Ex-HMAS Adelaide Artificial Dive Reef

Revised Long Term Monitoring and Management Plan - 2017-2026

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A	Issued for internal review	K Newton	H Houridis	H Houridis	3 Nov 2017
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O	Final issued to client	K Newton		H Houridis	10 January 2018

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Executive Summary

In 2009, the New South Wales (NSW) Government entered into a Deed of Gift arrangement with the Commonwealth of Australia for the Ex-HMAS Adelaide to be prepared and scuttled as an artificial reef and recreational dive site in Bulbararing Bay, offshore from Avoca Beach, NSW.

On 13th April 2011, the Ex-HMAS Adelaide was scuttled in front of an estimated 18,000 people. The final location of the vessel is approximately 1.4 km from Terrigal Headland and 1.9 km from Avoca Beach.

In accordance with the Sea Dumping Permit No. SD2008/1062, the Department of Industry (DoI) Crown Lands and Water was required to implement a Long Term Management and Monitoring Plan (LTMMP) for the artificial reef. The Plan was required to include structural and environmental monitoring components.

The Ex-HMAS Adelaide Long Term Monitoring and Management Plan (LTMMP) was developed in 2011 by WorleyParsons and all aspects of the plan have been implemented for the first five years post-scuttling. The results of studies and monitoring undertaken during the first five years post-scuttling have been reviewed and are summarised.

The Revised LTMMP (2017) takes into account the results of all monitoring undertaken to date and the recommendations made following first five years of post-scuttling monitoring. The LTMMP has been revised where appropriate to meet the requirements of Condition 26 of Sea Dumping Permit SD2008/1062. The Revised LTMMP covers monitoring requirements for the next 10 years (i.e. the period from six to 15 years post-scuttling; 2017-2026).

Key changes to the LTMMP for future monitoring along with a revised monitoring schedule for implementation over the next ten years are provided.

1 Introduction

1.1 Background

In 2009, the New South Wales (NSW) Government entered into a Deed of Gift arrangement with the Commonwealth of Australia for the Ex-HMAS Adelaide to be prepared and scuttled as an artificial reef and recreational dive site in Bulbararing Bay, approximately 1.87 km offshore from Avoca Beach, NSW.

The HMAS Adelaide was a long-range escort frigate with roles including air defence, anti-submarine warfare, surveillance, reconnaissance and interdiction. Built in the United States, HMAS Adelaide was commissioned in November 1980 and was the first of six Adelaide class guided missile frigates to be delivered to the Royal Australian Navy. The vessel's hull is constructed of steel and the superstructure is aluminium alloy. Antifouling was last applied to the hull of the vessel in 2003 and the product used did not contain tributyltin (TBT).

The vessel was prepared for scuttling by McMahon Services Australia in Sydney. Preparation included the removal (as far as practicable) of the following items and/or items containing the following substances:

- Polychlorinated biphenyls (PCB's)
- Chlorofluorocarbons (CFC's) (and other refrigerant chemicals)
- Hydrocarbons
- Plastics
- High pressure cylinders (removed or degassed)
- Loose items and fittings
- Items not expected to survive the scuttling event or that would degrade rapidly
- General rubbish
- Heavy metals such as lead, mercury, copper and zinc

The vessel was also prepared for use as a recreational dive site with dozens of additional access holes cut into the hull on the horizontal and vertical surfaces. Most fixtures along with non-structural bulkheads were removed to allow more room for divers to pass through the vessel safely. Some areas of the vessel were made inaccessible to divers (e.g. tanks and small void spaces), also for safety reasons. These areas either had their hatches removed or steel bars welded across their openings (to prevent diver entry) or the hatch was welded shut and the opening mechanism purposely damaged to prevent reopening.

Following an application by the No Ship Action Group (a community group against the proposed scuttling of the Ex-HMAS Adelaide) in 2010, the Administrative Appeals Tribunal reviewed the Decision of the Department of Environment and Energy (DoEE) (then the Department of Water, Heritage and the Arts; DEWHA) to issue Sea Dumping Permit No. SD2008/1062 under the *Environment Protection (Sea Dumping) Act* 1981. A copy of Sea Dumping Permit No. SD2008/1062

is provided in **Appendix A**. The Tribunal delivered its decision on 15th September 2010 adding extra permit conditions requiring the ship to be cleaned of "*all remaining wiring, including junction boxes, which might be associated with PCB's*", cleaned of "*all canvas and insulation*" and cleaned of "*all exfoliating and/or exfoliated red lead paint*". The additional preparation work to comply with these conditions was undertaken between October 2010 and March 2011.

In accordance with the Sea Dumping Permit No. SD2008/1062, the Department of Industry (DoI) Crown Lands and Water was also required to implement a Long Term Management and Monitoring Plan (LTMMP) for the artificial reef. The Plan was required to include structural and environmental monitoring components, as outlined in Section 1.2 and 2.

The original LTMMP was developed by WorleyParsons in 2011 and has been updated in the Revised LTMMP (2017) (current Plan) as per Condition 26 of the Sea Dumping Permit: *"A review of the LTMMP must be undertaken within five years of scuttling with the revised version submitted to the minister for approval. A revised LTMMP must not be implemented until it is approved by the Minister. If the Minister approves a revised LTMMP pursuant to this condition, the LPMA must implement that LTMMP instead of the LTMMP as originally approved".*

On 13th April 2011, the Ex-HMAS Adelaide was scuttled in front of an estimated 18,000 people. The final location of the vessel is approximately 1.4 km from Terrigal Headland and 1.9 km from Avoca Beach (Figure 1-1). Table 1-1 provides the scuttling co-ordinates for the ship.

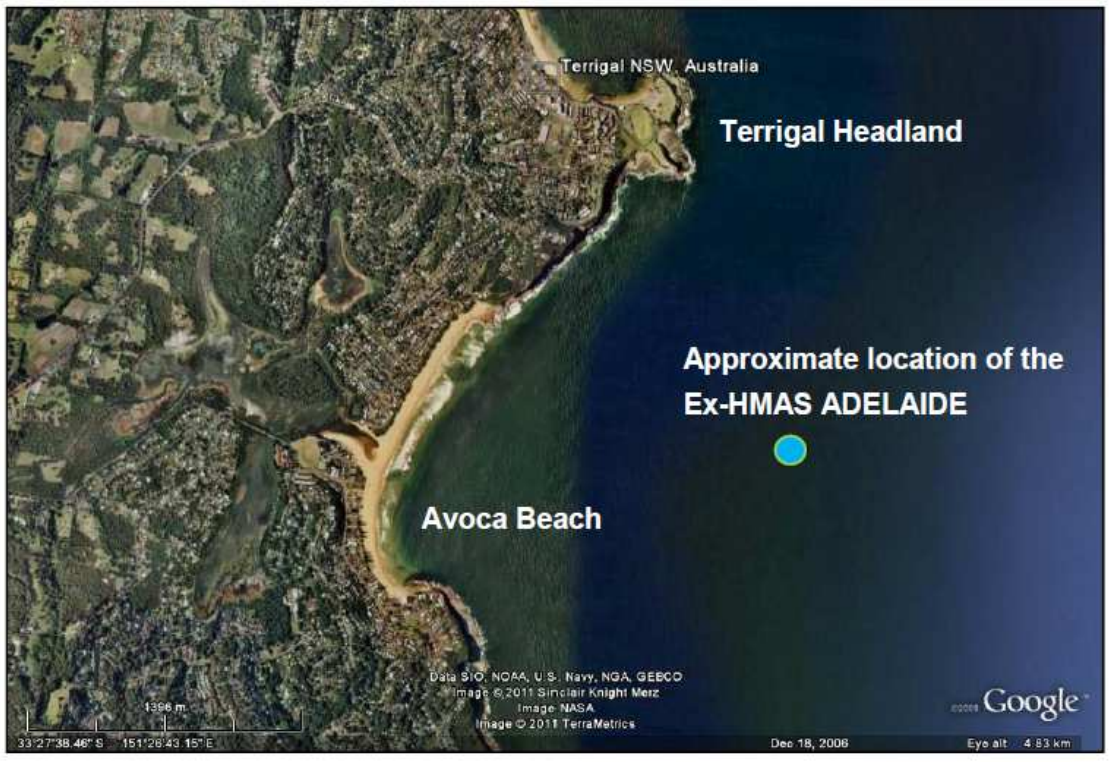


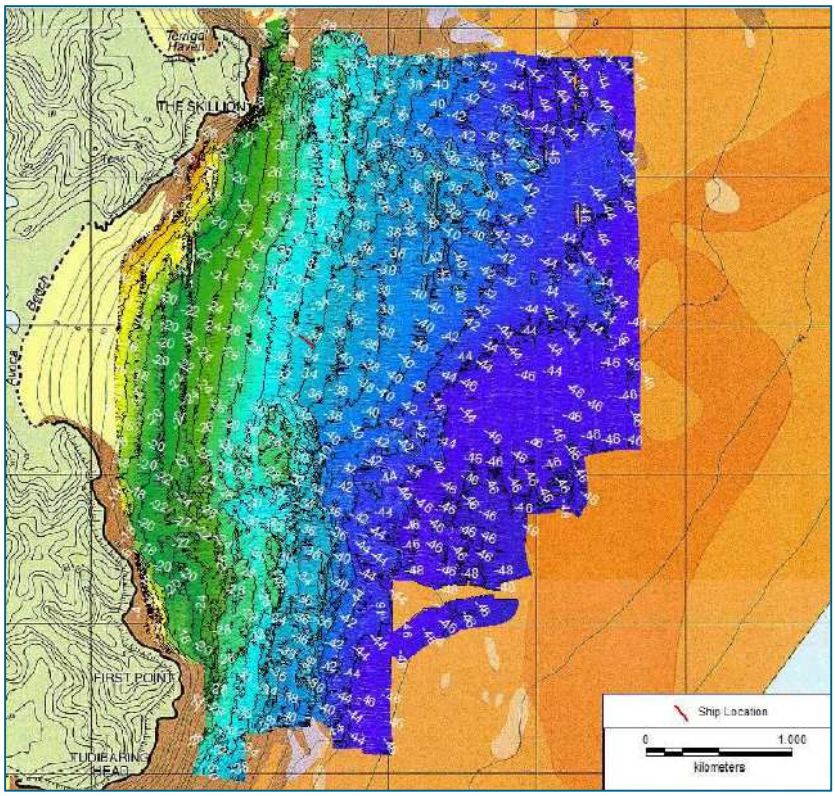
Figure 1-1 Location of the Ex-HMAS Adelaide dive reef.

Table 1-1 Co-ordinates of the scuttling location for the Ex-HMAS Adelaide.

Latitude / Longitude	Northing / Easting (MGA 94)
Latitude (south): 33°27.91'	Northing (MGA 94): 6,296,076.969
Longitude (east): 151°27.38'	Easting (MGA 94): 356,551.686

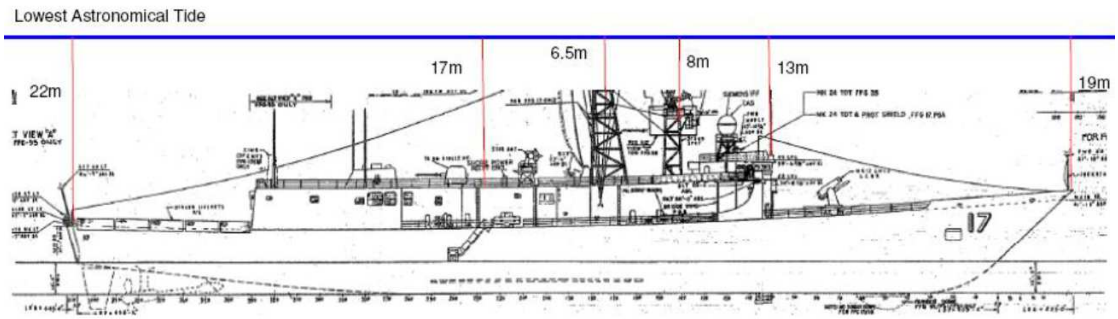
After site selection studies were completed it was determined that the vessel would be scuttled with an ESE orientation (112º), so that the bow would be facing into the general direction of the largest waves (coming from the SE, ESE and S). As sunk, the vessel is oriented at 116º and is generally upright (immediately after scuttling the vessel had a small list of 2.5 degrees to port (personal communication with DoI Crown Lands and Water in 2011)).

The final scuttling site is in 32 m of water at Lowest Astronomical Tide (LAT) and after scuttling, the depth of water over the main mast is 8.02 m LAT (personal communication with DoI Crown Lands and Water in 2011). The substrate on which the Ex-HMAS Adelaide rests is reasonably flat and sandy, with at least 6 m of sand overlaying bedrock as anticipated (Figure 1-2). Approximate depths to various levels on the ship are shown in Figure 1-3.



Note: depths relative to Australian Height Datum (AHD) (approximately 0.93m above LAT). Source: multibeam hydrographic survey data (DECC 2008) overlain on digitised NSW Public Works Department (PWD) survey (1m contours) (1984-1989).

Figure 1-2 Bathymetry in the vicinity of the scuttling site.



Note: depths in relation to Lowest Astronomical Tide (LAT) do not take into account settlement which is expected to be 0.5 m initially and approximately 2 m in the longer term.

Figure 1-3 Approximate depth to the Ex-HMAS Adelaide dive reef.

The dive reef has been operational since May 2011, following post-scuttling safety inspections of the vessel undertaken by McLennans Diving Service.

1.2 Purpose

The purpose of the Ex-HMAS Adelaide LTMMP is to provide for the post-scuttling management and monitoring (structural and environmental) of the Ex-HMAS Adelaide as an artificial reef for recreational diving, pursuant to the requirements of the *Environment Protection (Sea Dumping) Act* 1981. The focus of the vessel monitoring is to inform management actions and contingency measures to minimise potential risks to the uses of the artificial dive reef and also to the environment.

The original LTMMP (WorleyParsons 2011) addressed the monitoring requirements and methods for the vessel for the first five years post-scuttling, and forms the basis for ongoing monitoring and maintenance over the operational life of the vessel (taken to be 40 years). The original LTMMP includes schedules and methodologies for structural and environmental monitoring requirements as listed below:

1. Monitoring of Structural Integrity, Stability and Position.
2. Environmental Monitoring:
    - Sediment Quality Surveys
    - Bioaccumulation Surveys
    - Reef Community Surveys

There are a number of Plans which are independent of the LTMMP which relate to the Ex-HMAS Adelaide dive reef:

1. The *Scuttling Management Plan* (McMahon Services Australia 2010) provided a contingency plan in the event that a major storm was forecast on or around the proposed scuttling date, if the vessel did not rest upright on scuttling or if the vessel suffered damage during scuttling. The *Scuttling Management Plan* also includes repair work and checking of dive routes to assess whether other works are required to maintain safe diver ingress and egress.

2. The *Ex-HMAS Adelaide Asset Management Plan* (Capability by Design 2010) includes additional detail on management actions and contingency measures associated with structural monitoring, including repair work, if a problem is detected during the normal operational life of the vessel as a dive site (i.e. taken to be 40 years).

Condition 26 of the Sea Dumping Permit requires that a review of the Ex-HMAS Adelaide LTMMP is undertaken within the first five years post-scuttling as outlined previously. Following a review of the results of the first five years of monitoring for structural and environmental components (see summary in Section 3), the schedules and methods for these monitoring components going forward have been revised, the details of which are included in Section 4. The Revised LTMMP covers the period from six to 15 years post-scuttling inclusive (i.e. a 10 year period).

1.3 Responsible Parties

The Ex-HMAS Adelaide is located within a Crown Reserve (the Ex-HMAS Adelaide Reserve) which was gazetted for purpose on 20th June 2008 under the provisions of the NSW *Crown Lands Act* 1989. DoI Crown Lands and Water has responsibility for the administration and management of all Crown Land in NSW, including the seabed out to the 3 nautical mile (nm) limit of State waters (i.e. they are responsible for the seabed in which the Ex-HMAS Adelaide rests).

The Crown Lands Reserve Trust (CLRT) was appointed as the Trust Manager. The Trust is administered by the Lands Administration Ministerial Corporation (a statutory body representing the Crown) which has overall management responsibility of the reef, including implementation of the LTMMP.

Ongoing reporting associated with the LTMMP is required to include a description of the methodology, observations (e.g. material deterioration), any remedial works which may be required and the required timing of these works (e.g. urgent, routine). Responsibility for the ongoing implementation and reporting in accordance with the LTMMP ultimately rests with DoI Crown Lands and Water.

1.4 Goals and Objectives

The overall goal of the Ex-HMAS Adelaide artificial dive reef is to provide a world class recreational dive attraction which provides benefits to the local NSW Central Coast economy.

In relation to the artificial dive reef, the objectives are to:

- Provide a wreck which is maintained to ensure diver safety while retaining a quality diving experience;
- Provide an artificial reef that continues to remain stable and maintains its structural integrity;
- Enhance local marine biodiversity in the area and provide marine research opportunities;
- Minimise the debris field during degradation of the vessel; and
- Examine how the vessel is influencing / impacting on the surrounding marine environment and vice versa.

Section 2 of this Revised LTMMP provides the scope and rationale for all LTMMP monitoring components along with management criteria and mitigation measures, and requirements for reporting and personnel.

Section 3 (and Appendix E) of this Revised LTMMP summarises the results and recommendations of the first five years of monitoring.

Section 4 of this Revised LTMMP outlines the key changes to the LTMMP and revised monitoring schedules for the next ten years based on results and recommendations from the first five years of monitoring.

