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Anchorage Area Design and Management Guideline

Maritime Safety Queensland

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Queensland Government

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1. Introduction

Australia is an island nation and as such Australia's economy relies heavily upon shipping. Access to Australian ports requires ships to transit through and anchor in waters that may have significant environmental value. It is essential for Australia's economy that shipping activities, such as safe anchoring, can continue on a sustainable and equitable basis.

The broader Australian community has an expectation that shipping is managed without incident or adverse environmental effects. A national coordinated approach is therefore critical in developing and implementing consistent approaches and standards to address common objectives.

The purpose of this guideline is to prompt entities involved with the establishment and on-going management of anchorages to consider the range of operational, environmental and social impacts posed by anchorages and to provide strategic guidance for their sustainable management.

2. Assessing the Need

The first action to undertake is to assess the need for an anchorage.

The safe and efficient operation of a port often requires ships calling at the port to wait for an appropriate berth or to wait for their cargo to become available. There are a number of options available to a ship in such circumstances:

- If the ship has sufficient prior notice it may slow its speed so as to arrive at the port just in time for its entry into the port;
- The ship may choose to drift at sea until it is time for its entry into the port;
- The ship may go to anchor, or
- A combination of the above.

There are a number of reasons why a ship would choose to go to anchor rather than slow steaming or drifting, and they include:

- Reduce running costs;
- Manage crew fatigue;
- Conduct ship maintenance activities;
- Reduce or constrain impacts on other waterway users;
- It may be safer to anchor than to slow steam or drift;
- Port operational activities such as ship to ship transfers, and
- Uncertainty of loading date.

Each of these reasons need to be assessed against the potential adverse impacts of ships going to anchor, which include:

- Disturbance to seabed and supported biodiversity from anchor drop and chain drag;
- Potential for minor releases of emissions or pollutants/wastes from ships;
- A reduction or alteration of the aesthetic value of the coastal vista;
- Interference with other users' access to resources within a World Heritage Area;
- Potential for marine pest introduction, and
- Interference with behaviour of conservation-dependent species.

There are a number of factors to consider when assessing the need for an anchorage. The final outcome is generally a balance between ensuring the safety of the ship and crew, protecting the marine environment, and maintaining the efficiency of the port and local maritime industry.

For example, in order to reduce the risk to shipping and the environment from ships anchoring off a lee shore at the port of Newcastle, the Newcastle Port Corporation successfully implemented a vessel arrival system where ships are encouraged to arrive at the port just in time to load their cargo. The vessel arrival system acknowledges the ship's position in the arrival queue one to two weeks before arrival. This allows the ship to slow steam, limiting the ship's time at anchor at the port to under 48 hours. While this strategy is effective at the port of Newcastle, it may not suit other port operations. Ports and anchorage managers should assess all relevant factors when considering implementing a management plan.

3. Jurisdictional Authority

Once it has been determined that an anchorage is desirable, the next step is to assess who has the appropriate authority to implement or approve the anchorage.

There may be a number of agencies and stakeholders that have a role in the approval process, such as a port authority, a relevant environment protection authority and any zoning authority such as a marine park authority. Consider checking with the local maritime safety agency to assist in identifying the appropriate approval authority.

Maritime Safety Queensland has produced a paper Jurisdictional Responsibility for Anchorages in Queensland which outlines the jurisdictional issues to consider when designating and managing anchorages in Queensland. This paper is available from Maritime Safety Queensland's web site and may provide further guidance in identifying the appropriate jurisdictional authority.

It is a good idea to have early discussions with these agencies before undertaking any detailed anchorage design or stakeholder consultations as it may identify constraints and conditions that may affect the anchorage's location, size, layout and use.

4. Anchorage Design

There are many environmental, operational and physical factors to be considered that affect the location, size, layout and use of an anchorage.

In addition to the factors listed below, the World Association for Waterborne Transport Infrastructure (PIANC) have released a report titled *Harbour Approach Channels Design Guidelines (2014)* that provides further guidance when designing anchorages. PIANC brings together the best international experts on technical, economic and environmental issues pertaining to waterborne transport infrastructures to provide expert guidance, recommendations and technical advice. The *Harbour Approach Channels Design Guidelines (2014)* is available from PIANC's web site. (It is a technical report found under the publications tab, #121 in the Maritime Navigation Commission [MarCom] section.)

