establishment, as fragments are often able to reattach and grow (Paetzold & Davidson 2010, Hopkins *et al.* 2011a).

Figure 9. A recreational yacht being water-blasted at the Nelson Marina travel-lift dock. All waste discharged is collected in sumps, passing through a series of tanks and filter systems. Photo credit: L. Fletcher (Cawthron Institute).

4.1.2. Manual removal

A variety of hand tools, ranging from scrapers to shovels, can be used to remove visible biofouling from a vessel hull however most are ineffective at removing microscopic life–stages (*e.g.* new recruits). For larger vessels, this method will be most effective for low–levels of fouling, or when organisms occur in small patches (as is often the case with dry-docking strips). Care is needed not to damage antifouling coatings. Specific information on the feasibility of scraping as a treatment tool can be found in Piola *et al.* 2009, page 214; and Inglis *et al.* (2012), page 76.

Scraping can be used on a range of vessel types but is probably most suited to smaller craft. Scraping is most effective at treating biofouling on large, continuous surfaces, as opposed to angular or recessed structures. Most small recreational vessels can be treated within several hours (Floerl *et al.* 2010). As with water-blasting, care must be taken with appropriate waste disposal to prevent this being returned to the sea.

4.1.3. Desiccation

Fouled vessels can be removed from the water and left on a hard stand to kill all biofouling present through desiccation (or air–drying). This technique is most commonly used to treat biofouling on aquaculture and fishing equipment, as production cycles often allow for gear to be rotated and left for long enough periods to ensure complete mortality. There is also the potential for this technique to be applied to the movement of oil rig structures; heavy-lift vessels transport the rig structure out of the water, thus any associated biofouling is subjected to desiccation stress (see Prince 2014). The majority of biofouling dies within a few days to approximately 1–2 weeks, although some species can survive longer under low temperature and high humidity conditions. This is particularly relevant for hard-bodied organisms which are generally more resilient to air exposure. More detail on desiccation as a treatment tool can be found in Inglis *et al.* (2012), page 82.

As vessels will need to be removed from the water for several weeks to ensure complete mortality, desiccation as a treatment tool is realistically only feasible for small vessels (Inglis *et al.* 2012). Removing larger vessels (> 30 m) from the water for an extended period of time would require considerable slipway or hard-stand space, which are often in high demand and have a relatively high daily charge for their use. There would also be lost revenue associated with having the vessel inactive for such extended periods.

4.2. In-water treatment tools

In-water cleaning can be a useful tool for reducing biosecurity risks. In addition to treatment of high-risk vessels, it can form part of a proactive management programme to reduce the accumulation of biofouling on vessels or be applied to remove established growth from unmanaged vessels (Morrisey & Woods 2014). Due to limitations in biomass collection and disposal, the use of in-water cleaning can be associated with biosecurity and contamination risks which need to be managed for treatment to be meaningful (Floerl *et al.* 2010). Under the recently adopted (Australia) Antifouling and In-water Cleaning Guidelines (June 2013), in-water cleaning of vessels is considered acceptable under certain circumstances (see Section 3.2.5).

4.2.1. Manual removal

Smaller recreational vessels are often cleaned by divers using hand tools without removing the vessel from the water. A variety of techniques and tools can be used including hand-picking and cleaning with scrapers, brushes, and in the case of more fragile fouling release coatings, sponges or soft cloths. This method has been used when managing incursions of *Styela clava* and *Sabella spallanzanii* on vessel hulls and fixed structures in Lyttelton, Nelson, Picton and Whangarei harbours (Morrisey & Woods, 2014). More detail on manual removal as a treatment tool can be found in

Floerl *et al.* (2010), page 42; Inglis *et al.* (2012), page 48; and Morrisey and Woods (2014), page 13.

Manual removal can be applied to a range of vessel types; however, this technique is probably more suited to recreational yachts and motor launches. These smaller craft can be treated in under a day (Floerl *et al.* 2010), with larger vessels and barges taking several days to treat completely (*e.g.* Hodges & Simmons 2013). Manual removal may result in the release of antifouling coatings from hulls, although this will depend on the method used and coating type on the vessel. There is also the risk that some organisms (or their propagules) removed from the hull will still be viable, highlighting the importance of effective capture and containment (also see Section 6.2.3).

4.2.2. Mechanical removal

Mechanical removal involves technologies utilising powered devices (Morrisey & Woods 2014). Specific technology types and tools are discussed below.

Rotating brush technologies

Mechanical brush systems typically comprise a series of rotating brushes and have been used for several decades by the global shipping industry to remove biofouling organisms from submerged hull areas. There are three levels of systems generally employed: hand-held devices; diver-operated brush carts; and robotic or remotely operated vehicle (ROV) hull cleaners (Morrisey & Woods 2014). Devices generally consist of a treatment unit that houses one or several brushes that are rotated by a hydraulic motor (Floerl *et al.* 2013). Devices range in size from handheld systems of approximately 30 cm diameter to large, self-propelled systems such as submersible cleaning and maintenance platforms (SCAMPs) with a diameter of nearly 2 m (Davidson *et al.* 2008, Hopkins *et al.* 2008). A detailed review of mechanical brushes as a hull treatment tool, including assessment of five systems under development, can be found in Bohlander (2009). The logistics, feasibility and benefits of this treatment option are also discussed in Floerl *et al.* (2010), page 44; Inglis *et al.* (2012), page 76; and Morrisey and Woods (2014), page 15–21.

Experimental trials assessing the efficacy of rotating brush units have found that a portion of the fouling assemblage almost always remains on the vessel hull (Davidson *et al.* 2008, Hopkins & Forrest 2008). Most systems are not designed to capture and treat the biofouling removed, although they can be fitted with shrouds and suction hoses if required (Hopkins & Forrest 2008). A combination of rotating brush and vacuum systems provides additional efficacy; diver-operated brush units fitted with shrouds and suction hoses have been shown to capture around 95% of the biofouling material removed by the brushes when biofouling on the surfaces is relatively light (Hopkins *et al.* 2008).

An Australian company (Franmarine Underwater Services Pty Ltd) have recently designed and built a lightweight, portable hull cleaning system using brush technologies. The 'Envirocart' is a diver–steered, hydraulically–powered unit with twin rotating discs that can be fitted with either brushes or blades (Figure 10). Each cleaning tool has a suction shroud that connects separately to the central, fully enclosed suction system through which debris is pumped onto the support vessel or wharf for treatment (Lewis 2013). The Envirocart has undergone extensive performance testing in Australia and the company is looking at also bringing this product into New Zealand for testing and evaluation (pers. comm. Franmarine, 2014).

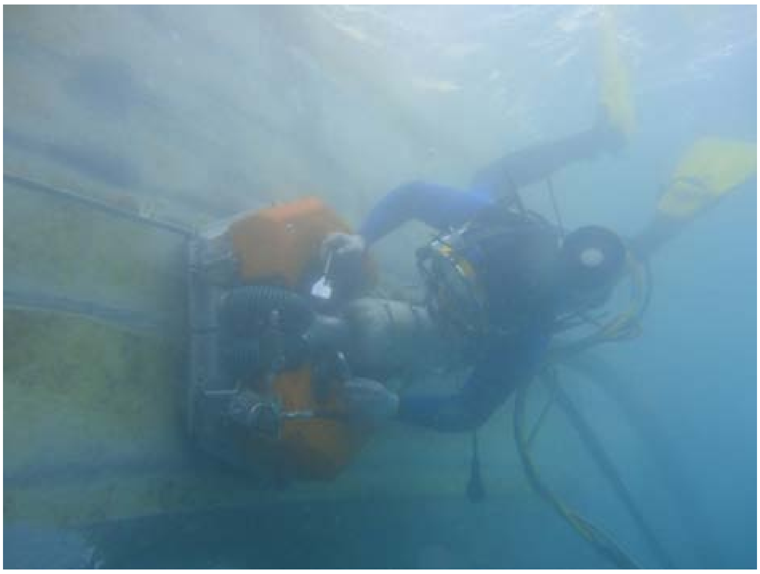

Figure 10. The Envirocart cleaning unit developed by Franmarine Underwater Services Pty Ltd. Photo source: http://www.gageroadsdiving.com.au/projects/envirocart/

Mechanical removal using brush or abrasive pad technologies can be applied to a range of vessel types and sizes although at present the technology is generally limited to use on commercial vessels. Basic systems without waste capture can treat 1000 m^2 per hour, with an entire merchant vessel (including hull areas, propeller and rudder) treated within 48–72 hours (Floerl *et al.* 2010). The Envirocart has the capability to clean 1,000 m^2 per 6-hour day (Lewis 2013). Mechanical cleaning using brushes or abrasive pads may result in the removal of antifouling coating material, resulting in contamination risks associated with technologies that do not provide capture ability. Larger brush units are best suited to flat or slightly curved surfaces, and cannot clean irregular hull surfaces, protrusions of the hull, and hull appendages.

Contactless mechanical systems

Contactless mechanical cleaning systems exploit the shear forces generated by turbulent flow above antifouling coating surfaces, in effect lifting and dislodging fouling from the surface (Lewis 2013). These technologies were developed due to concern over damage to antifouling coatings and increased regulation of the discharge of biocidal waste into the surrounding environment (Morrisey & Woods 2014).

There are two systems currently available (see Morrisey & Woods 2014; Appendix B). The Mini-Pamper brush cart and twin-brush diver-operated systems uses counter-rotating brushes to create suction that holds the cart onto the hull. The downward suction force generated by the brushes is transferred to the chassis so that the brushes are only just in contact with the hull surface, and thus do not damage the coating (Morrisey & Woods 2014). Franmarine Underwater Services have also developed a contactless cleaning system modification to their Envirocart cleaning unit. Rotating discs within the unit are fitted with blades instead of the conventional brushes. The blades generate uplift forces that dislodge biofouling from targeted surfaces. The unit can be operated in containment mode in which solids to 5 μm can be contained using a range of filtration stages. Filtration to 12.5 μm has been achieved in trials (Morrisey & Woods 2014).

In theory, mechanical removal using contactless cleaning systems can be applied to a range of vessel types and sizes, although this technology is largely used by the commercial shipping industry for large vessels. Treatment times are likely to be similar to those of brush-based Envirocart units (1,000 m^2 per 6-hour day). If the surface has degraded and lost the surface properties that reduce organism adhesion strength, a non-contact system will not clean effectively. Like mechanical brush systems, contactless systems are generally unsuited to treat curved or structurally complex surfaces and are mostly effective for flat, homogeneous surfaces.

High-pressure water jet

Water jet technology for removal of biofouling organisms is widely used in a range of maritime industries, including shipping and aquaculture. High-pressure water blast systems usually consist of a topside pump unit (diesel-powered or hydraulic) that delivers pressurised seawater to a submerged cleaning unit that is held against the target surface (*e.g.* a ship's hull or a fish cage net) using magnets or water pressure. A number of diver-operated high-pressure water systems are in operation, although at present their use is mainly restricted to *in situ* defouling of semi-submersible drilling rigs (Hopkins *et al.* 2011b).

As with brush-based systems, water jet systems include hand-held devices, diver-operated carts and ROV or robot carts controlled from the surface (Morrisey & Woods 2014). Two Norwegian systems are in production, ECOsubsea and the underwater cleaning vehicle CleanROV, with both designed to treat biofouling assemblages at early stages of development (*e.g.* slime, algae, and soft-bodied organisms) without causing damage to underlying antifouling coatings. The logistics, feasibility and benefits of high-pressure water jet technology as a vessel hull treatment option are discussed in more detail in Floerl *et al.* (2010), page 52; Inglis *et al.* (2012), page 81; and Morrisey and Woods (2014), page 24.

Treatment times are likely to be similar to basic brush-based cleaning units; one provider estimates 800–1,000 m^2 of hull surface can be treated per hour, with a vessel 140 m length and 8 m draft taking 5 hours to clean (Floerl *et al.* 2010). Many commercially available units (excluding ECOsubsea and CleanROV as well as the aquaculture net cleaner MIC) are unable to retain the organic and inorganic waste material that is removed from cleaned surfaces. All of these systems are large and unsuited to reach and clean small and structurally complex (*e.g.* curved or protruding) surfaces. However, smaller diver-operated water jets may allow better access and cleaning to restricted and niche areas than brush-based tools.

Cavitational water jet

Cavitational water jet systems are a refinement of traditional water jet methods, whereby microscopic bubbles of air and steam, generated by ultrasonic sound, are incorporated into the water jet. The 'collapse' of these bubbles generates cleaning action. Similar to contactless cleaning systems, cavitational jets were developed to reduce damage to antifouling coatings and also to reduce the hazard to operators of using high-pressure jets (Morrisey & Woods 2014). A range of tools are available, including hand-held pistols, diver-propelled and self-propelled carts, and a robot-based system that is in development (Morrisey & Woods 2014). Cavitational jet technology is discussed in more detail in Floerl *et al.* (2010), page 51; and Morrisey and Woods (2014), page 26.

Treatment times are likely to be similar to brush-based cleaning units and traditional water jet systems. Diver-operated vehicle systems can treat up to 1500 m^2 of algal biofouling per hour and 600 m^2 of calcareous fouling (*e.g.* barnacles) per hour (Floerl *et al.* 2010). The cavitational jets may not kill fouling beyond dislodging it from the hull surface and breaking it up (which may lead to risks of the discharge of propagules or organisms capable of regeneration). Similar to traditional water jets, cavitational jets may allow better access and cleaning to restricted and niche areas than brush-based tools.

Vacuum systems

Underwater vacuum systems are often used in conjunction with other treatment methods. Underwater vacuum systems generally consist of a diver-operated hydraulic cutter and vacuum head for collection and containment of the biological material removed from targeted areas, as well as a multi-stage filtration system on an adjacent support vessel. Vacuum systems as a vessel treatment tool are discussed further in Floerl *et al.* (2010), page 49.