Section 5 of this Revised LTMMP provides additional information on the requirements for maintenance of dive moorings and marker buoys.

2 LTMMP Scope

The Revised LTMMP includes structural and environmental monitoring components. The scope and rationale for these are outlined below. Detailed methods for each monitoring component can be found in the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011).

2.1 Monitoring of Structural Integrity, Stability and Position

2.1.1 Structural Integrity

The rationale for investigating the structural integrity of the Ex-HMAS ADELAIDE is to ensure that the vessel remains intact and is not showing signs of significant corrosion and weathering due to major storm events and that the vessel is suitable for on-going use as a recreational dive site.

For the purpose of this plan, a major storm event is defined as when the Bureau of Meteorology (BoM) has issued a Severe Weather Warning for Damaging Waves. This essentially means when onshore waves in the surf zone are expected to reach at least 5 m, generally within the next 24 hours.

The Bureau of Meteorology (BoM) website defines an East Coast Low (ECL) as *'intense low-pressure systems which occur on average several times each year off the eastern coast of Australia, in particular southern Queensland, NSW and eastern Victoria. Although they can occur at any time of the year, they are more common during autumn and winter with a maximum frequency in June. East Coast Lows will often intensify rapidly overnight making them one of the more dangerous weather systems to affect the NSW coast.'* The Bureau of Meteorology has a detailed database of these ECLs beginning in 1973, and advises that *'Each year there are about ten "significant impact" maritime lows. 'Generally, only once per year do we see "explosive" development. Looking at all the ECL between 1973 & 2004, there is no evidence of a trend.'* A more detailed description of weather patterns is covered in Section 5.6 Coastal Storms and Wave Climate of the Ex-HMAS Adelaide Artificial Reef Review of Environmental Factors (Worley Parsons, December 2009).

Within one week following a major storm event, inspections will be undertaken to identify and report on:

- debris requiring removal from within and surrounding the vessel;
- levels of corrosion;
- blocked or impeded diver entry and access points;
- access to areas designed to have no diver access; and
- structural damage or failure.

A general assessment of structural integrity will be undertaken by annual visual inspections and visual inspections immediately following major storm events (before diving is permitted to recommence). Where the weather permits, inspections will be undertaken within 7 days. The assessment will be undertaken under the direction of a qualified maritime structural engineer or naval architect.

Annual monitoring will be carried out for vessel components (barred off areas, lockers, bunks, masts etc) and a number of specified monitoring points along principal stress flow paths and where structural weaknesses were observed/ repairs were carried out when the HMAS ADELAIDE was in service. The registers of "Barred Off Items" and "Rapid Deterioration Items" referred to in the original Plan are included in **Appendix B** and **Appendix C** respectively. Ships drawings showing the location and photographs that identify each of these monitored items are enclosed on CD-ROM at **Appendix D**.

The locations of the monitoring points are as follows:

- Location 1 - the hull plating on the forecastle just aft of where the GMLS launcher was removed
- Location 2 - midships at the base of the forward screen (where the superstructure and hull are bonded together)
- Location 3 – at the vertical midpoint of the main mast Location 4 - where the main mast attaches to 02Deck Location 5 - the hull plating on the transom
- Location 6 – where the helicopter hangars are attached to the hull

As the aluminium superstructure will provide anodic protection to the steel hull, divers will photograph and record areas where pitting is occurring and take measurements using an ultrasonic thickness tester. Where pitting becomes severe, or there is other damage due to storm waves, demolition works will be undertaken to mitigate the risk to divers (based on stability modelling, it is not anticipated that the entire vessel would become unsafe for diving following a major storm within the initial period of the LTMMP). Where possible (and where this will not pose a risk to divers), structures/ components will be left on the ship, for example, if it is necessary to remove a portion of the mast it will be placed (or secured) on the deck to give the impression that it has fallen naturally, thus maintaining interest for divers.

AS 4997-2005 Guidelines for the design of marine structures specifies a corrosion allowance for untreated steel of 0.05mm/year for permanently submerged structures in sea water within the temperate zones (south of 30^{o}S). Note that the hull will still be protected by protective paint systems until they begin to breakdown (MacLeod et al 2004 noted that protective coatings were still providing considerable protection to the Ex-HMAS SWAN four years after scuttling).

In addition to scheduled monitoring, dive tour operators and others visiting the vessel will be required to report any structural issues to the DoI – Crown Lands and Water under the terms of the

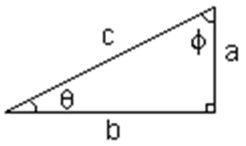
Permit / 'Code of Conduct' to dive on the wreck.

2.1.2 Vessel Stability

The rationale for investigating vessel stability is to ensure that the vessel remains stable on the seabed and is not inclining beyond acceptable limits that may result in blocked diver access holes or disorientation.

The stability of the vessel on the seabed will be examined by calculating the angle of incline of the vessel relative to a vertical surface on the superstructure, such as the helicopter hangar on the main deck. The locations selected for measuring the angle of the vessel will be marked clearly, and their exact locations accurately described relative to other permanent structures, allowing for repeat measurements to be taken.

The angle of the vessel will then be measured at each location by attaching a plumb bob (a strong cord attached to a heavy weight), to the edge of the vessel. The plumb bob will then be lowered until it remains stable in the water column. At a point toward the bottom of the vertical superstructure measuring location (e.g. near the bottom of the helicopter hanger wall), the vertical distance along the plumb bob and the horizontal distance from the plumb bob line to the vertical structure will be measured. The angle of incline is then calculated (i.e. tan θ) from the horizontal and vertical measures on the right angled triangle (see Figure 2-1).



where: tan (θ) = 0pposite / adjacent and tan $(\theta)^{-1}$= the angle of incline

Figure 2-1 Measurement of the incline of the vessel using a right angle triangle calculation

Wave loads during major storms have the potential to cause ship movement. If the ship were to list, this would most likely occur during a major storm event (when boating and hence diving would cease due to BoM weather warnings) with the ship essentially settling into a new position under its own weight.

The angle at which the vessel may become unstable would depend on a number of factors and is likely to change over time. Factors include how the ship initially settles on the seabed (upright / on an angle), depth of settlement over time and any movement under storm waves.

If thought necessary an analysis of the likely theoretical angle at which the ship becomes unstable could be undertaken for initial settlement conditions, post scuttling (taking into account the location of concrete pumped into the hull to account for the weight of material removed from the vessel during preparation).

If determined to be necessary in future, sensors (tilt monitors) and / or underwater video cameras / webcams could be installed on the vessel to record any movement immediately post storm event. An assessment could then be made of any actions required to ensure the wreck was safe for diving.

2.1.3 Vessel Position and Settlement

The rationale for investigating the position of the vessel is to document the vessel's position on the seabed and to monitor its position over time. The depth to deck level and highest points on the vessel will also provide an understanding of any changes in water depth over time, due to the vessel settling on the seabed.

The position of the vessel will be determined by divers attaching buoys to the stern and bow sections during slack water. The location of these buoys will then be determined using GPS located on the survey boat. This fieldwork should be undertaken during slack water, with minimal wind to prevent drift of the marker buoys. If fieldwork is not undertaken during slack water, the approach will be for divers to swim directly over the stern and bow of the ship and mark their locations using a waterproof hand held GPS unit.

During these dives, divers will also record the depths (relative to LAT) of the highest point of the vessel in the water column, as well as the depth at the bow and stern at main deck level. The depth at seabed will be measured using the diver's computer lowered to the seabed on a weight as the depth at the seabed is beyond the normal commercial diving (Level 1 and 2) approved depth limit of 30m. In essence, the overall vessel position task will be completed using a combination of GPS positioning and diver depth measurements, converted to LAT using published tide charts.

The extent of settlement will be determined by first calculating the vertical distance from a known point (same locations as for vessel stability) of the ship to the seabed using a plumb bob. This measurement, together with the measurements described above, will be used to calculate the angle of incline of the ship and the length of the hypotenuse, using the formula for a right angle triangle. The length of the hypotenuse will then be compared to the known vertical height of the whole hull of the Ex-HMAS ADELAIDE from naval drawings to indicate the depth of settlement.

Vessel stability, position and settlement will be measured in conjunction with annual and post

storm structural integrity inspections.

Results and recommendations from the first five years of monitoring of structural integrity, stability and position are provided in Section 3.1.

2.2 Environmental Monitoring

2.2.1 Reef Communities

The rationale for investigating reef communities on the Ex-HMAS Adelaide is to gain an understanding of the marine flora and fauna assemblages present on the vessel, examine the rate of development of fouling assemblages and how they change over time, identify whether there is variation in the rates of development on different surfaces of the vessel (i.e. horizontal versus vertical) and identify whether any introduced species are present.

Full details of the survey methods for monitoring of reef communities can be found in the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011).

Results and recommendations from the first five years of diver based reef surveys are provided in Section 3.2.

2.2.2 Sediment Movement

The rationale for examining sediment movement on the seabed is to gain an understanding of sediment movement around the vessel, accumulation rates and scour depths. Sediment movement will be reported annually and after major storm events. During a major storm it is predicted that a scour hole, approximately 0.7 m to 1.4 m in depth and 7 m to 14 m in diameter, could develop at the stern. At the bow it is estimated that a scour hole 1.5 m deep and 8 m to 10 m in diameter could develop.

The seabed will be described by taking incidental photographs around the vessel. Any sand waves or rippling effects occurring will be described. Incidental sightings of benthic fauna / flora present on the adjacent sandy substrate will also be recorded, as well as the presence or otherwise of any debris from the vessel. The ability to complete this survey using divers will be limited to making observations from above the 30 m depth limit for commercial divers. Consequently, the detail of the survey may be limited by visibility and distance off the seabed.

Full details of the survey methods for monitoring of sediment movement around the vessel can be found in the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011).

Results and recommendations from the first five years of diver based sediment movement surveys are provided in Section 3.3.

2.2.3 Sediment Quality

The rationale for documenting sediment quality around the Ex-HMAS Adelaide is to examine how metal corrosion and degradation of protective paint layers impacts on the surrounding environment, i.e. whether benthic organisms are affected by potential metal enrichment of sediments around the vessel.

Sediment samples are analysed for a suite of metals including aluminium and iron (primarily due to corrosion of the superstructure and hull) and chromium, copper, lead, nickel and zinc (heavy metals which may have been in paints or components of the vessel which were unable to be removed). Sediment quality results will be compared with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines (ISQG) and previous results for control sites.

Sediment samples are collected by deploying a Ponar benthic grab from a boat and testing for trace metals against NODG (National Ocean Disposal Guideline for Dredged Material and ANZECC/ARMCANZ (2000) ISQG.

The locations of sediment quality (and bioaccumulation) sampling sites are shown in Figure 2-1 and Figure 2-2. Samples are collected from three control locations (S2, S3 and S6) and six impact locations (I1, I2, I3, I4, I5 and I6) for all survey times.

Full details of the survey methods for monitoring of sediment quality around the vessel can be found in the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011) and Cardno 2016a.

Results and recommendations from the first five years of sediment quality monitoring are provided in Section 3.3.

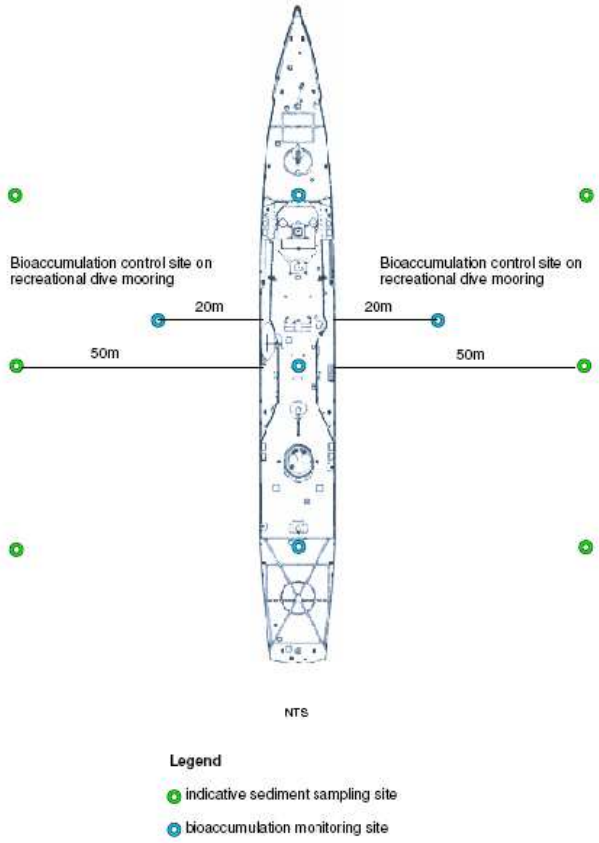


Figure 2-1 Location of sediment and bioaccumulation monitoring sites.

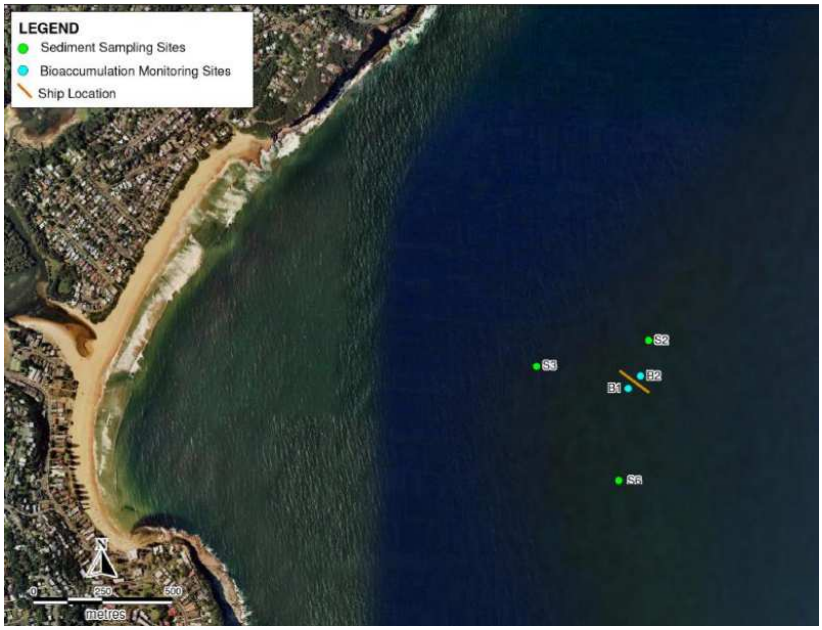


Figure 2-2 Sediment and bioaccumulation control sites.

2.2.4 Bioaccumulation Study

The aim of the bioaccumulation study is to determine whether resident biota are affected by the degradation of zinc chromate paint which may have originally been used on the aluminium alloy. As the initial process of biofouling was expected to take some time, active biomonitoring methods were to be adopted until there was sufficient growth on the ship for direct testing of resident fouling biota.

Full details of the survey methods for the bioaccumulation study can be found in the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011).

Results and recommendations from the first five years of bioaccumulation studies are presented in Section 3.4.

2.3 Management Criteria and Mitigation Measures

2.3.1 Structural Integrity, Stability, Position and Sediment Movement

A reduction in metal thickness of 50% should be used as a guide to initiate more frequent monitoring. The point at which various parts of the vessel become at risk of failure will vary in response to factors other than metal thickness, e.g. stress points. The point at which this becomes a risk to divers will also vary, e.g. collapse of the masts would be a risk to divers but severe corrosion in the centre of a plate on the side of the aircraft hangar may not pose a risk, or may be able to be managed. The point at which structural decay will warrant closing sections of the vessel or restricting access will be assessed though ongoing inspections.

An important consideration is whether diver access or egress is impeded, or disorientation of the divers inside the vessel is likely. Any major changes to structural integrity or stability of the vessel will typically occur during a major storm event. Divers would not be diving on the vessel under such conditions and so would not be subject to sudden entrapment or physical injury. Removal of encrusting biota may be required, in instances where significant fouling of the vessel is occurring, which limits diver access or egress or presents a hazard to divers.

If the wreck is deemed unsuitable for diving it will be closed until demolition / repair works and removal of debris are completed. Bookings will not be taken (or will be cancelled) and permits will not be issued for diving on the wreck until it is safe to do so.

Where monitoring determines that there is a risk to diver safety, the management actions outlined in Table 2.1 should be implemented.

Table 2-1 Diver safety management actions.

Monitoring Program	Response
Structural Integrity	Using an Ultrasonic Thickness Measurement Instrument, measure the thickness of the test site, and if there is significant deterioration (i.e. > 50% reduction compared to the pre-scuttling measurement) in the thickness of material (steel or aluminium) at the monitoring points, appoint a marine surveyor to determine the risk to divers of a structural failure. Advise divers not to enter internal spaces of the vessel until the area is certified safe and reopened.
Access holes, barring off and deterioration of furnishings and partitioning	If there is significant deterioration of the non-structural fittings or failure of the barring off then advise divers to avoid those areas until the risk can be either removed or rectified by a suitably qualified and authorised contractor. Advise divers not to enter the internal spaces of the vessel until the area is certified safe and reopened to divers.
Vessel Positional Stability (angle of rest)	In the unlikely occurrence that there is a significant change in the position of the vessel, then there will be a need to undertake a more detailed risk assessment of the impact of the change in position on diver safety. The immediate action is to advise divers not to enter the vessel. Appoint a suitably qualified marine surveyor and risk assessor to determine the significance of the change in position and to provide advice on remedial actions. Advise divers not to enter the internal spaces of the vessel until the area is certified safe and reopened to divers
Seabed Topography	If there is significant change in the sea bed topography (erosion of the sand from under the vessel) seek advice from marine surveyor to determine if there is a risk to the stability of the vessel. If there is then follow the actions outlined above. Historical information from other wreck sites indicates that once the vessel has settled into the seabed by 1.5 m it should become stable.
Introduced Marina Biota	If marine pest species are identified seek management advice from DoEE, Industry & Investment NSW (Fisheries) and/or the Office of Environment and Heritage (OEH).