4.1 Anchorage Location

There are many factors to consider when identifying an appropriate anchorage site and it will often require consultation with a wide variety of stakeholders. The following provides guidance on factors that should be considered.

4.1.1 Ship and Port Operations

The day to day operations of the port and the ship as well as the intended use of the anchorage will influence the site location of the anchorage.

For vessels arriving to load/discharge cargo in the port, the vessel may need to give Notice of Readiness (NOR) on arrival. Depending on the rules for the port this may need to be within prescribed port limits where port authority has jurisdiction, or within state waters where state has jurisdiction.

Service providers and regulators may need to access the ship via launches for operations such as Customs, crew transfers, and pilot transfer or similar. Ideally, the anchorage should be in a location that makes access by small launch safe and feasible.

For emergency anchorages, the port passage plan route will identify potential sites as they will need to be adjacent to the shipping channel/route.

The anchorage may need to be located in a specific area to enable regulatory control, such as within port limits or within state waters.

The proposed anchorage may be an addition to an existing anchorage area.

4.1.2 Water Depth

Anchorage sites will need to have adequate water depth for the expected vessels to safely operate, but not be so deep as to render anchoring ineffective.

An under keel clearance (UKC) of 10% of draught is considered to be a good working figure for sheltered location or alongside a sheltered port. However, for more open water anchorages, the UKC may need to be higher to allow for the ship roll and pitch while at anchor. For further information refer to the PIANC guidelines mentioned above.

The potential anchorage site should be surveyed to ensure depth information is accurate as the depth shown on navigation charts may be many years old, based on sparse information and have a low levels of confidence. Official Australian navigation charts provide users with an indication of the quality of the depth data presented using Zones of Confidence (ZOC) (Table 1).

Table 1 Zones of Confidence Categories

ZOC	Position Accuracy	Depth Accuracy	Seafloor Coverage
A1	+ 5m	=0.5m + 1%d	All significant seafloor features detected
A2	+ 20m	=1.00m + 2%d	All significant seafloor features detected
B	+ 50m	=1.00m + 2%d	Unchartered features hazardous to surface navigation are not expected (but may exist)
C	+ 500m	=2.00m + 5%d	Depth anomalies may be expected
D	Worse than ZOC C	Worse than ZOC C	Large anomalies may be expected
U	Unassessed – The quality of the bathymetric data has yet to be assessed		

4.1.3 Holding Ground

In benign conditions the weight of the anchor chain on the seafloor is generally sufficient to hold the ship in position, but in adverse weather conditions the bite of the anchor into the seafloor is also required to stop the ship from dragging out of position.

The physical composition of the seafloor in an anchorage is critical for providing a safe and effective anchorage. A ships anchor needs to embed into the seafloor so the anchor chain can lay out providing effective holding capacity for the ship.

Ideally an anchorage site should be relatively flat and free from obstructions, natural or manmade, this allows the anchor chain to be deployed without fear of it become entangled or ensnared. A ship at anchor will swing around its anchor under the forces of tide and wind. As the ship swings the anchor chain will drag along the seafloor, so it is important there are no obstructions in the anchorage.

Anchorage areas should be surveyed for both bottom type and obstructions before an anchorage plan is developed.

Seafloor composed of mud or sand or sand/shell provide good holding material as the anchor can readily embed into the seafloor.

Seafloor material made up of rocks and compacted sands are regarded as being quite poor holding grounds, with anchors often failing to hold in extreme weather conditions. Seafloors such as these are also susceptible to greater anchor and chain damage and often provide a substrate for more sensitive biological material. As such, these seafloor types should be avoided.

If the seafloor does not provide good holding capacity alternatives to anchoring, as mentioned in Section 2 above, should be further considered.

4.1.4 Weather

Wind, squalls, currents and tidal variations will all need to be considered to provide as safe an anchorage as possible.

Anchorages that are exposed to strong winds and/or high seas will impact on a ship's ability to safely manoeuvre to and from the anchorage as well as the ability of the anchor to hold the ship in position. Larger anchorage areas may be required for these locations to cater for the additional anchor chain that will need to be deployed and the higher potential for ships dragging their anchor.