This technology has been trialled in New Zealand during biosecurity responses for the sea squirt *Didemnum vexillum* and the Mediterranean fanworm *Sabella spallanzanii*. In both instances the vessels involved were heavily fouled barges. The *Didemnum* response, carried out over a 2–day period during August 2002, resulted in an estimated 473 kg of ascidian biomass being removed from the barge and filtered to 50 µm to minimise the release of any larvae present (Coutts 2002). However, the method was deemed too labour intensive and ineffective to be used for routine biosecurity responses (Coutts 2002). More recently, a combined hand-picking and vacuuming treatment was trialled during the incursion response for *Sabella* within Coromandel Harbour. Divers manually removed worms from the barge hull and deposited them directly into a vacuum hose connected to specialised filtering equipment. Although initially promising, this technique was reported to be very slow because the filtering equipment proved to be unreliable and work was frequently interrupted to resolve problems related to shell debris clogging the pump and issues with filter bags (Hodges & Simmons 2013). With further refinement it is hoped this method may still be useful for future incursion responses.

Treatment times will vary with vessel size and the level and type of biofouling cover present. Vacuum systems appear to be effective at removing soft-bodied organisms that extend from their attachment surface, such as large ascidians and, presumably, erect sponges and some species of macroalgae. However, the system is not effective at removing firmly attached organisms such as barnacles, tubeworms and cementing bivalves (Floerl *et al.* 2010).

4.2.3. Surface treatment

Surface technologies aim to kill the biofouling present on vessel hulls; however, they do not necessarily remove the associated biomass.

Heat treatment

Heat treatment has been used to remove biofouling growth from vessel hulls, the cooling systems of power plants, experimental marina pontoons, the shells of cultured bivalve species and natural habitats (Wotton *et al.* 2004, Aquenal 2007, Blakemore and Forrest 2007, Hunt *et al.* 2009). Heat treatment has also been used against viable organisms in ships' ballast water systems. Heat treatment is discussed in more detail in Piola *et al.* 2009, page 224; Floerl *et al.* (2010), page 56; and Morrisey and Woods (2014), page 28.

The only commercially available heat treatment tool is the Australian Hull Surface Treatment (HST), which is designed to remove marine slime (biofilm) and algal biofouling from ship hulls. The HST is aimed at preventing the development of complex biofouling assemblages by targeting and removing earlier stages of the biofouling sequence (biofilm and algal biofouling). It was not developed to kill and remove complex existing biofouling assemblages such as those containing mature barnacles, tubeworms and bivalves (Floerl *et al.* 2010).

Heat-treatment technologies can theoretically be applied to a range of vessel types and sizes although at present the technology is restricted to larger commercial vessels. Treatment times will vary with level of fouling cover; the HST system claims to be able to treat a 200 m vessel in 16 hours (two 8-hour shifts) using one unit, or a single 12-hour shift using one unit on each side of the hull (Floerl *et al.* 2010). The efficacy of hot water immersion is temperature dependent. Heat treatment is effective against biofouling in a few seconds at temperatures of ~60°C or greater, but may take > 10 minutes at temperatures of ~40°C. Organism morphology will greatly affect the successful outcome, with calcareous taxa (*e.g.* barnacles, tube worms, oysters) more tolerant than soft bodied taxa. Heat treatment does not remove biofouling organisms from the hull but simply kills them. Dead material either falls off the hull following treatment or is dislodged by turbulence and water drag when the vessel departs from the port; this is likely to exclude remnants of calcareous organisms (Floerl *et al.* 2013).

Ultrasonic treatment

Ultrasound is sound pressure waves that have a frequency greater than the upper limit of human hearing (normally > 20 kHz). The pressure waves inhibit biofouling by elevating temperature, by ultra-sonic wave-induced force, by ultrasonic cavitation or through a combination of these mechanisms (Guo *et al.* 2011). A number of companies currently market ultrasonic transducers that attach to vessel hulls and are claimed to prevent recruitment and establishment of fouling organisms. However, these commercially-available techniques have not been assessed for their ability to remove biofouling and as such this technology is still very much in development. A more detailed assessment of ultrasonic technologies can be found in Morrisey and Woods (2014), page 31.

4.2.4. Shrouding technologies

Shrouding technologies involve the use of an impermeable material to enclose the vessel in order to prevent water exchange between the area surrounding the hull and the outside, thereby creating toxic conditions for fouling organisms present. The fouling species are deprived of light and food while continued respiration and decomposition of organisms within the wrapping depletes dissolved oxygen in the water, thereby creating an anoxic environment that is eventually lethal to all enclosed organisms (Inglis *et al.* 2012). This method is also effective at treating niche areas of a vessel, including inside sea chests and around propellers without the need for mechanical disassembly. One method of preventing water exchange includes wrapping (or encapsulating) the hull in impermeable (*e.g.* plastic) sheeting. Alternatively, shrouding can involve the use of enclosure systems such as floating docks that surround the entire hull up to the water-line. The efficacy of both wrapping and enclosure systems can be increased through addition of chemicals to the enclosed water. Similarly, the vessel hull can be cleaned manually or mechanically while within enclosure systems.

Encapsulation via wrapping

In-water plastic encapsulation (‘wrapping’) is an effective treatment method for heavily fouled vessels and structures. This technique was first applied in the management of the sea squirt *Didemnum vexillum* (Coutts & Forrest 2007), and has since become a widely-used treatment method for vessels and marine structures in New Zealand.

Encapsulation of vessels using 'wrapping' is discussed further in Piola *et al.* 2009, page 221; Floerl *et al.* (2010), page 62; Inglis *et al.* (2012), page 58; and Morrisey and Woods (2014), page 32.

Encapsulation treatments are likely to be particularly useful for new recruits or small individuals. Larger organisms, as well as hard-bodied species such as barnacles and bivalves, can be more resistant to short-term exposure to unfavourable conditions and may require longer periods of treatment. Care must be taken to ensure that the wrap does not tear on sharp structures on the vessel or wharf. Difficulties with compromised wrapping often arise when the wrap must remain in place for extended time periods, particularly when there is strong currents or swell in the local area. Encapsulation treatments are also particularly useful for treating 'niche' areas of a vessel hull, including propellers and the rudder, and sea chests in larger ships.

Application of the wrap can usually be completed in one day. Smaller vessels such as recreational yachts will take ~2 hours to wrap from start to finish (pers. comm. B. Lines, Diving Services New Zealand). However, total treatment times will depend on the level of hull fouling present. Higher biomass will generally lead to anoxic conditions faster as oxygen is consumed more rapidly. The level of oxygen present within the enclosed water is able to be monitored fairly easily using a hand-held probe. Previous trials have indicated that oxygen levels can drop below 1 mg/L within one day (Coutts & Forrest 2005), although this relies on the wrap remaining water tight. The addition of chemicals (see below) will greatly decrease the treatment time required.

Encapsulation via floating docks or shroud systems

A range of floating docks (also known as 'slip liners') are currently available, these are used primarily as berthing aids for recreational craft to reduce maintenance and running costs. The docks are marketed as protection from the effects of a salt water environment. It removes the regular requirement to remove the vessel from the water to re-coat antifouling treatments, replace anodes and clean shafts and propellers. The docks have a floating (for example, air-filled) collar with a flexible plastic membrane suspended from it that forms a completely enclosed compartment (Morrisey & Woods 2014). The space surrounding the vessel can be water-filled or dry depending on the system employed (*i.e* the addition of pump to remove surrounding sea water). Floating docks are available commercially in various sizes and most systems are easily deployed and do not require the use of divers.

One of the more recent systems released is the 'FAB Dock', developed by an Australian company (Figure 11). The company advertises that it can make the docks for any size or shape of boat, with prices starting from AUD$9,990. Docks are available in either PVC or urethane alloy materials. An in-built bilge pump removes the surrounding sea water and works to continually keep space surrounding the hull dry while the boat is not in use. This is achieved using an electronic sensor, so when water enters the FAB Dock, through rain, waves or boat wash, the pump is activated until the space is empty again (see www.fabdock.com for more information).

Figure 11. A proprietary floating dock ('FAB Dock') deployed around a recreational craft. Photo source: www.fabdock.com.

A version of a floating dock has been developed specifically for treating hull fouling (the Introduced Marine Pest Protector, IMProtector™ developed by Biofouling Solutions Pty Ltd.). The shroud is deployed around the boat while stationary (in a marina berth, alongside a wharf or at anchor); this can be done from a small dinghy or from on board the vessel itself and does not require divers (Morrisey & Woods 2014). The IMProtector™ can currently treat vessels up to 18 m long and 5 m draft. Floating docks or shroud systems can be applied as a treatment tool in isolation (through reduction in available oxygen) or combined with the addition of chemicals as discussed above. More information on floating dock and shroud systems can be found in Morrisey and Woods (2014), page 32.

Addition of toxicant or accelerants

Various chemicals can be added to the water inside plastic wrap or floating dock systems to act as toxicants (*e.g.* acetic acid) or to enhance the development of anoxia (*e.g.* sugar, sodium sulphite). Treatment with relatively eco–friendly chemicals such as bleach and acetic acid is generally highly effective, often at relatively low concentrations (< 5%). There are sometimes difficulties in achieving and maintaining a high enough concentration of the toxicant. This is particularly the case when there are leaks in the wrap, the vessel is an unusual shape, or the wrap is not snug against the vessel hull. The benefits and limitations of several common toxicants or accelerants are discussed below:

Acetic acid: Acetic acid is the active ingredient in vinegar and is highly effective against biofouling assemblages at relatively low concentrations (Forrest *et al.* 2007). Encapsulation with acetic acid has been applied as part of an eradication programme for the ascidian *Didemnum vexillum* (Pannell & Coutts 2007), as well as more recently in Nelson during the treatment of a vessel fouled by the invasive fanworm *Sabella spallanzanii* (see Section 5.4.5). As a concentration of 4% is equivalent to the acetic acid content of domestic vinegar, there are unlikely to be significant environmental or occupational risks involved provided appropriate measures are put in place for handling and waste disposal (Forrest *et al.* 2007).

Chlorine: Chlorine (or sodium hypochlorite) has been proven to be an effective antifouling treatment against a range of fouling organisms (Anasco *et al*. 2008, Verween *et al*. 2009). The addition of 160 tonnes of chlorine to the water within a closed off boating marina in Australia was able to achieve 100% mortality of the invasive black–striped mussel *Mytilopsis sallei* (Field 1999). The active ingredient in bleach is usually hypochlorite. Bleach sprays and dips have been trialled against biofouling, although largely as part of experimental trials only. Spray applications of 5 and 10% bleach solutions removed < 50% of the original total cover, even after 12 hours exposure (Piola *et al.* 2010). The efficacy is usually dependent on a combination of concentration and exposure time. Concentrations rapidly degrade in the presence of organic matter, so likely to be difficult to maintain a stable concentration. Environmental or occupational risks will require appropriate measures are put in place for handling and waste disposal.

Freshwater or reduced salinity: Freshwater can be added to the encapsulation treatments as a more environmentally friendly toxicant. This is likely to be more effective if the majority of the enclosed seawater can be pumped out first, before the addition of freshwater. Freshwater is very effective against soft-bodied fouling organisms. In contrast, as hard-bodied organisms (*e.g.* mussels and oysters) are able to clamp shut for long periods of time (several days), freshwater is often not effective as a treatment for these types of species.

Northland Regional Council (NRC) has recently invested in two FAB Dock containment systems and has been trialing their use with chlorine as a treatment against the Mediterranean fanworm *Sabella spallanzanii* (Figure 12). The Council's unit can take vessels up to 16 m in length and was found to provide a robust containment area. Chlorine was added as pre-dissolved dichloroisocyanuric acid (dichlor) granules (3.3 kg used at a cost of ~$30). A target concentration for free available chlorine of 200 mg/L was set. 30 worms were examined one day after treatment; 28 showed no response to touch, and all had lesions on their bodies and all had lost or damaged fans (pers. comm. D. Morrisey, Cawthron Institute). Six days after treatment, none of the 33 tubes sampled had worms present inside, no *Sabella* fans were visible on the hull and all oysters and algae visible previously were either dead or absent (pers. comm. D. Morrisey, Cawthron Institute). Sodium thiosulphate (non-toxic) was added to the unit the day after treatment to remove residual chlorine from solution (as used in the pulp and paper industry and other wastewater treatment).

Figure 12. Trials of a FAB Dock containment system utilising chlorine for the treatment of a 8 m yacht heavily fouled with *Sabella spallanzanii*. Photo credit: Matt Smith, NIWA.

Following the trials, the FAB Dock system was proven to be an effective method for rapid (< 24-hour) treatment of vessels up to 15 m (and probably larger). Chlorine levels at the hull surface were maintained at lethal concentrations for long enough with a single dosing to 200 mg/L. While the floating dock system itself is an expensive initial investment (~$18,000 to $20,000 per unit; pers. comm. D. McKenzie, NRC), the treatment costs are minimal. Residual chlorine concentrations were acceptable; final concentrations were higher than acute toxicity criterion for total residual chlorine (US EPA acute criterion is 13 µg/L, ANZECC is 3 µg/L for freshwater), however there will be orders of magnitude dilution as the water is released from the dock (pers. comm. D. Morrisey, Cawthron Institute).

In addition to chemical treatment, the floating dock and shrouding systems described above can be combined with manual or mechanical removal (see Sections 4.2.1 and 4.2.2), effectively containing any waste produced during the cleaning process. Divers or remotely-operated cleaning devices can be deployed within the enclosure system; however, there must be sufficient space between the hull and the dock membrane for divers to operate safely and effectively inside, and so that the cleaning equipment does not tear the membrane. Poor visibility due to suspended waste within the system may reduce the efficacy of cleaning (Morrisey & Woods 2014). Material discharged from the hull can be collected via a suction pump and filtered before being discharged back into the sea. More information on enclosure systems can be found in Morrisey and Woods (2014), page 36.

5. REGIONAL AVAILABILITY OF TREATMENT TOOLS

This section on regional treatment infrastructure covers the Tasman, Nelson and Marlborough regions, including Golden and Tasman Bays, the Marlborough Sounds, and the ports of Nelson, Havelock and Picton and their marinas. Facilities are organised by geographic region (from west to east). A summary of regional treatment infrastructure, including maximum vessel dimesions that can be accomodated, an indication of costs involved and the capacity of each facility, is provided at the end of the section (Table 13). Contact details for all facilities are also provided (Table 14).

