Australian Government

Department of Agriculture, Water and the Environment

Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

INITIAL ENVIRONMENTAL EVALUATION RSV *NUYINA* OPERATIONS 2021-2024

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Contents

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1 NON-TECHNICAL SUMMARY

1.1 Introduction

The Australian Antarctic Division (AAD) has prepared this Initial Environmental Evaluation (IEE) to assess the potential environmental impacts associated with the operation of the Australian icebreaker RSV *Nuyina* from October 2021- June 2024. The Vessel has been designed and constructed to support the resupply of Australia's three Antarctic research stations and as a platform for supporting marine and atmospheric science in Antarctica and the Southern Ocean with and operational life of 30 years. The AAD proposes to continue using shipping to support the achievement of the Australian Government's Australian Antarctic Strategy and 20 Year Action Plan and goals of:

- Maintaining the Antarctic Treaty system and enhancing Australia's standing within the system,
- Protecting the Antarctic environment,
- Conducting world-class science, and
- Understanding the role of Antarctica in the global climate system.

This multi-year IEE has been prepared on the basis that station resupply operations for the next three years will continue at similar levels and over a similar geographic range used to support Australia's Antarctic program over the last decade. The increased cargo and logistics capability provided by the RSV *Nuyina* will enable the Australian Antarctic program to achieve greater efficiency in operations and station resupply, thus providing increased opportunities to conduct marine science in the Southern Ocean.

1.2 Description of the Proposed Activity

The AAD is responsible for the Antarctic research stations Casey, Davis and Mawson (and the sub-Antarctic station at Macquarie Island). These stations are dependent on seasonal resupply, normally performed during October to April. Annual resupply is essential to maintain station operations and Australia's year-round presence in Antarctica. Ice strengthened and icebreaker vessels are the principle means by which supplies (primarily dry cargo, fuel and water), equipment and expeditioners (personnel), are transported from Hobart to the research stations and are a vital platform for conducting science in the Southern Ocean.

RSV *Nuyina's* primary roles are to be a platform for station resupply and scientific research. RSV *Nuyina's* secondary purposes are to support the capability of Australia's other agencies and to contribute to emergency response (both Australian and international) as required.

Resupply Overview

The profile of future annual station resupply operations, for the RSV *Nuyina,* for each AAD research station, are provided in detail in Section 3 of this IEE. Resupply operations may be completed in a single station voyage, or as part of a multiple station resupply voyage. Voyage and station resupply programs will depend on the amount of cargo and expeditioners needing transport to and from respective stations. Voyages may be any combination and adaptation of the examples described below:

- A combined marine science and resupply voyage to any research station. Extension of a resupply voyage to encompass more extensive marine science activities including data and sample collection program,

- A multiple station resupply voyage could require any combination of key vessel to shore interface enablers including barges, amphibious vehicles (LARCs), helicopters, dedicated science tender, workboats and other small watercraft, and

- A combined voyage may support the delivery of supplies to more than one of the Antarctic stations and the sub-Antarctic station, combinations typically may include;

  (i) Mawson and Davis research stations, or
  (ii) Casey and Macquarie Island research stations.

Scientific Research Overview

RSV *Nuyina* will provide Australia's only icebreaking scientific research platform. The Vessel will provide a flexible platform supporting numerous sample and data collection systems along with associated services and workspaces for analysis and support.

Scientific equipment and support systems can be modified, installed and integrated into the Vessel permanently or temporarily as required to meet changing scientific requirements. This will range from simple configuration of temporary equipment for a particular voyage, through to significant engineering works to prepare for a major scientific research task.

Underway data collection will be conducted on all voyages, with usually one voyage each season dedicated to scientific research activities. A science voyage may be undertaken any time of year and will require a unique combination of science capabilities fitted to the vessel, often designed to support novel activities to enable new science. Science projects will require separate environmental approvals from this IEE.

1.3 Alternatives to the Proposed Activity

Currently the only feasible way to resupply the Antarctic stations with the quantity of food, stores, fuel and in some cases potable water is by ship. It is anticipated that as Australia's Antarctic stations are modernised over time, their needs will increase. The AAD does not have reliable access to a viable alternative vessel or vessels to undertake this activity. The reliance on other Antarctic program vessels or the use of leased vessels presents an unsustainable risk to maintaining three, year-round, Antarctic Research Stations and maintaining Australia's national interests in Antarctica.

Whilst some expeditioners and seasonal workers are currently flown in and out of Antarctica via Wilkins Aerodrome, there is insufficient capability to transport all necessary people by air and so passage on the ship will be required into the future. This situation may change if a year-round aviation capability becomes available, however, this is subject to separate feasibility and environmental assessment processes and the capability would not be realised until the late 2030's.

The scope of marine science in Antarctic waters requires that a blue water ice capable ship is available as a science platform. Hence, the RSV *Nuyina* is fitted with a sophisticated suite of scientific equipment purposely chosen for operation in Antarctic waters, as well operations below 60° south.

1.4 Impact Assessments

An assessment of the potential environmental impacts is included in this IEE. The majority of impacts identified are mitigated through the vessels systems as well as existing and new operating procedures including in RSV Nuyina's Environment Management Plan (EMP).

The most significant potential impacts predicted include:

- Pollution of the environment resulting from inadvertent release of fuel oil, oily water, sewage or waste,
- Pollution and emission to the environment from diesel engine exhaust,
- Impacts on wildlife through collisions, underwater noise and light,
- Wildlife disturbance from the operation of helicopters and remotely piloted aircraft,
- Impacts on near shore communities from anchors and small vessel operations, and
- Introduction of non-native species through cargo operations or as a result of biofouling.

1.5 Mitigation Measures

The following examples of mitigation measures address the abovementioned potential impacts. The EMP provides further detail on how such measures will be implemented during vessel operations:

- A comprehensive environmental monitoring plan will support RSV Nuyina operations.
- All oil and fuel tanks separated from the hull by compartments and double bottoms,
- Extensive safety and navigational systems such as ice radar, navigation radars and the use of satellite ice imagery,
- No oil/oily water/sludge, sewage (raw or treated) including grey water to be discharged overboard in Antarctic waters,
- Shipboard Oil Pollution Emergency Plan (SOPEP) and the provision of oil spill kits and oil spill booms,
- Vessel operated to maintain international Air Pollution Certificate, use of fuel additives to reduce Nitrogen Dioxide, NO2 emissions and fuel efficiency measures to reduce emissions,
- Vessel design, maintenance and operating procedures to consider minimising underwater noise as far as practical.
- External lighting minimised for safety and navigation purposes and black out blinds used to prevent light pollution, external to ship,
- AAD operating procedures and guidelines for helicopters and drones to be followed to mitigate potential impacts when in wildlife sensitive areas,
- AAD watercraft operating procedures to mitigate interactions between watercraft and wildlife and ensure low speed movements reduce wake and minimise impacts on benthic communities and sediments from turbulence by propulsion jets and propellers,
- Established anchorages and landing areas to be used,
- Purpose built dockside cargo biosecurity facilities and comprehensive operating procedures,
- AAD biosecurity training for expeditioners and crew and AAD biosecurity procedures include screening, treatment, surveillance and response measures, and
- Vessel biofouling plan.

1.6 Environmental Monitoring and Management

Key environmental indicators, activities and incidents will be monitored to ensure unforeseen and predicted impacts are monitored and managed appropriately. Monitoring activities will include audits and assessment of vessel systems undertaken to maintain compliance with international standards and the AAD's environmental policy and commitment to continuous improvement.

This environmental monitoring and reporting will be undertaken to:

- Ensure impacts are avoided or limited consistently with the environmental principles of the Madrid Protocol,
- Evaluate the IEE's conclusion that the impacts of shipping operations are likely to remain minor and transitory,
- Inform any changes needed to practices to comply with any impact thresholds described in the IEE and associated management systems,
- Ensure that environmental impacts are not in conflict with the community's expectations in relation to Antarctica's protection, and
- Inform the mitigation of any unforeseen and potentially significant impacts associated with shipping operations as described in this IEE.

1.7 Conclusion

This assessment concluded that the operations of RSV *Nuyina,* as described in this IEE, will result in some environmental impacts. However, provided the mitigation, monitoring and reporting measures described in this document are adhered to, these impacts will be no more than minor or transitory.

2 INTRODUCTION AND SCOPE

2.1 Introduction

Australia's Antarctic program is managed on behalf of the Australian Government by the Australian Antarctic Division of the Department of Agriculture, Water and the Environment. The AAD is tasked with advancing Australia's strategic, scientific, environmental and economic interests in the Antarctic by protecting, administering and researching the region. To this end, Australia maintains three research stations on the coast of East Antarctica – Casey in Wilkes Land, Davis in Princess Elizabeth Land, and Mawson in Mac Robertson Land.

In April 2016, the Prime Minister launched the Australian Antarctic Strategy, and 20-year Action Plan, which sets out Australia's national interests and our vision for Australia's future engagement in Antarctica. The new Icebreaker RSV *Nuyina* is the centrepiece of this strategy.

A multi-purpose icebreaker with capacity to resupply Australia's Antarctic station network and to support scientific research in the sea-ice zone and coastal fringe is an essential component in delivering Australia's national interests in Antarctica. Without access to the capability to undertake these tasks, either in a single ship, or use of multiple ships, Australia would be unable to operate its Antarctic stations or undertake scientific research in the sea-ice zone.

2.2 Icebreaker Project Background

Since 1990 the *Aurora Australis* has contributed, in conjunction with other ships, to the resupply of Antarctic and subantarctic stations and the conduct and support of scientific research. Each station requires resupply of personnel and provisions on an annual basis.

Although the *Aurora Australis* reached the end of its "design life" by 2015, a life extension and refurbishment program was undertaken to ensure continued availability of the vessel for a further period prior to the entry into service of a new shipping capability.

The keel laying for the new vessel occurred in August 2017 at a shipyard in Galati, Romania. The current timeline for the replacement icebreaking shipping capability is for delivery to Hobart late 2021. The AAD acquired interim shipping support arrangements for the 2020-2021 shipping season.

2.3 Statutory Requirements

To ensure the protection of the Antarctic environment, the Antarctic Treaty nations adopted the Protocol on Environmental Protection to the Antarctic Treaty, which came into force in 1998. Australia enforces the provisions of the Environmental Protocol through the *Antarctic Treaty (Environmental Protection) Act 1980* and Environmental Impact Assessment Regulations 1993. The *Antarctic Marine Living Resources Conservation Act 1981* implements the Convention of the Conservation of Antarctic Marine Living Resources.

2.4 Purpose and Scope of the Document

The purpose of this IEE is to provide details of the proposed use of RSV *Nuyina*, and to consider the potential environmental impacts and measures to minimise or avoid these impacts. This assessment covers the operations of the RSV *Nuyina* south of 60°S commencing in the 2021-22 austral summer to the 2023-4 austral summer shipping season.

This document contains the following sections:

- Section 3 describes the proposed activities,
- Section 4 proves and overview of science capabilities
- Section 5 describes the alternates considered,
- Section 6 describes the local environment,
- Section 7 describes the environmental impacts and the measures proposed to minimise or avoid them, and
- Section 8 provides the conclusions of the IEE.

A non-technical summary has been included at the beginning of the document to provide an overview of the IEE.

3 DESCRIPTION OF THE PROPOSED ACTIVITY

The AAD is responsible for the Antarctic research stations Casey, Davis and Mawson (and the sub-Antarctic station at Macquarie Island). These stations are dependent on seasonal resupply, normally performed during the period October to April, to maintain and support year-round station operations in Antarctica and on Macquarie Island. Shipping is the prime means used to deliver supplies (primarily dry cargo, fuel and water), equipment and expeditioners from Hobart to the research stations. A station resupply voyage could require any combination of key vessel to shore interface enablers including barges, amphibious vehicles (LARCs), helicopters, science tender, workboats and other small watercraft. Current and past resupply voyages to Australia's three Antarctic and one sub-Antarctic research stations are publicly available on the AAD voyage schedule page https://secure3.aad.gov.au/public/schedules/voyage.cfm.

3.1 Resupply Operations

The object of the activities is to conduct annual resupply of Australia's Antarctic research stations to facilitate the conduct of AAD sponsored scientific research, which delivers Australia's national scientific priorities and objectives.

3.2 Resupply - Davis Research Station

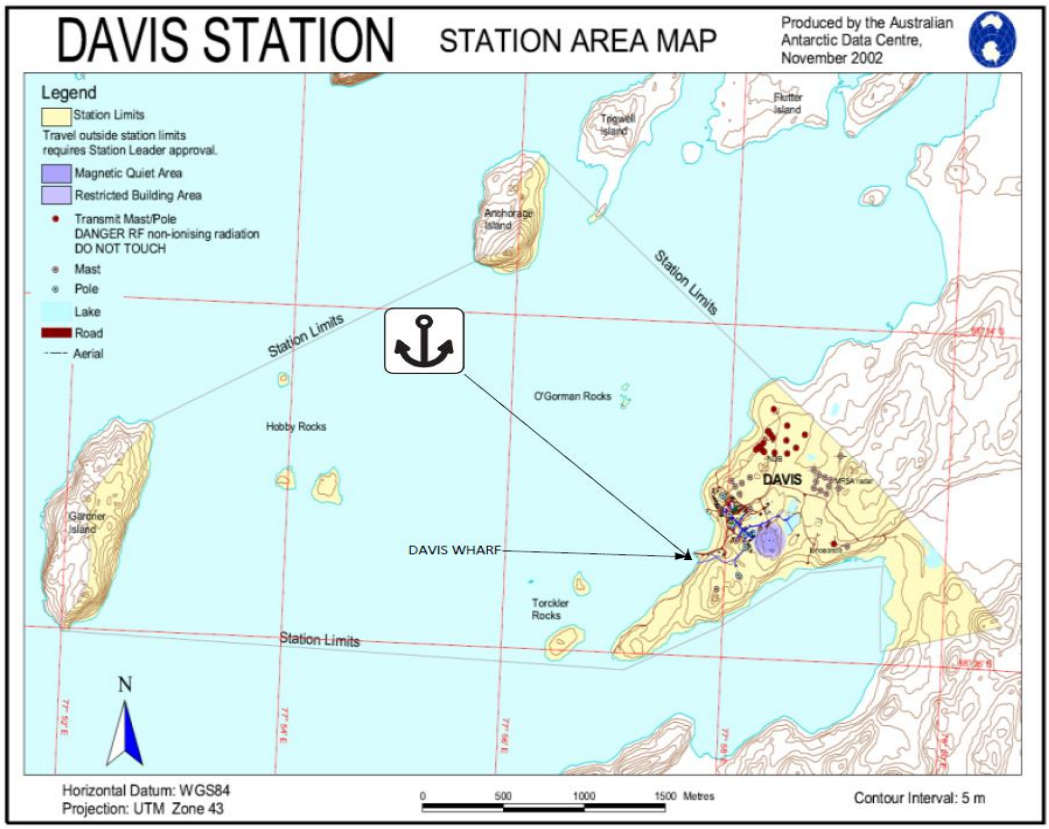
The first voyage of the season is usually dedicated to resupplying the Davis research station and may be required to transfer cargo and personnel to and from other stations en route to Davis research station. On average, the voyage transit takes between 10-13 days to cover the 2,597 nautical miles from Hobart to Davis research station. Transit time will depend upon environmental conditions and/or other en route tasks such as marine science activities or possible diversion to another research station.

The resupply voyage overarching objective is to deliver essential supplies of food and fuel as well as changeover personnel at the station. Additional personnel are also onboard, undertaking a round trip voyage, to support resupply activities such as refuelling and cargo operations. This early season resupply operation occurs in spring, usually October or November, and as such, the surrounding waters at Davis research station are usually beset in stable fast ice. The presence of suitable fast ice enables the construction of an ice road between the Vessel and the shore to support the transfer of personnel, solid cargo and bulk liquid (fuel and water) over the surface of the ice. The resupply

operation can take between 7-15 days depending upon the number of days that are unproductive due to poor environmental conditions.

It is expected that RSV Nuyina will break through the fast sea ice within one to two nautical miles from the station and maintain its position in the sea-ice without use of moorings or anchors (although position can be held through continuous use of the engines). The ice is drilled and tested for strength before cargo operations commence. The sea-ice is generally suitable for ice road operations until late November and the AAD is able to determine the gross vehicle mass (GVM) limitations for the thickness of ice on arrival. Typically, ice road operations are conducted when there is at least 1.35 metres of stable fast ice to allow the safe traverse of a 32 tonne GVM cargo vehicle.

Overwater resupply may be conducted at Davis research station when it is ice-free, utilising barges for cargo and smaller vessels for personnel transport as described for Casey and Mawson research station resupply (sections 3.3 and 3.4). In this instance the Vessel will anchor at a designated anchorage in approximately 20 metres of water and at the same location as the over-ice position (Map 1). Davis research station has a wharf that can accept two containers, twenty foot equivalent units (TEU), positioned side by side, a rough terrain 50 tonne crane, and a boat ramp to enable the driving of vehicles on and off the barges.



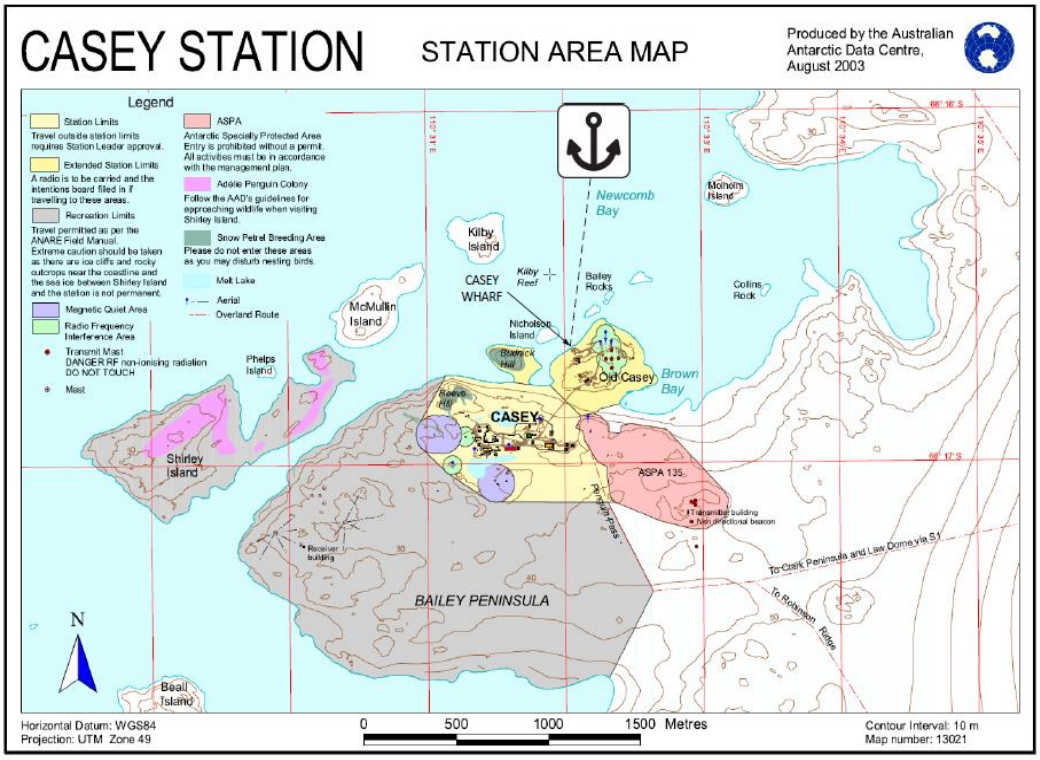
Map 1: Davis Research Station Area Map

3.3 Resupply - Casey Research Station

The resupply voyage to the Casey research station is usually a dedicated voyage due to the large volume of equipment and supplies requiring delivery each year. However, the Vessel may still also transfer some personnel and cargo to and from other stations before or after visiting Casey research station. On average the voyage transit takes between seven to 11 days to sail the 1,848 nautical miles from Hobart to Casey research station. This transit time will depend upon environmental conditions and/or other en route tasks such as marine science activities or diversion to another station. There may be a requirement to conduct icebreaking through approaches to Casey research station, over the Peterson Bank, which may cause voyage delays. The voyage is used to change over personnel at the station and also carries personnel undertaking a round trip voyage.