For ship to ship transfer activities, weather will be a critical factor. Anchorages that are subject to strong winds and/or high seas will constrain the amount of time available for safe transfer operations.

4.1.5 Port Layout and Infrastructure

The anchorage location will need to be situated so that it does not impinge on existing shipping channels, including keeping channel approaches clear, but still allow safe passage from the shipping channel to/from the anchorage and port.

Anchorages should be kept well clear of current and future planned infrastructure, such as gas or water pipelines, underwater electricity and telecommunication cables, overhead power lines, bridges and tunnels. A ships anchor can act like a plough and any infrastructure on the sea floor will sustain significant damage should a ship's anchor drag over it.

No matter how good the holding ground, ships do on occasion drag anchor. Anchorages should be far enough from hazards that a vessel's Master has enough time to act should there be a problem. The anchorage should not be close to critical shore facilities that would be potentially damaged by a drifting/dragging ship.

Communications to shore side facilities such as port Vessel Traffic Services (VTS) may be needed. This may require the anchorage to be within marine VHF radio or other communications range.

4.1.6 Other Waterway Users

Ports are generally collocated with, or in the near vicinity to, populous areas often resulting in multiple parties competing for use of the waterway. The equitable access and use of the waterway and seafloor are key considerations when choosing an anchorage location.

The factors that make good anchorage locations, relatively flat sandy or mud bottoms can also be conducive to the production of commercial quantities of seafood, especially for the trawl fishing industry. The needs of commercial and recreational fishing industry should be considered when determining the location of an anchorage.

With populous areas comes a myriad of recreational boaters, all competing for use of the waterway. It may be the weekend boater, the mid-week yacht race or the kayak club holding an event; they all use the waterway and have the potential to interact with ships at anchor.

4.2 Anchorage Size and Layout

The size and layout of an anchorage is very much determined by the number, size and type of ships expected to use it.

Ships of varying size, draughts and hull shapes behave differently to wind and tidal movements. An anchorage must take into consideration the swing arc of one vessel versus the adjacent ship(s) in order to avoid collision due to the potential of ships swinging in the opposite direction rather than in unison.

The PIANC guideline provides good guidance on how to determine the size of individual anchorage positions. These calculations generally result in an anchorage circle of a determined radius based on a vessel anchoring roughly at the centre, an allowance for length of anchor chain deployed based on predominate water depth, weather conditions, the length of the vessel and a safety margin.

An anchorage area may contain individual anchorage sites with different swing radius to cater for different size vessels. Smaller ships can safely anchor in shallower water which will require less anchor chain to be deployed, while large ships will need deeper water to safely anchor resulting in more anchor chain being deployed. By utilising a mix of anchorage swing circle sizes to match the expected ship sizes, a smaller overall anchorage area footprint can be achieved (Figure 1).

