Ministry for Primary Industries
Manatū Ahu Matua

Guidance Document

# Vessel Biofouling Inspections



Schedule 2 & 3 of the CRMS:Vessels with supplementary guidance and resources.

**30 June 2022**

A guidance document issued by the Ministry for Primary Industries

New Zealand Government

# Title

Guidance Document: Vessel Biofouling Inspections

# About this document

This document accompanies the proposed craft risk management standard *Vessels* (2022) (CRMS: *Vessels*). It provides extracts of schedule 2 & 3 of the proposed *CRMS:Vessels* and supplementary guidance and resources. It is not a legally binding document and it should be read in conjunction with the standard *Vessels* to ensure that all matters relating to the meeting the requirements are fully understood.

# Document history

| Version Date | Section Changed | Change(s) Description |
|---|---|---|
| June 2022 | NA | New document for public consultation |
| | | |

# Contact Details

Ministry for Primary Industries (MPI)
Biosecurity New Zealand
Animal and Plant Health
Invasive Species
PO Box 2526
Wellington 6140

Email: standards@mpi.govt.nz



# Disclaimer

Where the content of the extracts of schedule 2 and 3 differ between this document and the *Craft Risk Management Standard: Vessels*, the wording in the *Craft Risk Management Standard: Vessels* takes precedence.

This guidance does not constitute, and should not be regarded as, legal advice. While every effort has been made to ensure the information in this guidance is accurate, the Ministry for Primary Industries does not accept any responsibility or liability whatsoever for any error of fact, omission, interpretation, or opinion that may be present, however it may have occurred.

All vessel operators and third-party biofouling inspection providers are subject to legislation administered by other government departments (e.g., Hazardous Substances and New Organisms Act and Health and Safety at Work Act); this guidance document does not cover or negate those responsibilities.

# Copyright

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**Note for public consultation:**

MPI aims to provide this document to allow ease of access to the vessel biofouling inspection requirements of the *Craft Risk Management Standard: Vessels* (*CRMS:Vessels*) which apply to vessel operators, but also may need to be understood by third-party vessel biofouling inspection providers.

We would like feedback on this document on:

- what format you may prefer to see this information in
- what further resources you may like to see in this document
- what further guidance you may like to see in this document

This document is intended to support industry in meeting the requirements of the *CRMS:Vessels*. It will be linked within the *CRMS: Vessels* and found on the MPI Website.

# 1 Purpose

This guidance document combines extracts of the requirements specifically relating to vessel biofouling inspection reporting in the proposed *Craft Risk Management Standard: Vessels* (*CRMS:Vessels*) and supplementary guidance and resources to help vessel operators and third-party vessel biofouling inspection providers in acquiring evidence required to meet the requirements of the *CRMS:Vessels*.

Note for consultation:

MPI is seeking feedback on the form, format, and content of the guidance within this document. If you do not consider the proposed form, format or content to be the best way to provide guidance for the third-party inspection providers on how to meet the proposed requirement of part 1.4(5)(d) the *CRMS:Vessels*, please provide alternatives or other feedback to:

Ministry for Primary Industries (MPI)
Biosecurity New Zealand
Animal and Plant Health
Invasive Species
PO Box 2526
Wellington 6140

Email: standards@mpi.govt.nz

# 2 Background

Vessel biofouling is a major pathway for the introduction of non-indigenous marine species into New Zealand's territorial waters, some of which may be harmful to New Zealand's resources, economy, environment, or people's health and well-being.

This guidance document supports the minimisation of the risk of introduction of non-indigenous species associated with vessel biofouling into New Zealand's territorial waters by supporting operators in meeting the vessel biofouling inspection reporting requirements of part 2.4(5)(d) the *CRMS:Vessels*.

While the requirements of the *CRMS:Vessels* legally apply to vessel operators, the Ministry for Primary Industries (MPI) recognises that the vessel biofouling inspection requirements need to be understood by third-party vessel biofouling inspection providers. To aid operators and third-party providers in achieving the outcome of the requirements, MPI has provided this document for ease of use for third-party providers who may be hired to procure the required evidence.

This document is guidance information only and is not legally binding. However, it provides information, guidance, and resources to aid in vessel biofouling inspection reports meeting the requirements of the *CRMS:Vessels*.

Where the content of the extracts of schedule 2 and 3 differ between this document and the *Craft Risk Management Standard: Vessels*, the wording in the *Craft Risk Management Standard: Vessels* takes precedence.

# 3 Who should read this guidance?

Vessel operators in charge of vessels which may be required to meet part 1.4(5)(d) of the *CRMS: Vessels*, and third-party providers who may be employed to conduct a biofouling inspection on such vessels.

# 4 Definitions

The following terms and definitions apply to this operational code. Other terms used are as defined by the Biosecurity Act 1993.

**audit**
A systematic, independent and documented process for obtaining evidence and evaluating it objectively to determine the extent to which specific criteria are fulfilled.