Reports from dive operators regarding the safety of the dive site will be continuously monitored by DoI Crown Lands and Water. Should it become apparent that permanent closure of the site may be warranted, a working group will be formed to consider options for site management. Advice will be sought from divers, work place authorities, regulatory bodies and legal advice. It would be expected that the site would continue to be monitored to understand the potential for significant failure of the structure but diving would no longer be permitted.

As a permit condition, all dive operators will be required to have an emergency action plan and site induction plans for guides and divers, and to maintain appropriate insurances. They will also be required to comply with a Permit / "Code of Conduct" which includes hazard and incident

reporting as well as emergency contact phone numbers should any emergency response be required at the dive site.

2.3.2 Environmental Monitoring

Marine Biota

If any marine pest species are identified during the reef surveys, DoEE and Industry & Investment NSW (Fisheries) will be notified and advice sought on control / management measures.

In the event that any listed threatened or protected species are observed at the site, the appropriate authority (i.e. DoEE, Industry & Investment NSW (Fisheries) or the OEH) will be advised.

Sediment Quality

The relevant trigger levels for marine sediments identified in ANZECC/ARMCANZ (2000) will be adopted for sediment quality monitoring and are shown in Table 2-2. In the event that the ISQG-Low trigger value is exceeded for a particular metal, further investigation will be undertaken (such as leachate testing).

Table 2-2 Sediment quality guidelines (ANZECC/ARMCANZ 2000).

Parameter	ISQG - Low	ISQG – High
Aluminium	-	-
Chromium	80 mg/kg	370 mg/kg
Copper	65 mg/kg	270 mg/kg
Iron	-	-
Lead	50 mg/kg	220 mg/kg
Nickel	21 mg/kg	52 mg/kg
Zinc	200 mg/kg	410 mg/kg
PCBs	23 µg/kg	-

Notes: ISQG = Interim sediment quality guideline trigger values (metals reported in mg/kg dry wt). Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).

Bioaccumulation

If zinc chromate contamination is detected in biota then further monitoring should be undertaken. No special management strategies are proposed as removal of biota from the ship by divers is prohibited and all forms of fishing are prohibited within approximately 100 m of the ship.

2.4 Reporting

Monitoring results should be reported to the DoEE within one month of survey completion. In the event that an environmental or diver safety risk is identified, DoEE should be advised within 24 hours. Survey reports should be provided individually within one month of survey.

An annual survey report is to be prepared containing an introduction, objectives of the monitoring program, survey methods, results, conclusions and recommendations (including any necessary changes to monitoring frequency and duration). The annual survey report will include a description of sand movement around the vessel (including scour) and any changes in settlement depth and the angle of the vessel (compared to the scuttled position and previous field survey work), as well as a general description of the state of the vessel and amount of biological growth observed.

A locality plan and all photographs taken during the survey will be provided in an Appendix.

The annual survey report will form part of the Reserve Trust's annual reporting to the NSW Minister for Lands as required under Clause 32 of the *Crown Lands Regulation* 2006.

Reporting to the DoEE will be via the annual survey report or as required under the Sea Dumping Permit conditions and will occur separately to the reporting for the Minister for Lands.

2.5 Personnel

Environmental monitoring and reporting must be undertaken by qualified and experienced marine scientists using a commercially registered vessel. All diving work must be undertaken by commercially qualified divers. The assessment of structural integrity must be undertaken by a qualified naval architect or maritime structural engineer.

3 Results and Recommendations from the First Five Years of Monitoring

3.1 Monitoring of Structural Integrity, Stability and Position

Monitoring of structural integrity, stability and position was undertaken as per the original LTMMP schedules for the first five years post-scuttling. Annual and events based inspections were undertaken by McLennans Diving Service with review and comment on the structural integrity and safety of the vessel for diving undertaken by Shearforce Maritime Services Pty Ltd.

3.1.1 Results of First Five Years Monitoring

The most recent annual underwater inspection to monitor structural integrity, stability and position was undertaken by McLennans Diving Service in April 2017. The findings of this survey can be summarised as follows:

- The vessel was structurally sound and stable – it remained unchanged since the previous annual inspection in June 2016.
- No new dangers were found that could affect recreational divers.
- No signs of corrosion were observed.
- Hanger damage was stable.
- No change in the ships position or list had occurred.

A summary of the results of the most recent structural inspections are included in **Appendix E**. These provide an indication of the current structural condition of the Ex-HMAS Adelaide dive reef.

3.1.2 Recommendations for Future Monitoring

Due to a necessity to continually monitor the ship for potential hazards / risks to divers and ensure diver safety, monitoring of structural integrity, stability and position should continue as per the original LTMMP schedules, with a requirement for annual monitoring, as well as events based monitoring (i.e. following major storm events), for the next 10 years. Monitoring of corrosion as well as sediment movement around the vessel should be undertaken during all structural integrity inspections.

All ongoing structural integrity monitoring should refer to the Management Criteria for this component, as outlined in Section 2.3.1. Depending on the findings, the regularity of structural integrity monitoring may need to be increased, or the vessel closed to diving until necessary demolition or repair works are made. At any stage that the vessel is deemed unsafe for diving and

where repairs / demolitions to reduce risk to divers are not possible, all diving activities should cease either in localised areas, or on the entire vessel, permanently.

3.2 Environmental Monitoring – Reef Communities

Reef community surveys on the Ex-HMAS Adelaide were undertaken immediately post-scuttling and at numerous other time points during the first five years post-scuttling as follows, in accordance with the original LTMMP schedules:

- Baseline Survey (1 week) – 18th April and 30th May 2011 (WorleyParsons)
- Post-scuttling Survey 1 (6 months) – 11th and 13th October 2011 (Cardno)
- Post-scuttling Survey 2 (10 months) – 14th and 16th February 2012 (Cardno)
- Post-scuttling Survey 3 (12 months) – 3rd and 4th May 2012 (Cardno)
- Post-scuttling Survey 4 (15 months) – 27th July 2012 (Cardno)
- Post-scuttling Survey 5 (18 months) – 31st October and 1st November 2012 (Cardno)
- Post-scuttling Survey 6 (21 months) – 16th and 17th January 2013 (Cardno)
- Post-scuttling Survey 7 (24 months) – 29th and 30th April 2013 (Cardno)
- Post-scuttling Survey 8 (27 months) – 16th and 17th July 2013 (Cardno)
- Post-scuttling Survey 9 (2 years 6 months) – 16th and 21st October 2013 (Cardno)
- Post-scuttling Survey 10 (2 years 11 months) – 3rd and 4th March 2014 (Cardno)
- Post-scuttling Survey 11 (3 years 5 months) – 22nd, 23rd and 29th September 2014 (Cardno)
- Post-scuttling Survey 12 (3 years 11 months) – 26th and 27th March 2015 (Cardno)
- Post-scuttling Survey 13 (5 years 2 months) – 1st and 2nd June 2016 (Cardno)

The full methods and results of all reef community surveys can be found in WorleyParsons (2011b) and Cardno (2016a and 2016b).

3.2.1 Results of First Five Years Monitoring

Overall, the reef community monitoring program undertaken during the first five years post-scuttling has met the aims of the original LTMMP well:

- It documented the types of flora and fauna present on the vessel.

- It described the rates of development of fouling assemblages and changes over time.
- It described variation in rates of development on different surfaces of the vessel.

After a baseline survey (WorleyParsons 2011) and 13 post-scuttling surveys (Cardno 2016b), a total of 42 taxa / taxon groups were identified on the vessel, with the ten most numerically abundant taxa in terms of percentage cover being serpulid, barnacle and encrusting algae matrix (57.8%), large barnacles and brown filamentous algae (7.2%), solitary ascidians (6.7%), serpulid polychaetes (6.5%), jewel anemones (4.4%), brown filamentous algae (4.3%), kelp (2.3%), early colonising matrix (2.2%), base surface (1.3%) and red encrusting algae (1.3%) (Cardno 2016a and 2016b).

Multivariate analysis indicated that there were changes in reef assemblages over time, with significant differences in the overall assemblage composition between surveys (regardless of transect position / orientation). Surface orientation was a significant factor in structuring the epibenthic assemblages on the vessel for the first five years post-scuttling. The assemblages associated with horizontal deck surfaces were significantly different from those on the vertical surfaces of the hull during all surveys. Depth was also a significant factor in structuring the epibenthic assemblages on the vessel for the first five years post-scuttling. Assemblages associated with deep surfaces between 20 – 30 m were significantly different to those associated with shallower 13 – 20 m surfaces across all surveys.

Fish taxa identified during the 13 post-scuttling surveys included 62 species from 31 families. There was a clear increase in the number of species identified over time. No species of threatened or protected fish were recorded (although anecdotal evidence suggests that grey nurse sharks, *Carcharius taurus*, may occur at the site on occasion).

No listed marine pest species were detected during the first five years of monitoring, however, it was noted that the survey methods adopted may mean that small and cryptic pest species would be difficult to identify as they can be well camouflaged or found in crevices and overhangs.

Further detail on the results of the first five years of reef monitoring can be found in **Appendix E**

3.2.2 Recommendations for Future Monitoring

Reef Communities and Threatened Species

No further reef community monitoring is required under the Revised LTMMP. Any further monitoring of long-term changes to epibenthic reef communities and / or fish communities for ecological research or educational purposes could be undertaken by external agencies, educational facilities or organisations, but is not necessary to meet the goals of the LTMMP.

Any further external studies should include special consideration of the presence of threatened and protected marine species, as listed under the NSW *Fisheries Management Act* 1994 and/or NSW *Biodiversity Conservation Act* 2016 that may begin to utlise the artificial reef over longer time periods.

A volunteer sighting and reporting program for threatened and protected species may also be implemented by the local dive operators who regularly dive on the vessel with data provided to appropriate management agencies on a regular basis (e.g. a basic 6 monthly report with images if obtained). LTMMP Management Criteria (see Section 2.3.2) require that in the event that any listed threatened or protected species are observed, the appropriate authority (i.e. DoEE, Industry & Investment NSW (Fisheries) or OEH) should be advised.

Marine Pests

Ongoing surveys for marine pest species known from NSW and Australia which have the potential to occur on the vessel (see Cardno 2016a and 2016b) should occur for the next 10 years to ensure that the aims of the original LTMMP in regard to marine pest species are fully met and that environmental risk is appropriately managed.

As no pest species have been detected to date, it is considered that the frequency of these surveys could be significantly reduced. It is suggested that the next marine pest surveys are undertaken at 10 years followed by 15 years post scuttling (these could be undertaken in conjunction with the suggested future *in-situ* sediment quality and biomonitoring surveys – see Section 3.3.2 and 3.4.2).

Any future marine pest surveys should utilise a combination of survey methods including diver transects (with video footage and/or photquadrats taken), scrapings with subsequent taxonomic analysis and targeted diver searches for more cryptic pest species which have the potential to occur on the ship (refer to Cardno 2016a and 2016b for details of these). Appropriate monitoring methods for the detection of the species of interest should be implemented by the consultant / agency undertaking these surveys, with reference to The *Australian Marine Pest Monitoring Guidelines and Manual* (DAFF 2010).

In accordance with the Management Criteria for marine pests in Section 2.3.2, if any marine pest species are identified, DoEE and Industry & Investment NSW (Fisheries) should be notified and advice sought on control / management measures.

In accordance with the *Australian Marine Pest Monitoring Guidelines and Manual* (DAFF 2010), marine pest detections should also be reported to the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE) who are responsible for initiating action in response to any new or suspected new incursions of marine pests according to CCIMPE agreed protocols.

While the level of marine pest monitoring on the vessel would not necessarily adhere fully to the *Australian Marine Pest Monitoring Guidelines and Manual* (DAFF 2010), data collected during such monitoring could potentially be made available for inclusion in the National Introduced Marine Pest Information System (www.marinepests.gov.au/nimpis).

3.3 Environmental Monitoring – Sediment Quality

Sediment quality monitoring prior to scuttling and for the first five years post-scuttling was undertaken in accordance with the schedule in the original LTMMP as follows:

- Baseline sediment sampling (prior to scuttling) – 2009 (WorleyParsons)
- One month post-scuttling – 17th May 2011 (WorleyParsons)
- Six months post-scuttling – 20th October 2011 (Cardno)
- 21 months post-scuttling (i.e. 18 month event) – 11th January 2013 (Cardno)
- 62 months post-scuttling (i.e. 60 month event) – 10th June 2016 (Cardno)

Full details of the methods and results of these sampling events can be found in WorleyParsons (2009, 2011a and 2011b) and Cardno (2016c). Cardno (2016c) should be referred to for details of sediment sampling methodology and locations for any future monitoring.

3.3.1 Results of First Five Years Monitoring

The sediment quality assessment found that particle size distribution was relatively uniform across sampling sites. In addition, metal concentrations in sediments recorded at 62 months post-scuttling (June 2016) were similar to those recorded one month post-scuttling (May 2011) indicating no significant long-term effects on sediment quality as a result of the vessel being scuttled (aluminium was an exception). All metals measured for which ANZECC/ARMCANZ (2000) ISQG are available (i.e. chromium, copper, nickel, lead and zinc) had concentrations that were well below the ISQG low trigger values and therefore were not considered to be a contamination risk to the marine environment.

Further detail on the results from the first five years of sediment quality monitoring are provided in **Appendix E**.

3.3.2 Recommendations for Future Monitoring

Monitoring of sediments from within the hull of the Ex-HMAS Adelaide is not necessary going forward. Any impacts on sediments within the hull would be highly localised and contained. Furthermore, restrictions on commercial diving implemented after the preparation of the original LTMMP mean that there would be significant costs associated with undertaking this collection.

As the ship corrodes over time there remains the potential for metals to enter the surrounding marine sediments creating environmental risk, however, this is expected to be a long-term process. Considering the results of the first five years of monitoring (Cardno 2016c), continued monitoring of sediment quality at five year intervals up until 15 years post-scuttling (i.e. at 10 and 15 years post scuttling) is recommended. If after this time no impacts on sediment quality are seen, monitoring at an even further reduced rate for rest of the operational life of the vessel should be adequate (subject to future review and consideration).

For all future sediment quality sampling, additional sampling sites located further away from the vessel (i.e. several kilometres) should be included to validate the results from the existing control sites (which may be located too close to the vessel).

Ad-hoc sampling should also be undertaken if the results of any structural monitoring should warrant it.

3.4 Environmental Monitoring – Bioaccumulation Study

Bioaccumulation surveys undertaken within the first five years post-scuttling were completed in accordance with the schedule in the original LTMMP as follows:

- One week post-scuttling (baseline survey) – 19th April 2011 (WorleyParsons)
- Seven months post-scuttling – 24th November 2011 (Cardno Ecology Lab)
- 15 months post-scuttling – 21st September 2012 (Cardno Ecology Lab)

Full details of the sampling methodology and results of these sampling events can be found in WorleyParsons (2011), Cardno Ecology Lab (2012) and Cardno (2016a).

3.4.1 Results of First Five Years Monitoring

The results of the bioaccumulation study showed that there was no contamination of marine biota which could be attributed to zinc chromate paint over the 27 month post-scuttling monitoring period. However, issues with the loss of some samples limited the interpretation of results.

Further detail on the results from the first five years of bioaccumulation studies is provided in **Appendix E**.

3.4.2 Recommendations for Future Monitoring

Considering the insignificant results of the first five years of monitoring, no further active biomonitoring (i.e. deployment and testing of organisms) is required for the Ex-HMAS Adelaide to assess ecological risk from the vessel.

However, to fully meet the requirements of the original LTMMP, which requires testing of organisms directly from the vessel, at least one round of *in-situ* sampling and testing of resident biota should be undertaken. Cardno (2016a) suggested that a large gastropod or solitary ascidian be used for *in-situ* monitoring.

It is recommended that a common species with high abundance on the vessel and on nearby rocky reefs (which would be used as control sites) be selected. This is required for ease of collection and appropriate sample replication. The chosen organism should be relatively easy to collect by divers and preferably occur in shallower areas of the Ex-HMAS Adelaide dive reef for diver safety purposes.

Following a review of Cardno (2016a) and Cardno (2016b), two potential species include the sessile solitary ascidian *Herdmania momus* (red throated ascidian) and the gastropod *Dicathais orbita* (cartrutt shell). *Herdmania momus* is common and abundant on intertidal and shallow subtidal

reefs along the NSW coastline (Edgar 1997) and was also found to be common on vertical surfaces of the Ex-HMAS Adelaide dive vessel in the most recent reef surveys. Alternatively, the gastropod *D. orbita* (cartrutt shell - a genus of predatory sea snail), was identified on the vessel and is also common in rocky reef areas of the NSW coastline (Beechey 2000, Edgar 1997).