This resupply operation is usually at the beginning of summer, in December, and as such, the surrounding waters at Casey research station are clear of sea ice close to shore. This allows the use of barges and tenders to support the transfer of personnel, solid cargo and bulk liquid over the water to the shore. The resupply operation could take between 7-15 days depending upon the number of days that are unproductive due to poor environmental conditions.

The Vessel will usually anchor within one to two nautical miles from the station in Newcomb Bay in about 60 m of water as indicated below. The anchorage location is renowned for poor holding and the Vessel's dynamic positioning (DP) capability may be used to maintain its position when experiencing strong winds.



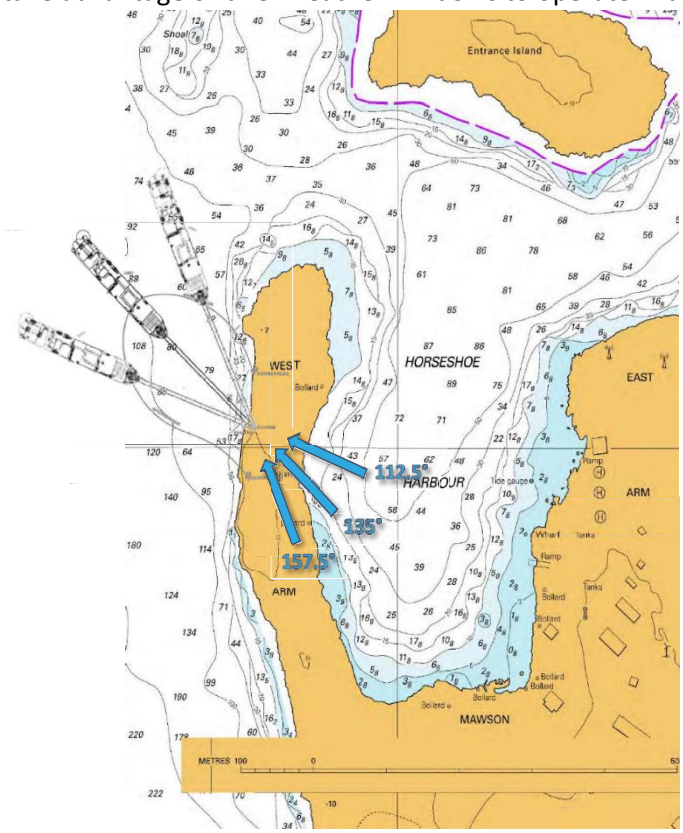
Map 2: Casey Research Station Area Map

3.4 Resupply - Mawson Research Station

The resupply voyage to the Mawson research station is usually conducted in January or February. Waters at Mawson are often unpredictable due to the prevalence of pack sea ice that is constantly moving with the changes in wind direction. The nature of these sea ice formations outside of the station's harbour does not usually support the over ice resupply operation utilised early in the season for Davis research station.

The challenging environmental conditions approaching and adjacent to Mawson station preclude access to the station's harbour until later in the season. Mawson resupply is generally a dedicated voyage or may be combined with a late season visit to Davis research station to deliver or collect cargo and personnel. In some years a purely helicopter supported resupply operation will be required if there is no clear/safe surface passage to Mawson.

On average, the voyage transit could take between 12-16 days to sail the 2,956 nautical miles from Hobart to Mawson. This transit time will depend upon environmental conditions and/or other en route tasks such as marine science activities or diversion to another research station. The resupply operation can take between seven to 15 days depending upon the number of days that are unproductive due to poor environmental conditions and the method of resupply cargo delivery. If harbour access is possible, the resupply operation will be undertaken similarly to the Casey research station over water operation described earlier. Due to its size and prevailing winds, the RSV *Nuyina* will moor close to outer West Arm using two lines secured from the bow, secured to bollards on the shore and holding position using astern thrust on the propellers (Map 3). The mooring arrangement may be assisted by dynamic positioning mode from time-to-time. Occasionally, the operation may take advantage of brief weather windows to operate in dynamic positioning mode alone.



Map 3: Mawson Research Station Area

3.5 Resupply Equipment, Logistics and Methods

3.5.1 Davis Research Station Resupply

The key activities to enable the over ice resupply operation at Davis research station are three station-based trucks, station based material handling equipment (MHE) and infrastructure, the Vessel's two main cranes, bulk fuel transfer capability, and the helideck. The trucks will conduct a line haul operation, which would see a truck arriving alongside the Vessel as often as every 20 minutes to deliver back loaded cargo before accepting resupply cargo and returning to the station. The Vessel's cranes will unload and load most cargo in TEU containers directly on to the trucks, while the Station's MHE will off load TEU, into a cargo laydown area.

Usually, two AS 350B3 helicopters will fly off the Vessel and remain at Davis research station over the summer season to support science and logistics operations before returning to Hobart on the Vessel at the end of the summer season. Helicopters are not usually used for resupply tasks during this voyage. Occasionally, helicopters are used for forward reconnaissance of sea-ice to reduce the time taken for the vessel to reach its destination.

The incoming solid cargo for a Davis research station resupply may range from between 650 and 900 tonnes per season. It may be delivered during one voyage or as part of a multiple station resupply voyage operation. The amount of solid cargo requiring back load to Hobart will vary significantly every season, but will always be less volume than the incoming resupply solid cargo.

On average, 700,000 litres of Special Antarctic Blend (SAB) diesel will be pumped ashore via a flexible lay flat fuel line connected to the shore side fuel farm, which has a maximum storage capacity of 1.2 million litres. The fuel line is deployed from a spool across the ice and is supported by a booster pump. The fuel line is then constantly monitored throughout the pumping period which typically takes 24 hours from deploying the hose to its cleaning and retrieval.

Currently the average amount of aviation fuel (JET/A1) transferred from the Vessel to the shore each season to Davis research station is approximately 165,000 litres. It is usually transported as containerised dangerous goods (DG) cargo in 20' ISO half height containers, that each hold 39 x 200 litre drums, and/or 1,000 litre Intermediate Bulk Containers (IBCs). In the future there may be an increased requirement to transport more JET/A1 in TEU bulk fuel containers and limited drum (each TEU capacity around 10,000-20,000 litres) or via a deployable pipeline from Vessel to shore.

Up to 200,000 litres of bulk potable water may be delivered to Davis research station during a voyage. It will be pumped from the Vessel to an alongside vehicle, loaded with a bulk water container. The vehicle may be alongside the Vessel on stable fast ice or on a barge if the Vessel is in open water.

There will be a requirement to transfer up to approximately 100 personnel ashore to assist with the resupply operation at the station and to conduct handovers between the outgoing winter station staff and the incoming summer rotation of personnel. These personnel are usually transported in station based passenger vehicles that could range from over snow vehicles to light four wheel drive wheeled vehicles or helicopters.

3.5.2 Casey Research Station Resupply

The key systems that enable the over water resupply operation are two barges, two personnel transfer tenders, three Caterpillar 725 trucks, station based MHE and infrastructure, the Vessel's two main cranes and bulk fuel transfer capability, and the helideck. Casey research station has a wharf, which can be used by a rough terrain crane to unload directly from a barge or tender, and a boat ramp/landing site to enable the driving of vehicles on/off the barges.

The trucks will be loaded on to the barges and receive a cargo load directly from the Vessel's crane before being transported to the shore and driving off the watercraft at the boat ramp. The trucks will then traverse to the station's cargo handling area approximately one kilometre away. The empty barge will then load another truck waiting ashore, usually with a back load, and transport it to alongside the Vessel to unload the returning cargo before reloading it with resupply cargo. The other barge will work in unison at the other end of the Vessel to shore cycle so that the barges pass each other in opposite directions to avoid choke points. This over water resupply cycle would see a barge and truck arriving alongside the Vessel as often as every 35-45 minutes (one to two nautical miles from Vessel to shore respectively). The Vessel's cranes will unload and load most cargo in TEU containers directly on to the trucks, while the station's MHE will off load the TEU, into a cargo laydown area, to avoid the manual transfer of the cargo.

It should be noted that the barges will be required to carry a large variety of cargo containers, wheeled and tracked vehicles, equipment and outsized materiel. Particularly important is the requirement for the barges to have a cargo deadweight carrying capacity of 45.5 tonnes. This caters for the larger vehicles that are often carried, like a Kalmar Rough Terrain Container Handler (with the lifting frame removed) or a Caterpillar 725 articulated truck loaded with a 21 tonne TEU (gross vehicle mass of 42 tonnes). This cargo vehicle is a key enabler to the future surface resupply process that is to be adopted when the new vessel is introduced into service. Heavier (>45.5 tonnes) indivisible loads will be transported ashore by government furnished equipment (GFE) modular pontoon barge systems (Uni-float) that will be carried as solid cargo on the Vessel.

There may be a requirement to transit two AS 350B3 helicopters with the Vessel to Casey research station to support science research operations or reconnoitre sea-ice for passage navigation. The helicopters are not usually used for resupply tasks during this voyage.

The incoming solid cargo for a Casey research station resupply can range from between 750 and 1,000 tonnes per season. It may be delivered during one voyage or as part of a multiple station resupply voyage operation. The amount of solid cargo requiring back load to Hobart will vary significantly every season, but will always be less volume than the incoming resupply solid cargo.

On average, 900,000 litres of SAB diesel will be pumped ashore via a flexible lay flat fuel pipeline connected to the shore side fuel farm, which has a maximum storage capacity of 1.3 million litres. The fuel line is deployed from a spool on a barge and fixed in position by an anchoring system established by personnel in Inflatable Rescue Boats (IRBs). The pipeline is monitored constantly for leaks and sea ice intrusion by up to three IRB crews and this operation can typically take 24-36 hours from deploying the pipeline to its cleaning and retrieval. This refuelling operation is the highest risk activity of the resupply and is only conducted in fair environmental conditions. The Vessel may also utilise its dynamic positioning capability to hold an exact position to minimise the effect of swing or drag while on the anchor and to keep the Vessel clear of the floating pipeline.

Currently the average amount of aviation fuel (JET/A1) transferred from the Vessel to the shore each season to Casey research station is approximately 165,000 litres. It is usually transported as

containerised DG cargo in 20' ISO half height containers, that each hold 39 x 200 litre drums, and/or 1,000 litre IBCs. In the future there may be an increased requirement to transport more JET/A1 in TEU bulk fuel containers and limited drum (each TEU capacity around 10,000-20,000 litres) or via a deployable pipeline from Vessel to shore.

There will be a requirement to transfer up to approximately 65 personnel ashore to assist with the resupply operation at the station and to conduct handovers between the outgoing winter station staff and the incoming summer rotation of personnel. These personnel are usually transferred to shore in the Vessel's personnel transfer tenders, station based IRB's or helicopters.

3.5.3 Mawson Research Station Resupply

The key systems that enable the Mawson over water resupply operation are two barges, two personnel transfer tenders, two Caterpillar 725 trucks, station based MHE and infrastructure, vessel's main cranes and bulk fuel transfer capability. The systems required to enable a purely helicopter enabled resupply are two to four helicopters, the helideck and winch only position. The vessel's MHE capability to transfer cargo to and from the helideck and winch only position, and the station based MHE and infrastructure.

The relatively short distance from the Vessel to the shore in the over water resupply option will generally only support single barge operations and so only two trucks will operate in the resupply cycle. This will see a truck loaded on to the barge to receive a cargo load directly from the Vessel's crane before being transported to the shore and driving off the watercraft at the boat ramp similar to the Casey research station resupply operation. The empty barge will then load the other truck waiting ashore, usually with a back load, and transport it to alongside the Vessel to unload the returning cargo before reloading it with resupply cargo. This over water resupply cycle would see the barge and truck arriving alongside the Vessel as often as every 35 minutes. The Vessel's crane will unload and load most cargo in TEU containers directly on to the trucks, while the station's MHE will off load the TEU, into a cargo laydown area, to avoid the manual transfer of the cargo. Mawson's current port facilities include a shore crane which has 10 tonnes lift capacity that can lift a load from a barge alongside.

The helicopter resupply operation could require the concurrent operation of the flight deck and winch-only position to transfer cargo to the station. The winch-only position will only transfer underslung cargo while the flight deck may be used concurrently to load underslung or internally loaded cargo, move passengers, or refuel and maintain helicopters and enable crew changes . The interval time between helicopters departing and arriving at the Vessel is dependent upon the number of helicopters in the cargo resupply cycle and the distance from the Vessel to the station.

The incoming solid cargo for a Mawson resupply can range from between 200 and 290 tonnes per season. It may be delivered during one voyage or as part of a multiple station resupply voyage operation. The cargo requirements dramatically reduce when only a helicopter resupply is conducted as only essential supplies are transferred to sustain the station through the upcoming winter. For example only 150 tonnes of solid cargo (includes containerised SAB diesel) was delivered to the station by helicopter in the 2013/14 season. Note that the AS 350B3 helicopter can carry a 1,000 kilogram underslung load or 400 kilograms internally. The amount of solid cargo requiring back load to Hobart will vary significantly every season, but will always be less volume than the incoming resupply solid cargo.

On average, 500,000 litres of SAB diesel will be pumped ashore via a flexible lay flat fuel pipeline connected to the shore side fuel farm, which has a maximum storage capacity of 1.2 million litres. The fuel line is deployed from a spool on a barge and fixed in position by an anchoring system established by personnel in IRBs. The pipeline is monitored constantly for leaks and sea ice intrusion by up to three IRB crews and this operation can typically take 12 hours from deploying the pipeline to its cleaning and retrieval. This refuelling operation is the highest risk activity of the resupply and is only conducted in fair environmental conditions. Only containerised SAB can be transferred by helicopters as underslung loads, usually in 200 litre drums or 1,000 litre IBC.

Currently the average amount of aviation fuel (JET/A1) transferred from the Vessel to the shore each season is approximately 20,000 litres. It is usually transported as containerised DG cargo in TEU half height cargo containers that hold 39 x 200 litre drums. In the future the JET/A1 may be delivered ashore in 1,000 litre intermediate bulk containers (IBCs) or TEU bulk fuel containers (capacity around 15,000-20,000 litres) or via a deployable floating pipeline from Vessel to shore.

There will be a requirement to transfer up to approximately 30 personnel ashore to assist with the resupply operation at the station and to conduct handovers between the outgoing winter station staff and the incoming summer rotation of station staff. These personnel are usually transferred to shore in the Vessel's personnel transfer tenders, station based IRB's or by helicopters.

The Vessel has capacity to carry and support the operations of a Science Tender, the acquisition of which is part of the scope of the Icebreaker project. Noting the comments above, this application covers the operation of the science tender as a watercraft only, with scientific operations subject to separate approvals.

3.6 Location of the proposed activity

Station resupply will be conducted in station operational areas with the Vessel positioned at or near to each Antarctic station, which are located as per below. No activities will be undertaken in protected areas.

Name of location(s): Davis research station, Casey research station, Mawson research station

Co-ordinates of location(s):

Davis: 68° 34 36"S 77° 58.03"E,
Casey: 66° 16' 55"S 110° 31'.39"E,
Mawson: 67° 36' 10"S 62° 52' 26"E
The map below shows the voyage routes for the 2017-18 season which are typical. Information on previous shipping schedules, situation reports and voyage tracks can be found at the following Link https://secure3.aad.gov.au/public/schedules/voyage.cfm

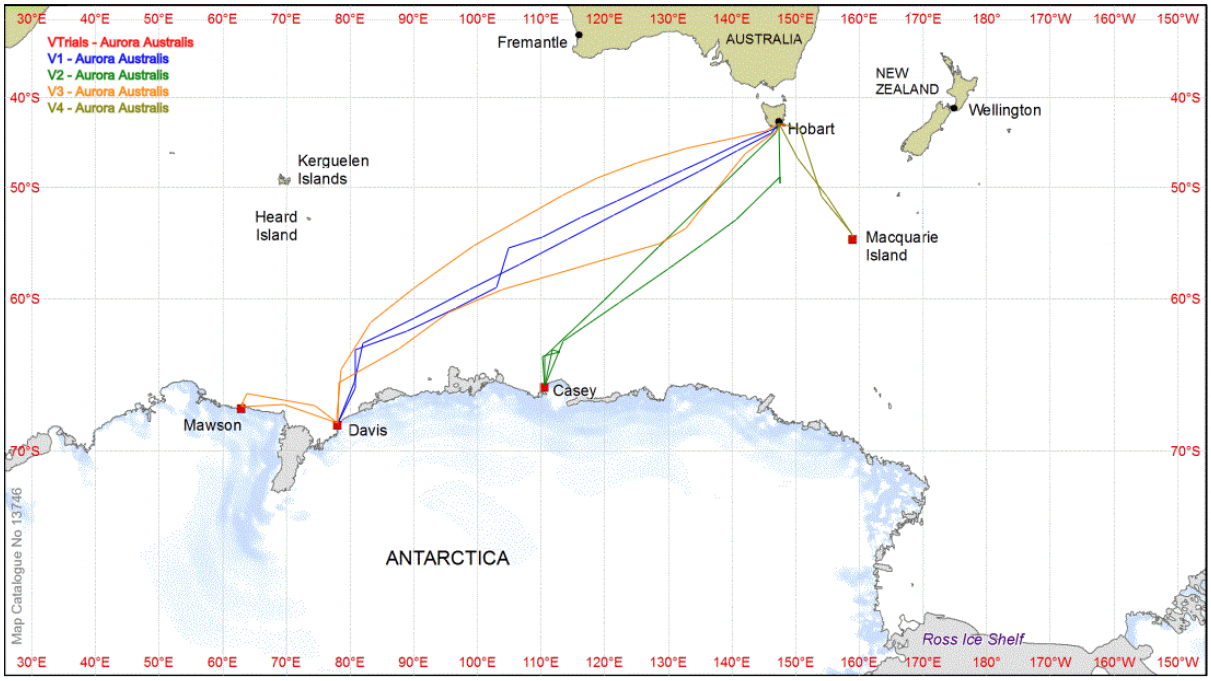


Figure 1 Typical voyage routes to Australian Antarctic stations

4 SCIENCE CAPABILITY

The following information provides an overview of the extensive scientific capability of the RSV Nuyina which will continue Australia's longstanding commitment to science in the Southern Ocean and Antarctica and the Antarctic treaty system.