**biofouling**
The accumulation of aquatic organisms such as microorganisms, plants and animals on surfaces and structures immersed in or exposed to the aquatic environment.

**hull**
The immersed (including occasionally immersed) surfaces of a vessel including the following three parts. The definition of hull includes pontoons.

- **hull area**
  The immersed surfaces of a vessel excluding niche areas and wind/water line.
- **niche areas**
  Areas on a vessel hull that are more susceptible to biofouling due to different hydrodynamic forces, susceptibility to coating system wear or damage, or being inadequately, or not, painted, e.g., sea chests, bow thrusters, propeller shafts, inlet gratings, dry-dock support strips, etc. Includes appendages.
- **wind and water line**
  The area of the hull that is subject to alternating immersion due to a vessel's movement or loading conditions (also known in shipping as the boot-top).



**IMO**
International Maritime Organization.

**macrofouling**
Multicellular biofouling organisms visible as individuals to the naked eye such as barnacles, tube worms, and algae.

**New Zealand's territorial waters**
The territorial sea and the internal waters which together comprise the sea surrounding New Zealand out to 12 nautical miles from an internal baseline as described in the Territorial Sea, Contiguous Zone, and Exclusive Economic Zone Act 1977.

**non-indigenous species**
Those organisms which are not native to New Zealand.

**slime layer**
A layer of microscopic organisms, such as bacteria and diatoms, and the slimy substances that they produce.

**vessel or seacraft**
A subset of 'craft' as defined by the Act and means every description of boat or other craft used in water navigation, whether or not it has any means of propulsion. Also includes: a barge, lighter, hovercraft or floating drilling rig. It does not include aircraft.

**operator**
The person or organisation in charge of a vessel.

**organisation**
An individual or company capable of providing underwater vessel biofouling inspection services.

# 5 *CRMS:Vessels* extract schedules

The following sections contain extracts of schedule 2 and 3 of the *Craft Risk Management Standard: Vessels* (*CRMS:Vessels*). Where the content of the extracts differ between this document and the wording in the *CRMS:Vessels*, the wording in *CRMS:Vessels* takes precedence.

## 5.1 *CRMS:Vessels* - Schedule 2: Minimum evidence requirements for vessel biofouling inspections

### General requirements

(1) The vessel operator, or person in charge of a vessel, must ensure the following process is met:

a) The vessel operator, or person in charge of a vessel, must provide a biofouling inspection provider, prior to any inspection, copies of the general arrangement (GA) and docking plan (i.e. placement of dry-docking blocks). If for any reason the documents cannot be obtained or are invalid, the vessel operator must discuss the arrangement with the biofouling inspector provider to clarify presence or absence and general locations of niche areas. A record of either of the above must be kept;
b) Vessel biofouling inspection must meet the evidence capture requirements below; and
c) When the inspection is completed, vessel biofouling inspection report must meet the reporting requirements as part of this schedule.

**Guidance**

- The following information relating to the vessel biofouling inspection requirements can be found on the MPI website:
  - The *Guidance Document: Vessel biofouling inspections*. This contains Schedule 2 and 3 and includes guidance and resources relating to hull biofouling inspection requirements
  - A list of MPI-approved biofouling inspection providers
  - The *Operational Code: Vessel biofouling inspection provider approval scheme*
- MPI-approved biofouling inspection providers are those providers who MPI has assessed to be competent in producing reports that meet the requirements of the CRMS.
- The goal of the inspection is not to estimate the abundance of individual species on the vessel (e.g. biomass, or numbers of individuals) but provide evidence of the level of fouling so MPI can determine whether it meets the "clean hull" definition.
- Providing quantitative reporting on the level of fouling on the hull does not mean the vessel complies or does not comply with this standard, but it may help MPI assess photo and video evidence.
- The in-water inspection may include, but is not limited to:
  - the vessel hull inspection provider undertaking a physical survey using underwater breathing apparatus (i.e. SCUBA); or
  - the vessel hull inspection provider directing an underwater remotely operated vehicle (UROV).

### Capturing evidence

(2) The evidence captured must be high-quality digital video footage and still photos of all locations on the hull listed in Schedule 3, regardless of the presence or absence of biofouling. High-quality means a level that allows the viewer to identify biofouling to broad taxonomic groups (e.g. barnacles, tube worms, macroalgae).

(3) Three photos and a video must be taken, no more than 0.5m from the hull, of each location listed in Schedule 3, except for the locations listed under "miscellaneous" where one photograph and one video is required for each location.

(4) The digital cameras used for gathering the evidence must be capable of time and date stamping footage or photos (i.e. the correct date and time must be on the photos), or alternatively the time and date must be saved as properties associated with the file.

(5) Each image or video must be labelled to identify the image's location in relation to the hull during the inspection, e.g. labels on a quadrat frame.