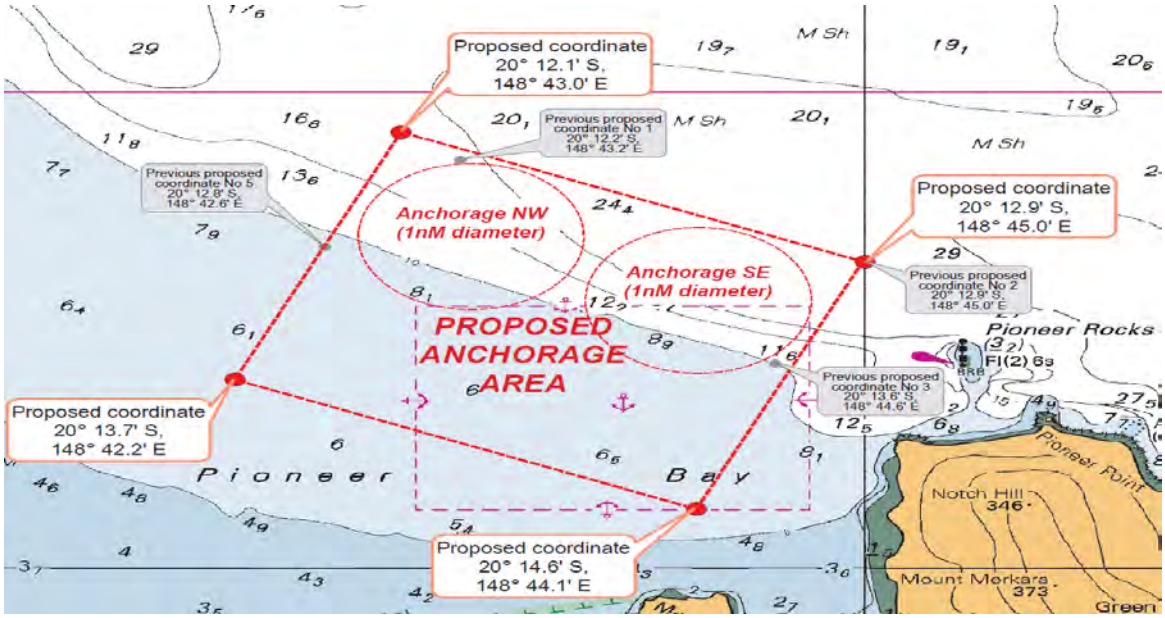


Figure 1 Example of a proposed general anchorage area

The number of individual anchorage positions is determined by the expected frequency of use, as well as the time spent at anchorage. If the anchorage is only expected to be used infrequently, then a single anchorage site may be suitable. If there is potential for multiple users at any one time, then that will result in more than one individual anchorage position being required.

There are several factors that indicate the required number of anchorages and expected anchorage time. These include port usage and commodity type, port/terminal loading rates and commodity mix, number of customers, and port arrival and departure management.

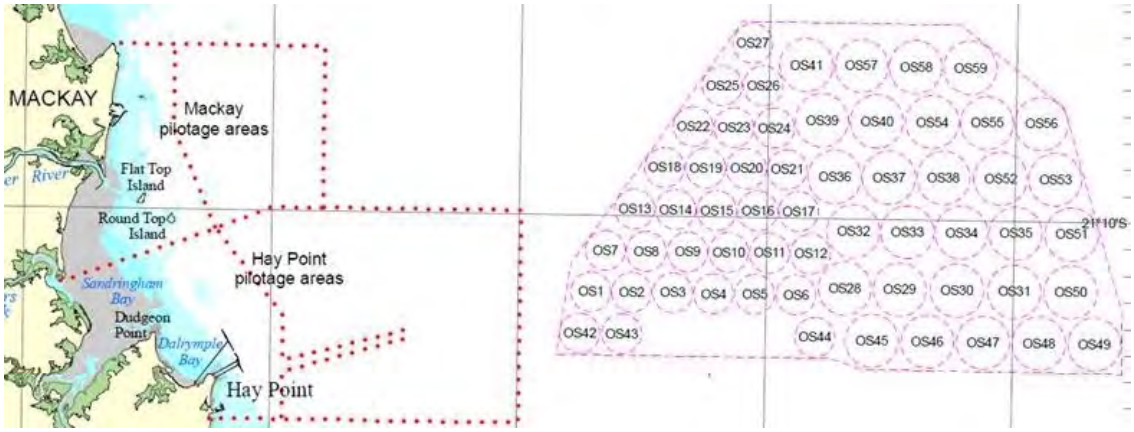
There may be times when many ships may require to go to anchor, dependent upon the trade at the port. This is often the case at multi-user bulk commodity export ports where competition for logistics and berth slots can result in large numbers of ships needing to wait for cargo. Adverse weather events can further exasperate the situation. In these cases additional overflow anchorages may need to be included in the design or ships may need to anchor outside the anchorage area. Where anchoring outside the designated anchor area is not acceptable, alternatives to anchoring (See Section 2 above) should be further considered.

Having determined the size of individual anchorage positions and the number required, the next decision is whether to have a general anchorage area within which ships can choose where to anchor or a series of designated anchorage positions.

A general anchorage area will work in cases where the number of ships expected to go to anchor at any one time is low, there is plenty of room available and there are few if any environmental concerns.

A series of designated anchorages is best where larger numbers of ships are required to go to anchor, where efficient use of the water space is required and to minimise the impact on the seafloor from anchoring (Figure 2).

Figure 2 Example of a designated anchorage for different size ships.



4.3 Anchorage Use

In general the main use of an anchorage is for vessels arriving to load or discharge cargo in the port. However there are other uses that may influence the design of an anchorage.