Ascidian and/or gastropod samples should be collected from the bow, midship and stern of the vessel (as per the active biomonitoring studies) and at multiple reef control sites located at a range of distances from the vessel (at least two). Once collected, sub-sampling and analysis methods should follow those outlined in Cardno Ecology Lab (2012). Sample numbers (i.e. within site replication) should be suitable to allow for meaningful statistical comparisons to be made, however, due to the nature of the study, may be limited by natural availability at the time of sampling and restrictions associated with diving. A sample size of 10-15 individuals per site / location should be collected if possible.

A Section 37 NSW Fisheries Collection Permit for Scientific Research (Section 37 Permit - https://www.dpi.nsw.gov.au/fishing/closures/section-37-permits) will be required prior to sampling.

The *in-situ* sampling and testing should be undertaken at 10 years post scuttling. Following a review of results from the first *in-situ* bioaccumulation study, along with results of corrosion monitoring on the vessel, the need for further *in-situ* sampling should be reviewed. If significant differences between metal concentrations in biota tissue between samples from the vessel and from control sites, or ecologically significant levels of chromium or zinc in tissues are detected at 10 years, the frequency of *in-situ* biomonitoring should be reviewed and an increased monitoring frequency may be required. If corrosion levels on the vessel are at any time found to increase significantly, additional biomonitoring may also be warranted.

4 Revised LTMMP and Monitoring Schedule 2017-2026

In accordance with Condition 26 of Sea Dumping Permit SD2008/1062 the original Ex-HMAS Adelaide LTMMP (WorleyParsons 2011a) was reviewed and a Revised LTMMP (current Plan) has been developed. The Revised LTMMP takes into account the results of all monitoring undertaken to date and the recommendations made by Cardno (2016a) following first five years of post-scuttling monitoring. Key changes to monitoring along with a revised monitoring schedule for the next ten years (i.e. years six to 15 post-scuttling; 2017-2026) are provided below.

4.1 Key Changes to LTMMP Requirements

4.1.1 Monitoring of Structural Integrity Structural Integrity, Stability, Position and Sediment Movement

No changes to the original monitoring schedules have been proposed in the Revised LTMMP. Annual monitoring of structural integrity, stability, position and sediment movement, along with monitoring after large storm events should continue. There may also be a requirement for increased structural integrity monitoring if Management Criteria outlined in Section 2.3.1 are met.

4.1.2 Environmental Monitoring

4.1.2.1 Reef Communities

No further monitoring of reef communities for ecological purposes is required under the Revised LTMMP, however, reef monitoring could be undertaken by external agencies for scientific research purposes. Monitoring for threatened or protected species could be undertaken concurrently or by local diver operators.

Surveys for detection of marine pest species should continue (at a reduced frequency considering the lack of positive data obtained to date) to ensure that environmental risk is managed. At this stage a marine pest survey should occur at 10 years (2021) and at 15 years (2026) with additional surveys to be scheduled during this time period if any marine pest incursions are detected. A greater range of survey methods which are targeted at pest species which are likely to occur on the vessel (i.e. for which suitable habitat is available) should be used.

4.1.2.2 Sediment Quality

Due to the insignificant results from sediment quality monitoring obtained during the first five years post-scuttling, a reduced monitoring frequency of marine sediment quality going forward is considered suitable. Monitoring every five years until 15 years post-scuttling is recommended (i.e.

at 10 and 15 years; 2021 and 2026). Additional control sites located further north and south of the vessel should also be included.

4.1.2.3 Bioaccumulation Study

Considering the insignificant results of the first five years of post-scuttling monitoring, active biomonitoring is no longer considered necessary. However, the fully meet the requirements of the original LTMMP, i*n-situ* biomonitoring (i.e. direct sampling and testing of biota from the vessel and nearby control reefs) should be undertaken at 10 years (2021). If any significant results are obtained at this stage then further testing should be considered and scheduled. The species to be used should be one which is common and abundant on the vessel and also on nearby rocky reefs, and should be easy to sample using divers (e.g. *H. momus* and/or *D. orbita*).

4.2 Revised Monitoring Schedule

A revised monitoring schedule from years six (2017) to 15 (2026) post-scuttling is provided in Table 4-1. After year 15 (2026) it is recommended that the results of monitoring from years six to 15 are reviewed and revisions once again be made to the Revised LTMMP as appropriate.

Table 4-1 Revised LTMMP monitoring schedule – years 6 - 15. (2017-2026)

Parameter	72 Months (6 years) Post-scuttling 2017	84 Months (7 years) Post-scuttling 2018	96 Months (8 years) Post-scuttling 2019	108 Months (9 years) Post-scuttling 2020	120 Months (10 years) Post-scuttling 2021	142 Months (11 years) Post-scuttling 2022	154 Months (12 years) Post-scuttling 2023	166 Months (13 years) Post-scuttling 2024	178 Months (14 years) Post-scuttling 2025	190 Months (15 years) Post-scuttling 2026	Ongoing Monitoring (operational life)
Structural integrity, vessel stability, position and sediment movement	At 72 months and 1 week after major storm events.	At 84 months and 1 week after major storm events.	At 96 months and 1 week after major storm events.	At 108 months and 1 week after major storm events.	At 120 months and 1 week after major storm events.	At 142 months and 1 week after major storm events.	At 154 months and 1 week after major storm events.	At 166 months and 1 week after major storm events.	At 178 months and 1 week after major storm events.	At 190 months and 1 week after major storm events.	Review results and revise the LTMMP for ongoing monitoring requirement.
Vessel components and specified structural monitoring points	At 72 months or as determined plus post major storm and if alerted to issue by commercial dive operators.	At 84 months and 90 months plus post major storm and if alerted to issue by commercial dive operators.	At 96 months and 102 months plus post major storm and if alerted to issue by commercial dive operators.	At 108 months and 114 months plus post major storm and if alerted to issue by commercial dive operators.	At 120 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	At 142 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	At 154 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	At 166 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	At 178 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	At 190 months and 126 months plus post major storm and if alerted to issue by commercial dive operators.	Review results and revise the LTMMP for ongoing monitoring requirement.
Reef Community Study	Not required.	Not required.	Not required.	Not required.	Marine pest survey to be undertaken at 120 months. Increased survey frequency between 10 and 15 years	Not required at this stage.	Not required at this stage.	Not required at this stage.	Not required at this stage.	Marine pest survey to be undertaken at 190 months.	Review results and revise the LTMMP for ongoing monitoring requirement.

Parameter	72 Months (6 years) Post-scuttling 2017	84 Months (7 years) Post-scuttling 2018	96 Months (8 years) Post-scuttling 2019	108 Months (9 years) Post-scuttling 2020	120 Months (10 years) Post-scuttling 2021	142 Months (11 years) Post-scuttling 2022	154 Months (12 years) Post-scuttling 2023	166 Months (13 years) Post-scuttling 2024	178 Months (14 years) Post-scuttling 2025	190 Months (15 years) Post-scuttling 2026	Ongoing Monitoring (operational life)
					if any pest incursions are detected.						
Bioaccumulation Study	Not required.	Not required.	Not required.	Not required.	In-situ bioaccumulation study to be undertaken at 120 months. Revised frequency of future sampling will be required if results are significant.	Not required at this stage.	Not required at this stage.	Not required at this stage.	Not required at this stage.	Not required at this stage.	Review results and revise the LTMMP for ongoing monitoring requirement.
Sediment Quality Study	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Sampling at 120 months and if results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Not required unless results of structural monitoring warrants.	Sampling at 190 months and if results of structural monitoring warrants.	Review results and revise the LTMMP for ongoing monitoring requirement.

5 Marker Buoys, Mooring Buoys and Navigation Aids

Following the scuttling of the Ex-HMAS Adelaide two marker buoys, six mooring buoys and associated navigation aids were installed in the vicinity of the vessel for use by dive vessels and to ensure the navigational safety of other recreational and commercial vessels which may be operating in these coastal waters. Figure 5-1 and Figure 5-2 show the location of these as originally installed. A summary of the various moorings / markers and required maintenance regimes for each is described in the following sections.

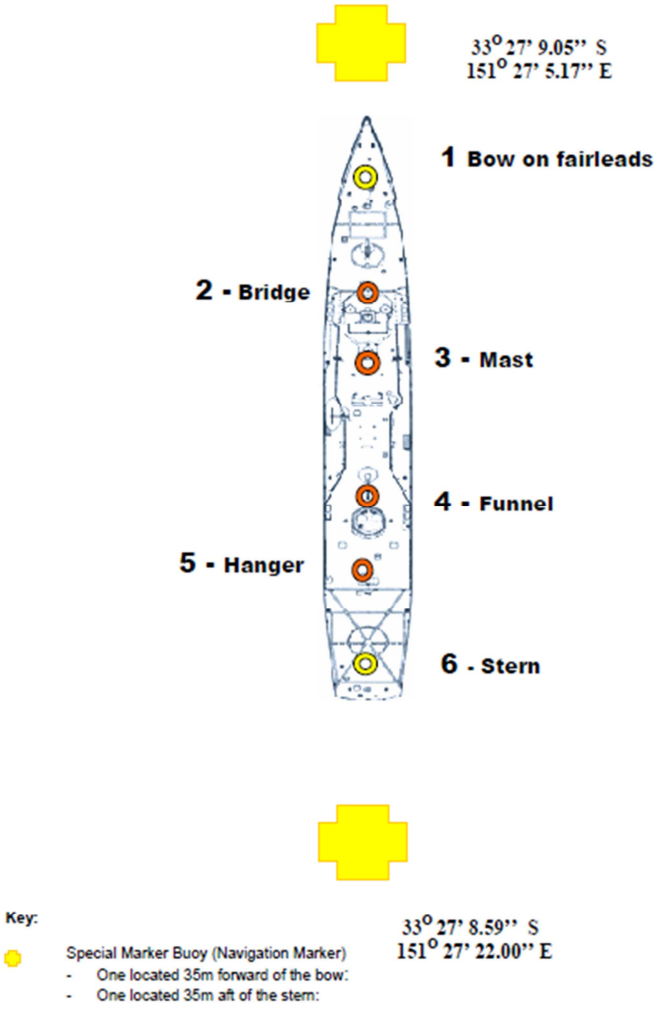


Figure 5-1 Location of all originally installed moorings and special markers around the Ex-HMAS Adelaide dive wreck. Note that the special marker buoys are now ~ 100 m off the bow and stern rather than the 35 m indicated here.

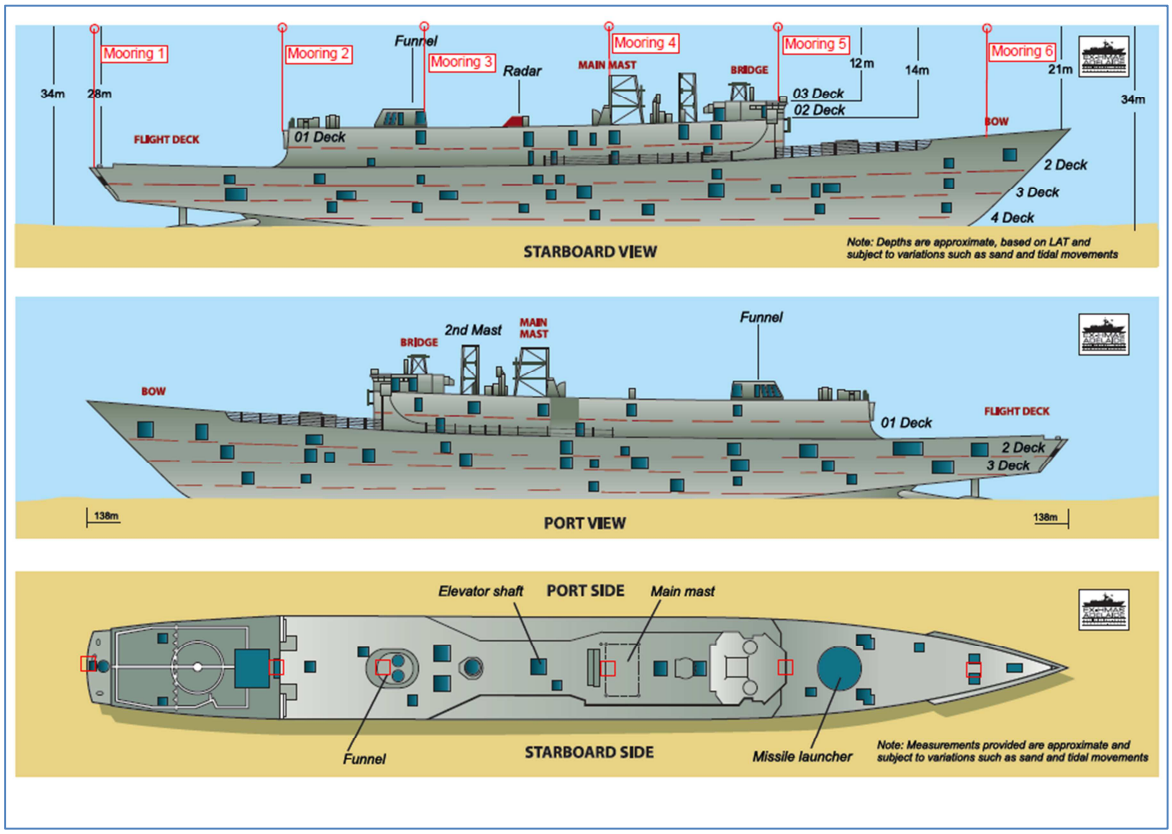


Figure 5-2 Mooring buoy numbering and locations on the Ex-HMAS Adelaide dive wreck.

5.1 Dive Moorings and Special Markers

5.1.1 Dive Moorings

There are six mooring sites on the Ex-HMAS Adelaide Reserve and one in Terrigal Haven that are authorised under commercial mooring Licence CL6353 (issued by Roads and Maritime Services). The design specifications for these moorings is shown in Figure 5-3.

Currently there are only four moorings physically available for use on the Reserve and one in Terrigal Haven. These moorings have adequately met diver demand to date (without considering visitor numbers generated by unauthorised access). Figure 5-1 and Figure 5-2 show the location of these moorings. These moorings are attached directly to the ship.

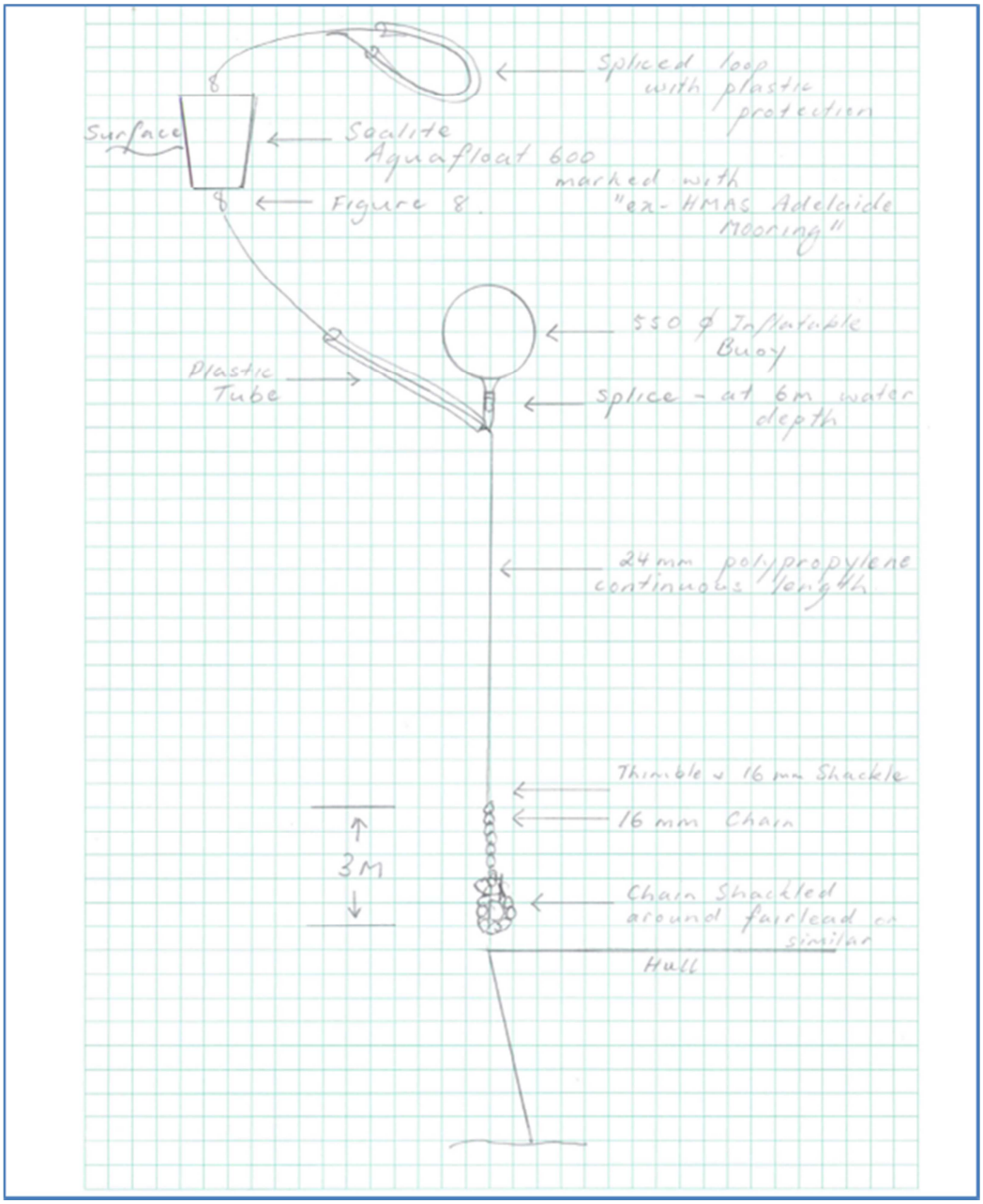


Figure 5-3 Design specifications for the mooring buoys on the Ex-HMAS Adelaide.