5.1. Golden Bay

5.1.1. Waitapu Bay slipway and hardstand

Waitapu Engineering
46 Motupipi Street, Takaka 7110
(03) 525 9575

There is a marine slipway at Waitapu Bay, on the mouth of the Takaka River. The slipway has a railway and beach cradle system to remove vessels from the water (Figure 13). Vessels are cleaned while on the cradle, this usually involves a combination of water-blasting and manual cleaning. There is an adjoining hardstand area where smaller vessels are maintained. The Waitapu slipway is under the control of Waitapu Engineering, but it is not fenced and there is little to restrict use by the general public (pers. comm. W. Galbreith, TDC).

Figure 13. Waitapu Bay slipway near the mouth of the Takaka River. Photo credit: P. Sheldon (Tasman District Council).

The area around the slipway has recently been found to have very high concentrations of copper, lead, zinc and tin, exceeding by 1,000 times the ANZECC sediment guidelines (Sheldon 2014). An abatement notice was served in June 2014 relating to this discharge of contaminants into the coastal marine area (CMA). Waitapu Engineering have ceased the use or hire of the slipway and boat cradle for the purpose of hull cleaning and paint scraping and are in the process of designing a mechanism which will prevent the further discharge of contaminants into the CMA. There is insufficient space to pull vessels far enough above mean high water to leave room for an effective trap however. As cost is an issue, the company are considering all options including closing or abandoning the facility (pers. comm. W. Galbreith, TDC).

5.1.2. Port Tarakohe vessel haul-out and storage

Port Tarakohe (Port Golden Bay)
995 Abel Tasman Drive, Takaka 7142
(03) 525 8174 or 027 446 3891 (Allan Kilgour; Harbour Manager)
port.tarakohe@tasman.govt.nz

There is a substantial hardstand area adjacent the Pohara Boat Club on the western side of Port Tarakohe. Vessels are removed from the water at the boat ramp using trailers or alternatively craned over the wharf area and transported via road. The option of lifting vessels over Port Tarakohe's main wharf is used only a few times during the year. The port is not involved in the organising of this other than giving permission to use the wharf. The crane and lowbed transporter is organised by the vessel owners or contractors; the port becomes involved again with the storage of the vessel in the hardstand area (pers. comm. A. Kilgour, Port Tarakohe). Generally, there are not substantial wait times involved (none to a few days). Vessels are cleaned while on the hardstand, this usually involves a combination of water-blasting and manual cleaning. Costs for boat storage at the hardstand are $26.00 per week or part thereof, $83.00 per month, or $985.50 per year (TDC 2015).

5.2. Motueka

5.2.1. Port Motueka slipways and vessel haul-out

Port Motueka has two slipways which are regularly used for maintenance of local recreational craft and inshore fishing vessels. The slipways are located to the west of the port area, and nearby to the Motueka Peninsula Marine Society marina. Vessels are cleaned while on trailers or hardstand facilities, this usually involves a combination of water-blasting and manual cleaning. There does not appear to be any waste capture systems in operation and, similar to the Waitapu Bay slipway, recent testing for heavy metals within sediments at this location show elevated levels of copper and zinc (Sheldon 2014).

Motueka Yacht and Crusing Club
2 Ward Street, Port Motueka, Motueka 7120
(03) 528 7291 or 027 606 3291 (Peter Dodgshun; Marina Custodian)

The Motueka Yacht and Cruising Club own and operate three trailers and a tractor for vessel haul-out. These are generally only able to be hired by club members as well as members of the nearby Motueka Peninsula Marine Society. The trailers cater to recreational craft < 12 m length (max. width 4 m, weight < 20 tonnes). Costs are dependent on the trailer used and range from $180-$220. There is a hardstand fee of $10 per day whilst the vessel is out of the water (pers. comm. N. Dicks, Motueka Yacht and Cruising Club). There are not generally substantial wait times to use the club equipment (none to a few days) although their use does increase over the summer months. When contacted in early March 2015, there were three vessels booked in to use the trailers over the upcoming Easter weekend (pers. comm. P. Dodgshun, Motueka Yacht and Cruising Club). Larger vessels contract Port Motueka Marine Services for haul all out requirements (see Section 5.2.2 below).

5.2.2. Vessel haul-out and cleaning

Port Motueka Marine Services
(03) 527 8515 or 021 022 47449 (Marc Wilson)
pmmservices@icloud.com

Port Motueka Marine Services offer a range of haul-out and cleaning services. The company has three large trailers capable of removing vessels up to 23 m length and 6 m beam. The trailers have a high level of use, with wait times of several days to weeks common. There is likely to be some flexibility in an incursion response situation, however (pers. comm. M. Wilson, Port Motueka Marine Services).

Vessel owners can choose to use the company for cleaning requirements, contract someone independent, or alternatively clean the vessel themselves. Once removed from the water vessels are cleaned on a hardstand area adjacent to the marinas. Vessels are cleaned using a combination of water-blasting and manual cleaning. Treatments times will vary from hours to days depending on vessel size and the level of biofouling present. Treatment costs vary with vessel length and time out of the water. There is a set haul-out and re-launch fee which ranges from $150–$800 + GST depending on vessel size. Daily charges, also based on vessel length, will apply for subsequent use of the trailers or stands (pers. comm. M. Wilson, Port Motueka Marine Services).

5.3. Mapua

Mapua Boat Club Inc.
(03) 540 2850 (Dennis Crawford; Wharf Custodian)

There is an inspection grid on the inshore side of the main wharf. Except in emergencies, use of the grid must be arranged in advance with the wharf custodian. Any biofouling or other contaminants (*e.g.* paint residues) must be collected and properly disposed of ashore.

5.4. Nelson

5.4.1. Inspection grid

Nelson Marina
110 Akersten Street, Nelson 7010
(03) 546 7768
marina@nelmac.co.nz

The tidal inspection grid is located in the inner portion of Nelson marina. This treatment facility is primarily for inspection and localised treatment of small recreational vessels. Maximum dimensions of boats that can be accommodated are 10 tonne and 9 m length. As disposal of waste removed from the boat hull is to the sea, council restrictions state that no water blasting, cleaning, scraping, painting or other physical work is allowed whilst on the grid. Treatment tools which capture waste produced such as manual removal, whereby organisms are hand–picked and collected for disposal on land, may be possible in some circumstances. The tidal grid can only accommodate one vessel at a time with treatment times governed by tidal cycles. The shortest treatment time will be approximately 12 hours (high tide through to high tide). Use of the inspection grid needs to be booked with the Marina Supervisor; there is not normally a wait list and a vessel should be able to be accommodated within one to a few days of enquiry. Use of the grid costs $20 plus GST per consecutive high tide (day).

5.4.2. Vessel haul-out and cleaning

Nelson Hardstand Ltd.
5 Cross Quay, Port Nelson, Nelson 7010
021 546 7768

Nelson Hardstand Ltd. own and operate a 50-tonne capacity travel-lift within the Nelson Marina. The travel lift is capable of removing vessels up to 25 m (80 feet) in length and 6 m (19.6 feet) in width. The travel-lift operates out of the marina's travel-lift dock, located between E and F berths. There is a courtesy berth available beside this dock. Vessels are removed from the water via straps under the hull used as slings, with the travel-lift then able to move and steer under its own power. The travel-lift is very busy over the summer months, particularly around the holiday breaks. That being so, a vessel could still be accommodated fairly promptly in an incursion response situation. Average usage is 2–5 boats per day, although up to 11 were slipped on one day during the holidays (pers. comm. P. O'Donoghue, Nelson Hardstand Ltd.). The costs to use the travel-lift and hardstand facilities are based on vessel length (see Appendix 7 for current rates).

Figure 14. The 50–tonne capacity travel-lift in operation at Nelson marina. Photo credit: B. Forrest (Cawthron Institute).

Once removed from the water, vessels are cleaned on a grid area adjacent to the marina (see Figure 9). Vessels are cleaned using a combination of water-blasting and manual cleaning. All waste discharged is collected in sumps, passing through a series of tanks and filter systems. Treatments times will vary depending on vessel size and the level of biofouling present. A simple vessel clean will take between 1–3 hours. Any vessel > 25 tonne weight will require four strops, as opposed to the standard two strop set-up, which may extend the cleaning time to several hours longer as the strops need to be repositioned during cleaning (pers. comm. P. O'Donoghue, Nelson Hardstand Ltd.).

5.4.3. Nelson Slipway

Nelson Slipway Ltd.
Vickerman Street, Port Nelson, Nelson 7010
(03) 545 6645 or 021 248 9139 (Daryl Seyb; Slipway Manager)
nelsonslipway@marineandgeneral.co.nz

Nelson Slipway is a very well used haul-out facility catering to light commercial and recreational boats. The slipway is capable of comfortably handling keeled, flat–bottomed and multi-hull vessels up to 130 tonnes and 25 m in length (larger vessels can be accommodated at the adjacent Calwell Slipway, see Section 5.4.4). The rail facility features a hardstand area, railed cradles and a traverse arrangement allowing multiple vessels to be slipped at any one time. Maximum capacity will depend on vessel size but averages ~8 vessels at any one time. The slipway prefers bookings at least one month in advance. If vessel haul-out is required at short notice they will do their best to accommodate this, although it will generally require a cradle being available between bookings (pers. comm. D. Seyb, Nelson Slipway Ltd.).

Vessel cleaning and maintenance once the vessel is out of the water is carried out by independent contractors. The facility can provide water-blaster hire, electricity and rubbish removal if required. Treatment times required vary depending on the size of the vessel. For instance, large yachts or launches may need 5–6 days out of the water for cleaning, maintenance and antifouling application, while larger fishing vessels may be out of the water for up to 2 weeks depending on the work required (pers. comm. D. Seyb, Nelson Slipway Ltd.). The slipway has resource consent for any discharges; liquid waste goes through two sets of filters before discharge and solid waste is disposed of at the landfill.

Prices vary according to the weight of the vessel, hull shape and keel blocking requirements, the number of days out of the water and the services required. Haul and launch cost estimates for different sized cradles are as follows; $120 for 12–15 tonne cradle, $680 for 80 tonne cradle, $900 for 100 tonne cradle, $1,200 for 130 tonne cradle. There are then daily cradle hire costs for any time spent out of the water ($5.50 per day per tonne; pers. comm. D. Seyb, Nelson Slipway Ltd.).

5.4.4. Calwell Slipway

Calwell Slipway Nelson Ltd.
6 Rogers Street, Port Nelson, Nelson 7010
(03) 539 3801 or 027 278 3777 (Andy Wills; Slip Master)
andy.wills@portnelson.co.nz

The Calwell Slipway is owned and operated by Port Nelson Ltd. The third largest slipway in New Zealand, it can accommodate vessels up to 80 m in length, 13.5 m beam and weight of up to 2,500 tonnes. Slip clearance is 6.2 m on a 4.0 m tide. A transfer system enables 16 vessels to be out of the water at any one time; however, slipping of larger vessels (> 40 m) is limited by availability of cradles meaning they must be slipped individually. Alongside the slipway are three dedicated lay-up berths, catering to vessels with a maximum length of 100 m and 8 m draft. The slipway facility primarily caters for medium to large sized vessels (22–80 m length) such as tugs and commercial fishing boats. Calwell slipway is used predominantly by New Zealand based vessels, and will slip 28–32 vessels on the larger slipway each year (pers. comm. A. Wills, Calwell Slipway Nelson Ltd.).

Vessels are removed from the water via a marine railway which uses a wheeled cradle to winch the vessel from the water up the incline of the slipway. Maintenance of the vessel is then undertaken on the slipway or nearby, with this work carried out by independent contractors. The treatment employed to clean vessels once removed is primarily water blasting, although some scraping of hard-bodied organisms such as oysters may also be used. The removal of sea chest gratings enables access to these niche areas. Similar to Nelson Slipway, all waste discharges from cleaning are contained and treated.

Figure 15. The fishing vessel *Voyager P* being slipped at Calwell Slipway in Port Nelson. Photo credit: L. Fletcher (Cawthron Institute).

Approximate treatment time (including removal and return to the water) depends on the vessel size and work required. Commercial fishing vessels may be out of the water for up to two weeks depending on the level of fouling present and any additional work required. Smaller vessels with specific work required may only be on the slipway for 24–48 hours (pers. comm. A. Wills, Calwell Slipway Nelson Ltd.). Availability of the slipway facilities is listed online[10] with bookings up to two years ahead possible. The facility is often very busy with the majority of a month listed as unavailable. Vessels are encouraged to make a shadow booking every two years as considerable wait times are common (pers. comm. A. Wills, Calwell Slipway Nelson Ltd.). In some instances, vessels may be able to be accommodated at short notice; however, this will generally require a gap in bookings or a cancellation. In a recent incursion response situation, the commercial fishing vessel *Voyager P* had to be wrapped as an initial treatment method while waiting for a gap in the slipway bookings.

Prices vary according to the weight of the vessel, hull shape and keel blocking requirements, the number of days out of the water and the services required. There is a set haul-out and re-launch fee based on vessel size; prices range from $5,500 for smaller vessels to $19,000 for a large tuna fishing vessel. Daily charges apply following haul-out, with these also based on vessel weight; prices range from $1,100 to $1,900 per day. All prices are excluding GST (pers. comm. A. Wills, Calwell Slipway Nelson Ltd.).

5.4.5. Commercial dive services

Diving Services New Zealand Ltd.
43 Sowman Street, Nelson 7010
(03) 546 9964 or 021 407 740 (Bruce Lines)
divingservicesnz@xtra.co.nz

Diving Services New Zealand Ltd. provide a range of diving services such as general ship repair and hull inspections, as well as a range of treatment options. The company has underwater photography and closed-circuit TV/video capability with diver-surface communications. There is also a dedicated support vessel with heavy lifting capability.