(6) Each video must be taken at a speed slow enough for the camera to operate in low-light conditions without blurring images in individual frames.

(7) All reasonable attempts to access and survey all submerged and relevant topside areas as thoroughly as possible.

(8) Any locations on the hull that are listed in Schedule 3 but were not surveyed must be identified in the report as per the reporting requirements below, along with the reason they were not inspected.

**Guidance**

The areas listed in schedule 3 under "miscellaneous" are small, and so one photo and video of each location is acceptable.

Valid reasons for the excluding locations on the hull listed in Schedule 3 could be concerns for human health and safety, risk of damage to equipment, or the location not being present on the hull.

If an area in Schedule 3 is not present on the hull, it is a good idea to provide evidence of this in the report.



# Reporting

(9) The vessel operator, or person in charge of a vessel, must provide MPI with the following when required:

a) A report in portable document format (PDF) that includes the following:

i) A signed and completed vessel checklist and reporting form (see guidance below) containing the following information:

1) Date and location of inspection, vessel name, IMO number, vessel type, inspection personnel, weather conditions, water visibility, number of images supplied, and number of videos supplied
2) A list of each required location (Schedule 3) with the following information accompanying each location:

- Confirmation of required evidence being gathered
- Mode and range (minimum and maximum) biofouling scores and description of the scoring system used.
- Description of broad taxonomic groups present (e.g. barnacles, tube worms, macroalgae).

(10) The vessel operator, or person in charge of a vessel, must also make the following available to MPI if requested:

a) All video footage of each location in Schedule 3 that are clearly filed and labelled;
b) Inspection plan outlining key locations identified for hull and niche areas, crew members consulted, and any other documents acquired for the planning process, e.g. GA, docking plan and internal seawater system schematics.

**Guidance**

**Inspecting a vessel that has a notice of direction (NOD) from MPI ordering it to be inspected:**

This guidance is only for vessel biofouling inspection providers in New Zealand. If you are asked to inspect a vessel because it has received a NOD to get inspected, MPI needs prompt and direct reporting. In this situation, the vessel has not complied with other requirements in this standard. Under a NOD, there is usually a tight deadline for the inspection, and so the reporting requirements above might not apply.

In this situation, follow the instructions from the MPI inspector. The MPI inspector may require:

c) the photos captured as specified in this schedule
d) the signed and completed vessel checklist and reporting form as per this schedule presented in a clear format
e) video footage and CCTV recordings

The *Guidance Document: Vessel Biofouling Inspections* contains Schedules 2 and 3 along with supplementary guidance and resources, including a template vessel checklist and reporting form and a biofouling scoring system.

This standard describes the minimum level of reporting that MPI needs to make an accurate assessment of a vessel's biofouling, but it is up to the vessel biofouling inspection provider and vessel operator to decide on the maximum level of reporting.

## 5.2 *CRMS:Vessels* - Schedule 3: Required locations for vessel biofouling inspections

| Stern | | Midship | | Miscellaneous |
|---|---|---|---|---|
| **Port** | **Starboard** | **Port** | **Starboard** | Starboard anodes |
| Hull wind/water line | Hull wind/water line | Hull wind/water line | Hull wind/ water line | Port anodes |
| Hull vertical deep | Hull vertical deep | Hull vertical deep | Hull vertical deep | Stern anodes |
| Hull flat bottom | Hull flat bottom | Hull flat bottom | Hull flat bottom | Earthing plates |
| Dry-docking blocks | Dry-docking blocks | Dry-docking blocks | Dry-docking blocks | Echo sounder transducers |
| Sea chests, internal | Sea chests, internal | Sea chests, internal | Sea chests, internal | Speed log fairings |
| Sea chests' gratings | Sea chests' gratings | Sea chests' gratings | Sea chests' gratings | Port pipework/discharge pipes |
| **Upper** | **Lower** | Bilge keel | Bilge keel | Stbd. pipework/discharge pipes |
| Rudder trailing edge | Rudder trailing edge | **Bow** | | |
| Rudder leading edge | Rudder leading edge | **Port** | **Starboard** | |
| Rudder vertical hinge/post gap | Rudder vertical hinge/post gap | Hull wind/water line | Hull wind/water line | |
| Rudder port flat side | Rudder port flat side | Hull vertical deep | Hull vertical deep | |
| Rudder stbd. flat side | Rudder stbd. flat side | Hull flat bottom | Hull flat bottom | |
| Rope guard, external | Rope guard, external | Dry-docking blocks | Dry-docking blocks | |
| Rope guard, internal | Rope guard, internal | Sea chests, internal | Sea chests, internal | |
| Rudder top | Rudder bottom | Sea chests' gratings | Sea chests' gratings | |
| Stern tube | Stern arch | Bow thruster grating | Bow thruster grating | |
| Rudder stock | | Bow thruster tunnel | Bow thruster tunnel | |
| Rudder post/pintle | | Bow thruster blades | | |
| Rudder horizontal hinge/post gap | | Bow thruster boss cone | | |
| Propeller blades – forward side | | Bow thruster rope guard, external | | |
| Propeller blades – aft side | | Bow thruster rope guard, internal | | |
| Propeller boss | | Bulbous bow - upper | | |
| Propeller shaft | | Bulbous bow - lower | | |

# 6 Supplementary guidance and resources

This following section is not a part of the requirements of the *CRMS:Vessels*. However, it contains guidance and resources which are provided to support vessel operators and third-party providers in producing adequate vessel biofouling inspection reports.