The commercial mooring Licence CL6353 must be renewed annually. Renewal requires a phone call to RMS and there is no charge for the Licence. If the Licence is not renewed by the due date DoI Crown Lands and Water is not lawfully occupying the mooring space. The mooring Licence is granted with the expectation that the RMS Commercial Mooring Licence Standard Conditions are adhered to. Failure to comply with any of the Conditions may lead to cancellation of the Licence. The RMS Commercial Mooring Licence Standard Conditions are provided in **Appendix F**.

5.1.2 Special Marker Buoys

There are two special marker buoys on the Reserve which mark the bow and stern of the sunken vessel. Special marker buoys are located approximately 100m forward off the bow and 100m aft of the stern of the Ex-HMAS Adelaide dive wreck. These are key for the navigational safety of Reserve users and other passing vessels. The GPS locations of the special marker buoys as installed are provided in Table 5-1.

Table 5-1 GPS locations of the special marker buoys (as installed location).

Special Marker	Latitude (S)	Longitude (E)
Bow Marker	33^{0}27′9.05′′S	151^{0}27′5.17′′E
Stern Marker	33^{0}27′8.59′′S	151^{0}27′22.00′′E

5.1.3 Terrigal Haven Mooring Buoy

The Terrigal Haven mooring buoy is used by diving vessels when transferring divers and equipment to and from the shore. The approximate location of this buoy is shown in Figure 5-4.

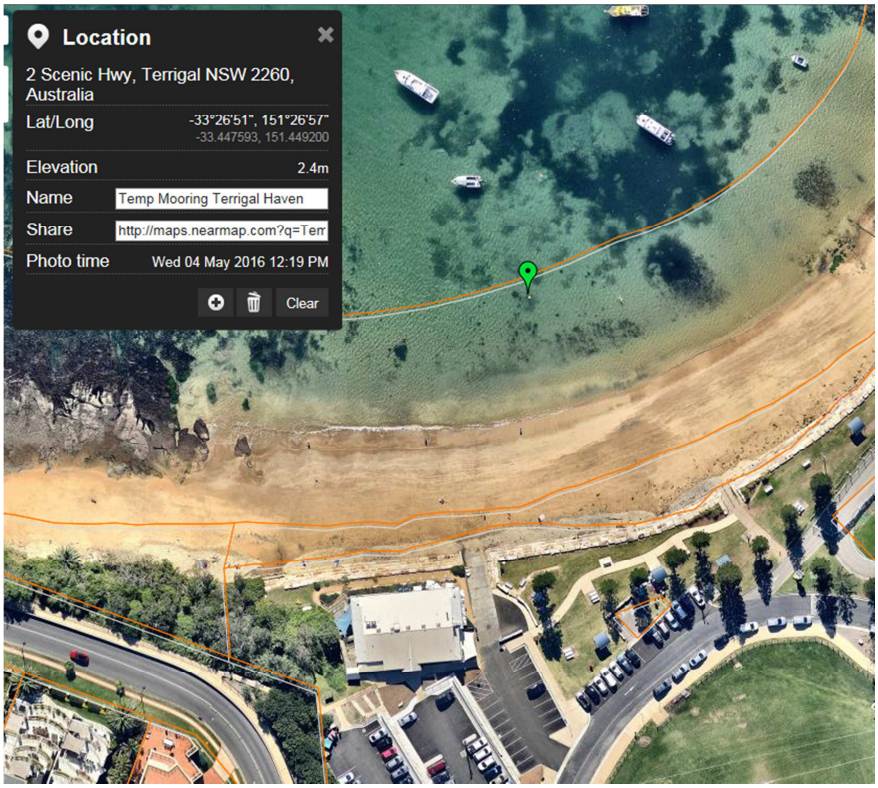


Figure 5-4 Location of the mooring buoy in Terrigal Haven.

5.2 Maintenance

Maintenance of marker and mooring buoys should be undertaken annually and also within one week of any major storm event.

5.2.1 Special Marker Buoy Maintenance

The maintenance regime for the special marker buoys is to be undertaken annually and involves the following:

- Lift both marker buoys and ground tackle.
- Clean and inspect.
- Check functionality of the flashing lights and replace all associated lights / batteries.
- Replace all fixtures and fittings annually.
- All shackles and fixtures previously welded shut are to be re-welded annually.
- Reinstall marks in the location they were retrieved from.
- Provide a report on the condition of the equipment and all works undertaken including a photographic record of before and after works.

5.2.2 Dive Mooring Buoy Maintenance

The maintenance regime for the dive moorings buoys is to be undertaken annually and involves the following:

- Divers will need to inspect mooring attachments to the Ex-HMAS Adelaide decks.
- Moorings are to be retrieved and cleaned (i.e. remove barnacles and other marine growth).
- Replace all fixtures or fittings annually.
- Any shackles welded shut are to be re-welded annually.
- Reinstall the mooring on location.
- Provide a report on the condition of the equipment and works undertaken including a photographic record of before and after works.

5.2.3 Terrigal Haven Mooring Buoy Maintenance

The maintenance of the commercial mooring buoy in Terrigal Haven is to be undertaken annually and involves the following:

- Lift the marker buoy and ground tackle.
- Mooring to be retrieved and cleaned (i.e. remove barnacles and other marine growth).
- Replace all fixtures and fittings annually.
- Reinstall on location.
- Provide a report on the condition of the equipment and works undertaken including a photographic record of before and after works.

6 References

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Appendix A Sea Dumping Permit

AUSTRALIA

ENVIRONMENT PROTECTION (SEA DUMPING) ACT 1981

SEA DUMPING PERMIT No. SD2008/1062

for

NEW SOUTH WALES LAND AND PROPERTY MANAGEMENT AUTHORITY

I, VICKI JANE MIDDLETON, a delegate of the Minister for Environment Protection, Heritage and the Arts, acting under Section 19 of the *Environment Protection (Sea Dumping) Act 1981*, hereby grant a sea dumping permit to the New South Wales Land and Property Management Authority, PO Box 2185, Dangar, NSW, 2309, for an artificial reef placement of the vessel "Ex- HMAS *Adelaide*" off Avoca Beach, New South Wales, commencing on the date of signature of this permit and extending for a period of fifty years, subject to conditions which are specified in Appendix 1.

DATE.....22nd.....day of.....March.....2010

Vicki Middleton
.....
VICKI MIDDLETON
Delegate of the Minister

This permit comprises six (6) pages, including Appendix 1.

Appendix 1

CONDITIONS FOR ARTIFICIAL REEF PLACEMENT OF THE VESSEL "Ex-HMAS *ADELAIDE*", OFF AVOCA BEACH, NEW SOUTH WALES.

Definitions

In this permit:

"the Act"	means the *Environment Protection (Sea Dumping) Act 1981*;
"the Application"	means the Application for a permit under the *Environment Protection (Sea Dumping) Act 1981* submitted by the NSW Lands and Property Management Authority, received by the Department on 16 December 2008;
"the Department"	means the Department of the Environment, Water, Heritage and the Arts, Ports and Marine Section, GPO Box 787, Canberra ACT 2601. Telephone – 02 6274 1111 Facsimile – 02 6274 1620 Email – portsandmarine@environment.gov.au or successor entities;
"Ex- HMAS *Adelaide*"	means the decommissioned FFG-7 Class Guided Missile Frigate *Ex-HMAS Adelaide*;
"environmental incident"	any event which has the potential to, or does impact, on the environment;
"environmental risk"	any risk, additional to those risks previously identified in the Application, which has the potential to, or does impact, on the environment;
" final exclusion zone"	means the area within a radius of 500 metres of the *Ex-HMAS Adelaide* following the successful scuttling of the vessel and prior to the vessel being opened to the public as specified in the scuttling Plan;
"IALA"	means the International Association of Lighthouse Authorities;
"initial exclusion zone"	means the area within a radius of 1000 metres of the *Ex-HMAS Adelaide* during placement;
"LAT"	means lowest astronomical tide;
"LTMMP"	means the Long Term Monitoring and Management Plan (Revision D) received by the Department on 17 March 2010;
"Minister"	means the Australian Government Minister who administers the *Environment Protection (Sea Dumping) Act 1981*;
"monitoring zone"	means within 2 nm radius of the *Ex-HMAS Adelaide*;
"placement"	includes all activities associated with the placement permitted under this permit, including, but not limited to the placement of the *Ex-HMAS Adelaide*;

"Scuttling Plan"	means the Scuttling Plan (Revision 3) for the *Ex-HMAS Adelaide* received by the Department on 17 March 2010;
"LPMA"	means the New South Wales Land and Property Management Authority, PO Box 2185, Dangar, NSW, 2309; and
"unauthorised people, boats"	means any people and boats not authorised by NSW Maritime to be within the initial exclusion zone.

1. Except so far as the contrary intention appears, terms used in these conditions to this permit have the same meaning as such terms in the Act.

Material to be Placed

2. LPMA must place the *Ex-HMAS Adelaide* in the same preparation condition as per the ship inspection on 25 February 2010, with the addition of the following clean up preparations:
   (a) all temporary barricades, planks, wooden or steel blanking and other safety fittings are removed;
   (b) all ladders not permanently fixed into place and intended to remain in that position post scuttling are to be either removed or lowered to the deck;
   (c) the mast/structure must be modified to give a minimum over water clearance of 6 m at LAT immediately after scuttling; and
   (d) the ship must be cleaned of all other loose, unattached material and debris.

   LPMA must notify the Department in writing that the above preparations have been completed prior to the scuttling of the *Ex-HMAS Adelaide*.

3. LPMA must ensure no material additional to the *Ex-HMAS Adelaide*, in the condition described under Condition 2, is to be taken to sea and disposed of in association with this placement.

Location of Placement Site

4. LPMA must place the *Ex-HMAS Adelaide* on the designated scuttling datum of 151° 27.38 East, 33°.27.91 South. (MGA 94, Easting 356,551.686, Northing 6,296,076.969)

Conditions Applying Prior to Placement

5. LPMA must ensure the scuttling of the *Ex-HMAS Adelaide* is undertaken in accordance with the Scuttling Plan.

6. LPMA must advise the Department the planned date and time of commencement of the tow and scuttling process no less than 24 hours in advance of the tow commencing.

7. LPMA must advise the Department and other relevant authorities as soon as practicable of any delay, postponement or cancellation of the final tow and scuttling, whether due to actual or forecast weather or sea conditions or any other contingency or incident.

8. LPMA must ensure the pyrotechnic display is conducted as per the scuttling plan. All 28 pyrotechnic units must be removed as part of the post scuttling activities.

9. The person engaged to manage the deployment and detonation of explosives (including pyrotechnics) used in the placement of the Ex-HMAS Adelaide, must hold a current shotfirers permit.

10. LPMA must undertake visual reconnaissance of the placement area using binoculars from the shot firing vessel and by a spotter aircraft before and during the placement phase to ensure the exclusion zone of 1000 metres is clear of all unauthorised people or boats. The initial exclusion zone must be maintained until such time as the *Ex-HMAS Adelaide* is checked for non-detonated explosives and declared safe. Any unauthorised people or boats not essential to the scuttling straying into the exclusion zone are to be requested to clear and/or be escorted to the exclusion zone boundary. Scuttling charges are not to be detonated if any unauthorised people or boats are within the exclusion zone.

11. LPMA must ensure a spotter aircraft is in the air above the placement site at least 30 minutes prior to and during the placement phase to ensure that no cetacean, seal, Grey Nurse shark or great white shark are within a 2 nautical mile radius of the *Ex-HMAS Adelaide*. Detonation of the scuttling charges is to be suspended should any cetacean, seal, Grey Nurse Shark or Great White Shark be detected within a 2 nautical mile radius of the *Ex-HMAS Adelaide*, and must remain suspended until such time as the cetacean, seal or great white shark has been seen to leave the monitoring zone or until 30 minutes after the last sighting of the cetacean, seal, Grey Nurse Shark or Great White Shark within the monitoring zone. The spotter aircraft must maintain audio contact with the shot firing vessel monitoring the scuttling to ensure that the above procedures are followed.

12. LPMA must ensure no persons, vessel or aircraft pursue, herd or harass any cetacean, seal, Grey Nurse Shark or Great White Shark prior to or during the placement phase.

Conditions Applying Following the Placement

14. LPMA must ensure that the *Ex-HMAS Adelaide* sinks and settles on the seabed, and that the placement occurs centrally within the scuttling zone specified in Condition 4.

15. LPMA must undertake visual footage of the scuttling, including video reconnaissance of the placement location, and sea surface, immediately after placement, to detect the presence, or confirm the absence, of any visible pollution or debris, such as oil slicks or floating material. Any material left floating after the placement operation must be retrieved prior to access by recreational divers.

16. LPMA must ensure that after the *Ex-HMAS Adelaide* has been placed, a diving team checks all explosives have been detonated correctly. In the event that an explosive fails to detonate, it is to be made safe prior to the initial exclusion zone being removed.

17. LPMA must ensure that the highest point of the *Ex-HMAS Adelaide* is no less than 6.0 m below sea level at LAT immediately following placement. If this was not achieved during placement, then the mast and/or other structure must be lowered to the required height prior within 14 days.

18. LPMA must ensure after the placement, and prior to the final exclusion zone being removed, that a diving team inspects the *Ex-HMAS Adelaide*, and undertakes all repair work required to ensure that the *Ex-HMAS Adelaide* is safe for recreational divers.

19. LPMA must ensure within 5 days of scuttling, the *Ex-HMAS Adelaide* is to be marked as a navigation hazard by a marker that conforms to the IALA maritime buoyage system. The marker must be effective during all visibility conditions.

20. LPMA must provide a report to the Department within 5 days of placement which includes:

    (a) date and time of placement;

    (b) the position of the *Ex-HMAS Adelaide* (confirmation of the placement site to two decimal places of a minute, plus horizontal datum, in latitude and longitude format);

    (c) the estimated depth of water over the *Ex-HMAS Adelaide* as measured at LAT, and the date and time of the observation;

    (d) video footage (as specified in Condition 15) including a discussion on the scuttling detailing whether any problems arose during the scuttling, how they were rectified and if any clean up actions were undertaken;

    (e) verification from an independent observer, agreed by the Department, of the highest point of the vessel (as specified in Condition 17) prior to the exclusion zone being removed;

    (f) details of the inspection dive (as specified in Condition 18) including whether any items were removed or hazards rectified;

    (g) confirming the removal of all pyrotechnics equipment from the vessel (as specified in condition 9);

    (h) the position and description of the cardinal mark and any other visual indicators (e.g. buoys and/or lights) marking the wreck;

    (i) evidence of notification to the RAN Hydrographic Office and NSW Maritime as specified in Condition 21;

21. LPMA must provide the details specified in Condition 20 (a), (b), (c) and (h) to the Australian Hydrographic Office and NSW Maritime within 5 days of placement.

Environmental Risk and Incidents

22. If, at any time during the course of the placement activities, an environmental incident occurs or environmental risk is identified, or the placement does not occur in accordance with the Scuttling Plan as specified in Condition 5, all measures must be taken immediately by LPMA to mitigate the risk or the impact. The Department must be notified in writing within 24 hours of the occurrence or identification of an environmental incident or risk, and the measures taken, the success or otherwise of those measures in addressing the incident or risk, and any additional measures proposed to be taken or advised by the Department.

Monitoring and Reporting

23. LPMA must implement the Long Term Management and Monitoring Plan (LTMMP) for the *Ex-HMAS Adelaide* following the scuttling of the vessel. The results of the LTMMP must be published on the *Ex-HMAS Adelaide's* website (www.hmasadelaide.nsw.gov.au) within 1 month of the completion of sampling for the life of the LTMMP.

24. LPMA may submit for the Minister's approval a revised version of the LTMMP specified under Condition 23. If the Minister approves such a revised LTMMP, that LTMMP must be implemented in place of the LTMMP as originally approved.

25. If the Minister believes that it is necessary or desirable for the better protection of the environment to do so, the Minister may request LPMA to make specified revisions to the LTMMP and submit the revised LTMMP for the Minister's approval. If the Minister approves a revised LTMMP pursuant to this condition, the LPMA must implement that LTMMP instead of the LTMMP as originally approved.

26. A review of the LTMMP must be undertaken within five years of scuttling with the revised version submitted to the Minister for approval. A revised LTMMP must not be implemented until it is approved by the Minister. If the Minister approves a revised LTMMP pursuant to this condition, the LPMA must implement that LTMMP instead of the LTMMP as originally approved.

Compliance of all Parties engaged in dumping activities

27. LPMA must ensure that all persons engaged in the placement activities under this permit, including the owner(s) and person(s) in charge of the vessel, comply with this permit and the requirements of the Act.

Access for Observers

28. LPMA must allow at least two Australian Government nominees access to witness, inspect, examine or audit any part of the operations, including any placement or monitoring activity, the vessel or any other equipment, or any documented records, and are to be provided with any necessary assistance in carrying out their duties.

Auditing

29. After placement of the *Ex-HMAS Adelaide*, if the Department believes that it is necessary or desirable to undertake an audit of the permit conditions, LPMA must comply with any such request and must provide any necessary assistance to the Department's representatives in carrying out their duties.