The company has particular experience with in-water plastic encapsulation (‘wrapping’) of fouled vessels and structures. Diving Services are able to wrap a range of vessel types and sizes. Previous jobs have included wrapping small recreational vessels (10–15 m; Figure 16), commercial barges (up to 90 m length) and in one instance a navy frigate (~110 m length). Diving Services recently wrapped two boats as part of separate biosecurity responses. The super-yacht *Columbus* was wrapped and treated with acetic acid, with the wrap remaining in place for one week. The larger commercial fishing vessel *Voyager P* (35 m length) was wrapped and no chemical treatment added, in that instance the wrap remained in place for ~ 2 weeks.

[10] http://web.portnelson.co.nz/slipway/slipwayavailability.pdf

Figure 16. Two recreational yachts wrapped by Diving Services New Zealand Ltd. as part of the regional eradication and control programme for the sea squirt *Didemnum vexillum.*

The cost of boat wrapping services vary depending on the size of the vessel, the vessel's location (vessels are easier to wrap in shelter locations aligned with the prevailing current), and the number of return visits required. Estimated total treatment costs (includes material and labour) as at February 2015 are provided below (pers. comm. B. Lines, Diving Services New Zeland). Vessels:

- < 10 m length would require 2 people and cost ~$800-$1500;
- 10–24 m length would require 3–4 people and cost ~$2,000–$5,000;
- 24–50 m length would require 3–5 people and cost ~8,000–$13,000;
- >50 m length would require >6 people and cost ~$10,000–$18,000.

Diving Services New Zealand may also be able to carry out additional types of in-water treatment, although this will depend on relevant consent requirements with regards to discharging biofouling. At present, no in-water cleaning is carried out if the vessel has more advanced fouling than a slime layer present on the hull as no in-water waste collection systems are currently used. Tools which capture waste produced (*e.g.* mechanical brushes fitted with shrouds) or controlled manual removal, whereby organisms are hand-picked and collected for disposal on land, may be possible in some circumstances. Other services available include vessel hull and sea chest inspections. Fouling inspections will take ~1 hour per 10 m of boat hull. Diving Services can provide a full team and gear for $285 per hour plus $115 per hour for boat hire if required (pers. comm. B. Lines, Diving Services New Zealand). Estimated rates are current as at February 2015.

5.5. Havelock

5.5.1. Havelock Slipway

Havelock Slipway
14 Rose Street, Havelock 7100
(03) 574 2476 (Wayne Griffiths; Manager)
info@havelockslipway.co.nz

Havelock Slipway is privately owned and operated and is located at the southern end of the Havelock Marina facility. The slipway has five cradles which operate on three sets of rails. The steel cradles are designed to accommodate both mono-hulls and multihulls. The slipway can generally accommodate vessels up to 120 tonnes, 25 m vessel length and 7m vessel width. However, there is the potential for larger vessels to be slipped if adequate notice provided (*e.g.* a 200 tonne barge is booked in to be slipped in mid-2015). Vessels are slipped on an incoming tide. The slips are often busy so early bookings are recommended.

Vessel cleaning and maintenance once the vessel is out of the water is carried out by the company or vessel owners themselves. One cradle is set aside for customers that would prefer to work on their own vessel with power and water available. Treatment times vary depending on the size of the vessel and the work required. Haul-out, water-blast and re-launch of a recreational yacht can usually be completed in 1 day, although 2–3 days will be required for sand-blasting services (pers. comm. Havelock Slipway). The slipway has resource consent for any discharges; liquid waste goes through two sets of filters before discharge and any solid waste is disposed of at landfill.

Prices vary according to the weight of the vessel, the number of days out of the water and the services required. Haul and re-launch costs range from $220 to $3,000 depending on vessel size. Cradle hire costs $25 per day for any time spent out of the water (pers. comm. Havelock Slipway). Water-blasting services are $62 per hour. Water-blaster hire is included in the price of slipping. All prices are excluding GST.

5.5.2. Vessel haul-out and cleaning

Sounds Shipwright Services Ltd.
6 Rangitane Drive, Havelock 7150
(03) 972 0101 or 027 243 8047 (Lloyd Price; Manager)
sounds.shipwright@gmail.com

Sounds Shipwright Services Ltd. provides maintenance and servicing from their purpose-built facility at the southern end of the Havelock Industrial Marina. Their premises are located adjacent to Havelock Marina's vessel haul-out and launching ramp (see Section 5.5.1) with its approved wash down area. The company use large trailers for vessel haul-out and can cater to vessels up to 75 tonnes and ~30 m length. There is a secure hardstand area for up to 15 vessels on site. Sounds Shipwright Services' yard has a collection system for all discharged waste with the relevant resource consents held.

Once removed from the water, vessels are treated using water-blasting and scraping with hand tools to remove hull fouling. Treatments times will vary based on vessel size and level of fouling, but most small to medium size vessels can be cleaned in under a day. Haul-out and maintenance charges vary according to the length of the vessel, the number of days out of the water and the services required. Haul-out and re-launch fees are based on vessel length and range from $250-$600 for vessels ≤ 80 foot (~24 m). Vessels > 80 foot are priced on enquiry. Water-blasting services are $55 per hour. Hard-stand fees are also dependent on vessel length and range from $20 to $50 per day. There is a mark-up of approximately 60% if owners work on the vessel themselves. All prices are excluding GST (see Appendix 8 for current rates).

5.6. Picton

5.6.1. Slipway and vessel cleaning

TCC Boats
Port Picton (old Carey's Boatyard)
(03) 573 7975 or 021 240 5030 (Sam Edwards)
tccboats@xtra.co.nz

Tory Channel Contracting Boats (a division of Tory Channel Contracting Ltd.) runs a full service shipyard specialising in large vessels. Vessels up to 150 tonnes can be catered for. As the cradle set–up can be adjusted, vessel length is not as restrictive as vessel draft. Maximum vessel widths are ~8–9 m. The company provides slipping and maintenance services, with two large capacity slipways and an undercover shed area. Once removed from the water vessels are water-blasted to remove fouling. Application of antifouling treatments is also available. Haul-out and maintenance charges vary according to the length of the vessel, the number of days out of the water and the services required. Haul-out and re-launch fees are $15 per foot (up to 70 feet) and $25 per foot (over 70 foot). Vessel lengths >70 feet are price on enquiry. Vessel storage costs are either $2 or $3 per foot, per day, depending whether the vessel is in the outside or inside hardstand. In addition, water blaster hire costs $50 per day (or $75 for self-use). Other maintenance or services are $55 per hour. All prices are excluding GST.

5.6.2. Commercial dive services

Marlborough Commercial Diving Services Ltd.

Marlborough Commercial Diving Services Ltd.
(03) 573 7903 or 027 441 9520 (James Brodie)

Marlborough Commercial Diving Services Ltd. offer a range of diving services such as general ship repair and hull inspections, as well as a range of treatment options for fouled vessels or structures. Port Marlborough has used James Brodie for diving activities previously, including plastic wrapping of wharf piles. James has also carried out work for The New Zealand King Salmon Co. Ltd, wrapping the pontoons of a number of salmon farm structures to minimise biofouling biomass at the farms. Costs for these services are based on the number of divers and days required. The daily rate for James Brodie and his boat is $750 + GST (materials and fuel additional). Additional divers or to hire a diver only is $650 + GST per day. The company has all relevant equipment needed to wrap a vessel or structure.

Commercial Diving Consultants Ltd.

N-Viro Ltd.
12 Kent Street, Picton 7220
(03) 573 8045 or 027 4466 725 (Mike Baker)

N-Viro Ltd. (formerly Commercial Diving Consultants Ltd.) offers comprehensive diving services, in particular to the marine farming industry in the field of both diving expertise and anchoring consultancy. The company is well equipped to carry out a range of general diving projects, including in-water cleaning options for vessels using a hydraulic cleaning package which allows cost effective hull cleaning. They also offer underwater inspection and video services. Costs are based on the number of divers and time required and can be obtained from N-Viro Ltd. directly.

5.7. Waikawa

5.7.1. Travel-lifts and contractors

Port Marlborough Ltd. travel-lift

Waikawa Marine Centre
Waikawa Marina Yard, Picton 7220
(03) 520 3017 (Sally Wright; Marinas Service Coordinator)
service@msmarinas.co.nz

Port Marlborough Ltd. own and operate a 35-tonne capacity travel-lift (equipped with mast gantry) at the Waikawa Marine Centre adjacent to the marina. The travel lift is capable of removing vessels up to 27 m (88 ft.) in length. The travel-lift operates out of the marina's travel lift dock, located between the 1W and 1E berths at the head of the marina. The travel-lift is very busy over the summer months (September to April), particularly on a Monday and Friday (pers. comm. S. Wright, Waikawa Marine Centre.) and waiting times of days to weeks will apply. Shorter waiting periods can be expected during winter. The cost to use the travel-lift is based on vessel length (see Appendix 9 for current rates).

Once removed from the water, vessels are cleaned on the hardstand area adjacent to the marina. Cleaning usually involves a combination of water-blasting and manual cleaning with scrapers and hand tools. All waste is filtered with solid waste going straight to landfill. Treatment times vary on the work required as well as the level of biofouling present. The facility allows 75 minutes to remove and water-blast a vessel before being moved to the hardstand. Re-launching takes approximately 30 minutes. A 'quick water-blast' service is offered, primarily used by the racing yachts to clean the hull. This service takes 20 minutes with the vessel remaining on the cradle for the entire treatment (pers. comm. S. Wright, Waikawa Marine Centre). Costs to use the hardstand area incorporate a daily charge based on vessel length (see Appendix 9 for current rates).

Sounds Marine Ltd.

Sounds Marine Ltd.
Waikawa Marina Yard, Picton 7220
(03) 573 8554 or 021 212 0296 (Jeremy Hay)
admin@soundsmarine.co.nz

Sounds Marine Ltd. operate a boat refit and maintenance facility also located in Waikawa Marina. Sounds Marine have access to the Port Marlborough Ltd. 35 tonne travel-lift for vessel haul-out, followed by cleaning and maintenance within their yard. There is a 7,000 m^2 full service hardstand area equipped with catchment sumps. Treatment tools utilised include water-blasting and scraping with hand tools. Treatment times are generally relatively short; the company aims to water blast vessels on the same day they are removed from the water. Waiting times are dependent on availability of the travel lift (see Waikawa Marine Centre in paragraphs above). Wet sanding services are often carried out on the same day as well, or the following day if the vessel is removed late in the afternoon. Costs for cleaning and maintenance services are based on vessel length and the time involved. As at March 2015, water-blasting costs $42 for a 25-foot vessel and $99 for a 55-foot vessel. All prices are excluding GST.

5.7.2. Slipway and cleaning

Franklin's Boatyard
325 Waikawa Road, Picton 7220
(03) 573 8500

Franklin's Boatyard operate a vessel haul-out and maintenance facility on the south shore of Waikawa Bay (see Figure 8). The business is located at the former Jorgensen's boat building site. The slipway at Franklin's Boatyard can accommodate vessels up to 15 m length and 40 tonnes weight. There is capacity for three vessels to be out of the water at any one time. A range of maintenance activities are carried out at the site once vessels are removed from the water. Vessel hull cleaning is achieved primarily through water-blasting although small hand-tools are often employed. Liquid and solid waste from dislodged vessel hull fouling is captured at the site and the installation of settlement tanks is in process. Haul-out and maintenance charges vary according to the length of the vessel, the number of days out of the water and the services required. Haul-out and re-launch fees range from ~$300 for a 30-40 foot vessel to $600 for a 50 foot vessel. Vessel storage costs are $40 per day. Water-blasting is charged at $60 per hour. All prices are excluding GST.

Figure 17. Franklin's Boatyard in Waikawa Bay, Picton. Photo credit: B. Lines (Diving Services NZ).

Table 13. Regional treatment infrastructure including maximum vessel dimensions that can be accommodated, an indication of costs involved and vessel capacity of the facility. An indication of waste capture is also provided.

Regional treatment provider	**Max. vessel dimensions**			**Treatment costs**			**Capacity**	**Waste capture**
	Length (m)	**Width (m)**	**Weight (tonnes)**	**Removal and re-launch**	**Storage or hardstand**	**Treatment**		
Golden Bay								
Waitapu Bay slipway and hardstand	Not in operation due to discharge of contaminants						1 vessel	No
Port Tarakohe Ltd.	Not restricted by size			NA[1]	$26 per week	NA	Multiple vessels	No
Motueka								
Motueka Yacht and Cruising Club	12	4	20	$180-$220	$10 per day	NA	3 trailers	No
Port Motueka Marine Services	23	6	–	$150–$800 + GST	Varies	Varies	3 vessels	No
Mapua								
Mapua Boat Club (inspection grid)	Small recreational craft			NA	NA	NA	1 vessel	No
Nelson								
Nelson Marina (inspection grid)	9	–	10	$20 + GST	NA	NA	1 vessel	No
Nelson Hardstand Ltd.	25	6	50	$267–$1353 + GST	$43–$165 per day + GST	Water-blasting: $65 per hour	11 vessels in one day	Yes
Nelson Slipway Ltd.	25	–	130	$120–$1,200 + GST	$5.50 per day per tonne + GST	NA[2]	~8 vessels at one time	Yes
Calwell Slipway Ltd.	80	13.5	2500	$5,500–$19,000 + GST	$1,100–$1,900 per day + GST	NA[2]	~16 vessels at one time[3]	Yes
Diving Services New Zealand Ltd.	NA	NA	NA	NA	NA	Wrapping: $800–$18,000 depending on vessel size	Multiple vessels	Partial

[1] Vessel removal and re-launch is organised by the owner or independent contractors
[2] Vessel cleaning and treatment is carried out by independent contractors
[3] The number of larger vessels (> 40 m length) will be limited by the availability of cradles

Regional treatment provider	Max. vessel dimensions			Treatment costs			Capacity	Waste capture
	Length (m)	Width (m)	Weight (tonnes)	Removal and re-launch	Storage or hardstand	Treatment		
Havelock								
Havelock Slipway[4]	~25	7	120	\$220–\$3000	\$25 per day	\$62 per hour + GST	5 vessels	Yes
Sounds Shipwright Services Ltd.	30	unknown	75	\$250–\$600 + GST	\$20 to >\$50 per day	\$55 per hour + GST	Up to 15 vessels	Yes
Picton								
TCC Boats (Tory Channel Contracting)	~25	~8–9	180	\$15–\$25 per foot + GST	\$2–\$3 per foot per day + GST	\$55 per hour + \$50 per day water-blaster hire + GST	Two slipways and boat storage	Yes
Marlborough Commercial Diving Services Ltd.	NA	NA	NA	NA	NA	\$750 per day + GST	Multiple vessels	Partial
N-Viro Ltd.	NA	NA	NA	NA	NA	Price on request	Multiple vessels	No
Waikawa								
Waikawa Marine Centre	27	~6	35	\$225–\$1,863 incl. GST	\$23–\$149 per day incl. GST	Water-blast: \$50–458 incl. GST	Vessel haul-out: ~10 vessels per day. Hardstand: >50 vessels	Yes
Sounds Marine	27	~6	35	NA	Included in removal charge if company working on vessel	Vessel water-blasting: \$42–\$99 + GST	Reliant on Waikawa Marine Centre travel-lift	Yes
Franklin's Boatyard	15	Any	40	\$250–600	\$40 per day	Water-blasting: \$60 per hour	3 vessels	Yes

[4] Dimensions listed are the standard maximum however there is the potential for larger vessels to be slipped if required (*e.g.* a 200 tonne barge from Australia to be slipped in next few months)

Table 14. Contact details for regional treatment infrastructure facilities.