A comprehensive assessment, testing and deployment of onboard science capabilities will be undertaken during the first two seasons of commissioning. Once commissioning has been completed it is anticipated that a range of onboard science capabilities will become part of RSV Nuyina's day-to-day operations in the Southern Ocean. The deployment of equipment and utilisation of science capabilities listed below will be assessed during this commissioning period and prior to their use in the Southern Ocean, consistent with Australia's obligations under the Antarctic Treaty system and domestic legislation.

4.1 Marine Science Operations

A wide variety of scientific equipment and support systems will be modified, installed and integrated into the vessel permanently or temporarily as required to meet changing scientific requirements. This will range from simple configuration of temporary equipment for a particular voyage possibly through to significant engineering works to prepare for a major scientific research task.

Underway science in some form will be conducted on all voyages supporting resupply operations. It is planned that at least one voyage each season will be dedicated to scientific research activities outside of resupply operations, referred to as a science voyage. A science voyage can be undertaken any time of year and will require a unique combination of science capabilities fitted to the Vessel that may be designed to support novel activities to enable new science. Science research tasks may be completed on a single resupply or dedicated science voyage or occasionally a major task may require multiple voyages by a range of nations, spread over many years.

The following sections provide the background to key science systems, capability and potential research conducted while the Vessel is underway during a resupply voyage or undertaking a specific marine science voyage.

The environmental impacts of underway science systems and activities will be assessed during commissioning and included in the application and assessment process for individual science projects undertaken as part of the Australian Antarctic Program. Following the end of commissioning, underway science activities will be assessed under a new IEE in 2024-25.

4.2 Science Operations – Underway

Summary

Scientific data will be collected from sensors fitted or tethered to the Vessel during every voyage that the Vessel is on task supporting the Australian Antarctic Program (AAP), including dedicated resupply voyages. Other minor science research operations may also be conducted during the Vessel's transit to the research stations, with little or no deviation from the most efficient route.

These minor activities could include deploying or recovering remote or towed sensors or sample collection systems that operate at the sustained economical cruising speed or only require short periods at slower speeds. There may also be high priority or unplanned opportune science research support tasks that would require short deviations from the direct transit route, that only usually amount to a few extra days on the voyage.

Operating Environment

The environment that underway science operations from the Vessel will be conducted is predominately in the Southern Ocean and the sea-ice zone. This region experiences some of the most severe climatic conditions and consequently, the Vessel is designed to ensure science operations underway can be supported in this harsh environment.

Key Systems

Key scientific systems will operate while the Vessel is underway, to continuously collect data, and predominately collect meteorological, oceanographic, atmospheric and acoustic data. These systems have permanent or temporary sensors attached to numerous locations on the Vessel, including the superstructure and within sea chests fitted to the Vessel's hull. The associated on-board data management systems will make this information accessible to the AAD head office through satellite communications systems while subsets of data would be automatically transferred in near real time to a variety of other science stakeholders.

Other minor science operations that may be conducted underway include the deployment and recovery of autonomous sensor systems, like moored sensors, towed sensors and sampling systems, sea water sampling in support of wet well operations, or simply observations of environmental conditions and wildlife. Some examples of minor science operations that will be conducted underway are:

- Continuous Plankton Recorder (CPR) operations,
- Krill collection from small nets or vessel wet well sampling space,

- Small mooring and drifting equipment deployment and recovery operations,
- Laboratory based experiments including seawater filtration and air sampling,
- Opportunistic sampling of seawater and sea ice,
- Weather balloon releases,
- Remote Piloted Aircraft (RPA) or helicopter operations to observe sea-ice conditions,
- Regular weather observations and weather reporting, and
- Sea-ice, iceberg and wildlife observation and reporting.

The environmental impacts of underway project specific science systems and activities will be assessed separate to this IEE and as part of the application and assessment process for individual science projects undertaken as part of the Australian Antarctic Program.

4.3 Sea Ice Research

Voyage Summary

A dedicated science voyage may be conducted in late winter to study sea ice physics and ecosystems in and around a sea-ice free pool close to the Antarctic coast, known as a polynya. This open water pool is of ecological significance when it recurs at the same time and place each year, caused by strong prevailing off-shore winds that keep it free of sea-ice.

The voyage transit generally takes approximately 13-15 days to sail nearly 3 000 nautical miles from Hobart, Tasmania to the edge of the sea-ice, before the Vessel begins to break in towards the polynya, which, under one scenario, is located off the Mawson Coast (west of Mawson Research Station). The Vessel may then take as many as 14 days to arrive at its final destination as it slowly negotiates a path through the sea-ice, stopping regularly to conduct research activities. This transit time can vary significantly depending on the location of this phenomenon, weather and sea-ice conditions.

In winter the Vessel will experience more extreme weather and sea state conditions en route to the sea-ice edge before transiting through increased expanses of thick sea-ice. The Vessel could remain on Station for four to five days at the polynya before commencing its return. It is possible that a number of detailed scientific research tasks are conducted during this type of voyage research activity with the possibility of the Vessel remaining at sea for up to 60 days.

Operating Environment

The Mawson Coast experiences similar environmental conditions to the Mawson research station. In late winter there is only 4-6 hours of daylight and average temperatures are at their lowest for the year (occasionally less than -30 °C). Mawson research station frequently experiences prolonged periods of strong wind averaging over 50 knots, with maximum gusts often exceeding 130-140 knots. These extreme environmental conditions will warrant careful negotiation of the sea-ice as there will be a heightened risk of the Vessel becoming beset in ice.

Vessel Position

The Vessel would transit to the edge of the sea-ice by the most economical course with only minor route deviations or reductions in the Vessels speed. While transiting through the sea-ice the vessel would stop briefly to deploy small numbers of personnel to take measurements and samples before moving to the next research site. Once in the polynya, the Vessel will anchor or maintain its position

using DP, and/or moor to the surrounding sea-ice to deploy field parties and significant amounts of equipment onto the sea-ice.

Key Systems

The key science systems that could be utilised during a dedicated sea-ice research voyage are:

- Underway data collection systems,
- Bridge and above bridge observation stations,
- Upper deck atmospheric and meteorological science laboratories,
- Vessel's cranes,
- Vessel's tenders (personnel transfer, science and aft tenders),
- Moon pool operations (remotely operated vehicle (ROV), autonomous underwater vehicle (AUV), conductivity temperature and depth (CTD), rectangular mid-trawl (RMT), drop nets),
- AUV and ROV through moon pool, side and stern deployment systems,
- Marginal and safe ice access and mooring systems,
- CTD system through the moon pool,
- Electro-optic winch systems for lowered and towed equipment,
- Helideck and winch only position operations,
- Laboratory, IT and support services, and
- Forward boom sensor system.

The transit through the sea-ice may be interrupted by regular halts, about every 6 hours, to quickly deploy field parties onto the safe sea-ice for approximately 20 minutes, just outside the Vessel affected zone, to take measurements and collect samples. The forward instrument boom may also be deployed to lower instruments close to the ice while underway and while stationary in the ice. Unsafe ice operations may also be carried out to sample and measure thin sea-ice, or deploy small drifting ice buoys (using the Vessel's crane and small boat operations) or ROVs through the ice.

A series of multiple day field operations may also be conducted en route to establish ice stations that may see the Vessel mooring to ice floes before it deploys up to 40 personnel on the sea-ice, along with tracked vehicles and sleds. The ice stations are assessed for stability by trained personnel, with thickness and condition testing, deployment of safety equipment, and establishing standby emergency response teams.

The Vessel may also shut down its propulsion system to operate noise sensitive AUVs. The moon pool may be used to operate ROVs, CTD and RMT systems and deploy and recover other deployable instruments. Watercraft operations may occur in the polynya, to support the deployment of moored sensors, autonomous systems along with analysing forming sea-ice in the open water pool at the back of the Vessel using the aft tender.

Helideck operations are likely to occur to support sea-ice surveys to assist the Vessel's navigation while the winch only position may be used to move science equipment to and from an ice station that is inaccessible over the surface of the sea-ice.

4.4 Key Science Systems

Conductivity Temperature and Depth Instrument Operations

The CTD instrument is a large multidisciplinary science sampling apparatus that is one of the most commonly used systems supported from the Vessel. Some voyages will require customised sensors, cameras and sampling facilities to be integrated into the CTD system prior to its deployment. CTD operations can be conducted over a number of days as the Vessel cycles through a process of stopping to deploy and retrieve the instrument before cruising to another location to take more samples and readings. This cycle could involve 30 minutes to 4 hours of CTD deployment operations before the Vessel transits 5-40 nautical miles to the next location to conduct the subsequent CTD deployment. CTD operations are usually conducted concurrently with many other science activities to ensure the efficient use of the Vessel.

The instrument is prepared for deployment before the Vessel is positioned at a plotted location that the Vessel may maintain by dynamic positioning. The CTD is then quickly lowered into the water, to reduce the likelihood of freezing the integral sensors, to complete a test and calibration process that may involve it being lifted back out of the water. Once the apparatus has been deemed operational, it can be lowered up to a depth of 6,500 m at variable speeds using a remotely controlled winch system. The wire is constantly monitored to determine the CTD's depth, rate of descent and ensure the wire angle and tension remains within safety limits. Once the CTD is under the water it is centrally controlled from the science operations room through a system that provides full visibility of the CTD's operational status to the operators in this room and personnel on the Vessel's bridge.

The CTD may dwell at its deepest position to take detailed measurements before it commences its incremental ascent at variable speeds to predetermined depths to take samples and collect data. The sample collection process is also remotely controlled from the CTD operations workspace to optimise the process of incrementally measuring the water column's properties. The CTD is recovered on to the Vessel where the water samples are recovered and placed in storage facilities and analysed in the on-board science laboratories, before the apparatus is prepared for the next deployment. **Autonomous Sensor System Operations**

The Vessel will support the deployment, operation and/or monitoring and recovery of a spectrum of autonomous sensor and sampling systems that could range in complexity from weather balloons to advanced AUVs. These systems' support requirements range from just uninterrupted access to the water or atmosphere for hand release and recovery, through to heavy winch systems to deploy sensor instrument, thousands of metres of mooring lines and a heavy anchor from the aft deck. Examples of the types of operations that support these systems are described below.

A range of moored instrument systems are regularly deployed and recovered after up to two years in the Southern Ocean. These systems may have mooring lines that are many kilometres in length that are wound on to the aft deck winches for deployment and retrieval over the stern. Deep water mooring deployments may require the trawl ramp cover to be in place and the use of the net drum for spooling the tethering wires. Careful sequencing of operations minimises the re-spooling of wires and net changeovers between trawl, mooring and other operations requiring common winches, wires or deck facilities.

There may be a requirement to conduct an acoustic survey of the local bathymetry if it is unknown before these systems are deployed. Long moorings in open water are usually deployed sensor first before the lines are deployed followed by the mooring anchor. Deployment of moored sensors in

sea-ice conditions is usually with the weight being released first and could be through the moon pool if the Vessel is beset in thick sea-ice.

The Vessel then surveys the moored sensor using acoustic ranging to determine its exact position to ensure its recovery when it returns. The open water recovery process involves positioning the Vessel in the general area of the sensor before determining its exact location by its integral strobe light, radar, radio frequency (RF) beacon, and/or GPS coordinates. The initial recovery may utilise a grapple gun or tender capture before its recovery over the stern onto a winch while the Vessel makes way on DP to keep light tension on the mooring line. In-ice recovery may include ROV capture and recovery via the moon pool.

Other autonomous sensor systems that may be deployed, operated and recovered from the Vessel could include AUVs, floats, gliders unmanned aerial vehicles and weather balloons. These systems range in size from large items that would be launched and recovered from the aft deck with the A frame to smaller units they may be launched by hand (e.g. balloons) from the helideck. Over the side deployment into the water amidships is preferred for sensitive to relative motion systems, but stern and moon pool operations will be more practical for more robust surface and sub-surface systems. These sensor platforms usually have acoustic; GPS or RF capabilities for navigation and recovery positioning needs, but some will have the ability to transfer data via satellite or line of sight RF communications.

Acoustic Survey

Acoustic surveys can typically last for a number of weeks and can be conducted concurrently with other science activities, including CTD operations. Acoustic surveying capabilities are used for a range of purposes including sea floor mapping, sea life assessments, benthic ecosystem characterisation, and seismic survey. The Vessel will enable this process by operating within an acceptable low bubble and noise interference level that will be verified by underwater cameras and regular received noise tests of the Vessel's acoustic signature.

The Vessel's drop keel will be used to house temporary and fixed acoustic transducers. This capability can be deployed at varied depths under the hull including intermediate positions that enable optimised Vessel fuel consumption while reducing the effect of the sea state induced bubble interference along the hull of the Vessel.

Towed Systems

There are a number of towed systems that will be deployed, operated and recovered from predominately the aft deck, moon pool and from frames positioned along the side of the Vessel. In most cases, the Vessel will slow from its operational speed to deploy and recover these towed systems. These capabilities include a range of nets, trawls, environment data sensors and specialist sea life collection apparatus that may have real time sensor data transmission and/or live streaming of video from the tethered system.

Some towed systems have unique operational requirements. Some examples are:

- The RMT is used on at least one voyage every season. This is a 3 metre wide instrumented multi bar one wire trawl that is controlled from the surface to only sample specific targets in the water column utilising an open / close mechanism. It can be deployed both over the stern and through the moon pool.
- Trawl net systems are used regularly to capture sea life and other matter. These systems can be towed with one or two wires and be up to 60 metres wide at the

mouth of the net once deployed, held open by 1.5 tonne trawl vanes, down to depths of 2,000 metres. The larger nets will only operate from the aft deck through the integral stern frame over the stern ramp and can bring significant volumes of mud and other sea floor samples. These samples are then sieved and washed in a sheltered area on the aft trawl deck.

- The Continuous Plankton Recorder (CPR) is a small mechanical towed body that is towed behind the Vessel at economical cruising speed whilst transiting across the Southern Ocean. It is operated during almost all voyages and is deployed by slowing the Vessel to below five knots for a few minutes while the CPR is deployed into the water. The CPR is then recovered a few days later by slowing the Vessel again to collect the samples it has captured. This apparatus may be deployed from stern frame or side frames depending on other concurrent operations requirements.
- A range of acoustic and camera based towed bodies will be deployed from different locations on the Vessel. The larger items will be deployed from the stern frame while the small ones can be deployed over the side by hand or via a side deck frame. Some of these systems may come with specialised containerised deployment equipment that will be mounted on the aft trawl or side deck.

Sea Floor Coring Systems

Coring operations are only conducted occasionally and are usually carried out concurrently with other geoscience activities like acoustic surveys. There are many different types of corers that range in size from a hand deployed system to an apparatus that can be up to 24 metres in length that operates from a frame that deploys it over the side or from the aft deck. The large corer is usually stored in three metre segments and is assembled in the lifting frame before it is deployed to the sea floor to collect samples, while the Vessel maintains its position using DP. The corer will then be brought aboard, and the core cut into 1.0 to 1.5 metre sections as it is slid out of the corer. The core sections are then stored in a refrigerated container for subsequent processing.

Other Deployable Science Apparatus

There are numerous types of other science instruments and sampling systems that could be deployed and operated from the Vessel from over the side from the aft deck or through the moon pool. These systems could include the following:

- Portable pumping system that can lower a hose in to the water to deliver large volumes of water on to the Vessel to collect samples. This hose may be deployed to a few hundred metres depth concurrently with CTD operations,
- Sea floor grabs to collect sample sea floor matter
- ROVs
- Drop nets,
- Video and still camera systems, and
- Instrument booms deployed over the bow to collect data or samples.

Wet Well Sampling Operations

Wet well sampling is a process where uncontaminated sea water is gravity fed at various rates to the wet well sampling space where it is finely filtered to collect fragile sea life. This sea water delivery system will be designed to minimise damage to the sea life in delivery to the sampling collection facility. The water will be delivered from inlets at different depths in the Vessel's hull. These inlets will be designed to reduce the likelihood of blockages from sea ice and other matter, and have systems to clear debris from these intakes.

This process occurs at least once every season and can run continuously for extended periods requiring shifts of personnel to operate the system and collect the samples. These live samples are then transferred to aquarium facilities for preservation and study on-board and in AAD facilities at Kingston. This wet well system will also be used for processing seawater from lowered hoses deployed through the moon pool and from the aft deck.

Scientific Watercraft Operations

These operations are defined as any science related operation conducted from a small watercraft that could include small IRBs through to the Science Tender or a larger government furnished equipment (GFE) science workboat. The types of science operations that can be conducted from this watercraft are:

- Cetacean tissue sampling using the Personnel Transfer Tenders or GFE science watercraft,
- Survey of shallow or otherwise unsafe waters for the Vessel,
- Deployment, operation and recovery of scientific instruments and sampling systems like acoustic transponders and ROVs in open ocean and sheltered waters,
- Personnel and equipment movement in sea-ice zone,
- Maintenance and / or recovery line hook up AUV, gliders, floats and moored sensors, and
- Supporting diving operations.

Science Helicopter Operations

The helicopters deployed on the Vessel will be regularly used for scientific related tasks. The helicopters can be fitted with towed or integrated sensor systems and carry on-board observers during their flights. This fitted scientific equipment will be prepared and maintained close to the helideck in a specialist science equipment staging area before it is moved to the hangar or helideck to fit it to the helicopters. Data processing and transfer from the airborne instrumentation will also be conducted in this staging area.

The helicopters will also be extensively used to deploy personnel and light equipment from the Vessel in support of field operations and surveys. This may also include conducting underslung cargo transfer operations form the winch only position.

"Unsafe Ice" Access

There is a requirement to deploy personnel to access unknown or unsafe sea-ice for scientific analysis or sampling. Personnel will access the ice and water by a range of methods depending on scientific requirements and operating conditions. Remote sensors could be deployed over the bow

of the Vessel to collect data as the Vessel breaks through ice or collect samples. Personnel could also be lowered to the unsafe ice by a platform deployed over the side to ice outside the vessel-affected zone. This platform would lower up to three people to just above the surface to access unknown or unsafe sea-ice. In thicker conditions, subject to testing and assessment, the personnel may be tethered or range from the deployment device while collecting samples and taking measurements.

Field Operations

The Vessel will support scientific field operations in remote locations across the Australian Antarctic sector and Southern Ocean. These activities will include:

- Deployment of field camps by IRBs, Lighter Amphibious Resupply Cargo (LARC) vessel, helicopter, and over-ice vehicles. This will range in scale from shore parties deployed for many months with temporary buildings to a few people working away from the Vessel for a few hours,
- Use of the Vessel as a research station for work in remote areas (remote from any shore side infrastructure), and
- Support to scientific sea ice stations that involve personnel remaining on safe sea-ice for extended periods to conduct research and sample collection.