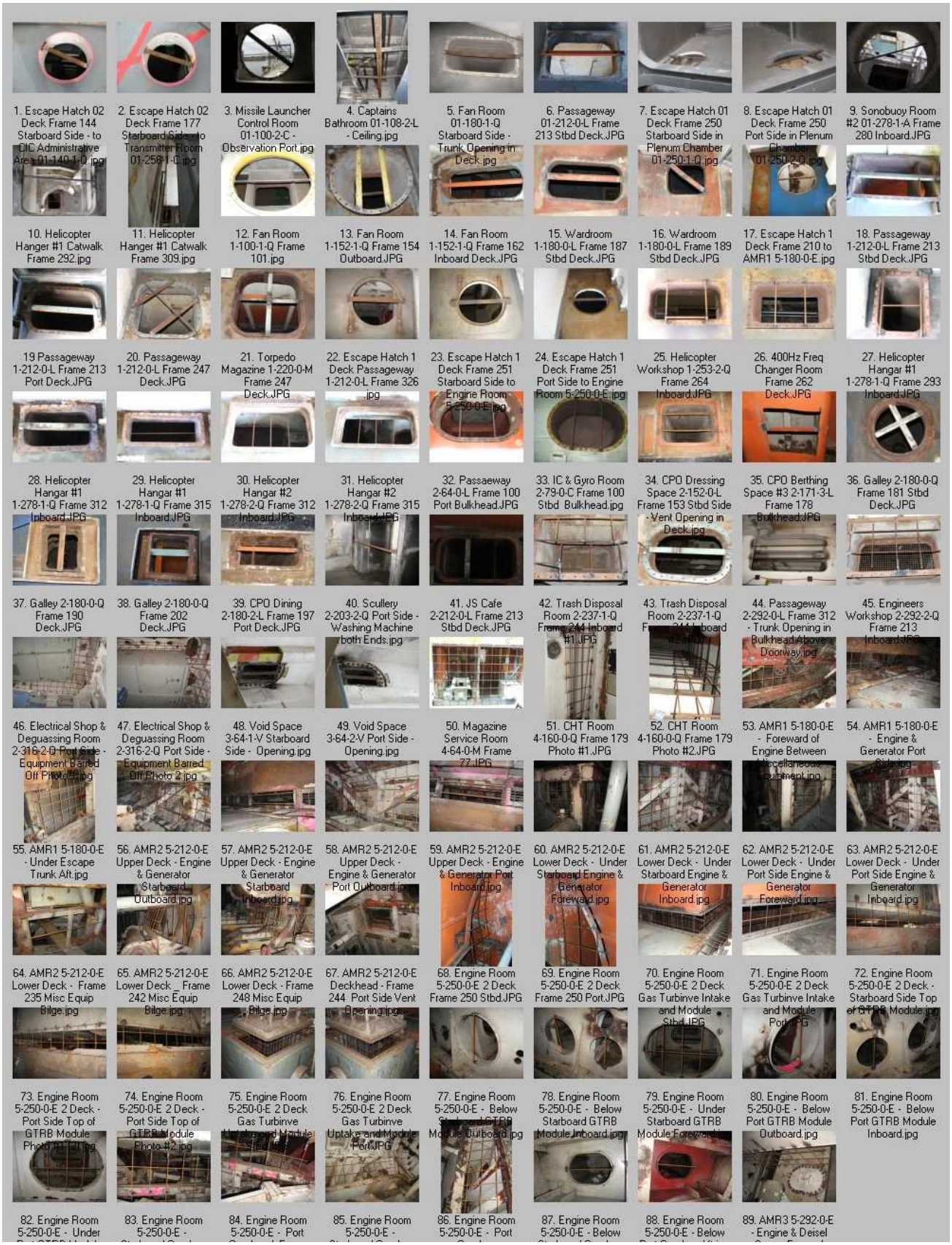
Appendix B Register of Barred Off Items

Ex HMAS Adelaide
Register of Barred OFF Items

Item #	Description	Location	Deck	Compartment #	Location Frame	Photo #
1	Escape Hatch		02 Deck	Upper Deck	Frame 144 Starboard	1
2	Escape Hatch		02 Deck	Upper Deck	Frame 177 Starboard	2
3	Port Hole	Missile Launcher Control Room	01 Deck	01-100-2-C	Frame 100 Port	3
4	Ceiling	Captains Toilet & Shower	01 Deck	01-108-2-L	Frame 109	4
5	Trunk Opening	Fan Room	01 Deck	01-180-1-Q	Frame 185 Starboard	5
6	Trunk Opening	Passageway	01 Deck	01-212-0-L	Frame 213 Starboard	6
7	Escape Hatch	Plenum Chamber	01 Deck	01-250-1-Q	Frame 251	7
8	Escape Hatch	Plenum Chamber	01 Deck	01-250-2-Q	Frame 251	8
9	Trunk Opening	Sonobuoy Room #2	01 Deck	01-278-1-A	Frame 280 Inboard	9
10	Trunk Opening	Helicopter Hanger #1 Catwalk	01 Deck	1-278-1-Q	Frame 292	10
11	Trunk Openings	Helicopter Hanger #1 Catwalk	01 Deck	1-278-1-Q	Frame 309	11
12	Trunk Openings	Fan Room	1 Deck	1-100-1-Q	Frame 101	12
13	Trunk Opening	Fan Room	1 Deck	1-152-1-Q	Frame 154 Outboard	13
14	Trunk Opening	Fan Room	1 Deck	1-152-1-Q	Frame 162 Inboard	14
15	Trunk Opening	Wardroom	1 Deck	1-180-0-L	Frame 187	15
16	Opening in Deck	Wardroom	1 Deck	1-180-0-L	Frame 189	16
17	Escape Hatch	Passageway	1 Deck	1-108-2-L	Frame 210 Port	17
18	Trunk Opening	Passageway	1 Deck	1-212-0-L	Frame 213 Starboard	18
19	Trunk Opening	Passageway	1 Deck	1-212-0-L	Frame 213 Port	19
20	Trunk Opening	Passageway	1 Deck	1-212-0-L	Frame 247	20
22	Trunk Opening	Torpedo Magazine	1 Deck	1-220-0-M	Frame 247	21
21	Escape Hatch	Passageway	1 Deck	1-212-0-L	Frame 326	22
23	Escape Hatch	Passageway	1 Deck	1-250-3-L	Frame 251 Starboard	23
24	Escape Hatch	Passageway	1 Deck	1-250-4-L	Frame 251 Port	24
25	Trunk Opening	Helicopter Workshop	1 Deck	1-253-2-Q	Frame 264 Inboard	25
26	Trunk Opening	400Hz Freq Changer Room	1 Deck	1-258-1-Q	Frame 262	26
27	Trunk Opening	Helicopter Hangar #1	1 Deck	1-278-1-Q	Frame 293 Inboard	27
28	Trunk Opening	Helicopter Hangar #1	1 Deck	1-278-1-Q	Frame 312 Inboard	28
29	Trunk Opening	Helicopter Hangar #1	1 Deck	1-278-1-Q	Frame 315 Inboard	29
30	Trunk Opening	Helicopter Hangar #2	1 Deck	1-278-2-Q	Frame 312 Inboard	30
31	Trunk Opening	Helicopter Hangar #2	1 Deck	1-278-2-Q	Frame 315 Inboard	31
32	Trunk Opening	Passageway	2 Deck	2-64-0-L	Frame 100 Port	32
33	Trunk Opening	IC & Gyro Room	2 Deck	2-79-0-C	Frame 98 Starboard	33
34	Trunk Opening	CPO Dressing Space	2 Deck	2-152-0-L	Frame 154	34
35	Trunk Opening	CPO Berthing Space #3	2 Deck	2-171-3-L	Frame 178	35
36	Exhaust Opening	Galley	2 Deck	2-180-0-Q	Frame 181 Starboard	36
37	Trunk Opening	Galley	2 Deck	2-180-0-Q	Frame 190	37
38	Trunk Opening	Galley	2 Deck	2-180-0-Q	Frame 202	38
39	Trunk Opening	CPO Dining Space	2 Deck	2-180-2-L	Frame 197	39
40	Dishwasher both ends	Scullery	2 Deck	2-203-2-Q	Frame 210	40
41	Trunk Opening	Jr Sailors Dining Area	2 Deck	2-212-0-L	Frame 213 Starboard	41
42	Trunk Opening	Trash Disposal Room	2 Deck	2-237-1-Q	Frame 244 Inboard #1	42
43	Trunk Opening	Trash Disposal Room	2 Deck	2-237-1-Q	Frame 244 Inboard #2	43
44	Opening	Passageway	2 Deck	2-292-0-L	Frame 312 Port	44
45	Trunk Opening	Engineers Workshop	2 Deck	2-292-2-Q	Frame 313 Inboard	45
46	Space Around Electrical Equipment Cabinet	Electrical Shop	2 Deck	2-316-2-Q	Frame325	46 & 47

Ex HMAS Adelaide
Register of Barred OFF Items

Item #	Description	Location	Deck	Compartment #	Location Frame	Photo #
47	Manhole	Void	3 Deck	3-64-1-V	Frame 76 Starboard	48
48	Manhole	Void	3 Deck	3-64-2-V	Frame 76 Port	49
49	Opening	Magazine Service Room	4 Deck	4-64-0-M	Frame 77	50
50	Opening Between CHT Tank and Bulkhead	Sewage Collecting Holding & Boiler	4 Deck	4-160-0-Q	Frame 179	51 & 52
51	Space Foreward of Engine between Misc Equipment	AMR1	4 Deck	5-180-0-E	Frame 182	53
52	Space under Engine and Generator	AMR1	4 Deck	5-180-0-E	Frame 182 to Frame 203	54
53	Space under Escape Trunk	AMR1	4 Deck	5-180-0-E	Frame 203 to Frame 208 Port	55
54	Deck level around Engine and Generator	AMR2	3 Deck	5-212-0-E	Frame 225 to Frame 250 Starboard	56 & 57
55	Deck level around Engine and Generator	AMR2	3 Deck	5-212-0-E	Frame 225 to Frame 250 Port	58 & 59
56	Space below Engine and Generator	AMR2	5 Deck	5-212-0-E	Frame 225 to Frame 250 Starboard	60 & 61
57	Space below Engine and Generator	AMR2	5 Deck	5-212-0-E	Frame 225 to Frame 250 Port	62 & 63
58	Space around Misc Machinery	AMR2	5 Deck	5-212-0-E	Frame 238 to Frame 250 Centreline	64, 65 & 66
59	Trunk Opening	AMR2	3 Deck	5-212-0-E	Frame 244 Port - Deckhead	67
60	Space Between Gas Turbine Intake and Bulkhead	Engine Room	2 Deck	5-250-0-E	Frame 250 Stbd	68
61	Space Between Gas Turbine Intake and Bulkhead	Engine Room	2 Deck	5-250-0-E	Frame 250 Port	69
62	Space Between Gas Turbine Intake and Gas Turbine Module	Engine Room	2 Deck	5-250-0-E	Frames 251 - 257 Stbd	70
63	Space Between Gas Turbine Intake and Gas Turbine Module	Engine Room	2 Deck	5-250-0-E	Frames 251 - 257 Port	71
64	Space Between Engine Module and Deck	Engine Room	2 Deck	5-250-0-E	Frames 254 - 275 Starboard	72
65	Space Between Engine Module and Deck	Engine Room	2 Deck	5-250-0-E	Frames 254 - 275 Port	73 & 74
66	Space Between Gas Turbine Uptake and Gas Turbine Module	Engine Room	2 Deck	5-250-0-E	Frames 271 - 277 Stbd	75
67	Space Between Gas Turbine Uptake and Gas Turbine Module	Engine Room	2 Deck	5-250-0-E	Frames 271 - 277 Port	76
68	Space under Engine Module	Engine Room	4 Deck	5-250-0-E	Frame 260, Frame 264, Frame 265 Starboard	77, 78 & 79
69	Space under Engine Module	Engine Room	4 Deck	5-250-0-E	Frame 260, Frame 264, Frame 265 Port	80, 81 & 82
70	Space Between Engine Module and Gearbox (A Frame)	Engine Room	4 Deck	5-250-0-E	Frame 278 Starboard	83
71	Space Between Engine Module and Gearbox (A Frame)	Engine Room	4 Deck	5-250-0-E	Frame 278 Port	84
72	Space Beside Gearbox lower area	Engine Room	4 Deck	5-250-0-E	Frame 282 to Frame 288 Starboard	85
73	Space Beside Gearbox lower area	Engine Room	4 Deck	5-250-0-E	Frame 282 to Frame 288 Port	86
74	Space below Gearbox	Engine Room	4 Deck	5-250-0-E	Frame 288 Starboard	87
75	Space below Gearbox	Engine Room	4 Deck	5-250-0-E	Frame 288 Port	88
76	Space under Service Tanks	AMR3	3 Deck	5-292-0-E	Frame 292 to Frame 298 Port	89


1. Escape Hatch 02 Deck Frame 144 Starboard Side - to CIC Administrative Area 01-140-1-Q.jpg
2. Escape Hatch 02 Deck Frame 177 Starboard Side - to Transmitter Room 01-258-1-C.jpg
3. Missile Launcher Control Room 01-100-2-C - Observation Port.jpg
4. Captains Bathroom 01-108-2-L - Ceiling.jpg
5. Fan Room 01-180-1-Q Starboard Side - Trunk Opening in Deck.jpg
6. Passageway 01-212-0-L Frame 213 Stbd Deck.JPG
7. Escape Hatch 01 Deck Frame 250 Starboard Side in Plenum Chamber 01-250-1-Q.jpg
8. Escape Hatch 01 Deck Frame 250 Port Side in Plenum Chamber 01-250-2-Q.jpg
9. Sonobuoy Room #2 01-278-1-A Frame 280 Inboard.JPG
10. Helicopter Hanger #1 Catwalk Frame 292.jpg
11. Helicopter Hanger #1 Catwalk Frame 309.jpg
12. Fan Room 1-100-1-Q Frame 101.jpg
13. Fan Room 1-152-1-Q Frame 154 Outboard.JPG
14. Fan Room 1-152-1-Q Frame 162 Inboard Deck.JPG
15. Wardroom 1-180-0-L Frame 187 Stbd Deck.JPG
16. Wardroom 1-180-0-L Frame 189 Stbd Deck.JPG
17. Escape Hatch 1 Deck Frame 210 to AMR1 5-180-0-E.jpg
18. Passageway 1-212-0-L Frame 213 Stbd Deck.JPG
19 Passageway 1-212-0-L Frame 213 Port Deck.JPG
20. Passageway 1-212-0-L Frame 247 Deck.JPG
21. Torpedo Magazine 1-220-0-M Frame 247 Deck.JPG
22. Escape Hatch 1 Deck Passageway 1-212-0-L Frame 326 .jpg
23. Escape Hatch 1 Deck Frame 251 Starboard Side to Engine Room 5-250-0-E.jpg
24. Escape Hatch 1 Deck Frame 251 Port Side to Engine Room 5-250-0-E.jpg
25. Helicopter Workshop 1-253-2-Q Frame 264 Inboard.JPG
26. 400Hz Freq Changer Room Frame 262 Deck.JPG
27. Helicopter Hangar #1 1-278-1-Q Frame 293 Inboard.JPG
28. Helicopter Hangar #1 1-278-1-Q Frame 312 Inboard.JPG
29. Helicopter Hangar #1 1-278-1-Q Frame 315 Inboard.JPG
30. Helicopter Hangar #2 1-278-2-Q Frame 312 Inboard.JPG
31. Helicopter Hangar #2 1-278-2-Q Frame 315 Inboard.JPG
32. Passaeway 2-64-0-L Frame 100 Port Bulkhead.JPG
33. IC & Gyro Room 2-79-0-C Frame 100 Stbd Bulkhead.jpg
34. CPO Dressing Space 2-152-0-L Frame 153 Stbd Side - Vent Opening in Deck.jpg
35. CPO Berthing Space #3 2-171-3-L Frame 178 Bulkhead.JPG
36. Galley 2-180-0-Q Frame 181 Stbd Deck.JPG
37. Galley 2-180-0-Q Frame 190 Deck.JPG
38. Galley 2-180-0-Q Frame 202 Deck.JPG
39. CPO Dining 2-180-2-L Frame 197 Port Deck.JPG
40. Scullery 2-203-2-Q Port Side - Washing Machine both Ends.jpg
41. JS Cafe 2-212-0-L Frame 213 Stbd Deck.JPG
42. Trash Disposal Room 2-237-1-Q Frame 244 Inboard #1.JPG
43. Trash Disposal Room 2-237-1-Q Frame 244 Inboard #2.JPG
44. Passageway 2-292-0-L Frame 312 - Trunk Opening in Bulkhead Above Doorway.jpg
45. Engineers Workshop 2-292-2-Q Frame 213 Inboard.JPG
46. Electrical Shop & Deguassing Room 2-316-2-Q Port Side - Equipment Barred Off Photo 1.jpg
47. Electrical Shop & Deguassing Room 2-316-2-Q Port Side - Equipment Barred Off Photo 2.jpg
48. Void Space 3-64-1-V Starboard Side - Opening.jpg
49. Void Space 3-64-2-V Port Side - Opening.jpg
50. Magazine Service Room 4-64-0-M Frame 77.JPG
51. CHT Room 4-160-0-Q Frame 179 Photo #1.JPG
52. CHT Room 4-160-0-Q Frame 179 Photo #2.JPG
53. AMR1 5-180-0-E - Foreward of Engine Between Miscellaneous Equipment.jpg
54. AMR1 5-180-0-E - Engine & Generator Port Side.jpg
55. AMR1 5-180-0-E - Under Escape Trunk Aft.jpg
56. AMR2 5-212-0-E Upper Deck - Engine & Generator Starboard Outboard.jpg
57. AMR2 5-212-0-E Upper Deck - Engine & Generator Starboard Inboard.jpg
58. AMR2 5-212-0-E Upper Deck - Engine & Generator Port Outboard.jpg
59. AMR2 5-212-0-E Upper Deck - Engine & Generator Port Inboard.jpg
60. AMR2 5-212-0-E Lower Deck - Under Starboard Engine & Generator Foreward.jpg
61. AMR2 5-212-0-E Lower Deck - Under Starboard Engine & Generator Inboard.jpg
62. AMR2 5-212-0-E Lower Deck - Under Port Side Engine & Generator Foreward.jpg
63. AMR2 5-212-0-E Lower Deck - Under Port Side Engine & Generator Inboard.jpg
64. AMR2 5-212-0-E Lower Deck - Frame 235 Misc Equip Bilge.jpg
65. AMR2 5-212-0-E Lower Deck _ Frame 242 Misc Equip Bilge.jpg
66. AMR2 5-212-0-E Lower Deck - Frame 248 Misc Equip Bilge.jpg
67. AMR2 5-212-0-E Deckhead - Frame 244 Port Side Vent Opening.jpg
68. Engine Room 5-250-0-E 2 Deck Frame 250 Stbd.JPG
69. Engine Room 5-250-0-E 2 Deck Frame 250 Port.JPG
70. Engine Room 5-250-0-E 2 Deck Gas Turbinve Intake and Module Stbd.JPG
71. Engine Room 5-250-0-E 2 Deck Gas Turbinve Intake and Module Port.JPG
72. Engine Room 5-250-0-E 2 Deck - Starboard Side Top of GTRB Module.jpg
73. Engine Room 5-250-0-E 2 Deck - Port Side Top of GTRB Module Photo #1.JPG
74. Engine Room 5-250-0-E 2 Deck - Port Side Top of GTRB Module Photo #2.jpg
75. Engine Room 5-250-0-E 2 Deck Gas Turbinve Uptake and Module Stbd.JPG
76. Engine Room 5-250-0-E 2 Deck Gas Turbinve Uptake and Module Port.JPG
77. Engine Room 5-250-0-E - Below Starboard GTRB Module Outboard.jpg
78. Engine Room 5-250-0-E - Below Starboard GTRB Module Inboard.jpg
79. Engine Room 5-250-0-E - Under Starboard GTRB Module Foreward.jpg
80. Engine Room 5-250-0-E - Below Port GTRB Module Outboard.jpg
81. Engine Room 5-250-0-E - Below Port GTRB Module Inboard.jpg
82. Engine Room 5-250-0-E - Under
83. Engine Room 5-250-0-E -
84. Engine Room 5-250-0-E - Port
85. Engine Room 5-250-0-E -
86. Engine Room 5-250-0-E - Port
87. Engine Room 5-250-0-E - Below
88. Engine Room 5-250-0-E - Below
89. AMR3 5-292-0-E - Engine & Deisel