Facility	Contact person	Address	Phone	Email
Waitapu Engineering		46 Motupipi Street Takaka 7110	(03) 525 9575	
Port Tarakohe	Allan Kilgour	995 Abel Tasman Drive Takaka 7142	(03) 525 8174 027 446 3891	port.tarakohe@ tasman.govt.nz
Motueka Yacht and Cruising Club	Peter Dodgshun	2 Ward Street Port Motueka Motueka 7120	(03) 528 7291 027 606 3291	
Port Motueka Marine Services	Marc Wilson		(03) 527 8515 021 022 47449	pmmservices@ icloud.com
Mapua Boat Club Inc.	Dennis Crawford (Wharf Custodian)		(03) 540 2850	
Nelson Marina	Paul Jonkers (Marina Supervisor)	110 Akersten Street Nelson 7010	(03) 546 7768	marina@nelmac.co.nz
Nelson Hardstand Ltd.	Pete O'Donoghue	5 Cross Quay Port Nelson Nelson 7010	021 546 7768	
Nelson Slipway Ltd.	Daryl Seyb (Slipway Manager)	Vickerman Street Port Nelson Nelson 7010	(03) 545 6645 021 248 9139	nelsonslipway@ marineandgeneral.co.nz
Calwell Slipway Nelson Ltd.	Andy Wills (Slip Master)	6 Rogers Street Port Nelson Nelson 7010	(03) 539 3801 027 278 3777	andy.wills@ portnelson.co.nz
Diving Services New Zealand Ltd.	Bruce Lines	43 Sowman Street Nelson 7010	(03) 546 9964 021 407 740	divingservicesnz@ xtra.co.nz
Havelock Slipway	Wayne Griffiths (Manager)	14 Rose Street Havelock 7100	(03) 574 2476	info@ havelockslipway.co.nz
Sounds Shipwright Services Ltd.	Lloyd Price (Manager)	6 Rangitane Drive Havelock 7150	(03) 972 0101 027 243 8047	sounds.shipwright@ gmail.com
TCC Boats	Sam Edwards	Port Picton (old Carey's Boatyard)	(03) 573 7975 021 240 5030	tccboats@xtra.co.nz
Marlborough Commercial Diving Services Ltd.	James Brodie		(03) 573 7903 027 441 9520	
N-Viro Ltd.	Mike and Donna Baker	12 Kent Street Picton 7220	(03) 573 8045 027 4466 725	donna@n-viro.com
Waikawa Marine Centre	Sally Wright (Marinas Service Coordinator)	Waikawa Marina yard Picton 7220	(03) 520 3017	service@ msmarinas.co.nz
Sounds Marine Ltd.	Jeremy Hay	Waikawa Marina yard Picton 7220	(03) 573 8554 021 212 0296	admin@ soundsmarine.co.nz
Franklin's Boatyard	Ian Franklin	325 Waikawa Road Picton 7220	(03) 573 8500	

6. CONSTRAINTS ON THE USE OF TREATMENT METHODS

Each of the treatment methods and technologies described in earlier sections are associated with some degree of environmental and/or health and safety (H&S) risk. In addition, resource consents may be required before they can be used to treat or clean vessels, particularly if this is undertaken in-water. This section outlines the risks and local consent requirements for currently available vessel treatment technology in the TOS region.

6.1. Risks

The potential environmental and H&S risks associated with different types of treatment for vessels are broadly categorized in Table 15 and include physical injuries, exposure to chemicals, diving injuries and illnesses, and the release of chemical contaminants and viable biological material that could include non-indigenous propagules or organisms. The use of desiccation as a treatment method for biofouling and/or internal cavities appears associated with the least number of risks but, at the same time, it is also likely to be the most time-consuming method. All of the environmental and health and safety risks listed in Table 15 can be mitigated through the use of appropriate training for personnel involved, adequate communications with port/marina authorities and adjacent vessels (if treatment carried out in-water) and the use of effective debris capture and containment systems.

Table 15. Potential health and safety and environmental risks associated with the various treatment methods. The risks are assigned to generic groups of treatment tools. Particular types or models of tools within a group are likely to differ in the risks they pose. For example, mechanical removal technologies are unlikely to release viable biological material if they feature an effective vacuum system.

	Land-based treatment technologies			**In-water treatment technologies**			
	Water-blasting	**Scraping**	**Desiccation**	**Manual removal**	**Mechanical removal**	**Surface treatment**	**Shrouding technologies**
Health and Safety risks							
Physical injury[1]	●	●		●	●	●	●
Exposure to hazardous chemicals[2]	●	●		●	●		●
Diving–related accidents and illnesses[3]				●	●	●	●
Environmental risks							
Release of contaminants[2, 4]	●	●		●	●		●
Release of viable, non-indigenous biological material[4,]	●	●		●	●		●

[1] Physical injuries can occur during all stages of treatment where handling by humans is involved (*e.g.* set–up of equipment, operation, *etc*.).
[2] Includes antifouling coating residues and chemicals used to enhance or accelerate treatment.
[3] Includes overhead risks associated with working underneath vessels and in port/marina environments (vessel traffic), as well as diving illnesses and trauma.
[4] In absence of containment systems such as bunds, vacuum devices or similar.

6.2. Consent requirements

6.2.1. Background

All activities pertaining to vessel hull maintenance or other treatments are governed through Resource Management Plans prepared by the TOS councils under the Resource Management Act 1991 (RMA).

Activities described in the RMA, regional plans or other regulations governed by the RMA fall into a range of categories that are defined in s 87A:

- *Permitted activities* do not require a resource consent, provided they comply with the requirements, conditions and permissions of the RMA, plan or regulations.
- *Controlled activities* require a resource consent, which has to be granted if the activity complies with the RMA, plan or regulations.
- *Restricted discretionary activities* require a resource consent, and the power of the consent authority to decline the consent is restricted to the matters over which discretion is restricted. A resource consent can only be granted if the activity complies with the RMA, plan or regulations.
- *Discretionary activities* require a resource consent, and the consent authority has the power to decline or grant the consent with or without conditions. A resource consent can only be granted if the activity complies with the RMA, plan or regulations.
- *Non-complying activities* require a resource consent. The consent authority has the power to decline or grant the consent with or without conditions. The consent authority must be satisfied that the requirements of section 104D are met, namely that adverse effects will be minor or that the activity is not contrary to the objectives and policies of the relevant plan. A resource consent can only be granted if the activity complies with the RMA, plan or regulations.
- A resource consent cannot be applied for, or granted, for *prohibited activities*.

Sinner *et al.* (2014) recently outlined New Zealand's statutory and legal framework pertaining to marine biosecurity, including the RMA. The purpose of the RMA, set out in Part 2 s5, is to promote the sustainable management of natural and physical resources. Of particular relevance to biosecurity are the requirements to safeguard the life-supporting capacity of ecosystems and to avoid, remedy, or mitigate any adverse effects of activities on the environment.

In order to give effect to the RMA in the coastal marine area, s 30(1)(d) gives to regional councils the function of controlling the following:

- occupation of space
- discharge of contaminants into or onto land, air or water and discharges of water into water
- dumping of waste or other matter
- activities in relation to the surface of water.

Sections 12, 14 and 15 of the RMA restrict certain activities in the coastal marine area unless expressly allowed by a rule in a national environmental standard, a rule in a regional coastal plan or proposed regional coastal plan, or a resource consent. Section 12 sets out the *restrictions on the use of the coastal marine area*. Section 12(1)(d) states that no person may deposit in, on or under any foreshore or seabed any substance in a manner that has or is likely to have an adverse effect on the foreshore or seabed. Under s 12(1)(f), no person may introduce or plant any exotic or introduced plant in, on, or under the foreshore or seabed.

The *restrictions applying to the discharge of contaminants* into the environment are set out in s 15 of the RMA. Discharge is defined in the RMA as 'emit, deposit and allow to escape'. Under s 15, no person may discharge any contaminant (defined as 'any substance that, when discharged into water, changes or is likely to change the physical, chemical or biological condition of water') into water unless the discharge is expressly allowed by a rule in a regional plan or proposed regional plan, or by a resource consent.

6.2.2. Discharges associated with vessel cleaning or maintenance

In-water treatment or maintenance activities associated with vessels can result in discharges to the environment in three ways. This includes discharges of:

- antifouling coating residues
- biological material (dead or alive)
- chemicals or toxicant associated with treatment tools

The definitions and provisions in the RMA of the terms 'discharge' and 'contaminant' are very relevant in this context. For example, while dead biofouling organisms released into the water pose no biosecurity risk, the release of dead biofouling organisms, and their deposition and decay on the seafloor, may still be a discharge of a contaminant.

Under s 15A, the dumping of waste or other matter in the coastal marine area from a ship or offshore installation has to be expressly allowed by a resource consent. The discharge of harmful substances or contaminants from a ship or offshore installation into water in the coastal marine area is prohibited under s 15B unless the discharge is specifically permitted or controlled. Under Regulation 4 of the Resource Management (Marine Pollution) Regulations 1998, the dumping of dredge material and organic material of natural origin (which could include biofouling) is deemed to be a discretionary activity in any regional coastal plan or proposed coastal plan.

6.2.3. Regional legislative context

The Regional Resource Management Plans for the three TOS councils (unitary authorities), can be accessed online.

- Marlborough Sounds Resource Management Plan (MSRMP): http://www.marlborough.govt.nz/Your–Council/RMA/Marlborough–Sounds–Resource–Management–Plan.aspx
- Nelson Resource Management Plan (NRMP): http://nelson.govt.nz/environment/nelson–resource–management–plan/nelson–resource–management–plan–2/view–the–nrmp/download–the–nrmp–2/
- Tasman Resource Management Plan (TRMP): http://www.tasman.govt.nz/policy/plans/tasman–resource–management–plan/

Each of the three plans includes policies, rules and information requirements that govern activities relevant to in-water vessel treatment and maintenance. These are chapters 35–37 of the TRMP (in particular Rules 36.2.2.8 and 36.2.3), chapter 13 of volume 2 of the NRMP (rule CMr.39) and chapters 33–35 of volume 2 of the MSRMP.

In the NRMP and TRMP, the discharge of contaminants into coastal water is listed as a discretionary activity, which requires a coastal permit that may be granted with specific conditions. The NRMP states the discharge of contaminants into coastal water is a discretionary activity if particular standards are met relating to the scale of effects on the receiving environment. If these standards are not met the activity becomes non-complying. The MSRMP's provisions for discharges and depositions are divided into Port Zones (chapter 33), Marina Zones (chapter 34) and Coastal Marine Zones (chapter 35). The discharge of substances into the coastal marine area is listed as a discretionary activity, while deposition of any substance on the seabed is classified as a non-complying activity. Resource consent is required for either type of activity.

The NRMP is used as an example to illustrate the types of conditions that could be imposed on a coastal permit for discharging contaminants:

- flow recording
- review of conditions
- the mixing zone
- receiving water standards to be upheld
- monitoring of receiving environment
- the location, flow rates, timing of the discharge
- effluent standards, composition, concentration, total load of contaminants
- effluent monitoring

- means to avoid, remedy or mitigate potential adverse effects including the use of the best practical option for the treatment or disposal of contaminants
- preparation of contingency plans
- provision of warning signs
- public notification of the intention to discharge
- the term of the consent
- administrative charges
- transferability of resource consents as set out in Section 135 of the Resource Management Act 1991

6.2.4. Consultation with Top of the South councils regarding consenting requirements for vessel treatment

This section summarises the outcomes of our dialogue with the three TOS councils regarding vessel biosecurity treatments in the region. Because the requirements and advice provided are to some degree similar for the three councils we present a single, combined summary. We have assumed that maintenance and treatment activities carried out in land-based facilities (slipways, haul-out facilities, *etc*.) are conducted under existing resource consents held by the owners or operators of these facilities. This section is, therefore, restricted to in-water treatment of vessels. Any discussions with council representatives were purely for the purpose of establishing the current situation for consenting requirements and for starting a dialogue on areas that could be considered for review. None of the text in this section is intended to reflect the definitive position of any council.

As outlined in the preceding section, a significant consideration for a regional authority relating to any kind of vessel treatment or maintenance in the coastal marine area is whether the activity will result in the discharge of a contaminant (see definitions above) into water or onto the seabed. The council representatives confirmed that, where there is a risk of this occurring in association with an activity, a resource consent is required. Depending on the context, the consent holder can be the owner of a vessel, the provider of treatment services, the owner of port or marina facilities, or the regional council itself.