For vessels anchoring for ship to ship transfers, weather and sea state are critical factors that can affect cargo transfers. Locations that provide protection from the elements results in fewer delays lost due to adverse weather conditions.

For passenger vessels carrying out passenger transfers utilising the ships tenders, the shorter the distance for these tenders to travel, the safer and more efficient it becomes, especially in areas exposed to weather conditions.

Once an anchorage area is designated, they may be used for a variety of activities not related to the port or trade: Some examples include:

- As a layover place while waiting for their next contract;
- As a safe location to carry out repairs or maintenance;
- For crew or spare parts transfers, or

- For medical emergency transfers

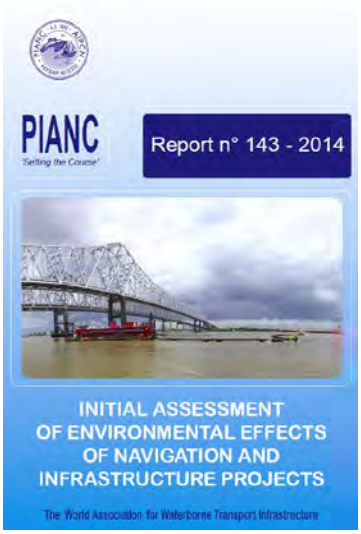
4.4 Environmental Considerations

The overall objective of anchorage proponents should be to minimise environmental and social impacts associated with anchorage use while maintaining efficient port operation.

There are numerous potential environmental matters to consider when assessing an anchorage location, many of which will be specific to individual sites that only a detailed environmental assessment can identify.

However, there are some key environmental factors that are consistent across all sites.

4.4.1 Environmental Assessment



There are numerous methodologies for assessing the potential environmental impacts of proposed anchorages. This guideline does not suggest one methodology over any other, but does note that PIANC released a report in 2014 to assist with environmental assessments. PIANC report #143 on Initial Assessment of Environmental Effects of Navigation and Infrastructure Projects 2014

Before an environmental assessment is undertaken, proponents should investigate any previous environmental assessments or zoning rules by relevant environmental protection agencies. It is worth taking some time to look into this, as it can reduce the need for the significant investment in time and effort required for an environmental assessment. For example, Marine Park zoning plans may already allow for anchoring in certain areas, thus negating the need for further environmental assessment.

4.4.2 Disturbance to Seabed from Anchor Drop and Chain Drag

Anchor and chain drag may create furrows or divots across the seabed. This may remove any biota in the pathway of the chain and anchor. This can be avoided or reduced by limiting the need for ships to go to anchor and by minimising the area affected by the anchor and chain.

Improvements in whole of supply chain management may lead to a more efficient use of anchorage sites. For instance, ships may not be required to anchor if they can proceed direct to loading/unloading berths on arrival in the port.

Alternatively time spent at anchor may be reduced if supply chain logistics are aligned to provide the most efficient operation. (GHD, 2013)

Design consideration aimed at minimising potential environmental impacts which can result from ship anchorage include minimising the area needed for safe anchorage, minimising the number of vessels that are required to anchor and using defined anchor drop points to minimise the area of seabed affected by anchoring. Reducing the footprint of the anchorage area reduces the extent exposed to habitat impacts. (GHD, 2013)

Without use of designated ship anchor drop points there is increased potential of seabed fragmentation and potential for impacts to be realised across a larger spatial footprint than if the anchorage area was designated (GHD, 2013).

At the Towards Sustainable Anchoring Practices in Australian Ports workshop hosted by the University of Wollongong in 2014 it was determined that it was better for the environment to concentrate anchoring to regular anchorages and to keep to these spots and not move them around. Having designated anchor drop points and managing the allocation of anchorages so that a minimum few are used most often with others used only when demand requires it, the impact of the seabed disturbance is reduced to a minimal footprint.

It is recommended to give preference to areas with lower biodiversity or areas of common and wide spread biodiversity/habitat types. These areas will have less of an overall population impact than rarer habitats.

4.4.3 Management of Emissions, Pollutants or Wastes

Consideration must be given to the availability of services to accept ship waste, versus the expected need for these services, as determined by the anticipated vessel types, anchorage time, distance from open to sea to allow legal processed sewage discharge.