## 6.1 Vessel inspection protocols

### Inspection design

Biofouling on flat submerged surfaces typically occurs on the following areas:

a) **Wind and water line:** the antifouling coating is often damaged during berthing operations or by striking floating debris or compromised due to turbulent water movement, paint degradation from wet-to-dry cycles or UV degradation of the biocide.
b) **Bow area:** Prone to antifouling paint wear and collision damage.
c) **Stern area:** Reduced hydrodynamic drag.

Because of these characteristics, the following areas of the hull should be surveyed.

**Hull area:**

The hull is separated into three main areas (stern, amidships and bow). Capture evidence at each major area.

On each of these three regions, take representative videos and photos in six sub-regions of the wind and water line, deep hull, and the flat bottom, on both port and starboard sides (see Figure 1) as a sample representative of each of the three regions of the hull.

All photos and videos must meet the evidence requirements outlined in Schedule 2 of the *CRMS:Vessels*.

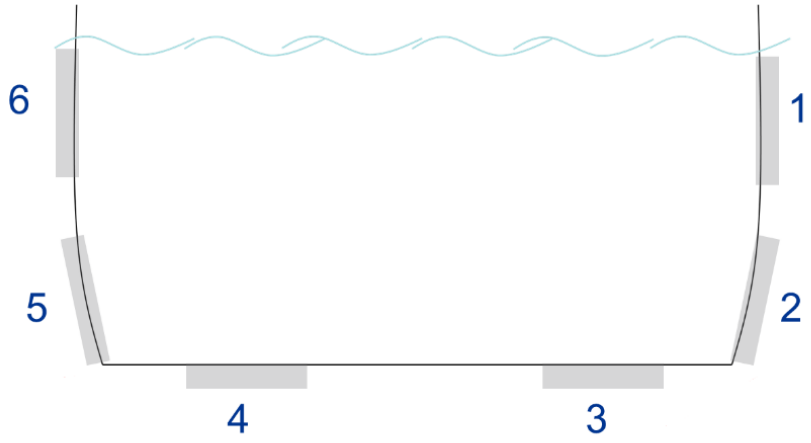


**Figure 1** Cross-section schematic of a vessel hull. Numbers are the six sub-regions where video footage and still images must be captured at the bow, amidships and stern.

**Niche areas:**

Vessel niche areas are more prone to biofouling than the flat submerged hull surfaces. The number and type of niche areas varies from vessel to vessel. This is why it is important to see the vessel general arrangement, docking plan and internal seawater system schematics before inspecting the vessel or discuss these details in depth with the vessel master. This will help with the preparation of a plan that will include all the specific niche areas to target for evidence gathering.

Divide large niche areas, such as the rudder, into sub-regions (as listed in schedule 3 of the *CRMS:Vessels*) to capture areas particularly prone to fouling and collect reliable representative evidence for each location.

All photos and videos should meet the evidence requirements outlined in schedule 2 of the *CRMS:Vessels*.

You should inspect all the following, as far as is practicable, on both sides of the ship. For vessels where more than one of a particular type of niche area is present, survey all niche areas:

(1) Rudder
(2) Propeller and shaft
(3) Rope guard
(4) Stern tube
(5) Stern arch
(6) Stern thruster
(7) Sea chest(s)
(8) Bilge keel
(9) Bow hull
(10) Bow thruster
(11) Bulbous bow
(12) Anodes
(13) Areas of paint damage
(14) Dry docking support strips
(15) Openings on intake or outflow pipes