Appendix C Register of Rapid Deterioration Items

Ex HMAS Adelaide
Register of Rapid Deterioration Items

Item #	Description	Location	Deck	Compartment #	Location Frame	Photo #
1	Captains Chair	Bridge	02 Deck	02-100-0-C	Frame 106 Starboard	1
2	Chart Table & Chart	Chart Room	02 Deck	02-116-2-C	Frame 122 Port	2
3	Cabinet	Mk 92 Equipment Room	02 Deck	02-116-1-Q	Frame 120 Starboard	3
4	Cupboards & Honeycomb Bulkhead	Captains Pantry	01 Deck	01-108-4-Q	Frame 108 Port	4
5	Cupboards	Operations Room	01 Deck	01-113-0-C	Frame 122 Starboard	5
6	Lamp with Extention Arm	Communications Centre	01 Deck	01-156-0-C	Frame 162	6
7	Desks & Cupboards	Communications Centre	01 Deck	01-156-0-C	Frame 162	7
8	Desks & Cupboards	Communications Centre	01 Deck	01-156-0-C	Frame 168	8
9	Desks & Cupboards	Communications Centre	01 Deck	01-156-0-C	Frame 178 Centreline	9
10	Cabinet	ECM Room	01 Deck	01-180-0-Q	Frame 190	10
11	Cabinet	ECM Room	01 Deck	01-180-0-Q	Frame 193	11
12	Cabinets	Officers Staterooms XO/MEO	01 Deck	01-215-2-L	Frame 223	12
13	Honeycomb Bulkhead	Officers WC & Shower	01 Deck	01-220-2-L	Frame 220 Port	13
14	Cabinet & Shelf	76mm Ammo Magazine Local Control Room	01 Deck	01-238-2-C	Frame 238 Port	14
15	Desk	Helocopter Office	01 Deck	01-285-0-Q	Frame 292 Centreline	15
16	Lamp with Extention Arm	Radar, IFF, CIC Equipment Room	1 Deck	1-100-0-C	Frame 112 Port	16
17	Desk & Cabinet	Radar, IFF, CIC Equipment Room	1 Deck	1-100-0-C	Frame 112 Port	17
18	Cabinet	Radar, IFF, CIC Equipment Room	1 Deck	1-100-0-C	Frame 125 Port	18
19	Bunks, Honeycomb Bulkhead & Cupboards	Officers Staterooms 3	1 Deck	1-140-0-L	Frame 140 Centreline	19
20	Bunks, Honeycomb Bulkhead & Cupboards	Officers Staterooms 2	1 Deck	1-140-2-L	Frame 140 Port	20
21	Honeycomb Bulkhead	Officers Staterooms 2	1 Deck	1-140-2-L	Frame 148 Port	21
22	Honeycomb Bulkhead	Officers WC & Shower	1 Deck	1-151-1-L	Frame 151 Starboard	22
23	Bunks, Honeycomb Bulkhead & Cupboards	Officers Staterooms 4	1 Deck	1-156-2-L	Frame 156 Port	23
24	Honeycomb Bulkhead & Cupboards	Officers Staterooms 5	1 Deck	1-164-1-L	Frame 164 Starboard	24
25	Bunks, Honeycomb Bulkhead & Cupboards	Officers Staterooms 6	1 Deck	1-164-2-L	Frame 164 Port	25
26	Bunks, Honeycomb Bulkhead & Cupboards	Officers Staterooms 8	1 Deck	1-172-2-L	Frame 172 Port	26
27	Trunking	Passageway	1 Deck	1-108-2-L	Frame 180 Port	27
28	Honeycomb Bulkhead	Wardroom	1 Deck	1-180-0-L	Frame 188 to Frame 202 Port	28
29	Honeycomb Bulkhead	Wardroom Pantry	1 Deck	1-198-1-L	Frame 198 Starboard	29
30	Trunking	Passageway	1 Deck	1-212-0-L	Frame 246 Starboard	30
31	Desk & Cabinet	Helicopter Workshop	1 Deck	1-253-2-Q	Frame 253 Port	31
32	Cabinet	Helicopter Hangar #1	1 Deck	1-278-1-Q	Frame 312 Starboard	32
33	Cabinet	Helicopter Hangar #2	1 Deck	1-278-2-Q	Frame 312 Port	33
34	Rack and Shelving	Bosuns Storeroom #1	2 Deck	2-Z-0-A	Frame 19 Port	34
35	Cupboards	Windlass Room	2 Deck	2-32-0-Q	Frame 32 Starboard	35
36	Desk	Registered Publication Vault	2 Deck	2-48-2-Q	Frame 52 Port	36
37	Cabinet	Foreward Repair #2	2 Deck	2-55-1-A	Frame 56 Starboard	37
38	Desks	IC, Gyro Room & Electronic Shop	2 Deck	2-79-0-C	Frame 79 Centreline & Frame 98 Starboard	38 & 39
39	Honeycomb Bulkhead	PO Sanitary Space	2 Deck	2-111-0-L	Frame 111 Centreline	40
40	Honeycomb Bulkhead	Junior Sailors Sanitary Space	2 Deck	2-111-1-L	Frame 112 Starboard	41
41	Bunks, Honeycomb Bulkhead & Cupboards	POs Sleeping Space	2 Deck	2-120-2-L	Frame 120 Port	42
42	Bunks, Honeycomb Bulkhead & Cupboards	POs Sleeping Space	2 Deck	2-120-2-L	Frame 126 Port	43
44	Bunks & Honeycomb Bulkhead	Officers Stateroom	2 Deck	2-140-1-L	Frame 140 Starboard	44
45	Honeycomb Bulkhead & Cupboards	Officers WC & Shower	2 Deck	2-140-2-L	Frame 140 Port	45
46	Honeycomb Bulkhead	Next to Passageway near doorway	2 Deck	2-140-2-Q	Frame 140 Port	46
47	Honeycomb Bulkhead & Cupboards	Medical Treatment Room	2 Deck	2-152-2-L	Frame 152 Port	47

Ex HMAS Adelaide
Register of Rapid Deterioration Items

Item #	Description	Location	Deck	Compartment #	Location Frame	Photo #
48	Operating Table	Medical Treatment Room	2 Deck	2-152-2-L	Frame 158 Port	48
49	Honeycomb Bulkheads and Doors	Medical Treatment Room	2 Deck	2-152-2-L	Frame 161 Port	49
50	Desk and Cabinet	Medical Treatment Room	2 Deck	2-152-2-L	Frame 166 Port	50
51	Honeycomb Bulkhead	CPO WC & Shower	2 Deck	2-154-0-L	Frame 154 Centreline	51
52	Bunks & Honeycomb Bulkhead	CPO Berthing	2 Deck	2-171-3-L	Frame 171 Starboard	52
53	Cupboards	CPO Berthing	2 Deck	2-171-1-L	Frame 171 Starboard	53
54	Honeycomb Bulkhead	Galley	2 Deck	2-180-0-Q	Frame 184 Starboard Outboard	54
55	Honeycomb Bulkhead and Fittings	Galley	2 Deck	2-180-0-Q	Frame 184 Starboard Inboard	55
56	Bench & Cupboards	Galley	2 Deck	2-180-0-Q	Frame 188 Starboard Inboard	56
57	Cupboard	Galley	2 Deck	2-180-0-Q	Frame 203 Starboard Inboard	57
58	Honeycomb Bulkheads & Cupboards	Galley	2 Deck	2-180-0-Q	Frame 210 Starboard Outboard	58
59	Honeycomb Bulkheads & Cupboards	Galley	2 Deck	2-180-0-Q	Frame 210 Starboard Inboard	59
60	Honeycomb Bulkhead	CPO Dining Space	2 Deck	2-180-2-L	Frame 187 Port	60
61	Honeycomb Bulkhead	CPO Dining Space	2 Deck	2-180-2-L	Frame 195 to Frame 199 Port	61
62	Honeycomb Bulkhead	Scullery	2 Deck	2-203-2-Q	Frame 203 Port (2-180-4-L printed on bulkhead)	62
63	Cabinets	JS Dining Area	2 Deck	2-212-0-L	Frame 214 Starboard	63
64	Cabinet	Repair #5	2 Deck	2-225-1-A	Frame 230	64
65	Shelving	General Workshop	2 Deck	2-292-2-Q	Frame 300 Port	65
66	Fan	General Workshop	2 Deck	2-292-2-Q	Frame 316 Port	66
67	Desk & Honeycomb Bulkhead	Disbursing Office	2 Deck	2-328-0-Q	Frame 328 Centreline	67
68	Cabinets	Aft Repair #3	2 Deck	2-344-2-A	Frame 350 Port	68
69	Honeycomb Bulkhead	PO & Coxswains Office	2 Deck	2-360-0-Q	Frame 360 Centreline	69
70	Honeycomb Bulkhead	Junior Sailors Sanitary Space	3 Deck	3-113-0-L	Frame 113 to Frame 123 Centreline	70
71	Honeycomb Bulkhead	Junior Sailors Sanitary Space	3 Deck	3-140-0-L	Frame 140 to Frame 150 Centreline	71
72	Cabinets	Junior Sailors Berthing & Dressing Space	3 Deck	3-144-0-L	Frame 150 Centreline	72
73	Cabinet	Dry Provisions Storeroom	3 Deck	3-180-5-A	Frame 191 Starboard Inboard	73
74	Cabinet	Dry Provisions Storeroom	3 Deck	3-180-5-A	Frame 191 Starboard Outboard	74
75	Lamp with Extention Arm	Naval Store Storeroom	3 Deck	3-328-0-A	Frame 342 Starboard	75
76	Ironing Presses	Laundry	4 Deck	4-140-0-Q	Frame 143 & Frame 148 Port	76 & 77
77	Fans	Laundry	4 Deck	4-140-0-Q	Frame 150 & Frame 164 Port	78 & 79
78	Workbench and Cabinet	AMR3	3 Deck	5-292-0-E	Frame 300 Starboard	80
79	Trunking	Upper Deck	02 Deck		Frame 178 Port	81
80	Trunking	Upper Deck	02 Deck		Frame 180 Starboard	82
81	Trunking	Upper Deck	02 Deck		Frame 182 Starboard	83
82	Trunking	Upper Deck	02 Deck		Frame 292 Starboard	84
83	Trunking	Upper Deck	02 Deck		Frame 293 and Fame 294 Port	85
84	Trunking	Upper Deck	02 Deck		Frame 303 Port	86
85	Trunking	Upper Deck	02 Deck		Frame 313 Port	87
86	Guardrails	Upper Deck	02 Deck			88, 89 & 90
87	Guardrails	Upper Deck	01 Deck			91
88	Guardrails	Upper Deck	1 Deck			92, 93, 94 & 95
89	Portable Gun Mount Shield	Upper Deck	1 Deck		Frame 168 Port	96
90	Portable Gun Mount Shield	Upper Deck	1 Deck		Frame 171 Starboard	97

Advisian
WorleyParsons Group

Department of Industry Crown Lands and Water
Ex-HMAS Adelaide Artificial Dive Reef
Revised Long Term Monitoring and Management Plan - 2017-2026

NSW GOVERNMENT Department of Industry Lands

Appendix D Ship Drawings – CD ROM

Appendix E Summary of Findings From the First Five Years of Monitoring

Monitoring of Structural Integrity, Stability and Position

Underwater Inspection by McLennans Diving Service - 18th May 2015.

The 18th May 2015 underwater inspection was undertaken by McLennans Diving Service following two significant East Coast Lows. The report prepared by McLennans (10th June 2015) provided the following details regarding impacts to the vessels structure:

- The starboard helicopter hangar wall was missing for a length of 10.5 m horizontally and its full height vertically.
- Four vertical frames were missing (sheared off their weld points at the deck). At the top of the wall the frames had sheared off the corresponding roof frames, taking the knee braces with them.
- There was a loose section at the forward end of the gap which was cracked horizontally for 700 mm near the top and bottom (at the time of survey this section was not moving but was predicted to break off in the next big swell).
- The missing wall relived pressure on the remaining hanger by allowing improved water flow through the hanger, however, one side of the roof had become unsupported. It was expected that the roof would tear apart when the next significant swell hit. If it collapsed downward (rather than onto the seabed) it would present a significant obstruction.

  A review of the above report was undertaken by Shearforce Maritime Services Pty Ltd on 23rd June 2015. Following the review it was the opinion of Shearforce Maritime Services Pty Ltd that:

- The structure forward of the helicopter hanger transverse bulkhead was structurally sound. However, the starboard hanger top structure may deteriorate over time due to a lack of support of the starboard side, therefore this area should be monitored over time.
- Diving activities around the starboard hanger should be suspended and all visiting divers warned to stay clear of that area due to risks associated with jagged metal from the failed areas.

Underwater Inspection by McLennans Diving Service – 13th April 2017.

The most recent annual underwater inspection to monitor structural integrity, stability and position was undertaken by McLennans Diving Service on 13th April 2017. During this inspection McLennans divers made two full sweeps from bow to stern and observed the major monitoring points listed in the LTMMP. The report prepared by McLennans following this dive inspection (dated 18th April 2017) provided the following details:

Structural Integrity

- Steel Hull – Remained unchanged since the previous inspection. No sign of any cracking or deformations. Main deck was free of cracking with no signs of warping. The hull had a uniform coverage of marine life with few signs of corrosion outbreaks. Corrosion levels appear to be very low. Hull was fully supported by the sand with no scouring observed. The sand level was very close to the ships waterline.
- Aluminium Superstructure – No new cracking of the superstructure was seen. Cracks that existed in the lift shaft area on Deck 02 had not propagated since the previous year's monitoring. The previously jagged edges of the cracks were now completely covered in marine growth indicating a low level of movement.
- LTMMP Monitoring Locations - A number of monitoring locations were examined and showed no new signs of deterioration or deformation.
- Internal Debris – All accessible portals above 30 m were verified as clear. The large swell restricted access to the internal parts of the wreck.

Vessel Stability

- In 2012 the vessel developed a 4 degree list to port. This list remained unchanged in the 2017 inspection.

Vessel Position and Settlement

- Vessel position was unchanged since the previous annual inspection. The trim was unchanged based on water depth measurements at the bow and stern. The vessel had not moved its horizontal position as tested using a GPS.