The capabilities required to support these types of field activities are:

- Deployment systems and staging areas to deploy personnel and equipment to the ice,
- Efficient personnel and cargo workflows from access points on the Vessel to laboratories, change / drying rooms, and storage areas (that facilitate efficiency and meet quarantine requirements) and other key scientific facilities on the Vessel,
- Suitable spaces for storing, maintaining, refuelling, recharging and preparing equipment, and
- Facilities for rapid deployment of emergency response capabilities to field parties.

5 ALTERNATIVES TO THE PROPOSED ACTIVITY

Resupply

Currently the only feasible way to resupply the Antarctic stations with the quantity of food, stores, fuel and in some cases potable water is by ship. The station needs will increase in the future. The AAD does not have a viable alternative vessel to undertake this activity.

Personnel

Whilst some expeditioners and seasonal workers are currently flown in and out of Antarctica on chartered aircraft, there is insufficient capability to transport all necessary people by air and so passage on the ship will be required into the longer term. This situation may change if a year-round aviation capability becomes available however, this would not be realised until the late 2030's and remains subject to a comprehensive feasibility and environmental evaluation and approval processes.

Science

The scope of marine science in Antarctic waters requires a blue water ice capable ship. The Vessel is fitted with a sophisticated suite of scientific equipment purposely chosen for operation in Antarctic

waters. It would be detrimental to Australia's national interests if Antarctic science were not to be conducted. There is no acceptable alternative.

5.1 Not Carrying on the Activity

Shipping has played a vital role for the Australian National Antarctic Research Expedition (ANARE). Ships have transported people, equipment and supplies for ANARE, since its establishment in 1947.

Ships have been crucial in scientific research and Antarctic operations. Surveying the coastline, conducting marine science, and resupplying stations, have all relied on shipping.

Over the years, the AAD has chartered polar icebreakers and other vessels to support its program. The *Aurora Australis*, launched in 1989, initiated a new era of research and resupply capability. After 31 years of Antarctic service, the *Aurora Australis* completed its last voyage for the Australian Antarctic Program in March 2020.

Currently the only feasible way to resupply the Antarctic stations with the quantity of food, stores, fuel and in some cases potable water is by ship. The Australian Antarctic program chartered the MPV Everest in the 2020/21 summer season. However, this vessel does not provide sufficient icebreaking, cargo and science capabilities to support the Australian Antarctic program into the future.

Australia's new icebreaker, RSV *Nuyina*, will further advance Australia's Antarctic program and marine science capabilities.

5.2 Alternate locations and timing

No feasible alternative locations or timing would deliver the essential resupply function and science capability provided by the RSV *Nuyina.*

5.3 Alternative methods and technologies

Considering current technologies, sea freight remains the most efficient, environmentally friendly and feasible means to resupply and support Australia's three year-round Antarctic research stations.

Alternative fuels were considered and investigated during the scoping phase of the *Aurora Australis* replacement work. Diesel was determined to be the only viable option to be used as fuel for a resupply vessel to be operated in Antarctica waters.

Currently the only feasible way to resupply the Antarctic stations with the quantity of food, stores, fuel and in some cases potable water is by ship. The station needs will increase in the future. The AAD does not have a viable alternative vessel to undertake this activity.

6 DESCRIPTION OF THE ENVIRONMENT

6.1 Physical characteristics of the Southern Ocean

The Southern Ocean comprises the southernmost waters of the world south of 60° S latitude and encircling Antarctica. The Southern Ocean supports rich and diverse communities, which exist and interact with the extreme environmental conditions surrounding and adjacent to Antarctica. The Southern Ocean plays a major role in driving climate processes including global ocean circulation of deep water that interacts with the Pacific, Atlantic, and Indian oceans. The Southern Ocean remains a key area of global scientific interest and research activities addressing, climate change, biodiversity and resource sustainability.

The sea ice that surrounds Antarctica adds an additional 19 million km^2 at its maximum extent in September–October (Fretwell et al. 2013), diminishing to 3 million km^2 in February (Parkinson & Cavalieri 2012). The annual growth and retreat of the Antarctic sea ice is one of nature's most significant large-scale annual cycles (Klekociuk & Wienecke. 2017). Antarctica is Earth's coldest, highest, windiest and driest continent, and its largest cold desert. Only about 21,745 km^2, or 0.18 per cent, of the total Antarctic land mass is ice-free (Burton-Johnson et al. 2016). Antarctica also has the deepest continental shelf and is surrounded by the largest wind-driven currents, which circulate the Southern Ocean.

The Southern Ocean is a vast and abundant ecosystem, where giant swarms of krill sustain an enormous diversity of species including fish, seals, penguins and whales. Lists for marine species have been compiled to form the Register of Antarctic Marine Species, includes well over 8,000 species (Griffiths 2010).

Shallow nearshore marine ecosystems are relatively rare on the continental Antarctic coast and are isolated from each other and thus are highly fragmented (Clarke et al. 2015). Most of the Antarctic coast is covered by the continental ice sheet, which depresses coastal bedrock, and coastal waters around the continent are predominantly very deep (coastal shelf areas are commonly up to 500 m deep). Shallow nearshore seabed habitat is further limited by permanent ice shelves that are up to hundreds of kilometres wide and hundreds of metres thick with very deep seabed habitats below. Shallow water habitats (less than 200 m depth) are located terrestrial areas of seasonally or permanently ice-free rocky islands, peninsulas and coastal continental Antarctica. Deglaciated areas located within five km of the coast are estimated to comprise less than 0.06% of the Antarctic continent(Brooks et al. 2019). Shallow water habitat less than 100m deep, generally associated with ice free land, is estimated to cover approximately 25,000 km^2 around the 45,317 km of Antarctic coastline (Clarke et al. 2015). Areas of shallow nearshore seabed may be separated from other areas of similar habitat by many hundreds to thousands of kilometres of deep water.

Coastal marine ecosystems in Antarctica are biologically diverse, have high but intensely seasonal levels of productivity, and encompass a wide range of habitats and communities, from dense beds of macro algae to invertebrate-dominated communities in shallow water. They are influenced by a range of physical and biological processes, some of which are unique to polar regions, such as sea ice cover, ice scour (e.g. by iceberg contact with the seabed), and dramatic seasonal changes in light availability (also affected by seasonal sea ice presence/absence).

6.2 Physical Characteristics of the Davis Research Station

Davis research station is in the Vestfold Hills, a triangular ice-free area of approximately 400 km^2. The region is visually distinctive and considered to be one of the most significant oases in Antarctica, the

Vestfold Hills bearing rock exposures with crustal histories in the 2.5 billion year range. The area's hills are of low relief (< 160 m) and are intersected by numerous fjords and lakes. Davis research station is accessed by ship and intra-continental flights, most often by ski-equipped fixed-wing aircraft originating from Casey/Wilkins.

6.2.1 Wildlife

Bird species in vicinity of Davis research station station include Adélie Penguins (*Pygoscelis adeliae),* Emperor Penguins *(Aptenodytes forsteri),* Cape Petrels (*Daption capense*), Southern Giant Petrels (*Macronectes giganteus*), South Polar Skuas *(Stercorarius maccormicki),* Snow Petrels *(Pagodroma nivea), and* Wilson's Storm Petrels *(Oceanites oceanicus).* Adélie penguin rookeries are known in offshore islands, while Emperor Penguins have only ever been observed transiting, using occasional moulting sites. Adélie Penguins, Cape Petrels, or Southern Giant Petrels have established breeding colonies on Gardner and Lugg Islands.

Four seal species are found locally – Southern Elephant Seals (*Mirounga leonina*) which is a summer visiter, Weddell Seals (*Leptonychotes weddelli*) which breed in Tryne and Long Fjords, Crabeater Seals (*Lobodon carcinophagus*) and Leopard Seals (*Hydrurga leptonyx*) which are a summer predator. Southern Elephant Seal haul out areas are known at the station itself and Old Wallow, with occasional observations around the coast towards Law Cairn and other sites, but these are sporadic and unpredictable. Weddell seals are common in Long Fjord during the summer (in particular at Weddell Arm and Shirokaga Bay), and Leopard Seals have been observed throughout the region, and

in particular near penguin colonies. Davis wildlife concentration are shown below:

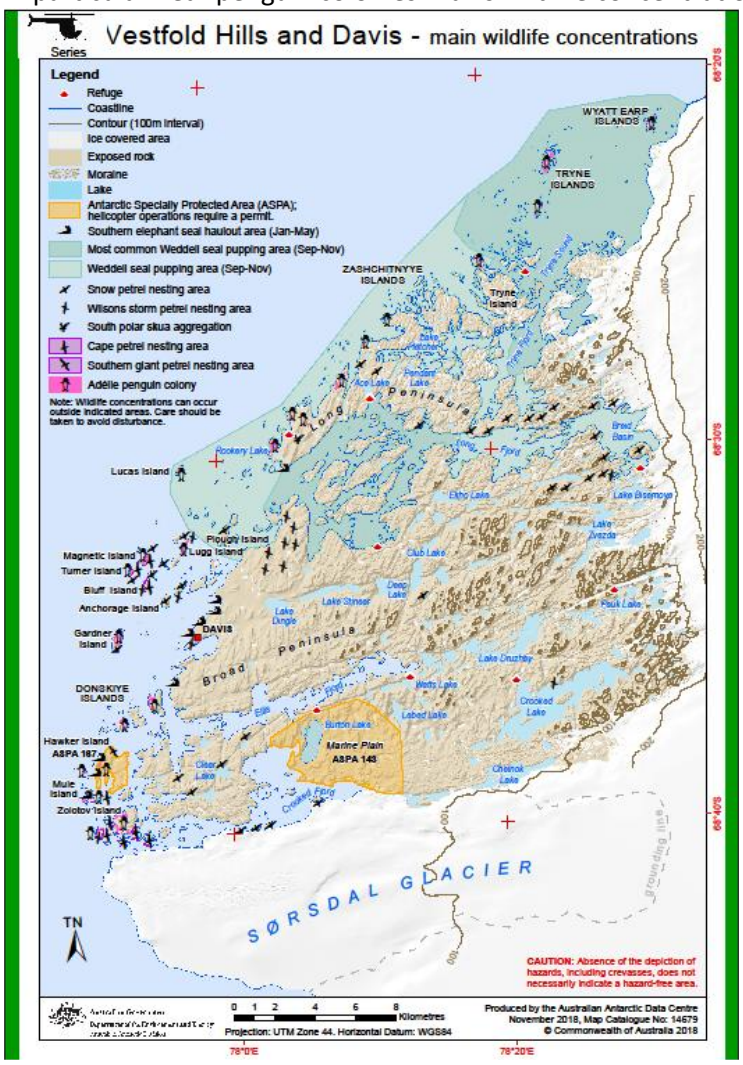


Figure 2 Vestfold Hills and Davis research station – main wildlife concentrations

6.2.2 Marine Benthic (Seabed) Biota

The Vestfold Hills in East Antarctica is an area of permanently ice free coastal habitat, consisting of rocky peninsulas, valleys and islands with marine systems that include shallow embayments, deep fjords (>200 m), protected coast in between islands and the mainland and open coast. The Vestfold Hills shallow nearshore marine area is comparable in extent to the terrestrial ice-free area but in general is much shallower in comparison to the Windmill Islands (Casey research station), with much of the inshore area between the islands and mainland less than 40 m deep. The nearshore marine ecosystem of the Vestfold Hills is spatially variable and highly diverse, with a wide range of different habitats and benthic communities. Habitats, sediment properties, and associated benthic communities vary markedly between locations with some areas having considerable variation within those locations.

The Vestfold Hills nearshore marine ecosystem contains communities that are similar to other areas of coastal Antarctica, particularly off East Antarctica (such as the Windmill Islands near Casey research station). The Vestfold Hills nearshore marine ecosystem communities include demersal fish species, a large variety of invertebrates including echinoderms (starfish, sea urchins, brittle starts, sea cucumbers), crustaceans, porifera (sponges), ascidians (sea squirts), bryozoans, polychaete worms, cnidarians (anemones, hydroids and corals), molluscs and other phyla.

The Vestfold Hills also includes communities and species that have not been previously reported elsewhere, such as the polychaete reefs in Ellis Fjord, which may be present more broadly in the Vestfold Hills, however, only a relatively small area has been sampled and most of the marine ecosystem remains unknown, particularly the fjords.

6.2.3 Meteorology and Climate

Davis research station has a relatively mild climate and is known as the 'Riviera of the South'. The 400 km^2 of exposed undulating rocks dampens the katabatic winds off the ice sheet, resulting in an average yearly wind speed of around 20 km/h. Summer temperatures can reach a maximum of +13°C, the winter temperature can reach -40°C with mean maximum temperatures averaging at +3.2°C in summer and -14.0°C in winter, and mean minimum temperatures averaging -1.2°C in summer and -20.8°C in winter (averages taken from all years of occupation from 1957 to 2016).

The predominant wind direction is from the northeast and is rarely strong, although sudden storms can occur with gusts in excess of 200 km/hr.

Precipitation is usually in the form of snow, although rain has been experienced. Snowfall is up to 50 mm/yr (average being 33 mm/yr), and can be a blend of snow blown off the ice sheet, or locally falling. Snow drifts are common in the lee of rocky ridges and station buildings.

In the Davis research station summer, the sun stays above the horizon for most of December and January and in winter it stays below the horizon for about two months from early June. During the winter, the 'day' is made up of one to two hours of twilight.

6.2.4 Human Presence

Davis research station was established as a scientific research base in 1957. A number of outbuildings, accommodation, laboratories, workshops, antenna installations, weather stations, etc make up the station footprint. The station is considered a large and complex facility by Antarctic standards. The research station accommodates up to 93 personnel on site and has existing infrastructure including cargo laydown areas, boat ramps, wharves, jetties and roads to facilitate resupply activities.

6.3 Physical Characteristics of Casey Research Station

Casey research station is located on Bailey Peninsula in the Windmill Islands, Wilkes Land. The peninsula is located on the west coast of Law Dome, an almost circular 200 km diameter ice cap rising to a height of 1,395 m. The stands of moss and lichen in Casey's vicinity are so significant that Casey research station is often referred to as the 'Daintree of Antarctica'. Casey is accessed by ship and inter and intra-continental aircraft.

6.3.1 Wildlife

Adélie penguins breed throughout the Windmill Islands with Shirley Island, about 1.5 kilometres west of Casey research station, being the nearest breeding colony (Woehler and Johnstone, 1991). Shirley Island is within the Casey research station extended station limits and recreational area. Snow petrels breed throughout the Windmill Islands and on a number of ice-free areas around the

station and the quarry, including around Reeve Hill, immediately to the west and northwest of the main station area. Wilson's storm petrels at Casey research station breed throughout the Windmill Islands, including in ice-free areas around Casey research station.

Four species of seal are found in the Casey research station region. Low numbers of non-breeding male southern elephant seals haul out to moult during summer in the Casey research station region. The main haul out areas are at Peterson Island and Browning Peninsula (about 15-20 kilometres south of Casey research station). Weddell seals are common in the area and regularly haul out around the Bailey Peninsula. These seals are seen year-round in the Windmill Islands and their main breeding area in the region is on the sea ice between Herring Island and the continent (about 15 kilometres southeast of Casey research station). A secondary pupping site is in the Swain Group (seven kilometres northeast of the station) (Orton, 1963). Small numbers of crabeater seals are seen offshore on ice floes near Casey research station. Breeding populations are not found close to the station, as breeding and pupping takes place in the pack ice. Small numbers of leopard seals are seen offshore on ice floes near Casey research station. Breeding populations are not found close to the station, as breeding and pupping takes place in the pack ice.

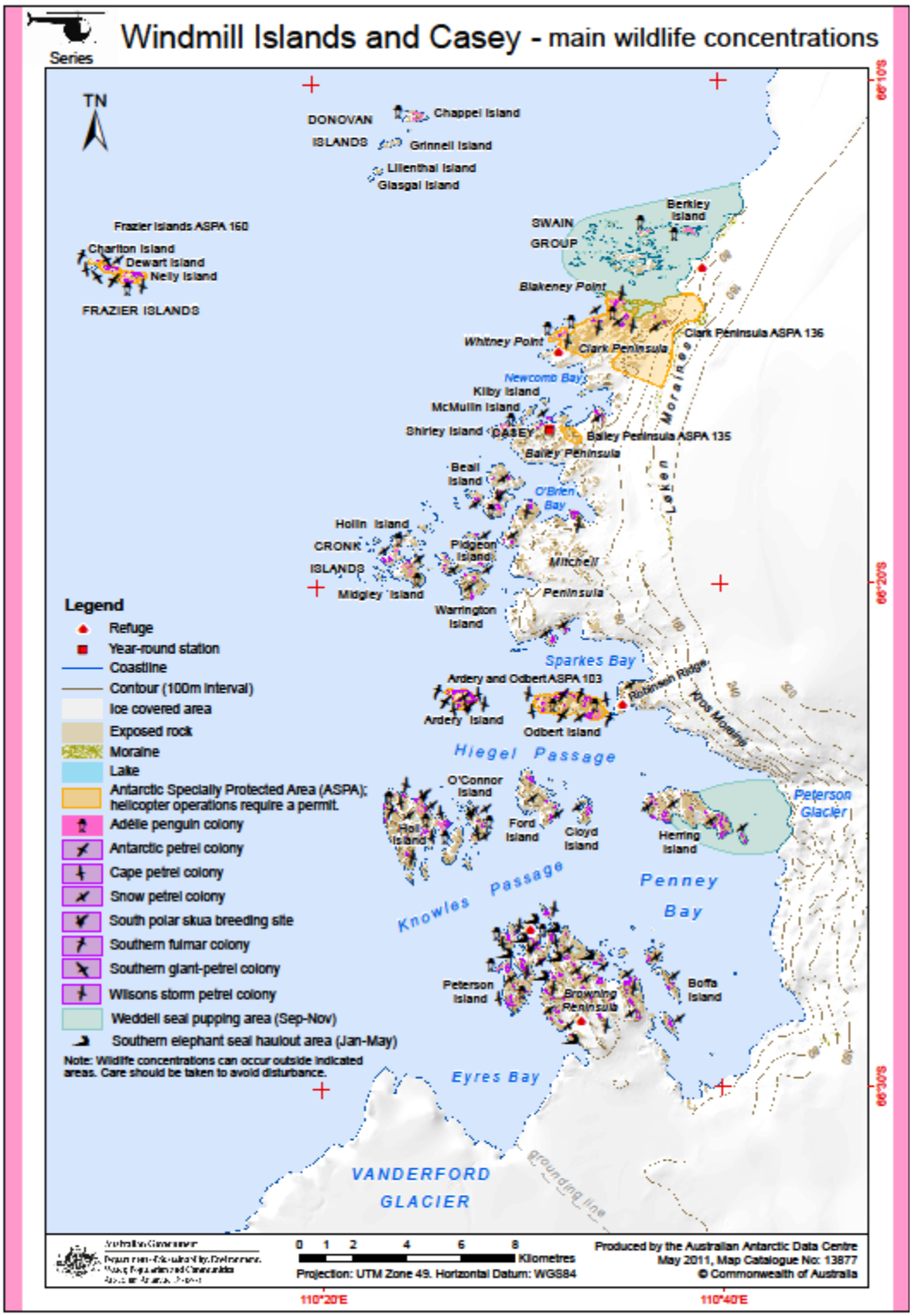


Figure 3 Windmill Islands and Casey research station main wildlife concentrations

6.3.2 Marine Benthic (Seabed) Biota

The nearshore marine environment of the Windmill Islands area is characterised by a series of permanently ice free coastal peninsulas and offshore islands within 15 km of the coast. The bathymetry is highly variable on small spatial scales, with abrupt transitions from shallow reefs to deep basins (<250 m). There are a range of environments from exposed open coast to sheltered

embayments and sheltered areas in between islands and the mainland. Benthic habitats are highly spatially variable and diverse, ranging from rocky reefs formed by bedrock outcrops, steep scarps (slopes), to sedimentary basins.