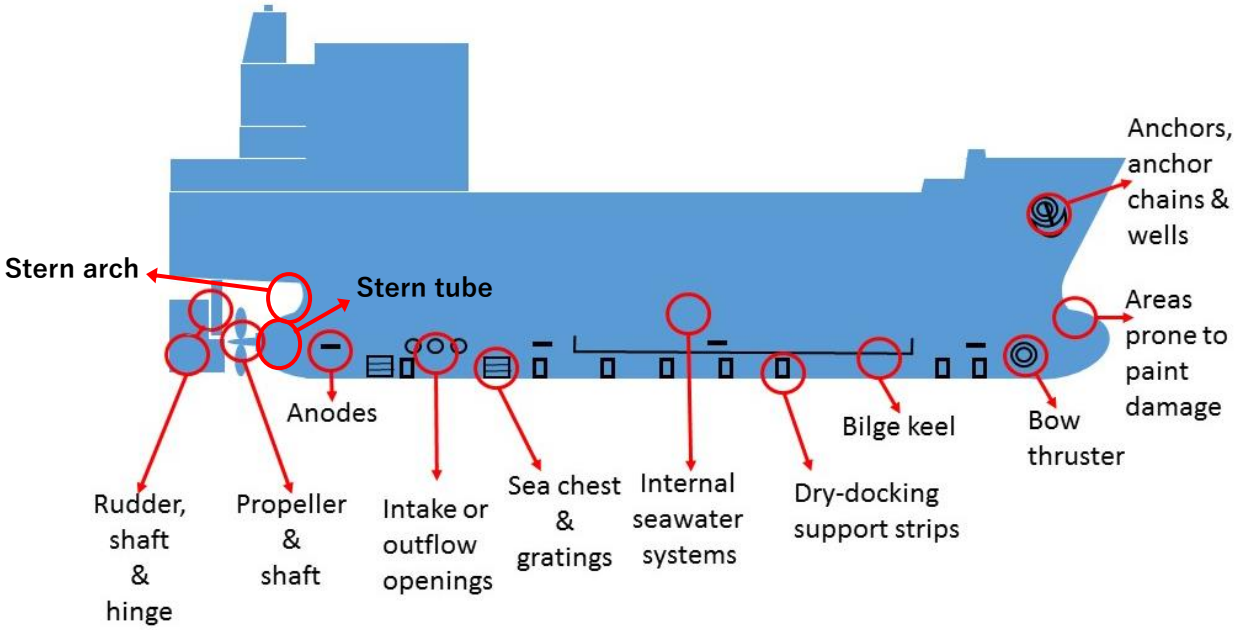


**Figure 4: Common niche areas and their locations on a vessel**

### Large niche areas

Niche areas which are larger in area consist of different parts that can accumulate biofouling at different rates. For example, the sides of the rudder are less prone to fouling than the hinge/post gaps because the sides are more exposed to hydrodynamic flow. This is why you should divide large niche areas into sub-regions like those listed in Schedule 3 of the *CRMS:Vessels* or in the vessel checklist and reporting form (see section 6.2).

Below (Figure 6) is an example diagram of how large niche area can be broken down and sub-regions targeted:

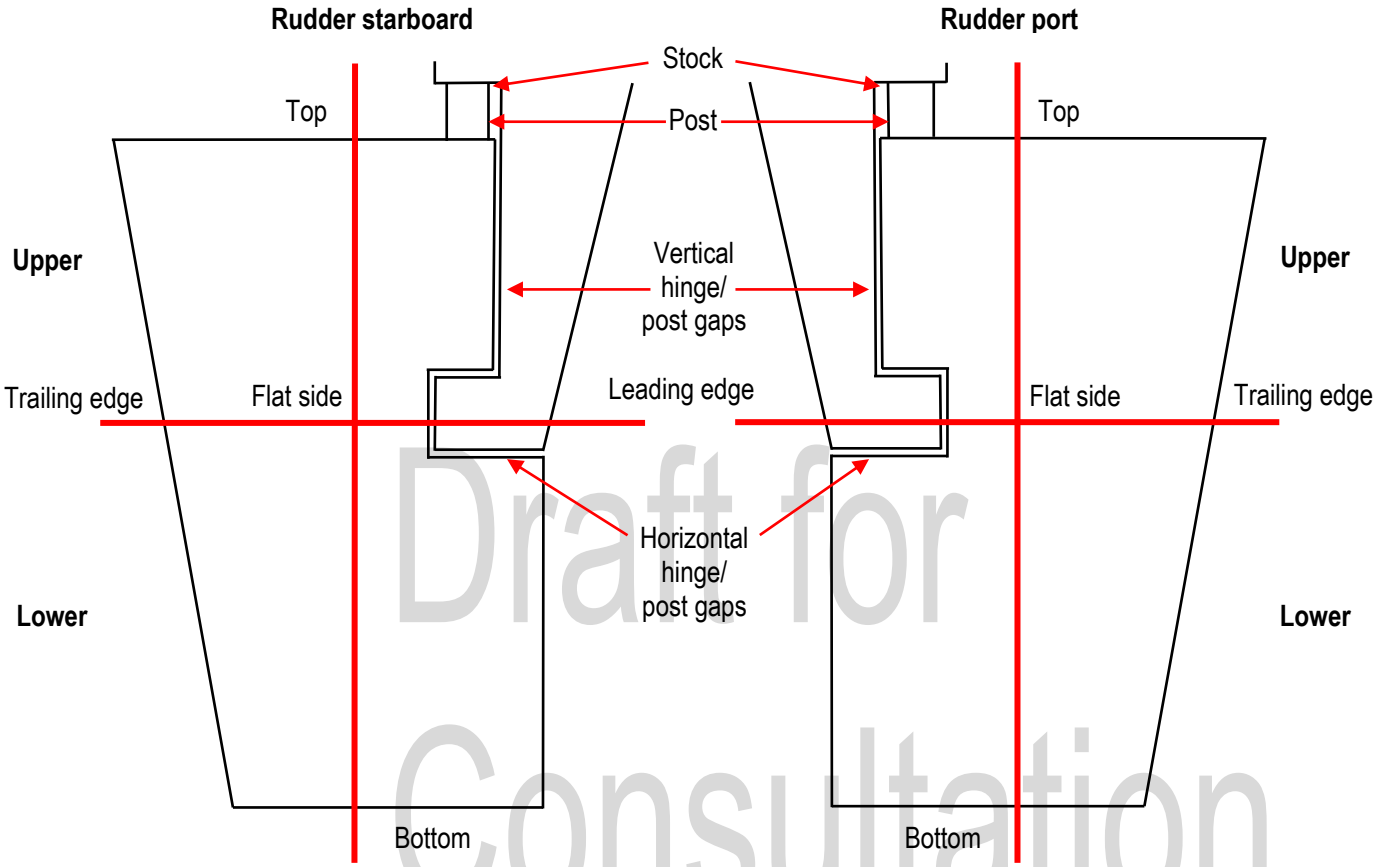


**Figure 6: A breakdown of the rudder into smaller areas for inspection and reporting**



### Opportunistic observations

It is good practice to record any macrofouling you encounter outside the designated hull and wind and water line transects and surveys of identified niche areas.

### Topside surveys (for independent biofouling inspector)

In some cases, MPI may require a survey of topside surfaces as part of the vessel inspection. For a topside survey, include surfaces (including submersible equipment) above the wind and water line that have the potential to be exposed to the marine environment. Topside surveys are likely to be unique for each vessel. They may include surfaces like:

- anchors, anchor chains, chain lockers, cables, winches, sheave rooms
- mooring lines, fenders, floats and buoys
- safety equipment (e.g. life rings, rafts and boats)
- diving equipment and UROVs
- acoustic positioning equipment

- miscellaneous equipment for project vessels (e.g. drills, dredges, piping, environmental monitoring equipment)

Survey and record each piece of immersible equipment on a vessel.

## 6.2 Vessel checklist and reporting form

| VESSEL CHECKLIST AND REPORTING FORM | | |
|---|---|---|
| **Ship name:**<br>**IMO number:**<br>**Vessel type:**<br>**Date:** | **Lead vessel hull inspector:**<br>**Personnel involved:**<br>**General Arrangement obtained:** Yes No | **Inspection location:** *Name of anchorage or Latitude and Longitude (if offshore).*<br>**Weather conditions:**<br>**Visibility:** |
| **Number of photos supplied to MPI:** | **Number of videos supplied to MPI:** | **Supplied via (circle one):** **Email**<br>**MPI share file** **Secure drive** |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling**[1] (Floerl et al. 2005) | **Range (min–max) of level of fouling**[1] (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| ***(Example row) Stern*** | ***Rudder vertical hinge/post gap - upper*** | ***Y*** | ***Y*** | ***Y*** | ***3*** | ***2-5*** | ***Barnacles, bryozoans, macroalgae, oysters*** | ***damaged*** |
| Stern | Hull stbd wind and water line | | | | | | | |
| Stern | Hull stbd vertical deep | | | | | | | |