The anchorage may need to be close enough to a port for services, such as garbage and fuel barges to safely service the ships. Generally garbage, sewage, grey water and oily waste can be held on-board ship, but tank sizes and holding spaces will determine retention times.

4.4.4 Aesthetic Value

The presence of anchored vessels within view from land and adjacent to vessel passage routes has the potential to detract from the aesthetics of the vista. However, the impact to the vista is highly subjective.

The assumption is that most people relate ports to shipping and would expect to see ships at a port. Indeed, for many the opportunity to watch ships is an attraction.

Due to the size and draught of most ships requiring anchorages to be in deep water, anchorage locations are generally well out to sea thus reducing the visual impact created by ships at anchor.

The location of any anchorages should consider the effect ships would have on the aesthetics of the vista. Placing anchorages in a location that degrades a known and appreciated vista should be avoided.

4.4.5 Marine Pest Introduction

Ships transiting between international ports have the potential to carry and introduce marine pests as biofouling or within ballast water. The International Maritime Organisation's International Convention for the Control and Management of Ships' Ballast Water and Sediments along with supporting national legislation provide an effective framework reducing the risk of marine pest incursions.

While anchorage design has little effect on the prevention of an incursion, regular and effective monitoring at anchorage sites can assist with early detection and therefore early intervention.

4.4.6 Conservation-Dependent Species

While anecdotally we know that ships and marine species co-exist in and around ports and shipping routes, it is not known to what extent shipping operations interfere with marine species behaviours. However, it must be considered that there is potential for shipping to displace marine species from that habitat. As such, the establishment of ship anchorages within the vicinity of important feeding or breeding habitats for any protected species should be avoided.

The impact of artificial lighting upon certain species, such as sea turtle hatcheries, must be considered during the design and the long-term management phases of an anchorage. Light pollution can interfere with sea turtle hatchlings and confuse their sense of navigation. When designing an anchorage, the proximity of anchored vessels to a species nesting area should be considered to ensure anchored vessels are at a distance far enough away to not cause interference.

Vessels sitting at anchor and vessels underway generate noise as part of their normal ship operations. While not considered significant when compared to the noise from nearby port operations, it is not known to what extent ship noise interferes with marine species behaviours. Implementation of a management regime for ship activities above normal operations will assist to reduce any potential effect.

4.4.7 Local Heritage Values

Port and coastal anchorages should have a set policy in place for local heritage. Potential areas may have cultures with differing environmental, cultural heritage and social values that should be considered. Discussions should be had with local stakeholders about the impact of the potential anchorages, to discover any areas of significance.

Vessels that are anchored may disrupt areas that have significance to local groups, including traditional owners of the land. Measures should be taken to avoid any activities above normal operations where local values have been identified.

5. Anchorage Management

5.1 Allocation of Designated Anchorages

Aggregating ship anchorages into a designated area reduces the footprint for potential adverse effects from ships anchoring to a concentrated area. This allows the seafloor and marine biota in surrounding areas that were previously effected by anchoring to recover over time.

It has been identified that it is better for the environment to heavily use a small number of anchorage sites on a regular basis than spreading the impact over a wide number of sites. By implementing an anchorage allocation regime, the anchorage authority can direct ships to specific anchorages to ensure that the same minimum number of anchorages are continually utilised, further reducing the footprint on the seafloor affected by ships anchoring.

5.2 Anchorage Rules and Communications

The anchorage authority will need to develop rules for anchorages and communication requirements.

The anchorage authority will need to have plans and procedures for providing and receiving ship information that are proceeding to, at, or departing from an anchorage. Information may include requests such as vessel arrival times, timings of information of expected anchor aweigh times, and other information being provided such as security alerts and traffic information.

5.3 Release of Emissions, Pollutants or Wastes

Anchorages should have an overarching policy of no solid and liquid waste disposal, as well as measures to limit Greenhouse Gas emissions while ships are anchored. Relevant International and state legislation on discharges from ships should be followed. Strategies including providing ships with access to waste disposal facilities, limiting time at anchorage, and active management will lower the risk of ships discharging while anchored.