The use of some in-water treatment tools, particularly those without capture facilities are likely to have an associated risk of discharge and require a consent. For treatment methods that do not involve a discharge and may therefore be permitted activities, it is best practice to seek confirmation from the relevant council that the activity is permitted prior to undertaking the treatment activity.

As a first step, a description of the intended treatment or maintenance activity needs to be submitted to the council outlining:

- the objective of the activity
- the location that the activity is to take place
- the type of treatment tool and process proposed
- the conditions under which the treatment tools will be used
- the scale and duration of the activity
- the likelihood and nature of any associated discharges into the environment and any methods used to lessen the effect of that discharge.

The councils' decisions will be based on the RMA and regional plans and rules. However, the councils advised that they will consider specific factors associated with proposed activities in their decision on: (i) whether there is a risk of a discharge, and (ii) whether the material that may be discharged represents a contaminant. These factors include the type and quantity of organisms or other material likely to be released into the environment, their state (dead or alive/viable) and their origin (local, domestic or international). Together, they determine the ability of the released material to 'change the physical, chemical or biological conditions of water', which is the definition of a contaminant under the RMA. In summary, the need for a resource consent may not only be determined by the technology used to treat or clean a vessel but also by the nature of the material that may be released during the process. It is the responsibility of the party proposing the activity to ensure that the councils are provided with the right information and detail to enable reasonable decisions to be made.

The biological characteristics (slime layer vs. macro biofouling) and geographical origin of biofouling (local, domestic or international) are also key risk factors recognised in the recently developed *Guidelines for Antifouling and In-water Cleaning* (Commonwealth Government of Australia 2013), which represent the revision of the *ANZECC Code of Practice for Antifouling, In-water Cleaning and Maintenance* (1996). These guidelines were adopted by the Australian Commonwealth Government in 2013 and are due to be adopted by New Zealand in the near future. These guidelines provide a valuable resource for regional decisions on in-water cleaning and treatment activities for vessels.

Once a description of an intended treatment activity is submitted to the regional council, a response would be anticipated within 1–3 (MDC) or 3–5 (NCC, TDC) working days. Therefore, if no resource consent is required this represents the minimal waiting period for treatment.

In situations where a resource consent is required, the application needs to include specific information relating to the activity, details of which are listed in the regional resource management plans for each council. The information provided should include sufficient detail on the treatment method proposed, the associated environmental risks (if any) and ways in which these are mitigated. An example of information required by TDC to support resource consent applications relating to discharges in the Tasman area is provided in Appendix 10.

Marlborough District Council advised that the recent amendments to the RMA will require a significant review of the council's regional plans, as well as the Regional Policy Statement and NZCPS. These reviews may affect parts of these documents that deal with activities such as vessel treatment and maintenance, and should therefore be carefully examined once completed.

The processing time for resource consent applications will be affected by whether a consent is notified or not. Non-notified consents take up to 20 working days to process. The applicant may be required to obtain written approvals from affected parties. If these approvals cannot be obtained a limited notified process will be required where submissions are invited only from those deemed to be affected by the proposal. Notified consents are required where an activity will have or is likely to have adverse effects on the environment that are more than minor. Notification requires the applicant to undertake consultation with key stakeholders of the coastal marine area associated (*e.g.* in the case of the Nelson area this would include Port Nelson, Friends of the Haven, Iwi, Department of Conservation and other agencies or entities).

Where a non-notified resource consent is required, the council's decision can take up to 45 working days. Limited notified or notified consent processes can take up to 100 and 130 working days, respectively, during which submissions from the public are invited on the granting or refusal of consent and consent conditions if approved (Table 16). Any party in the notified process can then appeal the decision to the Environment Court. Guidelines on time requirements for consenting processes is also provided by the Ministry for the Environment[15].

[15] http://www.mfe.govt.nz/publications/rma/resource–consent–process–for–notified–applications

Table 16. Consenting timeframes for decisions regarding in-water treatment of vessels in the Top of the South region.

Activity		Timeframe
1	Initial consultation with council on whether resource consent required for intended activity	1–5 working days
2	Notification process determination by council	20 working days
3	Submission period for notified or limited notified applications	20 working days
4	Non-notified decision on resource consent issued by council	20 working days
	Approximate extra time if applicant required to provide additional information following submission of initial application (item 2)	15 working days
5	Total maximum time for limited notified process	100 working days
6	Total maximum time for notified process	130 working days

6.2.5. Overview of likely consent requirements

A recent review of in-water treatment technology identified seven stages of the cleaning process that can be associated with a biosecurity risk (Morrisey & Woods 2014). Some of these seven stages are irrelevant to the risk of contaminant discharge. A simplified version of Morrisey and Woods' (2014) findings is presented below (Table 17). This table illustrates where during the treatment process, using methods and tools outlined in Section 4.2, there is the possibility of a contaminant discharge (Stages 1–3). All in-water treatments previously discussed are included, for details on these and their regional availability refer to Table 12.

During the equipment set-up (stage 1), any discharge is likely to be from divers and/or equipment dislodging biofouling organisms from the vessel. It is likely that the quantity of material removed in this way would be very small. Discharges during the treatment stage (Stage 2) may occur of the treatment method is unable to effectively capture and contain material removed from the vessel. Where there is waste filtration associated with a treatment tool (Stage 3), discharges may arise where there is incomplete filtration of waste material prior to effluent water discharge back into sea.

As outlined above, any discharge of a contaminant requires a resource consent in either of the three TOS jurisdictions, but currently the information provided on each proposed treatment activity will be considered by the councils in order to decide whether or not there is a risk of discharge and whether any discharged material would be regarded as a contaminant. The final column of Table 17 identifies situations for which resource consents are likely required at present. However, it is a simplistic, informative overview and cannot be used as a definite decision tool. Decisions regarding consent requirements are currently made by the relevant council on a case-by-case basis.

One critical information requirement that will enable councils to decide on the risk of a discharge is the effectiveness of any capture and filtration tools in preventing or limiting the loss of biological or chemical (*e.g.* antifouling coatings) material to the environment. It is unlikely that generic claims made on the websites of equipment manufacturers would be accepted as sufficient evidence. However, the Ministry for Primary Industries has commissioned the development of a testing framework and protocol for in-water treatment and cleaning technologies for vessels. The work is being carried out by the National Institute of Water and Atmospheric Research (NIWA) and is due for completion in March 2015. The councils indicated that the inclusion of independent, verified test results for treatment technologies into information on the intended activity that is supplied to councils would support their decision process.

Table 17. Possibility of biofouling ('contaminant') discharge associated with the in-water treatment technologies reviewed in Section 4 based on Morrisey and Woods (2014). 'Y' indicates that there is a potential risk of discharge. Some treatment tools have associated capture technologies (see footnotes below); however, unless reliably verified the effectiveness of this capture is unknown.

Treatment method	Stage 1: Set-up	Stage 2: Treatment process	Stage 3: Waste filtration	Likely consent requirements
Manual removal				
Hand-picking	Y	Y		Resource consent may be required depending on biofouling parameters[1].
Hand-removal with brushes, scrapers and pads[2]	Y	Y	Y	Resource consent required in principle but depending on biofouling parameters and demonstrated ability of capture/filtration tool to prevent discharge.
Mechanical removal				
Rotary brush / pad (including hand-held devices[3], diver-operated brush carts[4], robots or ROV's and contactless systems[5]).	Y	Y	Y	Resource consent required in principle but depending on biofouling parameters and demonstrated ability of capture/filtration tool to prevent discharge.
High-pressure water jet (including hand tools[6] or carts and ROVs[7])	Y	Y	Y	Resource consent required in principle but depending on biofouling parameters and demonstrated ability of capture/filtration tool to prevent discharge.
Cavitational jet[8] (self-propelled, diver-operated carts and hand-held pistols)	Y	Y	Y	Resource consent required in principle but depending on biofouling parameters and demonstrated ability of capture/filtration tool to prevent discharge.

[1] 'Biofouling parameters' relate to quantity, viability and origin of biofouling on vessel, and perhaps additional factors considered by the councils.
[2] Some hand–tools can have capture/filtration ability.
[3] Prototypes with capture systems have been tested and commercial version is available, but not generally used.
[4] Most currently–used systems do not incorporate capture systems but many could be modified if market demand was sufficient.
[5] Currently available devices incorporate capture and filtration systems.
[6] Most currently–available devices do not incorporate capture and filtration systems but commercial versions are available.
[7] Currently–available devices incorporate capture and filtration systems.
[8] Among currently–available models, hand tools do not generally have capture and filtration systems but some carts do. Unclear whether fouling organisms are killed by the force of cleaning, but assume not.

Treatment method	Stage 1: Set-up	Stage 2: Treatment process	Stage 3: Waste filtration	Likely consent requirements
Surface treatment				
Hot water/heat/steam	Y	Y	N (if killed)[9]	Resource consent may be required since RMA controls discharge of hot water. Also depending on biofouling parameters and verification that all biofouling has been killed.
Ultrasonic	Y	Possibly[10]	N (if killed)[9]	Resource consent required in principle but depending on biofouling parameters and demonstrated ability of capture/filtration tool to prevent discharge.
Shrouding technologies				
Wrapping and floating dock technology (including manual or mechanical cleaning within the shrouding)	Y	Y[11]	N (if killed)[9]	Resource consent may be required but depending on biofouling parameters and verification that all biofouling has been killed.
Shrouding with toxicant	Y	Y[11]	N (if killed)[9]	Resource consent may be required but depending on nature and persistence of toxicant, biofouling parameters and verification that all biofouling has been killed.

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[9] Verification that all fouling has been killed is critical

[10] A risk of discharge will be possible if the treatment dislodges fouling present

[11] Biofouling may be discharged unless retained within the floating dock or wrapping material when it is removed. Water with low dissolved oxygen may be discharged when the shrouding is removed (unless pumped out prior to removal). Residual toxicant may be released if these have been used, unless they are neutralized prior to removal of the shrouding or consumed during the treatment process.

6.2.6. Potential avenues for streamlining the consent process

The information presented in Table 17 illustrates that resource consents could be required for almost any of the treatment technologies mentioned in this report, including those currently available in the region. In the event of an increase in demand and frequency for in-water treatment of vessels it would be prudent to ensure both that the councils' decisions on whether a resource consent is required for an activity, and the assessment of applications for resource consent, are streamlined to allow efficient decision making and decreased turnaround times for vessels requiring treatment. This would be the case both for situations where high-risk vessels are identified as requiring treatment (potentially urgently), and for those where in-water treatment could be used for improved routine 'hull hygiene' (*e.g.* using in-water cleaning to limit the extent of local biofouling that develops on vessels that are not in use for extended periods). The issue of consistency of decisions, both within and among councils, is also relevant here. With regard to this last statement, MDC advised that they perceive their region as different to the Nelson and Tasman regions, due to its coastline and concentration of aquaculture industry. Hence, MDC do not necessarily see a need for consistency in decision making.

Two options for minimising turnaround times were discussed with the councils. The first option is the establishment of global resource consents for particular treatment methods. A global consent would allow the consent holder to undertake a particular type of treatment anytime it is required, provided the activity is undertaken in accordance with the conditions of the approved consent. There are several important factors that require consideration when applying for global consents. These include:

1. The range of localities covered by the consent (e.g. single designated treatment locality vs. a broader geographical range where treatment may occur). Selection criteria would include the capacity of water movement to disperse contaminants (either to dilute contaminants to acceptable concentrations or to reduce their spread) and proximity to sensitive or valued habitats or features;
2. The number of operators allowed to undertake the treatment (single approved operator or any operator offering the treatment technology). Approval of operators could be based on a process administered by the councils or MPI;
3. The specificity of the equipment the global consent is granted for (a particular brand or model of equipment vs. any brand or model able to achieve specific standards). Approval of methods could be based on a process administered by the council or other regulators (such as the testing framework currently under development for MPI, referred to above).

Item 2, for example, can be influenced via the choice of consent holder. If a particular operator is the consent holder then only this person or company is able to undertake the treatment. If the consent holder is a council, a wider range of operators may be approved or appointed under that consent. Other parties that could be consent holders are port or marina companies (however, this would potentially restrict geographical range) or the Ministry for Primary Industries—that could allow councils to operate on their behalf under their consent. Conversely, where MPI is the lead agency but the council holds a consent, MPI may be able to operate under the Council's consent on their behalf.

The option for developing global consents is currently being explored by NCC via an Envirolink Medium Advice Grant (to Cawthron) on the use of encapsulation and chemical accelerants (chlorine) for treating vessels in the Nelson region. MDC indicated that in their experience global consents are untenable and not effective, and would be unlikely to be issued. They consider that the effects of treatment activities are site-specific and the site-specific distribution of values across the region (*e.g.* aquaculture, cultural, recreational) mean that blanket consents are presently not considered a useful option.

The second option to minimise turnaround times is to reduce the processing time for individual resource consent applications. This could be achieved, for example, by submitting detailed information to councils on treatment methods (including their ability to prevent or minimise discharge and contamination risks), treatment locations, environmental effects and other relevant information for each different treatment method. This information could be reviewed and 'accepted' by the councils and then stored in the councils' consents section. It would then be possible to refer to this information in future resource consent applications for treatment of vessels and limit applications to essential, case-specific information such as vessel name, origin and extent of biofouling, intended treatment location, *etc*., on the basis of which councils may be able to grant or decline resource consents with reduced turnaround times.

Nelson City Council and TDC feedback suggests that reduced processing times can be assisted by already having approved the methodologies but would also depend on current workloads and the ability to prioritise this processing over other applications. There is the possibility of sharing processing regardless of the location of the activity within a given set of parameters to overcome the resourcing issue.

Marlborough District Council outlined its preferable alternatives to the options described above. One of these is to modify the emergency provisions of the RMA, where consent for treatment activities can be sought retrospectively if it can be justified. However, this would only be appropriate for 'emergency' scenarios, where high-risk vessels are identified and require urgent treatment. With regard to more predictable activities, such as routine in-water hull maintenance to prevent biofouling development or to remove local biofouling prior to departure, MDC recommend that permitted activity rules or plan standards (either in a specific zone or as a general rule) are considered to improve efficiency and remove time barriers. MDC will review its regional plan later in 2015, providing an opportunity for MPI to suggest changes to plan standards or rules.