[1] See section 5.3: Level of fouling (LOF) ranks

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Stern | Hull stbd flat-bottom | | | | | | | |
| Stern | Hull port flat-bottom | | | | | | | |
| Stern | Hull port vertical deep | | | | | | | |
| Stern | Hull port wind and water line | | | | | | | |
| Stern | Port dry-docking blocks/support strips | | | | | | | |
| Stern | Stbd dry-docking blocks/support strips | | | | | | | |
| Stern | Rudder trailing edge - upper | | | | | | | |
| Stern | Rudder leading edge - upper | | | | | | | |
| Stern | Rudder vertical hinge/post gap – upper | | | | | | | |
| Stern | Rudder horizontal hinge/post gap | | | | | | | |
| Stern | Rudder top edge | | | | | | | |
| Stern | Rudder port flat side - upper | | | | | | | |
| Stern | Rudder stbd. flat side - upper | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Stern | Rudder stock | | | | | | | |
| Stern | Rudder post/pintle | | | | | | | |
| Stern | Rudder trailing edge - lower | | | | | | | |
| Stern | Rudder leading edge - lower | | | | | | | |
| Stern | Rudder vertical hinge/post gap - lower | | | | | | | |
| Stern | Rudder port flat side - lower | | | | | | | |
| Stern | Rudder stbd flat side - lower | | | | | | | |
| Stern | Rudder bottom edge | | | | | | | |
| Stern | Propeller blades – forward side | | | | | | | |
| Stern | Propeller blades – aft side | | | | | | | |
| Stern | Propeller boss | | | | | | | |
| Stern | Propeller shaft | | | | | | | |
| Stern | Rope guard external - upper | | | | | | | |
| Stern | Rope guard external - lower | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Stern | Rope guard internal - upper | | | | | | | |
| Stern | Roper guard internal - lower | | | | | | | |
| Stern | Stern tube | | | | | | | |
| Stern | Stern arch | | | | | | | |
| Stern | Port sea chest gratings | | | | | | | |
| Stern | Port sea chest internal cavity | | | | | | | |
| Stern | Stbd sea chest external grating | | | | | | | |
| Stern | Stbd sea chest internal cavity | | | | | | | |
| Midship | Hull stbd wind and water line | | | | | | | |
| Midship | Hull stbd vertical deep | | | | | | | |
| Midship | Hull stbd flat-bottom | | | | | | | |
| Midship | Hull port flat-bottom | | | | | | | |
| Midship | Hull port vertical deep | | | | | | | |
| Midship | Hull port wind and water line | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Midship | Port dry-docking blocks/support strips | | | | | | | |
| Midship | Stbd dry-docking blocks/support strips | | | | | | | |
| Midship | Stbd bilge keel | | | | | | | |
| Midship | Port bilge keel | | | | | | | |
| Midship | Port sea chest gratings | | | | | | | |
| Midship | Port sea chest internal cavity | | | | | | | |
| Midship | Stbd sea chest grating | | | | | | | |
| Midship | Stbd sea chest internal cavity | | | | | | | |
| Bow | Hull stbd wind and water line | | | | | | | |
| Bow | Hull stbd vertical deep | | | | | | | |
| Bow | Hull stbd flat-bottom | | | | | | | |
| Bow | Hull port flat-bottom | | | | | | | |
| Bow | Hull port vertical deep | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Bow | Hull port wind and water line | | | | | | | |
| Bow | Port dry-docking blocks/support strips | | | | | | | |
| Bow | Stbd dry-docking blocks/support strips | | | | | | | |
| Bow | Port bow thruster grating | | | | | | | |
| Bow | Stbd bow thruster grating | | | | | | | |
| Bow | Port bow thruster tunnel | | | | | | | |
| Bow | Stbd. bow thruster tunnel | | | | | | | |
| Bow | Bow thruster blades | | | | | | | |
| Bow | Bow thruster boss cone | | | | | | | |
| Bow | Bow thruster rope guard external | | | | | | | |
| Bow | Bow thruster rope guard internal | | | | | | | |
| Bow | Stbd sea chest gratings | | | | | | | |
| Bow | Stbd sea chest internal cavity | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
|---|---|---|---|---|---|---|---|---|
| Bow | Port sea chest grating | | | | | | | |
| Bow | Port sea chest internal cavity | | | | | | | |
| Bow | Bulbous bow - upper | | | | | | | |
| Bow | Bulbous bow - lower | | | | | | | |
| Sacrificial anodes/ impressed current blocks/ earthing plates | Stbd anodes/impressed current blocks | | | | | | | |
| | Port anodes/impressed current blocks | | | | | | | |
| | Propellers/steering gear anodes/impressed current blocks | | | | | | | |
| | Earthing plates | | | | | | | |
| Sounder and speed log | Echo sounder transducers | | | | | | | |
| | Speed log fairings | | | | | | | |
| Internal sea water systems and bilge spaces | Port pipework/discharge pipes | | | | | | | |
| | Stbd. pipework/discharge pipes | | | | | | | |
| | | | | | | | | |

| **Area** | **Description** (Blank rows are for adding opportunistic observations) | **Location found? (Y/N)** | **Images taken (3 minimum) (Y/N)** | **Video completed (Y/N)** | **Mode level of fouling[1]** (Floerl et al. 2005) | **Range (min–max) of level of fouling[1]** (Floerl et al. 2005). | **Description and biofouling taxa observed** (e.g. slime, macroalgae, barnacles, bivalves, bryozoans, sea squirts, tubeworms) | **Condition of antifouling coating** (good, fair, damaged, depleted) |
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| OUTCOME OF VESSEL SURVEY |
| --- |
| **Based on the observations made by the vessel hull inspector (NAME) _____, the vessel**<br><br>**(NAME) _____, (IMO NUMBER) _____has been surveyed according to the MPI minimum evidence requirements for vessel biofouling inspections.**<br><br>**Vessel hull areas of concern fouling include (as applicable):**<br><br>**Reasons for specified vessel hull areas excluded from inspection (if applicable):**<br><br>**Number of photo and video files to be provided to MPI:**<br><br>**Completed by:_____ of _____**<br><br>**Signature**:_____ Date ____/___/_____<br><br>**Vessel representative/delegate**:_____ |