5.4 Ship Activities at Anchor

Ships will often take advantage of the down time while at anchor to conduct ship activities such as hot-work, lifeboat drills, over the side maintenance, engine immobilisation and even fishing. Implementation of a management regime for these ship activities above normal operations will assist to reduce any potential adverse effect. Management of these activities is recommended:

- Fishing from ships may not be allowed in certain areas due to local fisheries or Marine Parks regulations.
- Engine immobilisation policy will depend on the anchorage's exposure to any expected adverse weather, quality of the holding ground, and the requested period of immobilisation. Generally approval for engine immobilisation should not be granted when there is a severe weather event approaching.
- The allowing of waterborne lifeboat drills at anchor will depend on customs regulations in the port, any expected adverse weather, sea states and local currents.
- Any hot work or over the side work approved contingent on expected weather and that measures are taken to ensure no material is to enter the marine environment.

5.5 Minimise Conflict with Other Waterway Users

As anchorage areas are relatively big open places with large distances between ships at anchor, there is generally no need to exclude other waterway users from the area.

For safety or security reasons there may be the need to implement exclusion zones around certain ships at anchorage from time to time, such as for naval vessels or ships conducting ship to ship transfers.

5.6 Port State Control and Monitoring

The Australian Government is committed to the protection of life and property at sea and to the preservation of the marine environment. Port State Control (PSC) is one of the strategies used to ensure that these objectives are achieved. AMSA conducts PSC inspections in accordance with international guidelines and within the constraints of its authority. During an inspection there are clear grounds to suspect that the ship and/or its equipment or crew may not be in substantial compliance with the relevant international convention requirements, a more detailed inspection is undertaken.

One of the international conventions that PSC target is compliance with the International Convention for the Prevention of Pollution from Ships (MARPOL) which is the main international convention for preventing ship-sourced pollution.

If regular pollution of the anchorage is suspected, then an additional targeted local monitoring regime by the anchorage authority may be required to verify the situation, identify causal factors and put in place mitigation measures to address the behaviour.

5.7 Port Services

Ships are obligated under International Maritime Organisation conventions to manage their waste so that it does not adversely affect the marine environment. Ships implement these regulations by using on-board incinerators, holding tanks and environmentally sustainable discharges.

At ports where ships are expected to remain at anchor for extended periods of time, the capacity of the ship to manage its own waste internally can be reached. Such locations need to consider providing the appropriate port facilities and services to assist the ship manages its waste. This may be via on-shore reception facilities or by on-water contractors servicing ships at anchor.

5.8 Jettisoned Anchors

Where a jettisoned anchor has been lost within anchorage limits, notice should be put out while the retrieval process is underway. The notice should include approximate position. Further notice should be given once the anchor has been removed.

Slipped anchors pose a safety risk for other ships and trawl fleet in anchorages. The anchors should be removed as soon as feasibly possible to prevent further damage in the area.

Photo courtesy of Australian Hydrographic Surveys

5.9 Emergency Situations

Emergencies including medical emergencies, fires and damaged boats may occur while ships are at an anchorage. This can lead to injuries, or death, of passengers on the ship or other people in the area.

Authorities responsible for anchorages should have procedures in place in case of emergency, and these procedures should be promulgated and available to ships intending to use the anchorage. Factors including number of ships, accessibility to anchored ships and local emergency services need to be considered in the procedures.

Appendix A – Summary of Risks in Establishing and Managing Anchorages

Key risks for an anchorage	Establishment	Management	Mitigation strategies
Location	X	X	Ship and port operations Safe water depth Good holding ground Jurisdictional approval Adverse weather allowance Minimise effect on port and infrastructure Minimise conflict with other waterway users Efficient anchorage layout Design for variety of uses
Seabed disturbance	X	X	Avoid or reduce need for anchorage Design for reduced impact footprint Allocate anchorages to minimise impact Minimise time at anchorage
Species behaviour	X	X	Aggregated anchorages Avoid sensitive habitat areas Management of ship activities Minimise time at anchorage
Aesthetics	X		Consideration of visual impact when designing anchorages
Marine pests		X	Aggregated anchorages IMO ballast water controls Ship inspections Marine pest monitoring Minimise time at anchorage
Release of pollutants		X	Port State Control inspection Management of ship activities Provision of port waste services Minimise time at anchorage