Benthic communities range from extensive macroalgal beds in more exposed coastal areas (with longer periods of open water) to invertebrate dominated communities under sea ice in sheltered areas. Research into benthic communities has focused on areas around Casey research station and much of the local area remains unexplored. The Windmill Islands nearshore marine ecosystem contains communities that are similar to other areas of coastal Antarctica, with some demersal fish species, a large variety of invertebrates including echinoderms (starfish, sea urchins, brittle starts, sea cucumbers), crustaceans, porifera (sponges), ascidians (sea squirts), bryozoans, polychaete worms, cnidarians (anemones, hydroids and corals), molluscs and other phyla.

6.3.3 Meteorology and Climate

The Casey research station area is subject to frequently cloudy skies, very low absolute humidity, and low precipitation (falling mainly as snow). Temperatures range from an average daily maximum of +2.9°C in January to an average daily minimum of -19.2°C in August, with recorded extremes of +9.2°C and -41°C.

Winds, averaging about 20 km/hr in summer and 31 km/hr in winter, are generally from the east and east-northeast off Law Dome, and from the south. Blizzards (resulting from the passage of major low pressure systems from the west) can set in with very little warning and last for several days. The highest recorded wind speed is 291 km/hr. Regular katabatic winds are not a feature of the area, and consequently there are many calm days.

Snowfall occurs on average eight days per month throughout the year, with higher frequencies in winter. Snow fall is very light and most of the snow accumulation is a result of drift snow blown from the ice plateau between February and September.

In the Casey research station summer, the sun stays above the horizon for almost a month over December and January and in winter the nights are long but the sun still rises, with the shortest day (winter solstice) having sunlight for two and a half hours.

6.3.4 Human Presence

Casey research station was established in 1969, but rebuilt during the 1990s slightly inland of the original location. A number of outbuildings, accommodation, laboratories, workshops, antenna installations, weather stations, etc make up the station footprint. The station is considered a large and complex facility by Antarctic standards. The research station accommodates up to 120 personnel and has existing infrastructure including cargo laydown areas, boat ramps, wharves, jetties and roads to facilitate resupply activities.

6.4 Physical Characteristics of Mawson Research Station

Mawson research station, established in 1954, is the oldest, continuously-occupied facility south of the Antarctic Circle. The station is located on the south-eastern shore of Horseshoe Harbour, a small ice-free rock outcrop on the edge of the continental ice cap. The coastline to both Mawson's east and west is mostly sheer ice cliffs, while the continental ice sheet behind it attains a height of some 1,000 m within

35 km. The station is accessed by ship and intra-continental flights, most often by fixed-wing aircraft originating from Davis research station.

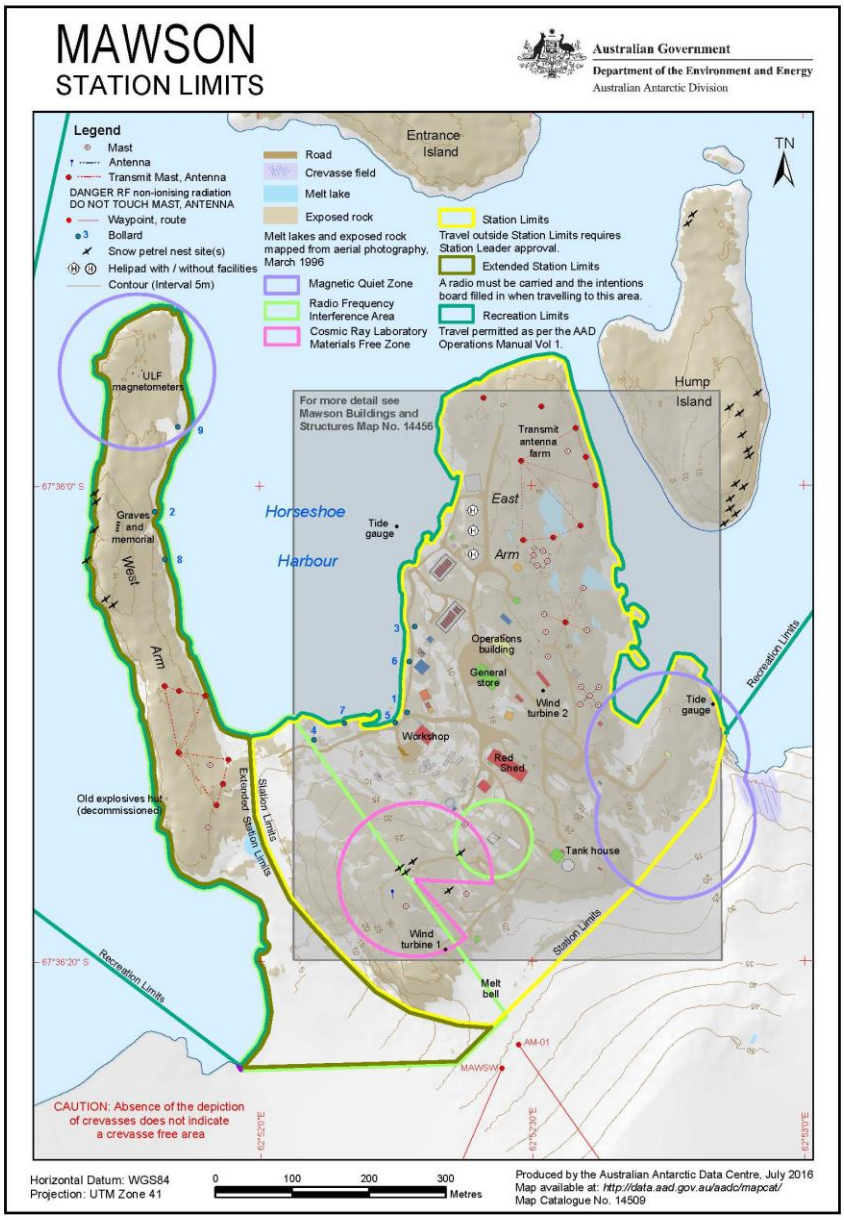


Figure 4 Mawson research station area map

6.4.1 Wildlife

The Mawson region is one of the richest areas for seabirds in the Australian Antarctic Territory.

This area supports breeding colonies of emperor and Adélie penguins, snow petrels, Antarctic petrels (the largest colony in Antarctica with 158,000 breeding pairs), Wilson's storm petrels, cape petrels, southern giant petrels, Antarctic fulmars and skuas.

There are 3 Antarctic Specially Protected Areas (ASPAs) near Mawson station. Taylor emperor penguin colony ASPA protects one of the largest emperor penguin colonies on land. The Rookery Islands ASPA protects 6 species of breeding seabirds including giant petrels. Protected areas at

Scullin Monolith and Murray Monolith, about 150km east of Mawson, protect large seabird breeding sites.

A long term monitoring program studying Adélie penguins has been run by Australian scientists at Béchervaise Island (67°35'S, 62°48'E), East Antarctica, since 1990. Similar programs are carried out by other nations working at other locations around Antarctica. These monitoring programs are run as part of the international CCAMLR Ecosystem Monitoring Program (CEMP).

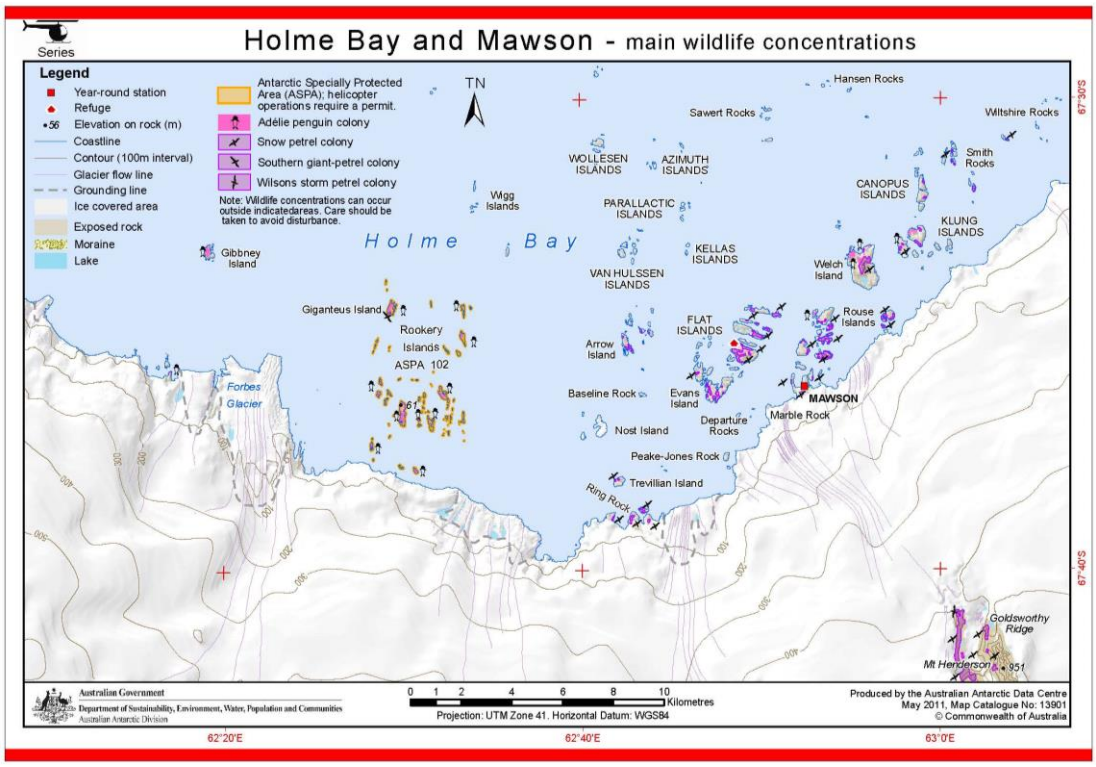


Figure 5 Holme Bay and Mawson main wildlife concentrations

6.4.2 Marine Benthic (Seabed) Biota

The Mawson nearshore marine environment consists of some offshore islands with a relatively small coastal ice free peninsula area. There are exposed coastal areas and sheltered areas between islands and the mainland peninsula. No marine benthic research has been done at Mawson research station. The only information on benthic ecosystems comes from anecdotal observations. It is expected that marine benthic communities would bear similarities to those found at Davis and Casey research stations.

6.4.3 Meteorology and Climate

The Mawson research station area is subject to frequently cloudy skies, very low humidity and limited snowfall. Mean temperatures range from +0.1°C in January to -18.8°C in August, with recorded extremes of +10.6°C and -36.0°C.

Winds are predominantly from a direction between east and south. The mean annual wind speed at Mawson research station is 39 km/hr but winds in excess of 50 km/hr are common. Katabatic winds are predominantly from the south-east. They have mean speeds of over 90km/hr with gusts often exceeding 200 km/hr. Such violent winds and blizzards can commence with little warning.

In the Mawson research station summer, the sun stays above the horizon for a month half over December and January and in winter the sun remains below the horizon for two weeks over the winter solstice, but twilight conditions remain.

6.4.4 Human Presence

Mawson research station was established as a scientific research base in 1954, with some of the original buildings remaining on site. A number of outbuildings, accommodation, laboratories, workshops, antenna installations, weather stations etc. make up the station footprint. The station is considered a large and complex facility by Antarctic standards. The research station accommodates up to 53 personnel and has existing infrastructure including cargo laydown areas, boat ramps, wharves, jetties and roads to facilitate resupply activities.

7 Assessment of Environmental Impacts

7.1 Methodology

The Assessment process involve four key stages consistent with the objectives of Annex I of the protocol on Environmental protection to the Antarctic treaty and AAD's Environmental Management System approach to managing the AAD's interaction with the environment.

The assessment of environmental impacts has followed the following staged approach:

1. Identify the key activities of the project,
2. Identify the environmental aspects – how the activities interact with the environment,
3. identify the environmental impact –change in environmental value or resource as a result of the activity, and
4. Assess the significance of impact –including spatial extent, duration, and environmental consequences.

The assessment of significance is based on the likelihood and consequence of a particular impact or group of impacts occurring because of an activity. This assessment has incorporated past knowledge and experience in conducting Antarctic shipping and resupply operations and advice from subject matter experts within the AAD operations, shipping and science areas.

7.2 Proposed Activities

A detailed description of the scope and locations of the activities associated with the operation of the Australian icebreaker RSV *Nuyina* is addressed in Section 3 of this document.

These activities have been summarised for the impact assessment process:

- Port call Hobart - Loading of cargo, equipment, stores and personnel in Hobart.
- Transit Voyages - Resupply and marine science voyages.
    - Ballast water management
    - Waste Management
    - Sewage management

- Anchoring - Includes the use of Mooring lines and over Ice resupply
    - Cargo transfer
    - Bulk Fuel Transfer
    - Personnel Transfer
- Emergency Response
    - Fire Fighting

7.3 Environmental Aspects

Environmental aspects are the element of an organisation's activities, products or services that interact or can interact with the environment (ISO-14001). As described in the Guidelines for Environmental Impacts Assessments in Antarctica (ATCM 2916), an environmental aspect may include emission of pollutants / noise / light, human presence, transfer of native or non-native species, direct contact with wildlife / vegetation, leak or spill of hazardous substances etc. Environmental aspects may also involve removal from the environment of organic or inorganic material including, collection of fauna and flora and the removal of water, ice or rocks.

The AAD uses the following definitions in its Environmental Management System (EMS) Environmental Aspects and Impacts Register.

- Energy Use - includes the use of electricity, non-renewable resources, refrigerants, water and release of exhaust, gaseous and radioactive emissions.
- Physical Disturbance - includes human activities, introduction of non-indigenous species, parasites and diseases, disturbance to soils, flora, fauna, communities and ecosystems, building and infrastructure maintenance and construction and station activities.
- Hazardous Chemicals - İncludes the storage, use and disposal of chemicals and hazardous materials.
- Waste Management - includes the management of combustible, hazardous, sewage and domestic liquid and solid waste products.

7.4 Potential Impacts and Mitigation Measures

This section outlines the potential environmental impacts resulting from the proposed activities described in Section3 and 7.2. The potential impacts, inherent and residual risk and mitigation measures are presented Section 7.6 RSV *Nuyina* Environmental Impacts matrix.

The following categories of environmental impact have been used in this assessment:

- Biological change,
- Habitat change,
- Disturbance of fauna,
- Degradation of wilderness values,
- Landscape change,
- Degradation of heritage/cultural values,
- Noise pollution,
- Pollution of sea water/sediments, and
- Pollution of the air.

The potential for these environmental impacts to occur is assessed against the four key activities listed in Section 7.2.

7.4.1 Biological Change and Habitat Change

The loading of cargo, equipment, stores and personnel in Hobart for transport to Antarctica has the potential to introduce non-native species to Antarctica and the sub-Antarctic.

Transit of the ship to Antarctica from Hobart presents the potential for invasive marine species transported on the ship's hull to establish in Antarctic coastal waters and for organisms to be introduced to the offshore marine environment during ballast water exchange.

Mitigation(s) include:

- Cargo, passenger and vessel biosecurity procedures include staff training, incident response, and maintenance of equipment and facilities and external work areas,
- Cargo, equipment and stores quarantined at AAD head office and a purpose built Cargo and Biosecurity Centre (CBC) before being loaded in RSV *Nuyina*,
- The CBC complies with standards required for Approved Arrangements to manage biosecurity risks on behalf of the Australian Government,
- RSV *Nuyina* carries ratguards for use on berthing lines when alongside,
- The AAD maintains an incident reporting system to monitor, respond and learn from biosecurity issues and threats, in a timely and effective manner,
- Vessel will hold a biofouling management plan and is subject to a ship sanitation certification scheme, and
- ultra-violet and filtration treatments of ballast water intake and discharge.

7.4.2 Disturbance of Fauna

Transit during resupply and marine science voyages poses a variety of potential causes and sources of impacts that may result in disturbance of fauna. These include exposure to chemical and biohazardous material from fuel spills or inadvertent release of oil, oily water, black or grey water or pumping of bilges; underway noise and vibration; noise and vibration and visual or habitat disturbance during icebreaking.

Activities during resupply including anchoring, station refuelling and small vessel and helicopter cargo and passenger movement between the ship and station also presents potential for disturbance of a range of fauna including benthic fauna, seals, whales, flying birds and penguins.

The AAD has extensive experience and established procedures and guidelines for working in and around wildlife. These are regularly reviewed and updated based on new information, research or investigations into past incidents. RSV Nuyina's EMP sets out the requirements for managing the potential disturbance to wildlife during each of the four key activities listed in 7.2.

Mitigation(s) include but are not limited to:

- All oil (lubricating and hydraulic) and fuel tanks within RSV *Nuyina* are located in protected areas away from the Vessel's hull which has no contiguous boundaries with the Vessel's external hull,
- AAD Station Refuelling Manual includes continuous monitoring of equipment during the transfer, routine inspection and testing of refuelling equipment and training of personnel,

- Mitigation of noise impacts resulting in disturbance to wildlife is addressed in 7.4.3,
- Searchlights are used between sunset and sunrise to locate vulnerable wildlife,
- Maintain constant watch and revise voyage pathway/route and speed if required to avoid wildlife concentrations (open water and icebreaking), and
- External lighting, not used for navigation or for the safety of personnel, will be dimmed to reduce backscatter and visual disturbance between sunset and sunrise to minimise the risk of bird strike (DoEE 2020)

7.4.3 Noise Pollution

During transit and underway operations noise and vibration created by the engines, generators, propellers and vessel passing through the water, as well as noise and vibration from the ship breaking ice may disturb marine life.

Resupply activities such as transfer of cargo, stores and equipment and personnel from ship to station using watercraft, helicopter and lifting equipment over ice. Noise from engines including underwater radiated noise and vibration during transit may disturb marine life activity.