## 6.3 Level of fouling (LOF) ranks

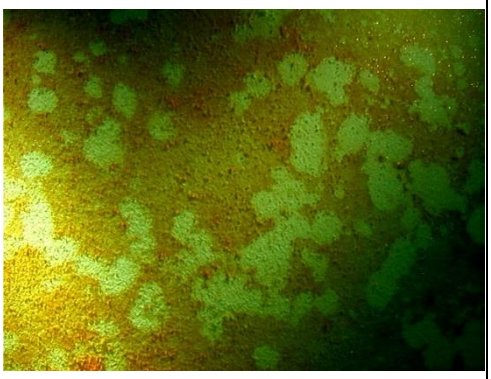
The level of fouling (LOF) scale was developed by NIWA as an effective and efficient method for quantifying the extent and diversity of biofouling on vessel hulls (Floerl *et al.,* 2005, *Environmental Management* 35(6): 765-778). MPI has used it in a variety of research projects. It also underpins the vessel hull survey procedures developed by NIWA for the Department of Conservation (Floerl *et al.,* 2010, NIWA Report No. CHC2010-086).

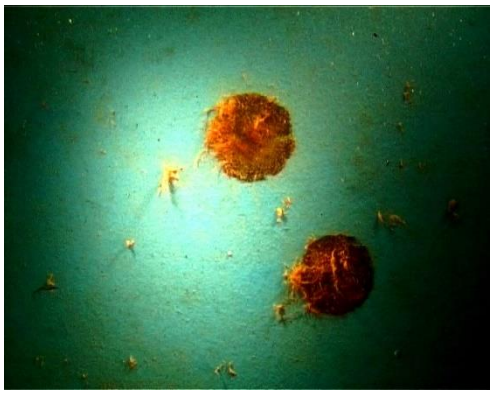
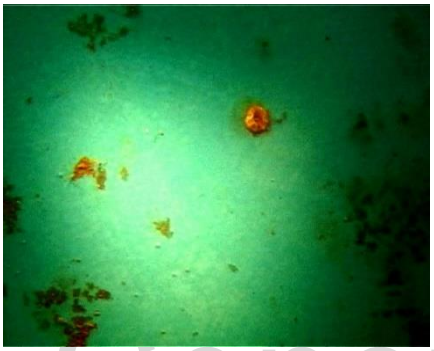
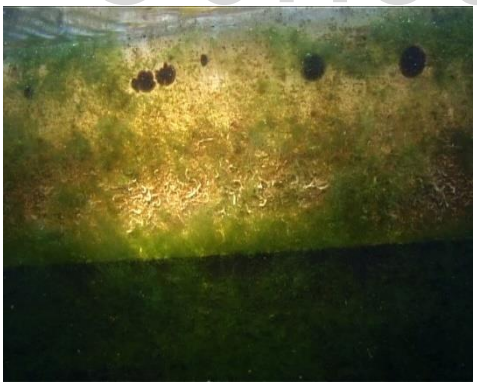
LOF ranks range from 0 to 5. The various ranks along with example images are listed below.

Note: Macrofouling organisms (e.g. barnacles, tubeworms, bivalves, macroalgae, etc.) are *absent* from areas described as LOF 0 (i.e. entirely free of biofouling) or LOF 1 (i.e. slime layer only). The lowest LOF rank that an area with a single barnacle, bivalve or other macrofouling organism can have is LOF 2.

Biofouling inspection providers should be able to give out LOF ranks confidently and consistently, with minimal variation among observations and observers.

During an in-water vessel survey, give each area where there is an observable change in LOF in the area being surveyed its own LOF rank, i.e. a niche area or a hull transect.

| Rank | Criteria |
|---|---|
| LOF 0 | No visible fouling. Hull is entirely clean, no biofilm (slime) on any visible submerged parts of the hull.   |
| LOF 1 | Hull is partially or completely covered in slime fouling (biofilm), no macrofouling.   |

| Rank | Criteria |
|---|---|
| LOF 2 | Light fouling. 1–5% of visible surface covered by very patchy macrofouling or filamentous algae. Remaining area often covered in slime. Examples below show presence vs. absence of fouling in two adjacent areas of a hull (low LOF overall).<br>   |
| LOF 3 | Considerable fouling. Macrofouling clearly visible (usually > 1 species) but still patchy. 6–15% of visible hull surface has macrofouling or filamentous algae. Remaining area often covered in slime<br>   |
| LOF 4 | Extensive fouling. 16–40% of visible hull surface has macrofouling or filamentous algae. Remaining area often covered in slime.<br>   |

| Rank | Criteria |
|---|---|
| LOF 5 | Very heavy fouling. 41–100% of visible hull surface has macrofouling or filamentous algae. Remaining area often covered in slime.   |