7. SUMMARY AND CONCLUSIONS

The TOS region is visited by thousands of vessels from domestic and international origins every year, including locations where populations of NIS are known to occur. Many of the commercial vessels visit the two main ports (Nelson and Picton), with Nelson being the largest fishing port in Australasia. The TOS is also the main aquaculture growing region of New Zealand, and is serviced by >50 vessels associated with this industry, including harvesters, sourcing boats and crew vessels. Picton is strongly connected to the lower North Island via frequent ferry movements. The region also has six main marinas that accommodate over 2000 recreational vessels, making it the largest vessel hub in the South Island. Collectively, this vessel traffic connects the TOS region, including high-value areas (*e.g.* Abel Tasman and Marlborough Sounds) to other marinas and ports throughout the country.

In additional to marina and port infrastructure, the region has boat ramps, slipways and haul-out facilities, with Nelson and Picton being the largest providers. These facilities cater for small-to-medium craft (< 80 m) and are generally available at short notice (*e.g.* during a pest response) throughout the year. An exception is the Calwell Slipway, where advance bookings are required unless there is a cancellation. This was highlighted during the recent *Voyager P* response, where there was a 3-week delay before the vessel could be slipped. At present, there are no land-based facilities for larger vessels (> 80 m) for either maintenance or treatment activities.

The TOS is well placed in terms of specialised diving services in the region, with the three main operators having been involved with biosecurity-related activities. Of note is the considerable collective expertise in encapsulation methods, which has now been applied to wharf piles, marina pontoons and vessels up to 110 m in length. Over the past decade, the range of in-water cleaning/treatment technologies has increased considerably to meet a growing and changing demand (*e.g.* due to advances in paint technologies). Some of the emerging treatment technologies are not presently available in the TOS (*e.g.* cavitation, floating docks) and nationally (*e.g.* ultrasonic methods). Once the performance and benefits of the new floating dock system operated by Northland Regional Council has been ascertained in more detail, this technology in particular could be a useful avenue for treating biofouling on small craft vessel in the TOS, both as a pre-emptive maintenance measure and as a response option.

Ongoing management of biofouling risks to the TOS region will be challenging. The recently introduced biofouling standard for international vessels (the CRMS) is intended to improve the level of hygiene of vessels visiting from overseas. However, domestic pathway management will require a more coordinated and diverse approach. Piola & Forrest (2009) provide several recommendations to reduce biofouling risks associated with recreational vessels, including the addition of stringent conditions in marina berth agreements relating to biofouling. In addition to this measure, which has already been considered by the Nelson Marina, TOS councils could add similar conditions to mooring consents (*i.e* the requirement to be maintained pest free). Training could be given to inspectors (and marina staff) in identifying marine pests. For domestic pathway management initiatives to be successful, we consider it critical for there to be improved coordination between councils, including outside of the TOS. For example, our discussions with marina operators in Wellington identified that recreational vessels often depart for isolated regions in the outer Marlborough Sounds, without visiting the main hubs. Measures or controls in place in the source region (*e.g.* the requirement to have low levels of fouling in a marina) would have flow–on benefits to regions where the vessels visited.

Based on discussions with the TOS councils, it is apparent that resource consents could be required for almost any of the treatment technologies mentioned in this report. This can be problematic when trying to quickly deal with a high-risk vessel, as illustrated by the recent activities associated with the *Voyager P*. In this example, it was not possible to add chemical treatment to encapsulated water (to improve the efficacy of the method and to decrease treatment time) without first obtaining a resource consent from NCC; a process that would have taken several weeks. As part of this project, two options for minimising turnaround times were discussed with the councils: the establishment of global resource consents for various treatment methods, and ways to reduce the processing time for individual resource consent applications. It seems that there is some level of agreement by NCC and TDC about how these two options could potentially be approached. However, MDC raised concerns regarding the efficacy of global consents, and that emergency provisions of the RMA and that permitted activity rules or plan standards would be a more effective approach. Clearly, it would be beneficial for there to be consistency between the TOS councils, therefore ongoing dialogue within and between the three councils (including both biosecurity and consenting personnel) is required throughout the development of pathway management approaches for the TOS.

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9. APPENDICES

Appendix 1. ‘Modes of infection’ (additional to vessel biofouling) by which vessels can transport non-indigenous species (NIS).

Sea chests:

Sea chests are internal recesses that house intake and outpipes for ballast and cooling water. They are covered by grates that are bolted or welded in place and are usually inaccessible to divers or other observers without specialised tools. Sea chests can harbour diverse assemblages of sessile and mobile marine organisms (Coutts & Dodgshun 2007). Due to the difficulty in accessing them, in this report sea chests are treated separately from ‘regular’ biofouling on submerged hull surfaces.

Biofouling associated with fishing gear and equipment:

Mobile structures used in commercial fishing (*e.g.*, buoys, ropes, anchors, benthic trawls *etc*.) or exploration activities (*e.g.* deployed subsea equipment) are also potential modes of infection. Commercial fishing operations around New Zealand mainly involve bottom and mid–water trawling. There is a risk that mobile capture equipment can entrain NIS propagules, planktonic organisms and other drifting material (*e.g.*, seaweed clumps and associated biota) that could then be transported to other locations. Static fishing equipment deployed for longer periods before retrieval (*e.g.*, lobster and cod pots and their associated lines and buoys) can accumulate biofouling and mobile organisms (*e.g.* decorator crabs, skeleton shrimps *etc*.). There is a risk that NIS may be transported with this equipment to other fishing grounds or to the vessels’ destination ports unless it is thoroughly cleaned. The extent of this risk has not been investigated in detail within this sector in New Zealand (Inglis *et al.* 2014).

Ballast water:

This term describes the water taken up by larger vessel types to maintain stability when unloaded. Ballast water is predominantly carried by merchant vessels (*e.g.* bulk carriers, container ships, tankers, *etc*.), some cruise ships and large ferries. Both domestic and foreign ships may load and unload cargo in New Zealand ports and hence discharge or recharge their ballast tanks with water from within New Zealand territorial waters. Ballast water transfer and discharge can facilitate the transport, release and establishment of NIS (Carlton 1985). Its most frequent constituents are the planktonic life stages of marine organisms (larvae, eggs, spores). However, fishes and adult mobile invertebrates have also been discovered in ballast water (Gollasch *et al.* 2002) and sediments in the bottom of ballast tanks can harbour diverse infaunal assemblages (Kelly 1993). The risks associated with ballast water are influenced by a range of factors that include in particular the volume of ballast discharged into a port by a vessel, the number of vessels discharging into the port, the contents of the ballast water, the transit time of the port–to–port journey and the environmental similarity of the source and receiving environments (Inglis *et al.* 2014).

Bilge water and other water taken up during ship-board operations:
Water trapped within vessels' anchor lockers and bilges is also able to facilitate the spread of NIS. The term bilge water refers to seawater other than ballast water that accumulates within the hull of a vessel during its operation. Bilge water can be found in the engine rooms of larger vessels (which it may enter via the stern glands) and in the bilge sumps of smaller vessels. Bilge water also includes any water trapped on vessel deck areas. The volume of bilge water on board a vessel is likely to be relatively small and, overall, its biosecurity risks on different vessel types and at local vs domestic or even international scales is poorly understood. Nonetheless, there is an indication that bilge water may pose a biosecurity risk. In a recent study, Darbyson *et al.* (2009) collected samples of bilge water from 35 recreational and commercial fishing vessels in eastern Canada. Thirty–one taxa were identified from the bilge water sampled. A range of planktonic organisms were recorded, including larval stages of marine invertebrates. Cawthron are currently engaged in preliminary research on the biosecurity risks associated with bilge water movements around New Zealand.

Dredge spoil and washings:
Transport and release of dredge material is a potential vector for NIS. The biosecurity risks of dredged material have not been examined in detail but there is potential for transport of sediment-dwelling organisms, including cysts or spores (Cohen & Carlton 1995). Preliminary research indicates that the amount of residual sediment that trailer suction hopper dredgers transport between deployment locations is likely to be greater than the quantities carried in ballast tanks and that the range of species carried is likely to be different (Australian Government 2009). There is also the potential for harmful organisms or their offspring to be transported within water taken into the dredge or auxiliary barges (Inglis *et al.* 2014).

Appendix 2. Organisations, facilities and individuals contacted for specific information.

Organisation	Contact person
Allspec Marine	Malcolm Coffey
Calwell Slipway	Andy Wills
Cawthron Institute	Don Morrisey
Dickson Marine	Malcolm Coffey
Diving Services New Zealand Ltd.	Bruce Lines
Franklin's Boatyard	Ian Franklin
Havelock Marina	Pete Mitchell
Lowry Bay Yacht Club	Margaret Lisette
Mana Cruising Club	Kathy Scott
Mana Marina	Peter Heart
Marlborough Commercial Dive Services	James Brodie
Marlborough District Council	Bruno Brosnan, Jono Underwood, Lynn Mullens
Marlborough Oysters Ltd	Aaron Pannell
Marine Farming Association	Debbie Stone
Motueka Power Boat Club	Alan Nobel
Motueka Yacht and Cruising Club	Peter Dodgshun, Nick Dicks
N-Viro Ltd.	Donna Baker
Nelson City Council	Kathy Mardon, Mandy Bishop
Nelson Hardstand Ltd	Pete O'Donoghue
Nelson Marina	Paul Jonkers
Nelson Slipway	Daryl Seyb
New Plymouth Underwater Ltd.	Mike Sharp
Northland Regional Council	Don McKenzie
Picton Marina	Dave Mahony
Pohara Boat Club	Kevin Winter
Port Marlborough Ltd.	Steve McKeown
Port Motueka Marine Services	Marc Wilson
Port Nelson	Dave Duncan
Port Tarakohe	Allan Kilgour
Proactive Commercial Diving	Anthony Bacon
Sanford	Zane Charman
Sounds Shipwright Services	Lloyd Price
Sounds Marine	Jeremy Hay
Southern Inshore Fisheries Management	Carol Scott
Talley's Group	Barry Gardiner
Tasman Bay Cruising Club	Veronika Westerson
Tasman District Council	Rosalind Squire, Leif Piggot, Paul Sheldon, Warren Galbreith
Tasman Harbour Master	Dan Cairney
TCC Boats	Sam Edwards
Waikawa Marina	Brian Carver
Waikawa Marine Centre	Sally Wright

Appendix 3. Aquaculture vessels operating in the Top of the South region. Modified from the Marine Farming Association Aquaculture Directory 2014.

Company	No. of vessels	Operating area
AJ and SA King	1	Pelorus Sound
Apex Marine Farm Ltd	5	Queen Charlotte Sound Pelorus Sound
Arista–cat Mussels	2	Golden Bay Tasman Bay
Aroma Aquaculture Ltd	1	Pelorus Sound
BDM Trust	1	Golden Bay
Clearwater Mussels Ltd	5	Pelorus Sound
Hebberd Marine	2	Croisilles Harbour Pelorus Sound
Kono Seafood	5	Pelorus Sound Port Underwood
MacLab	3	Golden Bay Tasman Bay Pelorus Sound
Madsen Marine Ltd	1	Golden Bay Tasman Bay Pelorus Sound Queen Charlotte Sound
New Zealand King Salmon Ltd	7	Queen Charlotte Sound Pelorus Sound
Port Underwood Contracting Services	2	Port Underwood
Port Aquaculture Ltd	1	Pelorus Sound Port Underwood Queen Charlotte Sound
Sanford Ltd	9	Pelorus Sound
Sea Investments	3	Golden Bay Tasman Bays Pelorus Sound
The Apple Buoys Ltd	1	Golden Bay Tasman Bay
UFL	1	Golden Bay Tasman Bay Pelorus Sound
Waimana Marine Ltd	2	Golden Bay Tasman Bay Pelorus Sound
Willowbrook	1	Pelorus Sound Port Underwood Queen Charlotte Sound
Womersley	1	Pelorus Sound

Appendix 4. Aquaculture vessels owned and operated by Sanford Ltd, and type of work and area of operation of each vessel.

Vessel	Work type	Area of operation	Other comments
San Nikau	Seeding, Harvesting, Floating, Spat Catching	Pelorus Sounds 90%, Queen Charlotte 5%, Golden Bay and Tasman Bay 5%	
Okiwi Spirit	Seeding, Harvesting, Floating, Spat Catching	Pelorus Sounds 80%, Queen Charlotte 5%, Golden Bay and Tasman Bay 5%, Banks Peninsula 10%	Will occasionally work in Stewart Island
Enterprise	Seeding, Floating, Spat Catching	Pelorus Sounds 95%, Queen Charlotte 5%,	
Lady Marie	Floating	Pelorus Sounds 100%	
Pacifica	Floating, Farm Development	Pelorus Sounds 90%, Queen Charlotte 5%, Golden Bay and Tasman Bay 5%	
Intrepid	Harvesting	Pelorus Sounds 90%, Queen Charlotte 5%, Golden Bay and Tasman Bay 5%	
Pelorus Trader	Harvesting	Pelorus Sounds 90%, Queen Charlotte 5%, Golden Bay and Tasman Bay 5%	

Appendix 5. Summary of treatment or risk–reduction technologies available for vessel biofouling. Treatments shaded orange are currently available in the Top of the South region, while treatments shaded blue are available nationally. Specific companies which can be contacted for each technology are indicated.