Mitigation(s) include:

- Nuyina's watercraft have been specified to meet the lowest practical airborne noise level,
- Nuyina's Silent R notation equivalent at 8 knots electric propulsion for science acoustic work. As a consequence of the decisions made on equipment and design (e.g. Engine choice and resiliently mounted equipment) the ship has much lower waterborne noise than equivalent sized ships across the range of ship speeds and operating modes,
- Compliance with IMO MSC.337(91) code on noise levels onboard ships assists with minimising the air borne noise emitted away from the ship,
- Main engines and genset exhausts are fitted with silencers to reduce the airborne noise,
- Air intakes for engine rooms are fitted with silencers to reduce the noise emitted from them during operation, and
- Aviation operations and flightpaths comply with existing guidelines and separation distances to reduce impacts on wildlife.

7.4.4 Pollution of Sea Water/Sediments

Transit during resupply and marine science voyages has the potential to result in pollution caused by a collision or grounding resulting in fuel and oil spills as well as the inadvertent release of oil, oily water, black or grey water or pumping of bilges.

During the resupply and refuelling of the station, as well as refuelling and operation of watercraft, presents the potential for pollution of the environment (including the shoreline from fuel spill or leaks).

There is also potential for pollution of the marine environments resulting from waste released over the side of the Vessel or materials lost overboard due to weather conditions.

Mitigation(s) include:

- All oil (lubricating and hydraulic) and fuel tanks within RSV *Nuyina* are located in protected areas away from the Vessel hull which has no contiguous boundaries with the Vessel's external hull,

- AAD Station Refuelling Manual includes continuous monitoring of equipment during the transfer, routine inspection and testing of refuelling equipment and training of personnel,
- AAD fuel spill contingency plans for each station and the supply of spill response equipment on vessel and at each station,
- Ship Specific Procedures (SSPs) require all watercraft to maintain any water in the bilges whilst underway,
- AAD Watercraft Standard Operating Procedures include actions for fuel management,
- RSV *Nuyina* has a two type-approved wastewater and sewage treatment plant (STP) contained within machinery spaces,
- RSV Nuyina is operated in accordance with MARPOL Annex IV Reg 11.1.2 and the requirement of Part II-A, Ch 4 of the Polar Code.
- Waste is separated and stored below decks to minimise risk of release to the environment.
- Garbage Management Plan (MARPOL Annex V, reg 10) (Madrid Protocol Annex 3) sets out the procedures to be followed on-board for collecting, processing, storing and disposing of garbage, and
- All cargo and materials, including waste being returned to Australia, securely stowed and checked regularly by the crew.

In the event of an emergency, such as a helicopter crash on deck, or an aviation fuel fire on the upper decks, it is likely AFFF would be disbursed overboard.

Mitigation(s) include**:**

- Ship based cargo and passenger helicopter operations are managed through AAD Aviation SOP', ship specific procedures and operating manuals,
- AAD fuel storage and handling procedures, the vessel's Cargo Management Manual,
- The vessel carries CO2 and DCP extinguishers which may (emergency dependant) be used in preference to AFFF,
- Fluorine free foams are able to be used in -30°C conditions therefore RSV *Nuyina* will carry the most environmentally friendly version of Formtec AFFF (short chained C6) which will work in Antarctic conditions, and
- AFFF will only be deployed in an emergency and not used for training purposes.

7.4.5 Degradation of Wilderness Values

Human presence in Antarctic has the potential to impact on landscape and wilderness values. This is an unavoidable consequence of operating in an environment characterised by the lack of human activity. The presence of the RSV *Nuyina* in the Southern Ocean and adjacent to Australia's research station represents a short term degradation of wilderness values.

Mitigation(s) include:

- Minimal external lighting used during transit and when at anchor, and
- Vessel to maintain International Air Pollution Prevention Certificate to minimise visual air pollution during operations.

7.4.6 Impacts on Other Programs or Projects

The RSV *Nuyina* will regularly interface with other programs and projects in the Antarctic region. These programs and projects will submit environmental applications as required and have not been considered within the scope of this IEE.

7.4.7 Cumulative Impacts

The activities being undertaken to facilitate station resupply have a potential cumulative impact as a result of increased cargo and associated material handling equipment. However, all activities are limited to within existing disturbed sites at the stations. Additional usage of existing station infrastructure is not anticipated to result in damage, beyond what would be considered normal wear and tear (subject to routine maintenance). There are no expected impacts on cultural or heritage values, or areas of historical importance resulting from the proposed activities.

7.5 Evaluation of Environmental Impacts

7.5.1 Methodology

This section evaluates the impacts identified in Section 7.4 for their significance. In order to determine the overall significance and risk, each potential impact has been assessed using the following criteria:

(i) **Likelihood of the impacts occurring**

Likelihood Guide	
Almost Certain	Is expected to occur in most circumstances. Has occurred in the AAD or similar in the past year.
Likely	Will probably occur. Has occurred in the AAD or similar in the past two years.
Possible	Might occur (**COULD HAPPEN**) at some time in the future. Has occurred in the AAD or similar in the past five years.
Unlikely	Could occur but considered unlikely or doubtful. Has occurred in the AAD or similar in the past ten years.
Remote	May occur in exceptional circumstances. Has not occurred in the AAD or similar in the past ten years.

Figure 8 Likelihood description

(ii) **Consequence of the impact occurring**

Consequences Guide	
Insignificant	Minor incident of environmental damage that can be reversed.
Minor	Isolated but significant instances of environmental damage that could be reversed with intensive efforts.
Moderate	Significant instances of environmental damage that could be reversed with intensive efforts.
Major	Major loss of environmental amenity and real danger of continuing.
Catastrophic	Severe widespread loss of environmental amenity and irrecoverable environmental damage.

Figure 9 Consequence description

In determining significance, the following additional criteria are used to take into consideration the range of potential consequences resulting from an activity or impact.

- Spatial extent,
- Reversibility,
- Intensity /magnitude, and
- Duration.

Where activities may result in a combination of impacts and consequence rating the highest rating has been used in the impact assessment.

Additional Guidance for Environmental Consequences.					
Environmental Consequences	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Spatial extent – over what approximate area are environmental impacts likely to occur?	<10 m^2 e.g. less than 3m x 3m or 5m x 2m	<100 m^2 e.g. less than 10m x 10m	<1,000 m^2 e.g. less than 32m x 32m or 10m x 100m	<10,000 m^2 e.g. less than 100m x 100m or 10m x 1000m	>10,000 m^2 e.g. over 100m x 100m or 10m x 1000m
Reversibility – how possible is it that the environmental ***impacts*** can be reversed?	Reversible with minor intervention	Reversible with moderate intervention	Reversible with intensive effort	Reversible with intensive long-term effort	Effectively irreversible
Intensity / magnitude – how much change to the environment is likely to occur?					
Consider change to landscape features *e.g. stone polygons, rare or unusual rock formations or mineral assemblages, ice-free areas.*	Degradation or loss of < 1% of the area of local occurrences of a landscape feature	Degradation or loss of < 5% of the area of local occurrences of a landscape feature	Degradation or loss of <20% of the area of local occurrences of a landscape feature	Degradation or loss of <50% of the area of **local** occurrences of a landscape feature *or* Degradation or loss of up to 5% of the area **of all known occurrences** of a landscape feature (globally)	Greater than 50% of the area of **local** examples of a landscape feature *or* Degradation or loss greater than 5% of the area **of all known occurrences** of a landscape feature (globally)
Consider change to species of fauna and flora, including threatened species *e.g. moss beds, invertebrates.*	No observable change	Some individuals impacted. No population impact and no impact on threatened species	Loss of individuals. Minimal impact on population *or* Some impact on individuals of threatened species	Substantial impact on or loss of population. Potential loss of genetic diversity *or* Loss of individuals of threatened species	Local extinction of species. Loss of genetic diversity *or* Impact on one or more populations of threatened species
Consider change to environmental values of sites *e.g. biological, scientific, historic, aesthetic or wilderness value.*	No observable change	Some degradation of values	Substantial degradation or loss of values *or* Some degradation of values within nationally or internationally significant sites (ASPA, ASMA & Heritage managed areas)	Loss of values *or* Substantial degradation of a nationally or internationally significant site	Loss of values of a nationally or internationally significant site
Duration – over what period are the ***impacts*** likely to occur?	<1 month	<1 year	<5 years	<15 years	>15 Years

Figure 9 Environmental Consequence criteria descriptions

(iii) **Risk Rating**

The likelihood and consequence has been considered for each activity against the aspects of the environment it interacts with and the potential environmental impacts. The following risk ratings are applied for activities pre and post mitigation.

Likelihood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain	Medium	Medium	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Low	Medium	High	High
Unlikely	Low	Low	Medium	Medium	High
Remote	Low	Low	Low	Medium	Medium

Figure 10 Environmental Risk Rating Matrix

For the purposes of this assessment the following classification has been has been applied to this residual risk rating for the activities described in Chapter 5. These reflect the three levels of impact significance described in Article 8(1) of the Environmental protocol.

Risk Rating	Level of Impact significance
Low	Less than minor or transitory
Medium	No more than minor or transitory
High	More than minor or transitory
Severe	