Corrosion

- No signs of corrosion were observed. Previous inspections had shown tell-tale signs of corrosion (red rusticles on the hull and white corrosion deposits on the superstructure) which were no longer present. The 100% cover of marine growth on exterior surfaces of the vessel indicates that the metal underneath is very stable.

Marine Life

- Marine growth was thicker and more widespread with well-developed over the aft deck, dense cunjevoi and anemones on the upper decks as well as kelp (Ecklonia) beds.
- Fish life was rich.

Conclusions

- Vessel was unchanged since previous annual inspection in June 2016.
- No new dangers were found that could affect recreational divers.
- No signs of corrosion were observed.
- Hanger damage was stable.
- No change in the ships position or list had occurred.

Images from this inspection can be found in the original report (McLennans Diving Service 2017).

A review of the above report was undertaken by Shearforce Maritime Services Pty Ltd on 20th April 2017. Following the review it was the opinion of Shearforce Maritime Services Pty Ltd that:

- The vessel was structurally sound and stable. There were no new factors that may affect recreational divers.

Reef Community Monitoring

The reef community monitoring surveys aimed to gain an understanding of:

1. The types of flora and fauna assemblages present.
2. The rates of development of fouling assemblages and changes over time.
3. Variation in the rates of development of fouling assemblages on different surfaces of the vessel (i.e. horizontal vs vertical).
4. The presence of introduced or pest species.

After a baseline survey (WorleyParsons 2011) and 13 post-scuttling surveys (Cardno 2016b), a total of 42 taxa / taxon groups were identified on the vessel, with the ten most numerically abundant taxa in terms of percentage cover being serpulid, barnacle and encrusting algae matrix (57.8%), large barnacles and brown filamentous algae (7.2%), solitary ascidians (6.7%), serpulid polychaetes (6.5%), jewel anemones (4.4%), brown filamentous algae (4.3%), kelp (2.3%), early colonising matrix (2.2%), base surface (1.3%) and red encrusting algae (1.3%) (Cardno 2016a and 2016b).

Multivariate analysis indicated that there were changes in reef assemblages over time, with significant differences in the overall assemblage composition between surveys (regardless of transect position / orientation). During the baseline survey very little growth was observed. Survey 1 was characterised by relatively monospecific matrices of serpulid worms and / or serpulids with barnacles and encrusting algae. Surveys 2 and 3 were similar to Survey 1 but also included solitary ascidians. Surveys 4 to 9 were

characterised by a high percentage of serpulids, barnacles and encrusting algae. The most recent surveys (Survey 11 to 13) were represented by more taxonomically diverse assemblages with jewel anemones, solitary ascidians, yellow sponges and brown filamentous algae (Cardno 2016a and 2016b). Ongoing changes in reef assemblages on the Ex-HMAS Adelaide indicate that the epibenthic assemblage is still developing and has not yet reached a state of equilibrium (Cardno 2016a and 2016b). To reach a state of equilibrium has been shown to take several decades, rather than years (Perkol-Finkel and Benayahu 2007) so may only be seen after much longer term surveys.

Surface orientation was a significant factor in structuring the epibenthic assemblages on the vessel for the first five years post-scuttling. The assemblages associated with horizontal deck surfaces were significantly different from those on the vertical surfaces of the hull during all surveys. The taxa predominantly associated with horizontal deck surfaces were serpulids with barnacles and encrusting algae matrix, red encrusting algae and red filamentous algae. Kelp (*Ecklonia radiata*) was only recorded on horizontal deck surfaces (mainly in the mid-ship area) and never on vertical surfaces over the five year period. The vertical surfaces of the vessel were consistently inhabited by solitary ascidians (e.g. *Herdmania momus*) and anemones (e.g. the jewel anemone, *Corynactis australis*), for all surveys during which they were recorded. Bryozoans and sponges were only ever recorded on vertical surfaces (and were only recorded in some of the 13 surveys) (Cardno 2016a and 2016b).

Depth was also a significant factor in structuring the epibenthic assemblages on the vessel for the first five years post-scuttling. Assemblages associated with deep surfaces between 20 – 30 m were significantly different to those associated with shallower 13 – 20 m surfaces across all surveys. Shallow transects were characterised by the presence of kelp (*E. radiata*), brown algae (*Lobophora sp*.) and red encrusting algae (which were not present on deep photo quadrats or had comparatively lower percentage cover). Serpulid, barnacle and encrusting algae matrix occurred on both shallow and deep surfaces but was consistently more prevalent on the deeper transects (Cardno 2016a and 2016b).

Fixed photograph analysis (of various ship structures) showed a rapid colonisation of the vessel during the first six months post-scuttling with an encrusting layer of serpulids, small and large barnacles, filamentous and encrusting algae, bryozoans and hydroids. More complex structures e.g. ladders, railings and mast structures, were quickly colonised by large barnacles, solitary ascidians, as well as a matrix of filamentous algae, hydroids, sponges and bryozoans. Over time kelp, white papillate sponges, soft tree corals and small tubular sponges appeared on the fixed photo surfaces. In general, after an initial rapid colonisation, the encrusting layer gradually developed over the first five years post-scuttling, with subtle differences in thickness and complexity between different structures seen (Cardno 2016a and 2016b).

While not a requirement of the original LTMMP, fish species utilising the vessel were recorded during all reef surveys. Fish taxa identified during the 13 post-scuttling surveys included 62 species from 31 families. There was a clear increase in the number of species identified over time. The family Monacanthidae (leatherjackets) was represented by the highest number of species (seven species), Labridae (wrasses) by six species, Carangidae (trevallies, jacks, mackerels and scad) by five species, Pomacentridae (damselfishes) by four species, Serranidae (bass and grouper) by three species and Cheilodactylidae (morwongs) by three species. All other families had less than one or two species.

Many of the species were recorded only once over the five year monitoring period. No species of threatened or protected fish were recorded (although anecdotal evidence suggests that grey nurse sharks, *Carcharius taurus*, may occur at the site on occasion) (Cardno 2016a and 2016b).

No marine pest species listed by NSW DPI which are known to occur in NSW, or known to occur in Australia, were detected on the vessel in any photquadrats, fixed photos, video footage or scrapings taken during the first five years of post-scuttling monitoring. However, one species of potentially introduced barnacle, the Panamanian large barnacle (*Megabalanus coccopoma*) has been observed on the vessel. While this species, and similar introduced species, may be problematic as fouling organisms, they do not pose a threat to native species or ecosystems (Cardno 2016a and 2016b).

Although no marine pest species have been identified on the vessel to date, the methods used for identification to date have been limited to diver observation, photquadrats and video footage. Cardno (2016a) notes that any small and cryptic pest species e.g. crabs, mussels and fan worms, would now be difficult to identify using these methods alone, as they can be well camouflaged or found in crevices and overhangs. Going forward, a greater variety of marine pest survey methods, targeted at species of interest which have the potential to occur on the vessel (see Cardno 2016a) would be more suitable for the detection of marine pests.

The full reef survey dataset can be found in WorleyParsons (2011b) and Cardno (2016b), along with the specifics of the survey methods and locations for the first five years of monitoring. This report should be referred to for any future reef surveys to allow for meaningful comparisons of changes in reef assemblages on the vessel over longer time periods.

Overall, the reef community monitoring program undertaken during the first five years post-scuttling has met the following aims of the original LTMMP well:

1. It has documented the types of flora and fauna present on the vessel.
2. It has described the rates of development of fouling assemblages and changes over time.
3. It has described variation in rates of development on different surfaces of the vessel.

Considering this, it is not thought that any further reef community monitoring to meet the above aims are necessary. Further surveys undertaken for ecological research or educational purposes could be undertaken outside the ongoing scope of the LTMMP and would provide information on long-term changes at the site. However, no further reef community monitoring to manage environmental risk or safety is considered to be required.

Since the methods adopted during the first five years of monitoring are no longer considered appropriate to properly survey the ship for the occurrence of marine pests (due to the now complex structure and thickness of the reef assemblages), ongoing targeted surveys for marine pest species utilising additional survey methods are recommended (at a reduced frequency).

Sediment Quality Monitoring

The main findings of the first five years of sediment monitoring were summarised by Cardno in their *Review of Ecological Monitoring Five Years Post-scuttling* (Cardno 2016a) as follows:

- In general, the metal concentrations recorded 62 months post-scuttling (June 2016) were similar to those recorded one month post-scuttling (May 2011), indicating that there were no significant long-term effects on sediment quality as a result of the vessel being scuttled.
- There was one exception to the above pattern which was aluminium – aluminium showed an overall increase in concentrations at the impact sites 62 months post-scuttling when compared to one month post-scuttling. The increase appeared to be greater at the impact location than the control location (in June 2016) which may indicate metal corrosion associated with the vessel. However, the difference was not statistically significant due to large variation between control samples.
- Particle size distribution was relatively uniform across sites and therefore was not considered to be a factor in the differences seen in aluminium concentrations between the control and impact sites.
- Metal concentrations recorded six months post-scuttling (October 2011) and 21 months post-scuttling (January 2013) were notably lower than the levels recorded one and 62 months post-scuttling.
- All metals measured for which ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines (ISQG) are available (i.e. chromium, copper, nickel, lead and zinc) had concentrations that were well below the ISQG low trigger values and therefore were not considered to be a contamination risk to the marine environment.

Bioaccumulation Monitoring

WorleyParsons undertook the baseline biomonitoring survey on the Ex-HMAS Adelaide one week post-scuttling using the blue mussel, *Mytilus edulis*, as a test organism. Results of the baseline survey showed significant differences in metal (chromium, zinc and lead) concentrations in blue mussel tissue between baseline controls (i.e. mussels sampled from the aquaculture facility prior to deployment) and the vessel impact monitoring sites (i.e. mussels deployed onto the vessel). Concentrations of metals were higher in samples which had been deployed near the vessel (WorleyParsons 2011). Samples from the control sites located ~ 35 m from the vessel were all lost in large seas and via suspected tampering so could not be tested and compared. So without any local or control site data on metal concentrations in blue mussels located away from, but in the vicinity of, the ship this result could not be directly attributed to the presence of the vessel (WorleyParsons 2011).

Results of further biomonitoring surveys undertaken by Cardo Ecology Lab (2012) at seven and 15 months post-scuttling (using the Sydney rock oyster, *Saccostrea glomerata,* as a test organism) showed that chromium concentrations in oyster tissue increased slightly over time at the stern of the ship (however this was also the case for baseline controls – the samples from the aquaculture facility). Concentrations of chromium at midship appeared to decrease substantially from seven to 15 months (although there was a high level of variation in the seven month samples). Zinc concentrations in oyster tissue also increased marginally over time at the stern of the ship and baseline control while concentrations at midship decreased (Cardno Ecology Lab 2012, Cardno 2016a).

Statistical analyses of the data showed no significant differences in the concentration of chromium or zinc in oyster tissue between the seven and 15 month sampling events or between control and impact samples. No oyster tissue samples had concentrations of chromium or zinc which were considered to be of toxicological significance. In summary, the results of the bioaccumulation study showed that there was no contamination of marine biota via zinc chromate paint over the 27 month post-scuttling monitoring period. However, issues with the loss of some samples limited interpretation of results (Cardno Ecology Lab 2012, Cardno 2016a).

More detailed methods and results can be found in WorleyParsons (2011), Cardno Ecology Lab (2012) and Cardno (2016a). These should be referred to for any future biomonitoring.

Appendix F RMS Commercial Mooring Licence Standard Conditions

NSW GOVERNMENT Transport Roads & Maritime Services

THIS IS EXTREMELY IMPORTANT
KEEP FOR REFERENCE

Commercial Mooring Licence Standard Conditions

FAILURE TO COMPLY MAY RESULT IN THE CANCELLATION OF YOUR MOORING LICENCE.

Note:

- Commercial moorings are only issued to:
  - **a business entity or person approved by Roads and Maritime Services**, as trading to provide approved marine type services to the boating public (eg: boat repair, marinas, commercial fishing, charter vessels, boat brokerage, mooring contractor); and
  - Any other business which cannot be accessed by means other than the water ie: there is no land access.
- Commercial moorings can only by sub-let if associated with a marina/boatshed (ie premises consisting of one or more moorings, pontoons, jetties, piers or other structures (whether water-based or landbased)) designed to provide:
  - Accommodation for, or means of securing vessels;
  - Preferably a Slipway, or some other way of taking a vessel out of the water; and
  - One or more of the following, or similar services for vessels: shipwright service, sewage pumpout facilities, dinghy/tender storage, fuel, engineering service, mechanical repair service, tender service, or provisioning services
- The mooring sites may only be used in accordance with the approved purpose of the Licence.

The mooring

The licensee must ensure that:

- The **mooring apparatus** (block and chain) **must be suitable** for the vessel attached thereto and for the mooring area allocated having regard to all possible adverse conditions, including potential flooding in the area. In view of the Mooring Licensee's responsibility in relation to the mooring and mooring apparatus it is strongly recommended that a professional mooring contractor is consulted to ensure that an appropriate mooring apparatus is provided and that it can withstand possible flood conditions when necessary.

- **The mooring apparatus must be kept in good condition and be serviced every 12 months or more frequently if subject to specific mooring conditions. It is strongly recommended that it be serviced by a professional mooring contractor. Proof of mooring service must be produced on request. Roads and Maritime Services will randomly require documentary proof of mooring service.**

- The **mooring buoy must be orange** (unless otherwise approved by Roads and Maritime) or **red for clubs**, be of the preferred type and meet the standard and have the issued identification number on it in characters at least 50mm high.
- Where a **pole/post mooring** exists it **must be kept in good condition** and have the issued Mooring Licence Number on it in characters at least 50mm high starting 250mm from the top in black letters on a white background and face the navigation channel. Nothing is to be attached to/or between the posts except the licensed vessel, without the written permission of Roads and Maritime.
- The **mooring buoy** must be lifted from the water when the vessel is moored. It **must be secured on the foredeck** of the vessel in a way that ensures the identification number can be clearly seen from a passing vessel.

The vessel on a commercial mooring

The licensee must ensure that:

- Only **one vessel is to be attached to each mooring** (unless written approval is given by Roads and Maritime).

- **The vessel is registered or holds a Certificate of Operation** and in survey if required to be under the ***Marine Safety (Domestic Commercial Vessel) National Law Act 2012***, at all times. **NSW registration** or a **NSW issued Certificate of Operation** is required if the vessel has been in NSW for three months or more.
- **The vessel is properly displaying appropriately sized registration** numbers in accordance with the Marine Safety Regulation 2016 and as outlined in the NSW Boating handbook or a vessel Unique Identifier in accordance with the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012*.
- **The vessel is not the subject of any construction, alteration repair work or use** at the mooring that causes, or is likely to cause, annoyance or pollution or contravention of any Regional or Local Environment Plan implemented under the Local Government Act. Approval from Roads and Maritime is also required.
- **The vessel is visually suitable** for the mooring area allocated and is **maintained in a seaworthy condition** (ie, capable of undertaking a voyage under its own power/sail).
- The vessel only occupies the mooring in pursuance of the approved purpose of the Licence and for no other purpose.
- **They are aware that it is prohibited to permanently live onboard a vessel attached to a mooring licensed by Roads and Maritime.** Contact Roads and Maritime for details.

Other

- **The Mooring Licensee is responsible at all times for damage caused by the licensee's vessel (or vessel in their charge) and/or mooring apparatus to any other vessel or property.** It is strongly recommended that the Mooring Licensee have adequate insurance to cover such contingencies as Roads and Maritime bears no responsibility.
- The Mooring Licensee's use of the mooring constitutes acceptance of the allocated mooring site as suitable for the licenced vessel with specific regard to sea room and water depth. Roads and Maritime bears no responsibility in relation to suitability.
- Mooring **fees are payable** until the date that the Mooring Licensee advises Roads and Maritime, in writing, of cancellation, or the date the mooring apparatus/vessel is/ are removed, whichever is the later.

- **Mooring fees are to be paid** on or before "the pay by date".
- **No more than the maximum number of mooring sites** specified by the Commercial Mooring Licence may be in the water.
- The Mooring Licensee must promptly advise Roads and Maritime of any change to the Commercial Mooring Licence details. Change of address/contact telephone number may be advised by phone, however all other changes must be advised in writing.
- The mooring licence may be transferable on sale of the business, subject to Roads and Maritime, and any other statutory approval that may be necessary.
- Roads and Maritime may impose additional conditions to be met by a Commercial Mooring Licensee.

Removal of mooring apparatus

The former Mooring Licensee* must provide to Roads and Maritime within 7 days of cancellation of the Mooring Licence a Statutory Declaration or other written evidence (from a mooring contractor or professional diver) that the mooring apparatus has been removed from the water, unless some other arrangement has been agreed with Roads and Maritime.

Failure to provide the required written evidence may result in Roads and Maritime conducting a check to establish whether the mooring apparatus has been removed. Any cost associated with such inspection, and any associated removal of the mooring apparatus, if applicable, will be the responsibility of the former Mooring Licensee*.

*former Mooring Licensee is the Licensee as at the date of mooring cancellation.

REMEMBER, FAILURE TO COMPLY WITH ANY CONDITION MAY LEAD TO CANCELLATION OF YOUR COMMERCIAL MOORING LICENCE

For further information please contact Roads and Maritime on **13 12 36** (8.30am to 5.00pm Mon to Fri and 8.30am to 4.30pm weekends) or visit our website **www.rms.nsw.gov.au**

NSW GOVERNMENT Transport Roads & Maritime Services

www.rms.nsw.gov.au