Treatment method	Company/Facility
Mechanical removal	
Rotary brush / pad (hand-held devices)	Diving Services New Zealand Ltd. New Plymouth Underwater Ltd. New Zealand Diving and Salvage Ltd.
Rotary brush / pad (diver-operated brush carts)	New Plymouth Underwater Ltd.
Rotary brush / pad (robots and ROVs)	New Plymouth Underwater Ltd.
Rotary brush / pad (contactless)	
High-pressure water jet (land-based hand tools)	Port Motueka Marine Services Nelson Hardstand Ltd. Nelson Slipway Ltd.[1] Calwell Slipway Ltd.[1] Havelock Slipway Sounds Shipwright Services Ltd. TCC Boats Waikawa Marine Centre Sounds Marine Franklin's Boatyard
High-pressure water jet (in-water hand tools)	Diving Services New Zealand Ltd. New Plymouth Underwater Ltd. New Zealand Diving and Salvage Ltd.
High-pressure water jet (carts and ROVs)	New Plymouth Underwater Ltd.
Cavitational jet (self–propelled, diver-operated carts and hand-held pistols)	New Plymouth Underwater Ltd.
Vacuum systems	Diving Services New Zealand Ltd. New Zealand Diving and Salvage Ltd.
Surface treatment	
Hot water / heat / steam	Department of Conservation New Plymouth Underwater Ltd.
Shrouding technologies	
Wrapping	Diving Services New Zealand Ltd. Marlbrough Commercial Diving Services Ltd.
Floating docks	Northland Regional Council
Shrouding with toxicant	Diving Services New Zealand Ltd.
Shrouding with manual or mechanical cleaning	Diving Services New Zealand Ltd. Marlbrough Commercial Diving Services Ltd.

Note: 'Manual removal' treatment methods have been excluded as these methods are easily applied and not restricted to specific companies.
Note: A largely regional focus has been given to the availability of some treatment technologies. It is anticipated that other companies and facilities may offer specific services, and readers are encouraged to investigate other options where necessary.

[1] Water-blasting is carried out at this facility by independent contractors (list of contractors available from facility directly)

Appendix 6. Contact details for companies and facilities providing specific treatment or risk-reduction technologies for vessel biofouling.

Company/Facility	Contact person	Address	Phone	Email
Calwell Slipway Nelson Ltd.	Andy Wills (Slip Master)	6 Rogers St, Port Nelson, Nelson 7010	(03) 539 3801 027 278 3777	andy.wills@ portnelson.co.nz
Diving Services New Zealand Limited	Bruce Lines	43 Sowman Street, Nelson 7010	(03) 546 9964 021 407 740	divingservicesnz@ xtra.co.nz
Franklin's Boat Yard	Ian Franklin	325 Waikawa Rd Picton 7220	(03) 573 8500	
Havelock Slipway	Wayne Griffiths (Manager)	14 Rose Street, Havelock 7100	(03) 574 2476	info@ havelockslipway.co.nz
Nelson Hardstand Ltd.	Pete O'Donoghue	5 Cross Quay, Port Nelson, Nelson 7010	021 546 7768	
Nelson Slipway Ltd.	Daryl Seyb (Slipway Manager)	Vickerman Street, Port Nelson, Nelson 7010	(03) 545 6645 021 248 9139	nelsonslipway@ marineandgeneral.co.nz
New Plymouth Underwater Ltd.	Mike Sharp	11-15 Breakwater Road New Plymouth	(06) 751 4104 027 447 0161	mike@newplymouth underwater.co.nz
New Zealand Diving and Salvage Ltd.	Sol Fergus	134 Gracefield Road Seaview, Lower Hutt 5010	(04) 568 2505	sol@nzds.co.nz
Port Motueka Marine Services	Marc Wilson		(03) 527 8515 021 022 47449	pmmservices@ icloud.com
Sounds Marine	Jeremy Hay	Waikawa Marina yard, Picton 7220	(03) 573 8554 021 212 0296	admin@ soundsmarine.co.nz
Sounds Shipwright Services Ltd.	Lloyd Price (Manager)	6 Rangitane Drive, Havelock 7150	(03) 972 0101 027 243 8047	sounds.shipwright@ gmail.com
TCC Boats	Sam Edwards	Port Picton (old Carey's Boatyard)	(03) 573 7975 021 240 5030	tccboats@xtra.co.nz
Waikawa Marine Centre	Sally Wright (Marinas Service Coordinator)	Waikawa Marina yard, Picton 7220	(03) 520 3017	service@ msmarinas.co.nz

Appendix 7. Nelson Hardstand Ltd. travel-lift, water-blast and hardstand charges as at 1 March 2015.

NELSON HARDSTAND LTD

Ph: 021 546 914 Postal: 17 Neale Ave, Stoke, 7011, New Zealand

RATES FOR TRAVELIFT HAULOUT AND HARDSTAND - ALL PLUS GST

Boat Length (next smaller value)		Lift, hold, blast, (1hr) and return	Lift, blast, set-down, and return	Hardstand first night	Hardstand (per night after first)	Storage >30 days (per day)	Storage >60 days (per day)
		excl GST	excl GST	excl GST	excl GST	excl GST	excl GST
m	ft	$	$	$	$/day	$/day	$/day
9.0	29.5	188	267	66	43	32	26
9.5	31.2	199	284	69	45	33	27
10.0	32.8	210	303	72	47	35	28
10.5	34.4	223	323	76	49	37	30
11.0	36.1	237	344	80	52	39	31
11.5	37.7	252	367	84	54	41	33
12.0	39.4	268	392	88	57	43	34
12.5	41.0	286	419	93	60	45	36
13.0	42.7	305	447	98	64	48	38
13.5	44.3	325	478	103	67	50	40
14.0	45.9	347	510	109	71	53	42
14.5	47.6	371	544	115	75	56	45
15.0	49.2	396	581	121	79	59	47
15.5	50.9	422	619	128	83	62	50
16.0	52.5	451	660	135	88	66	53
16.5	54.1	481	703	142	93	69	56
17.0	55.8	513	749	150	98	73	59
17.5	57.4	547	797	158	103	77	62
18.0	59.1	583	848	167	109	81	65
18.5	60.7	621	901	176	115	86	69
19.0	62.3	660	957	186	121	91	72
19.5	64.0	702	1015	196	127	95	76
20.0	65.6	746	1077	206	134	101	80
20.5	67.3	792	1141	217	141	106	85
21.0	68.9	841	1209	229	149	112	89
21.5	70.5	892	1279	241	157	117	94
22.0	72.2	945	1353	253	165	124	99
		Plus GST	Plus GST	Plus GST	Plus GST	Plus GST	Plus GST

1 Length is the nearest smaller value, compared to the measured length over all projections .

2 Prices include waterblasting. Washdown is compulsory if vessel is to be moved from dock area. Badly fouled hulls will incur additional waterblasting costs @ $65 /hr.

3 Extra charge of $80.00 applies when double strops are required (vessels over approx 20 t, or light construction hulls, at the discretion of the operator).

4 Special Travelift services, such as lifts to or from transporters, keel fitting etc, will be charged at $120.00 plus GST per half hour or part therof, with a minimum charge of $120.00.

5 No responsibility will be taken for damage to underwater appendages unless the operator has been advised of all locations and details.

6 Hardstand charges in yard include power, water and boat stands.

7 Storage rates only apply when vessel books for more than 30 days, and no work being undertaken.

8 No boats to be stored outside the fence.

9 Vessels must be insured for normal use by owners. Vessels are lifted and stored at owner's risk.

10 Travelift Haulout Sheet must be signed prior to Haulout

11 Nelson Hardstand Ltd Terms and Conditions, and Site Rules, apply in all cases.

12 All contractors working in the hardstand area must have a current licence issued by Nelson Hardstand Ltd.

13 Sites to be clean and tidy at all times. Clean-up charges may apply.

14 **Spray painting and abrasive blasting absolutely prohibited.**

(Rev G - From 1/3/15)

Appendix 8. Sounds Shipwright Services Ltd. slipping and hardstand charges as at 1 January 2015.

Sounds Shipwright Services Limited

Slipping Charges

Up to 12 metres (40 foot)	$250
12 to 15 metres (50 foot)	$350
15 to 18 metres (59 foot)	$400
18 to 21 metres (69 foot)	$500
21 to 24 metres (79 foot)	$600
Over 24 metres	POA
Catamarans	$500
Fin Keels	POA

Hard Stand Fees (Daily) – SSS Ltd Working on Vessel

Up to 12 metres	$20
12 to 15 metres	$25
15 to 18 metres	$30
18 to 21 metres	$35
21 to 24 metres	$40
Over 24 metres	$50

Hard Stand Fees (Daily) – Owner Working on Vessel

Up to 12 metres	$35
12 to 15 metres	$40
15 to 18 metres	$50
Over 18 metres	POA
Under the Lean-To	$50

(Current as at 1 January 2015)

Appendix 9. Waikawa Marine Centre Travelift, water-blast and hardstand charges as at 1 October 2014.

WAIKAWA MARINE CENTRE

WAIKAWA
MARLBOROUGH SOUNDS MARINAS

TRAVELIFT and HARDSTAND CHARGES AT 1ST OCTOBER 2014

All rates GST inclusive

Length - Metres Up to	Ft eqv	Two Way Lifts	Lift and Hold	Waterblast	Hardstand
9	*< 30 Ft*	$225.00	$173.00	$50.00	$23.00
10	*30-32 Ft*	$242.00	$187.00	$54.00	$27.00
11	*33-36 Ft*	$271.00	$217.00	$68.00	$30.00
12	*37-39 Ft*	$311.00	$246.00	$75.00	$34.00
13	*40-42 Ft*	$357.00	$277.00	$81.00	$38.00
14	*43-45 Ft*	$409.00	$311.00	$87.00	$43.00
15	*46-49 Ft*	$466.00	$350.00	$93.00	$48.00
16	*50-52 Ft*	$535.00	$394.00	$100.00	$53.00
17	*53-55 Ft*	$621.00	$455.00	$114.00	$59.00
18	*56-59 Ft*	$719.00	$521.00	$126.00	$65.00
19	*60-62 Ft*	$834.00	$598.00	$140.00	$73.00
20	*63-65 Ft*	$972.00	$687.00	$152.00	$81.00
21	*66-68 Ft*	$1,122.00	$790.00	$173.00	$89.00
22	*69-72 Ft*	$1,265.00	$901.00	$205.00	$97.00
23	*73-75 Ft*	$1,403.00	$1,015.00	$243.00	$107.00
24	*76-78 Ft*	$1,530.00	$1,123.00	$282.00	$118.00
25	*79-82 Ft*	$1,645.00	$1,239.00	$334.00	$128.00
26	*83-85 Ft*	$1,760.00	$1,364.00	$396.00	$138.00
27	*86-88 Ft*	$1,863.00	$1,483.00	$458.00	$149.00

Additional slings	$40 per lift
Crane Hire	$200/hr mast removal
Dock Hire	$50/hr
Emergency call out and after hours	50% surcharge
Forklift Hire	$80/hr or part thereof
Machine Hire	Keel Jobs $199/hr or part thereof
Mussel Removal Fee	$25 minimum
Overtime Rates	$60 hour
Travelift Hire	$103/hr or $60 per half hour
Work Berth Hire	Casual Berth rates apply

A division of Port Marlborough New Zealand Ltd

Appendix 10. Information required by Tasman District Council to support resource consent applications relating to discharges in the Tasman area (note that the list includes information requirements for discharges into terrestrial areas).

a. Location of proposed discharge activity, including legal description and address.
b. Name and address of the owner and occupier (other than the applicant) of any site to which the application relates.
c. A site plan showing, where appropriate, details of:
    - discharge treatment and disposal system layout;
    - existing or proposed pipelines, chimneys, plant and facilities;
    - property boundaries and ownership of adjoining land or sites;
    - public roads;
    - drains, watercourses, wells, sinkholes and other karst features, wetlands, lakes, and other water bodies;
    - proximity to coast;
    - topography;
    - stormwater collection, treatment and disposal systems and discharge points.
d. Details of any management plan for the operation and maintenance of the discharge, including any waste treatment and disposal systems or pesticide discharge spray plans.
e. Details of any other resource consent that may be required and whether such consent has been applied for or obtained.
f. The proximity of the discharge to any other contaminant discharges in the vicinity affecting the same receiving environment.
g. A description of any possible changes to the nature, volume, or rate of the discharge that might result from failure or breakdown of equipment, accidental spill or discharge, natural hazard such as flooding, industrial action, or a similar event, and the contingency measures that have been developed to deal with such situations.
h. An assessment of any actual or potential effects of the discharge on the environment, including visual impact and effects on amenity values, human health, ecosystems, including karst terrain, flora and fauna. Such an assessment shall be in such detail as corresponds with the scale and significance of the actual or potential effects that the activity may have on the environment and must be prepared in accordance with the Fourth Schedule of the Resource Management Act 1991.
i. Details of any consultation undertaken with any person or body likely to be affected.
j. Other information that is necessary to understand the application.

k. Information to show compliance with performance standards and conditions relating to the use and storage of hazardous substances.
l. Detail of low impact design solutions in the management of stormwater.
m. Detail of the degree of land cover change or change to land use that may be associated with the subject site and discharge activity.
n. Information to demonstrate that the proposed method of disposal will not result in an increased risk of slope instability or raised groundwater levels that result in an increased risk of slope failure or loss of amenity.
o. Detail regarding the methods and solutions used to avoid, remedy or mitigate actual and potential effects on stormwater flow, water quality and sedimentation effects.
p. Where the discharge is the result of a subdivision activity, information to satisfy sections 19.2.2.10 to 19.2.2.12.
q. Information to show how the proposed management of stormwater is consistent with the Tasman District Engineering Standards, current at the time of application.
r. Information about the range of naturally occurring groundwater levels where soakage to ground is to be used as all or part of the proposed methods of stormwater management.
s. Additional information required for discharges to water:
t. A description of the nature of the discharge, including:
    - types and quantities of contaminants in the discharge;
    - quantities to be discharged;
    - rate, frequency and duration of the discharge.
u. A description of any treatment prior to the proposed discharge.
v. A description of the receiving water, including:
    - dilution effects of water currents and volumes;
    - stream bed, lake or coastal substrate;
    - vegetation, including instream and on riparian margins;
    - aquatic life and ecosystems.
w. A description of the outfall and how the discharge will mix with the receiving water.
x. Brine O, Hunt L, Costello MJ 2013. Marine biofouling on recreational boats on swing moorings and berths. Management of Biological Invasions 4(4): 327–341.
y. Forrest BM, Gardner JPA, Taylor MD 2009. Internal borders for managing invasive marine species. Journal of Applied Ecology 46(1): 46-54.