Figure 11 Risk Rating Level of significance

7.6 RSV *Nuyina*: Environmental Impact Matrix

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
1	Australia, Antarctica	**RSV *Nuyina* Shipping:** *RSV Nuyina* port call - Hobart. Loading of cargo, equipment, stores and personnel in Hobart.	Normal	Physical disturbance-Introductions	Biological change, Habitat change	• Potential to introduce non-native species to Antarctica and the sub-Antarctic.	Almost certain	Moderate	**High**	• Biosecurity SOP D19/43754 includes procedures, staff training, emergency response and maintenance of buildings, external work areas and equipment. • It is mandatory for all AAP expeditioners to complete eLearning PDE101 *Introduction to Environmental Management in Antarctic/sub-Antarctic* and to attend an Environmental Management pre-departure session. Both presentations cover biosecurity. • Cargo, equipment and stores quarantined are at AAD head office/CBC before being loaded in RSV *Nuyina*. • The CBC has an approved arrangement with the Australian Government to manage biosecurity risks on the Government's behalf. • RSV *Nuyina* carries ratguards for use on berthing lines when alongside. • The AAD maintains an incident reporting system to monitor, respond and learn from biosecurity issues and threats, in a timely and effective manner.	Possible	Insignificant	**Low**
2	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal, Abnormal, Emergency	Hazardous Chemicals-Leak/spill	Disturbance of fauna, Pollution of sea water/sediments	• Oil pollution caused by collision or grounding. • Fuel and oil spills. • Pollution resulting from inadvertent release of oil, oily water, black or grey water or pumping of bilges. • Pollution of sea ice and water from hull paint residue. • Marine wildlife impacted by seawater intake in response to spill/leak clean up. Equipment used: • Ship (26,000tonnes), • 2 x Diesel engines (19,200kW total) • 4 x Diesel generators (11,000Kw total) • 3 x bow thrusters (1,300kW each) • 3 x stern thrusters (1,300kW each • Oily water separator • Holding tanks	Almost certain	Catastrophic	Severe	• RSV *Nuyina* is required to implement safe navigation practices in accordance with *International Regulations for Preventing Collisions at Sea, 1972*. RSV *Nuyina* Crew are required to comply with the mandatory training and standards of the STCW Code under the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978* as amended, and the *International Code for Ships Operating in Polar Waters (Polar Code)* under SOLAS Ch XIV). • RSV *Nuyina* Ship Specific Procedures (SSPs) require all RSV *Nuyina* watercraft to maintain any water in the bilges whilst underway and manually remove water when hoisted inboard the RSV *Nuyina* at the completion of operations. Any oily water from watercraft will be transferred to RSV *Nuyina's* tanks. • RSV *Nuyina* is required to maintain an Oil Record Book (MARPOL Annex I, reg 17 and 36) which details oils loaded by and disposed of by the vessel. • RSV *Nuyina* has a Shipboard Oil Pollution Emergency Plan (in line with MARPOL Annex I, reg 37;resolution MEPC.54(32), as amended by resolution MEPC.86(44)) which details an action plan, includes procedures to contain the discharge of oil. • *RSV Nuyina* carries oil spill kits to be used in case of an oil or fuel spill. • RSV *Nuyina* has an International Oil Pollution Prevention Certificate (MARPOL Annex I, reg 7) which requires initial, annual, intermediate and 5 yearly renewal surveys of the oil pollution prevention equipment installed in Nuyina. . • RSV *Nuyina* will be operated to retain all machinery space oily-water mixtures onboard when in the Antarctic area (MARPOL ANNEX 1, reg 15-B; PART II-A of the Polar Code (paragraph 1.1.1)). • RSV *Nuyina* will be operated to maintain OW class notation which requires all drainage from machinery space bilges in all areas to be discharged ashore (or discharged to sea where it can be demonstrated that the oil-in-water content of the water discharged is less than 5 ppm), except under exceptional circumstances. This is above the general MARPOL Annex I, reg 15-A requirement of the oil-in-water content of less than 15 ppm. • RSV *Nuyina* has been designed and built to achieve P class notation, which requires all fuel oil, lubricating oil tanks and hydraulic oil to be located in a protected location away from the ship's side or bottom. In the event of an oil tank becoming breached, RSV *Nuyina* also has a Ship Emergency Response Service (SERS) which is able to provide remote technical support to the vessel's master with regards to vessel safety and minimisation of pollution.• RSV *Nuyina* has been designed, built and operated to utilise waste heat recovery from the engines for water generation, which minimises fuel burn and emissions when generating water. • Seawater inlets are fitted with perforated steel plates (or similar) to restrict foreign objects and marine life from being sucked into the Vessel with seawater.	Remote	Major	**Medium**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
										• *RSV Nuyina's* bilge water treatment system is class approved and has been installed to maintain IBTS (Bilge Water Treatment System) class notation.			
3	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal	Physical disturbance-Introductions	Biological change, Disturbance of fauna, Habitat change	• Introduction of non-native species from ship's hull. • Organisms introduced/removed from the environment during ballasting, charging of fire main, engine cooling, fresh water generation (plate evaporator) and uncontaminated sea water system, trace metal sea water system, wet well sampling. • Organisms introduced from the atmosphere e.g. insects and birds	Almost certain	Moderate	**High**	• Nuyina has a Biofouling Management Plan in line with IMO resolution MEPC 207(62) which has been reviewed and approved by Lloyd's Register, and a Biofouling Record Book. Together these documents provide a system of biofouling monitoring and management aimed at minimising the risk of transferring invasive aquatic species. • Hull inspections will be undertaken in port prior to first Voyage of the shipping season. Additional measures may be required subject to voyage plan and inspection findings. • RSV *Nuyina* is required to maintain an International Antifouling System Certificate (*International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001*, Reg 2). This certificate indicates compliance with the convention and requires an initial survey of the ship's antifouling system and additional surveys when change or replacement of the system occurs. • Transit through sea ice removes encrusting organisms from hull. •General seawater inlets are fitted with perforated steel plates (or similar) to restrict foreign objects from being drawn into the vessel with seawater. • Wet well sampling inlet is sized to minimise loss of marine birds and mammals. • Reverse osmosis units on-board using two vacuum distillation plants take in raw seawater that surrounds the ship. Waste heat from the engines is utilised to evaporate fresh water from the seawater. The fresh water is used on-board, the brine (highly saline water) is discharged overboard in close proximity to the geographic location from which it is extracted.	Unlikely	Moderate	**Medium**
4	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal	Energy use-Emission of gases	Pollution of the air	• Pollution from diesel engine exhaust • Internal combustion engines using marine diesel oil will drive 'alternators' to generate electricity. • Fresh water generated from waste heat recovery from diesel generators and thermal oil boilers. Equipment: • 2 main engine driven electric motors (6,400kW total) • 4 x Diesel generators (11,000Kw total)	Almost certain	Moderate	**High**	• RSV *Nuyina* is operated to maintain an International Air Pollution Prevention Certificate (IAPPC), an International Energy Efficiency Certificate (IEEC) and a Statement of Compliance – Fuel Oil Consumption Reporting (MARPOL Annex VI, reg 6). An IAPPC requires compliance with a range of criteria and audit processes to minimise air pollution resulting from their activities. An IEEC requires an Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP). • RSV *Nuyina* is designed, built and operated with NOx-2 class notation which requires that all diesel engines on-board (other than those used solely for emergency purposes on the ship) meet MARPOL Annex VI, Reg 13 Tier 2 nitrogen oxides emissions limits. • RSV *Nuyina* is operated to meet the requirements of MARPOL Annex VI, Reg 14, limiting the sulphur content of the fuel oil used onboard to less than 0.50% m/m and less than 0.10% m/m in emission control areas. RSV *Nuyina* is planned to use only fuel oil with a sulphur content of less than 0.10% m/m • The vessel has been designed and built to utilise waste heat recovery from the generators for generation of water which minimises fuel burn and emissions. • RSV *Nuyina* is intended to be operated with the optional ECO EnMS class notation which requires the use of an Energy Management System, certified under ISO 50001 (Energy Management). ISO50001 certification requires baseline data (once the vessel is running normally) on energy consumption followed by a system of continual improvement.	Almost certain	Minor	**Medium**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
5	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal	Physical disturbance-Noise emission	Noise pollution, Disturbance of fauna, Degradation of wilderness values	• Noise and vibration created by the engines, generators, propellers and vessel passing through the water. • Noise and vibration from the ship breaking ice • Fresh water generated from waste heat recovery from diesel generators and thermal oil boilers - minimal impact.	Almost certain	Moderate	**High**	• All rotating machinery is resiliently mounted to minimise vibration. • RSV *Nuyina*'s watercraft have been specified to meet the lowest practical airborne noise level. • RSV *Nuyina* has been assigned DNV Silent R notation equivalence at 8 knots electric propulsion for science acoustic work. As a consequence of the decisions made on equipment and design (e.g. Engine choice and resiliently mounted equipment) the ship has much lower waterborne noise than many equivalent sized ships across the range of ship speeds and operating modes. • RSV *Nuyina*'s compliance with MSC.337(91) *Code on Noise Levels on Board Ships* under SOLAS 1974, reg II-1/3-12 assists with minimising onboard noise. • RSV *Nuyina*'s main engines and generator exhausts are fitted with silencers to reduce the airborne noise. • RSV *Nuyina*'s air intakes for engine rooms are fitted with silencers to reduce the noise emitted from them during operation.	Likely	Insignificant	**Low**
6	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal	Physical disturbance-Landscape	Disturbance of fauna	• Light pollution from navigation lights and internal lights. • Deck lighting. • Large object disturbance. • Visual disturbance to wilderness and wildlife.	Almost certain	Insignificant	**Medium**	• Black-out blinds are installed throughout the ship to enable the reduction light pollution. The use of vessel blinds and external lights will be identified in the ships environmental management plan with voyage management implementing routines and controls as required in consultation with the Master. • External lighting, not used for navigation or for the safety of personnel, can be reduced when possible pending voyage management and Master's requirements. • Voyage management to arrange regular checks for bird stike and landings on the vessel, all incidents of bird strikes to be recorded through appropriate reporting mechanisms. • Training provided to AAD voyage management representatives on how to deal with bird strikes and birds landing on the vessel, appropriate equipment to deal with birds following an incident included on Voyages. • AAD voyage management representatives on every voyage provide oversight of environmental procedures including management of light and procedures for responding to incidents. • Searchlights are available to locate vulnerable wildlife.	Possible	Insignificant	**Low**
7	Australia, Antarctica	**RSV *Nuyina* Shipping:** Transit. Voyages from Hobart to the stations and return. Including power & water generation. Multiple times during the season, approx 4 voyages.	Normal	Physical disturbance-Human impact	Disturbance of fauna	• Collision with cetaceans and other marine life. • Disturbance of marine life on voyage routes.	Possible	Moderate	**Medium**	• A constant lookout is maintained as part of the vessel's safe navigation practices. • Avoidance techniques can include a reduction in speed, alterations of course and increased lookout capability when appropriate and safe. •Voyage planning, where appropriate and the information is available, will identify high risk areas which should be avoided. • Searchlights are available to locate vulnerable wildlife when appropriate and safe.	Unlikely	Minor	**Low**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
8	Australia, Antarctica	**RSV *Nuyina* Shipping:** Waste Management. Waste generated during the voyage to be separated as it is produced and stored ready for incineration or to be returned to Australia for disposal. At all times whilst at sea and at anchor.	Normal	Waste Management-Combustible solids	Pollution of sea water/sediments	• Waste materials being dispersed due to weather conditions. • Waste materials being inadvertently released over the side of the Vessel. • Waste separation not adhered to by staff and crew. • General waste/items blown or washed off overboard. Equipment used: • Rubbish bins • Cage pallet • Incinerator • Refrigerated garbage store	Possible	Moderate	**Medium**	• Waste on-board RSV *Nuyina* is separated and stored below decks to minimise exposure to the environment. • RSV *Nuyina* uses a refrigerated garbage store to storage non-combustible waste on-board until it is offloaded in Australia. Storage capacity for 90 days has been shown to be adequate by the sub-contractor. • RSV *Nuyina* uses an incinerator to burn combustible waste, with the ash returned to Australia for disposal. • Medical waste will be retained on board and returned to Australia for disposal. • All recyclable materials will be stored onboard for processing on arrival in Australia. Capacity for 90 days has been demonstrated by the sub-contractor. • RSV *Nuyina* is required to maintain a Garbage Management Plan (MARPOL Annex V, reg 10; Madrid Protocol Annex 3) which sets out the procedures to be followed on-board for collecting, processing, storing and disposing of garbage on-board. The Garbage Management Plan also designates a person or persons in charge of carrying out the plan. This plan is audited by the Australian Maritime Safety Authority. • RSV *Nuyina* is required to maintain a Garbage Record Book (MARPOL Annex V, reg 10) on-board. The Garbage Record Book records details of all garbage discharged from or incinerated onboard RSV *Nuyina*. • All expeditioners embarking in RSV *Nuyina* are required to participate in waste separation guidance provided through AAD pre-departure online training and shipboard briefings.	Unlikely	Minor	**Low**
9	Australia, Antarctica	**RSV *Nuyina* Shipping:** Grey and black water management. Grey and black water to be treated on-board and stored in holding tanks or discharged into the environment, depending on vessel location.	Normal	Waste Management-Sewage/grey water	Pollution of sea water/sediments	• Grey and black water release: Failure of two sewage treatment plants are available to process grey and black water on-board. Equipment: 2 x Gertsen & Olufsen a/s sewage treatment plant.	Likely	Moderate	**High**	• RSV *Nuyina* is required to maintain an International Sewage Pollution Prevention Certificate (MARPOL Annex IV, reg 5) which requires sewage treatment plant and sewage discharge to comply with MARPOL Annex IV standards and is subject to a system of surveys to verify ongoing compliance. • RSV *Nuyina* has a two grey water and sewage treatment plants (STP) contained within machinery spaces. • The STPs are type approved and the quality of effluent discharge meets the standard set by MEPC 227(64) as amended under MARPOL Annex IV. • Vessel designed, built and operated to maintain GW class which means the grey water treatment plant discharge effluent meets the required standard and that grey water treatments and discharges are recorded. • There are two STPs on-board for redundancy purposes in the event that one should have a fault. • When in Antarctic waters sewage and grey water will be discharged as far as practicably from the nearest land, ice-shelf, fast ice or areas of ice concentration exceeding 1/10 in accordance with PART II-A of the Polar Code (paragraph 4.2.1.3). There is also capacity to store at least 3 days of sewage and grey water. • RSV *Nuyina* has a sewage disposal record book to record discharge times and locations of sewage and grey water.	Unlikely	Minor	**Low**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
10	Australia, Antarctica	**RSV *Nuyina* Shipping:** Ballast water. Ballasting will occur to ensure ship's stability is maintained as required at regular intervals throughout the voyage.	Normal	Physical disturbance-Human impact	Disturbance of fauna, Pollution of sea water/sediments, Destruction of flora	• Organisms and wildlife impacted from the environment during ballasting.	Almost certain	Moderate	**High**	• RSV *Nuyina* is required to maintain an International Ballast Water Management Certificate (BWM 2004, reg E-2) to ensure compliance with the requirements of the *International Convention for the Control and Management of Ships' Ballast Water and Sediments,* 2004 and with resolution MEPC.174(58) *Guidelines for Approval of Ballast Water Management Systems.* • RSV *Nuyina* is required to maintain a Ballast Water Management Plan (BWM 2004, reg B-1; res MEPC. 127(53) and a Ballast Water Record Book (BWM 2004, Reg B-2) for the purpose of recording all ballast water operations and use of the treatment system. This documentation and certification is subject to a 5-yearly system of initial, annual, intermediate and renewal surveys to verify compliance. • RSV *Nuyina* uses a type -approved ultra-violet and filtration treatment system for processing ballast water. This avoids the introduction of chemicals associated with chemical injection type systems. • RSV *Nuyina* seawater inlets are fitted with perforated steel plates (or similar) to restrict foreign objects from being sucked into the Vessel with seawater. • RSV *Nuyina* designed, built and operated to meet BWT class notation for treatment of ballast water which means the treatment system is installed and approved in accordance Lloyds Rules.	Likely	Minor	**Medium**
11	Australia, Antarctica	**RSV *Nuyina* Shipping:** Anchoring. Securing the Vessel(s) in position at the stations. During station visit or potentially during an emergency	Normal, Emergency	Physical disturbance-Landscape	Disturbance of fauna, Landscape change, Degradation of wilderness values	Anchor and cable will be dropped from the bow of the Vessel(s). Damage to the seafloor.	Almost certain	Moderate	**High**	• Designated anchorage areas at the stations will be used by RSV *Nuyina when safe navigation allows.* • RSV *Nuyina* has an anchor/chain washing system which will be used when raising the anchor, when safe and practical. • External lighting, not used for navigation or for the safety of personnel, can be reduced to minimise visual disturbance when required. Routines for the use of blinds and external lighting will be set during the voyage planning process and implemented and controlled by voyage management in consultation with the Master. • Voyage management to arrange regular checks for bird stike and landings on the vessel whilst at anchor, all incidents of bird strikes to be recorded through appropriate reporting mechanisms. • Training provided to AAD voyage management representatives on how to deal with bird strikes and birds landing on the vessel and have appropriate equipment to deal with birds following an incident. • AAD voyage management representatives on every voyage provide oversight of environmental procedures including management of light and procedures for responding to incidents. • Anchoring is not planned to occur at Mawson research station, with the vessel intended to be secured to shore using mooring lines and holding position engines/thrusters, reducing sea bottom interference. • When the Mawson bollard is unavailable or not suitable for use due to weather conditions, maintaining position using dynamic positioning may be possible, subject to Master/OOW's discretion and safety and operational requirements. • RSV *Nuyina* has DP(AA) class notation and therefore is able to reliably hold position, thus reducing the need to anchor for shorter-term cargo operations, reducing the number of anchoring evolutions.	Almost certain	Insignificant	**Medium**
12	Australia, Antarctica	**RSV *Nuyina* Shipping:** Bulk fuel transfer. Transfer of bulk quantities of Special Antarctic Blend (SAB) Diesel to station bulk storage tanks. Once per resupply voyage at each station.	Normal, Emergency	Hazardous Chemicals-Leak/spill	Pollution of sea water/sediments, Disturbance of fauna, Destruction of flora	• Fuel leaks / spills leading to sea water/ice/ground contamination • Fuel spill during station refuelling operations or small boat refuelling at sea. Equipment: • Fuel hoses, manifold, couplings and pumps. • Inflatable Rescue Boats (IRBs)	Likely	Moderate	**High**	• In the event of a spill onboard during ship to shore transfer, Serco are responsible. The ship will have onboard spill response equipment and a Ship Oil Pollution Prevention Emergency Plan (SOPEP) (MARPOL Annex I, reg 37). • In the event of a spill during ship to shore transfer AAD personnel are responsible after fuel has left the manifold (i.e. for the length of hose into the station). AAD Operations Manual Volume 6 Section F: Station Refuelling Manual CD18/10, includes: constant monitoring of equipment during the transfer stage by workers, including a dedicated crew member to be rostered on the deck to share the monitoring of the refuelling; routine inspection and testing of refuelling equipment; and training and briefing of personnel. • AAD has fuel spill contingency plans for each station and supply spill response equipment at each station. • AAD Crisis Management and Recovery (CMR) Manual details environmental management representation and duties on the CMR team as required. • In the event of a spill from ship's tanks Serco are responsible and SERS would be of assistance.	Possible	Minor	**Low**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
13	Australia, Antarctica	**RSV *Nuyina* Shipping:** Cargo, stores and equipment transfer. Transfer of cargo, stores and equipment in containers from ship to station using watercraft, helicopter and lifting equipment over ice.	Normal	Physical disturbance-Human impact	Disturbance of fauna, Landscape change, Noise pollution	• Transport of organisms or wildlife in or on cargo. • Loss of container or equipment over side of ship • Collison with cetaceans and other marine life causing injury or death. • Landing barges will impact shoreline. • Noise from engines • Disturbance of wildlife by vehicle, helicopters, personnel walking and equipment movements.	Likely	Moderate	**High**	• AAD has existing well developed cargo Biosecurity procedures to prevent the introduction of non-native species to Antarctica. The AAD's EMS includes audits and assurance of high risk activities including biosecurity controls. • RSV *Nuyina* is required to maintain a Cargo Securing Manual (SOLAS 1974, reg VI/5.6 and VII/5; MSC.1/Circ.1353/Rev.1), which aims to provide a safe system of cargo securing and to reduce the risk of containers or equipment being lost over the side of the vessel whilst at sea due to inadequate securing onboard. • The carriage of dangerous goods on RSV *Nuyina* is required to comply with the requirements of the International Maritime Dangerous Goods (IMDG) Code under SOLAS Ch VII Reg 3. • RSV *Nuyina* is required to comply with *Marine Order 32 (Cargo handling equipment) 2016* which prescribes 'matters for machinery and equipment that belong to a vessel and are used for loading or unloading the vessel, including inspection, testing, maintenance and operation'. • Serco will be required to comply with AAD Watercraft Standard Operating Procedures which set out environmental requirements, including speed and distances to maintain from fauna when watercraft are being used during resupply operations. • Watercraft are biosecurity cleaned and inspected prior to reaching Antarctic waters. • AAD Environmental Policy and Code of Conduct set out the principles and requirements for avoiding interactions between vehicles, watercraft and wildlife. • Watercraft refuelling inlets are bunded to contain any oil spilt during refuelling, oil spill equipment on board is available to clean out the bund prior to the watercraft's departure from the ship. • AAD SOPs for Barges and watercraft operations require speeds in shallow waters to reduce wake and wash on shore as well as minimise impacts on benthic communities and sediments of turbulence from jets or propellers. • Voyage planning activities will assess likelihood of encountering cetaceans and other wildlife during resupply activities. Mitigation include additional lookouts onboard the RSV *Nuyina* and watercraft, operating at safe speeds, and alterations of course when appropriate and safe. • There are designated station boat ramps/wharves/jetties for discharging and backloading cargo and personnel. • AAD Standard Operating Procedure Vol. 5 Aviation includes ship-to-shore helicopter operations. It includes fixed landing sites, requires aircraft movements to be initiated by a task approval process and risk assessment, and sets out fuel management guidelines, including storage of fuel drums.	Possible	Minor	**Low**
14	Australia, Antarctica	**RSV *Nuyina* Shipping:** Personnel transfer. Transfer of expeditioners from RSV *Nuyina* to the stations. Multiple times per resupply. Via helicopters, watercraft, vehicles and on foot.	Normal	Physical disturbance-Human impact	Disturbance of fauna, Noise pollution	• Personnel walking ship-to-shore • Noise from engines • Underwater radiated noise and vibration during transit may disturb marine life activity. • Collison with cetaceans and other marine life causing injury or death. Equipment: Vessel watercraft	Likely	Major	**High**	• Serco will be required to comply with AAD Watercraft Standard Operating Procedures which outline the Environmental requirements for interactions between watercraft and wildlife. • There are designated station boat ramps/wharves/jetties for discharging and backloading cargo and personnel. • Watercraft are biosecurity cleaned prior to reaching Antarctic waters. • It is mandatory for all AAP expeditioners to complete eLearning *PDE101 Introduction to Environmental Management in Antarctic/sub-Antarctic* and attend Environmental Management pre-departure session. Both presentations cover wildlife management and the AAD Environmental Code of Conduct for expeditioners. • AAD voyage environmental procedures include use of biocide footbaths and provision of cleaning equipment at embarkation and disembarkation locations on the Vessel. • Cetacean avoidance techniques include a proper lookout onboard the watercraft, operating at safe speeds, and alterations of course when appropriate and safe.	Unlikely	Insignificant	**Low**
15	Australia, Antarctica	**RSV *Nuyina* Shipping:** Personnel transfer Transfer of	Normal	Hazardous Chemicals-Leak/spill	Disturbance of fauna, Pollution of sea	• Fuel leaks / spills leading to sea water/ contamination	Likely	Moderate	**High**	• RSV *Nuyina* SSP require all watercraft to maintain any water in the bilges whilst underway and manually remove water when hoisted inboard the RSV *Nuyina* at the completion of operations. • Two watercraft have inboard engines that could mix water with oils/coolant. AAD SOPs include the requirement carry clean empty fuel containers for removing and storing contaminated water from the watercraft bilge. This is then disposed of through the ship's oily water system. All other watercraft use outboard engines (any water in bilge	Unlikely	Insignificant	**Low**

RSV *Nuyina:* Environmental Impact Matrix							Inherent Risk Rating				Residual Risk Rating		
Activity #	**Location**	**Activity description**	**Condition**	ASPECTS	**IMPACT(S)** *- can choose multiple impacts*	**Potential causes/sources of an impact happening** *- brief dot points*	Likelihood	Consequence	**RISK**	**Existing Reduction/Control Measures - against the Aspect.** *e.g. Policy, procedures, outside controls or organisations, monitoring and reporting systems…*	Likelihood-2	Consequence-2	**RISK2**
		expeditioners from RSV *Nuyina* to the stations. Multiple times per resupply. Via helicopters, watercraft, vehicles and on foot.			water/sediments	Equipment: Vessel watercraft				would be just local sea water). • Watercraft are biosecurity cleaned prior to reaching Antarctic waters. • AAD Watercraft Standard Operating Procedures, OPS Manual Volume 7 include fuel management. • AAD Standard Operating Procedure Vol. 5 Aviation includes ship-to-shore helicopter operations. It includes fixed landing sites, requires aircraft movements to be initiated by a task approval process and risk assessment, and sets out fuel management guidelines, including storage of fuel drums.			
16	Australia, Antarctica	**RSV *Nuyina* Shipping:** Firefighting. Firefighting capability to extinguish helicopter and aviation fuel fires on-board RSV *Nuyina*.	Normal, Abnormal, Emergency	Hazardous Chemicals-Leak/spill	Disturbance of fauna, Pollution of sea water/sediments, Pollution of the air	A helicopter crash on deck, or an aviation fuel fire on the upper decks would be extinguished using manually operated fire hoses and/or automatic fire canons positioned forward and after. It is likely AFFF would be disbursed overboard.	Almost certain	Moderate	**High**	• Seawater inlets are fitted with perforated steel plates (or similar) to restrict foreign objects from being sucked into the vessel with seawater. • RSV *Nuyina* carries the most environmentally friendly version of Formtec AFFF (short chained C6) as practicable in Antarctic conditions (-30 degrees C). No fluorine free foams are able to be used in -30ºC conditions. This makes fluorine free foams unfit for purpose for RSV *Nuyina*. Short Chained (C6) AFFF foams are able to be used effectively in our operating conditions and break down considerable quicker in the environment than conventional AFFF. These foams consequently accumulate far slower in water systems making them considerable less hazardous to life. • Foam will only be deployed in an emergency. At the end of its shelf life, it will be disposed of without impact to the environment.	Likely	Insignificant	**Low**

Figure 11 Environmental impact Matrix

This Impact matrix has referred to a number of documents and procedures, which are the responsibility of the AAD or the vessel's operator, Serco. A list of supporting documentation is contained in the appendices including a summary of the Class notations assigned to the RSV *Nuyina* that have environmental performance or compliance standards.

7.7 Environmental Monitoring and Management

Australia is strongly committed to the comprehensive protection of the Antarctic environment. The AAD is responsible for fulfilling that commitment, as well as mitigating and managing the environmental impacts of Australia's activities in the Southern Ocean and sub-Antarctic.

The AAD's Environmental Policy outlines a commitment to continual improvement in environmental performance and forms the foundation of the AAD's Environmental Management System (EMS). The EMS is a systematic framework for managing the AAD's interaction with the environment. The system considers the environmental; aspects, impacts, risks and opportunities associated with activities and strategic planning. A key objective of the Australian Antarctic Program is to protect the unique environmental values of Antarctica and the Southern Ocean and, to ensure environmental monitoring and management are foremost in planning and operations within the organisation.

The AAD's environmental monitoring activities form part of an integrated monitoring system that collects, records and reports on performance data collected from a wide range of applications, networks and programs. Environmental monitoring activities undertaken by the AAD includes data collected in relation to the main risks and key environmental indicators identified in the AAD environmental aspects and impacts register.

The environmental monitoring associated with the operation of the RSV *Nuyina* will be integrated into the AAD wide environmental monitoring program described above.

The objective of the environmental monitoring for RSV *Nuyina* will be to:

- Ensure impacts are avoided or limited consistent with the environmental principles of the Madrid Protocol,
- Establish the accuracy of the IEE's conclusion that the impacts of aviation are likely to remain minor and transitory,
- Inform any changes needed to practices to comply with impact thresholds set by regulators,
- Ensure impacts are not in conflict with the broader community's expectations in relation to Antarctica's protection; and

Inform the mitigation of any unforeseen but potentially significant impacts associated with operations and activities described in this IEE.
Ongoing monitoring and measurement of the main impacts and key environmental indicators identified in the IEE include but are not limited to:

- Vessel's fuel consumption and engine performance,
- Vessel noise levels,
- Ballast water and sewage management,
- Biosecurity management, and
- Incident reporting.

The AAD State of Environment database includes a range of indicators relevant to shipping and station operations. These indicators are located in the Human Settlements Theme and includes indicators associated with fuel, electricity and water consumption; wastewater and solid waste management; and personnel numbers. This data will be updated annually at the end of the austral summer operations season.

7.7.1 Incident and Hazards Reporting

The AAD's environmental incident and hazard reporting system is a key component of the AADs' EMS and provides the capacity to monitor and track activities or incidents which either directly or indirectly have the potential (near misses and improvements) to impact the environment.

This reporting system forms part of a monitoring framework that identifies, prioritises and responds to environmental impacts or risks in real-time. The integration of this reporting system into AAD quarterly and annual reporting provides analysis of incidents and trends to identify and monitor environmental impacts and response actions. AAD's environmental incident reporting system provides an evidence-based approach for the development and delivery of continual improvements to the AAD's EMS and Antarctic operations, including the RSV *Nuyina* operations.

7.7.2 Compliance Monitoring- Maritime Regulations

As a regulated Australian vessel, the RSV *Nuyina* is subject to various requirements set out by the International Maritime Organisation (IMO) in international conventions, codes and resolutions. These are implemented in Australia by the Australian Maritime Safety Authority (AMSA) through a variety of national laws and regulations. Among many other things, these regulations set out requirements and standards and the system of surveys relating to environmental protection. The major items of those referenced S7.6 RSV *Nuyina* Environmental Impact Matrix are described in Appendix 1.

In addition, RSV *Nuyina* is subject to the relevant Classification Rules and Regulations of Lloyd's Register Classification Society. Lloyd's Register requires a system of survey and certification to verify the vessel meets the required standards under these rules. The rules aim to ensure the structural strength of the vessel, the safety and reliability of certain critical onboard systems, and the effectiveness of certain other systems/features for the safe carriage of vessel-appropriate cargo and persons. Nuyina has been designed to meet certain class rules above the basic requirements, which certify elements of the vessel's environmental performance. Lloyd's Register has assigned Nuyina certain 'ECO' sub-notations to indicate this these are provided in Appendix 1

8 CONCLUSION

A multi-purpose icebreaker with capacity to resupply Australia's Antarctic station network and to support scientific research in the sea-ice zone and coastal fringe is an essential component of the Australian Antarctic Strategy and 20 Year Action Plan to build and operate a world-class research and resupply Antarctic icebreaker. Without access to a capacity to perform these tasks, Australia would be unable to operate its Antarctic stations or to undertake scientific research in the sea-ice zone.

The vessel operation and resupply activities have been designed to have minimum impact on the environment while delivering improved cargo, logistics and science capabilities to the Australian Antarctic Program. All procedures will conform to relevant AAD and IMO standards and operating procedures in environmental management, and will adhere to all conditions and permits issued under the ATEP Act.

The assessment of impacts included in Chapter 7 of this IEE has identified that the majority of impacts can and will be mitigated through the intrinsic design of the vessel and existing AAD and ship specific procedures and monitoring.

This IEE concludes that, provided the activity and the mitigations are undertaken in the manner described, this activity will have no more than a minor or transitory impact.

9 AUTHORS

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11 ACRONYMS AND ABBREVIATIONS

AAD	Australian Antarctic Division
AAP	Australian Antarctic Program
AFFF	Aqueous Film-Forming Foam
ANARE	Australian National Antarctic Research Expedition
ASPA	Antarctic Specially Protected Area
ATEP	Antarctic Treaty (Environment Protection)
AUV	Autonomous Underwater Vehicle
CBC	Cargo and Biosecurity Centre
CCAMLR	Convention for the Conversation of Antarctic Marine Living Resources
CEMP	CCAMLR Ecosystem Monitoring Program
CMR	Crisis Management Response
CTD	Conductivity, Temperature and Depth
CPR	Continuous Plankton Recorder
DG	Dangerous Goods
DNV	Det Norsk Veritas
DP	Dynamic Positioning
EEDI	Energy Efficiency Design index
EMS	Environmental Management System
GVM	Gross Vehicle Mass
GFE	Government Furnished Equipment
GPS	Global Positioning System
IAPPC	International Air Pollution Prevention Certificate
IEEC	International Energy Efficiency Certificate
IBC	Intermediate Bulk Container
IEE	Initial Environment Evaluation
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
IRB	Inflatable Rescue Boat
IT	Information Technology
LARC	Lighter Amphibious Resupply Cargo
MARPOL	The international Convention for the Prevention of Pollution from Ships
MHE	Material Handling Equipment
MPV	Multi-purpose Vessel
RF	Radio Frequency
RMT	Rectangular Mid-water Trawl
ROV	Remotely Operated Vehicle
RPA	Remote Piloted Aircraft
RSV	Research Supply Vessel
SAB	Special Antarctic Blend
SEEMP	Ship Energy Efficiency Management Plan
SERS	Ship Emergency Response Service
SOLAS	International Convention for the Safety of Life at Sea

SOPEP	Shipboard Oil Pollution Emergency Plan
SOP	Standard Operating Procedure
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STP	Sewage Treatment Plant
SSP	Ship Specific Procedure
TEU	Twenty Foot Container Equivalent Units

12 REFERENCES

AAD (Australian Antarctic Division) - Australian Antarctic Strategy and 20 Year Action Plan; Commonwealth of Australia 2016.

Brooks, S., J. Jabour, J. van den Hoff, and D. Bergstrom. 2019. Our footprint on Antarctica competes with nature for rare ice-free land. Nature Sustainability 2:185-190.

Burton-Johnson A, Black M, Peter TF & Kaluza-Gilbert J (2016). An automated methodology for differentiating rock from snow, clouds and sea in Antarctica from Landsat 8 imagery: a new rock outcrop map and area estimation for the entire Antarctic continent. Cryosphere 10(4):1665–1677.

Cavalieri DJ & Parkinson CJ (2012) Arctic sea ice variability and trends, 1979–2010. Cryosphere 6:957–979.

Clark, G. F., B. Raymond, M. J. Riddle, J. S. Stark, and E. L. Johnston. Vulnerability of shallow Antarctic invertebrate-dominated ecosystems. Austral Ecology 40:482–491.

Fretwell P. et al. (2013). Bedmap2: improved ice bed, surface and thickness datasets for Antarctica. Cryosphere 7(1):375–393.

Griffiths HJ (2010) Antarctic Marine Biodiversity – What Do We Know About the Distribution of Life in the Southern Ocean? PLoS ONE 5(8): e11683. https://doi.org/10.1371/journal.pone.0011683

Klekociuk A & Wienecke B (2017). Australia state of the environment 2016: Antarctic environment, independent report to the Australian Government Minister for the Environment and Energy, Australian Government Department of the Environment and Energy, Canberra, doi:10.4226/94/58b65b2b307c0

DoEE 2020. National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, Commonwealth of Australia 2020

Woehler, Eric. (1990). The Distribution of Seabird Biomass in the Australian Antarctic Territory: Implications for Conservation. Environmental Conservation. 17. 256 - 261. 10.1017/S0376892900032409.

APPENDIX 1

Table A1.1- Environmental protection regulations and classifications

Regulation/Lloyds Register Classification Notation	Basic explanation
International Regulations for Preventing Collisions at Sea, 1972	Set out the 'road rules' with which vessels are required to abide.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, revised 1995/2010 (STCW)	Sets out training and certification requirements of crew along with watchkeeping standards. These requirements cover many items including for example, training in electronic navigation for watchkeepers.
International Code for Ships Operating in Polar Waters (Polar Code) under International Convention for the Safety of Life at Sea 1974 (SOLAS) Ch XIV)	Amends and adds to safety, environmental and training requirements under other international maritime conventions for vessels operating in Arctic or Antarctic (>60°S) waters. Nuyina holds certification indicating compliance with Polar Code requirements and is subject to a system of surveys to maintain this.
International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I	MARPOL is the primary international convention on the prevention of pollution from ships. Annex 1 to the convention deals with the prevention of pollution by oil. Nuyina is required to maintain an Oil Record Book (MARPOL Annex I, reg 17 and 36) which details oils loaded by and disposed of by the vessel. Nuyina has a Shipboard Oil Pollution Emergency Plan (in line with MARPOL Annex I, reg 37;resolution MEPC.54(32), as amended by resolution MEPC.86(44)) which details an action plan and includes procedures to contain the discharge of oil. Nuyina carries oil spill kits to be used in case of an oil spill. Nuyina has an International Oil Pollution Prevention Certificate (MARPOL Annex I, reg 7) which requires initial, annual, intermediate and 5 yearly renewal surveys of the oil pollution prevention equipment installed in Nuyina & the associated monitoring equipment required under the convention. Nuyina will be operated to retain all machinery space oily-water mixtures onboard when in the Antarctic area (MARPOL ANNEX 1, reg 15-B; PART II-A of the Polar Code (paragraph 1.1.1). Nuyina also has an Oil Record Book to record all transfers, loading and discharge of oil. This book is audited by AMSA.
Lloyds Register notation: ECO(OW)	ECO(OW) relates to oily bilge water management. Nuyina will be operated to maintain OW class notation which requires all drainage from machinery space bilges to be discharged ashore (or discharged to sea where it can be demonstrated that the oil-in-water content of the water discharged is less than 5 ppm), except under exceptional circumstances. This is above the general MARPOL Annex I, reg 15-A requirement of the oil-in-water content of less than 15 ppm.
Lloyds Register notation: ECO(P)	ECO(P) relates to protected oil tanks (i.e. to minimise the risk of oil pollution should the vessel experience grounding or collision). Nuyina has been designed and built to achieve P class notation, which requires all fuel oil, lubricating oil tanks and

	hydraulic oil to be located in a protected location away from the ship's side or bottom.
Lloyds Register notation: (SERS)	This is a descriptive note that indicates that the vessel is registered with Lloyd's Register's Ship Emergency Response Service (SERS). SERS provides access to a team of experts (e.g. naval architects, ex mariners) using pre-prepared ship modelling and specialised software to provide technical expertise and assist in critical decision making in the event of a collision, grounding etc.
Lloyds Register notation: ECO(IBTS)	ECO(IBTS) relates to Integrated Bilge Water Treatment Systems which provide a means of separating and disposing of operational oil and water waster from onboard machinery spaces, meeting IMO guidelines and MARPOL requirements. Nuyina's bilge water treatment system has been designed and installed to meet IBTS (Bilge Water Treatment System) class notation.
Lloyds Register notation: ECO(BIO)	ECO(BIO) relates to hull biofouling management. To achieve this notation, Nuyina has a Biofouling Management Plan in line with IMO resolution MEPC 207(62) which has been reviewed and approved by Lloyd's Register, and a Biofouling Record Book. Together these documents provide a system of biofouling monitoring and management aimed at minimising the risk of transferring invasive aquatic species.
International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001	This convention deals with anti-fouling systems (generally hull paint systems) on ships and aims to achieve environmentally safe and effective antifoul systems. Nuyina will hold an International Antifouling System Certificate under this convention. This certificate indicates compliance with the convention and requires an initial survey of the ship's antifouling system and additional surveys when change or replacement of the system occurs.
International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI	MARPOL is the primary international convention on the prevention of pollution from ships. Annex VI to the convention deals with the prevention of air pollution. Under Annex VI Nuyina is operated to maintain an International Air Pollution Prevention Certificate (IAPPC), an International Energy Efficiency Certificate (IEEC) and a Statement of Compliance – Fuel Oil Consumption Reporting (MARPOL Annex VI, reg 6). An IAPPC requires compliance with a range of criteria and audit processes to minimise air pollution resulting from activities. An IEEC requires an Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP). This documentation and certification is subject to a system of surveys to verify ongoing compliance. Nuyina is meets the requirements of MARPOL Annex VI, Reg 14, limiting the sulphur content of the fuel oil used onboard to less than 0.50% m/m and less than 0.10% m/m in emission control areas. Nuyina is planned to use only fuel oil with a sulphur content of less than 0.10% m/m
Lloyds Register notation: ECO (EnMS)	Nuyina is intended to be operated with the ECO EnMS class notation which requires the use of an Energy Management System, certified under ISO 50001 (Energy Management). ISO50001 certification requires baseline data (once the vessel is running normally) on energy consumption followed by a system of continual improvement.
Lloyds Register notation: ECO(NOX-2)	This indicates that the marine diesel engines on-board (other than those used solely for emergency purposes) meet MARPOL Annex VI, Reg 13 Tier 2 nitrogen oxides emissions limits.
Lloyds Register notation: ECO(SOX)	This indicates that sulphur oxide emissions from fuel oil are managed as per the above requirements. This is done by limiting the sulphur content of fuel oil used onboard (as per above).
Lloyd's Register Statement of Compliance - Det Norske Veritas Silent-R notation	This notation relates to underwater radiated noise and indicates the vessel meets the strictest low level of noise, as required for research. Nuyina has been assigned DNV Silent R notation equivalence at 8 knots electric propulsion for science acoustic work. As a consequence of the decisions made on equipment and design (e.g. Engine choice and resiliently mounted equipment) the ship has much lower waterborne noise than many ships across the range of ship speeds and operating modes.

MSC.337(91) Code on Noise Levels on Board Ships under SOLAS 1974, reg II-1/3-12	Nuyina's compliance with MSC.337(91) Code on Noise Levels on Board Ships under SOLAS 1974, reg II-1/3-12 assists with minimising onboard noise for the protection of the crew. AAD is in discussions with Tasports to assess the noise emitted from Nuyina while alongside. This will give an indication of the external airborne noise produced.
International Convention for the Prevention of Pollution from Ships (MARPOL) Annex V	MARPOL is the primary international convention on the prevention of pollution from ships. Annex V to the convention deals with the prevention of pollution from garbage. Nuyina is required to maintain a Garbage Management Plan (MARPOL Annex V, reg 10; Madrid Protocol Annex 3) which sets out the procedures to be followed on-board for collecting, processing, storing and disposing of garbage. Nuyina is required to maintain a Garbage Record Book (MARPOL Annex V, reg 10) on-board. This records details of all garbage discharged from or incinerated onboard Nuyina. The plan and record book are audited by the Australian Maritime Safety Authority for compliance. Garbage discharges are limited to those in line with MARPOL Annex V Reg 6 and PART II-A of the Polar Code, Ch 5.
International Convention for the Prevention of Pollution from Ships (MARPOL) Annex IV	MARPOL is the primary international convention on the prevention of pollution from ships. Annex VI to the convention deals with the prevention of pollution from sewage. Nuyina is required to maintain an International Sewage Pollution Prevention Certificate (MARPOL Annex IV, reg 5) which requires sewage treatment plant and sewage discharge to comply with MARPOL Annex IV standards. This certification is subject to a system of surveys to verify ongoing compliance. Nuyina has a two grey water and sewage treatment plants (STP) contained within machinery spaces. The STPs are type approved and the quality of effluent discharge meets the standard set by MEPC 227(64) as amended under MARPOL Annex IV. There are two STPs on-board for redundancy purposes in the event that one should have a fault. When in Antarctic waters sewage will be discharged as far as practicably from the nearest land, ice-shelf, fast ice or areas of ice concentration exceeding 1/10 in accordance with PART II-A of the Polar Code (paragraph 4.2.1.3). There is also capacity to store at least 3 days of sewage and grey water. Nuyina has a sewage disposal record book to record discharge times and locations of sewage and grey water.
ECO(GW)	This indicates that the discharge from Nuyina's grey water treatment plant discharge effluent meets the required standard under Lloyd's Rules Pt 7, Ch 11, Para 3.8.2 and that grey water treatments and discharges are recorded.
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM)	Nuyina is required to maintain an International Ballast Water Management Certificate (BWM 2004, reg E-2) showing compliance with the requirements of the convention and resolution MEPC.174(58) Guidelines for Approval of Ballast Water Management Systems. Nuyina is required to maintain a Ballast Water Management Plan (BWM 2004, reg B-1; res MEPC. 127(53). Nuyina is required to maintain a Ballast Water Record Book (BWM 2004, Reg B-2) for the purpose of recording all ballast water operations and use of the treatment system. This documentation and certification is subject to a 5-yearly system of initial, annual, intermediate and renewal surveys to verify compliance. Ballast water treatment has replaced ballast water exchange as the acceptable way (internationally and under Australian law) to manage marine organisms within ballast water. Ballast water is used on ships to maintain safe and operationally effective draft, trim, list, stresses and stability. It is taken in, discharged and internally transferred as required both at sea and in port. Cargo movements can require the movement of ballast water as a critical element in order to be undertaken effectively and safely as they effect the location and quantity of masses on the vessel.

	Nuyina uses an approved ultra-violet and filtration treatment system for processing ballast water. This avoids the introduction of chemicals associated with chemical injection type systems.
Lloyds Register notation: ECO (BWT)	Nuyina has a ballast water treatment system which is approved and installed in accordance Lloyd's Register Rules.
DP (AA) notation	This indicates that Nuyina is fitted with a dynamic positioning (DP) propulsion and positioning system with in-built redundancies. The vessel can therefore reliably hold position, thus reducing the need to anchor for shorter-term cargo operations, reducing the number of anchoring evolutions.
Marine Order 42 (Carriage, stowage and securing of cargoes and containers) 2016 (Australian regulation)	This requires Nuyina to maintain a Cargo Securing Manual (SOLAS 1974, reg VI/5.6 and VII/5; MSC.1/Circ.1353/Rev.1), which aims to provide a safe system of cargo securing and to reduce the risk of containers or equipment being lost over the side of the vessel whilst at sea due to inadequate securing onboard.
International Maritime Dangerous Goods (IMDG) Code	The carriage of packaged dangerous goods on Nuyina is required to comply with the International Maritime Dangerous Goods (IMDG) Code under SOLAS Ch VII Reg 3. This code requires certain aims to ensure safe carriage of such goods and to prevent pollution of the environment.
Marine Order 32 (Cargo handling equipment) 2016 (Australian regulation)	Nuyina is required to comply with this Australian regulation which prescribes 'matters for machinery and equipment that belong to a vessel and are used for loading or unloading the vessel, including inspection, testing, maintenance and operation'. To comply, Nuyina's material handling equipment (e.g. cranes) will be subject to a system of testing, inspections, examinations and certification aimed at ensuring safety and reliability of this equipment.

Table A1.2 RSV *Nuyina* Class notations addressing environmental performance

Notation	Meaning
ECO	Prefix notation to indicate LR ECO rules have been applied on a voluntary basis
ECO(BIO)	Biofouling Management Plan
ECO(BWT)	Type-approved ballast water treatment system installed on board
ECO(GW)	Grey water
ECO(NOX-2)	NOX emissions do not exceed 80% of Tier II NOX emission limits of MARPOL Annex VI
ECO(OW)	Oily bilge water management
ECO(P)	Protected oil tanks
ECO(SOX)	Oxides of sulphur
ECO(IHM)	Inventory of hazardous materials
ECO(SEEMP)	Ship Energy Efficiency Management Plan
ECO(EnMS)	ISO 50001 Energy Management System
ECO(IBTS)	Integrated Bilge Water Treatment System
Lloyd's Register Statement of Compliance	Det Norske Veritas Silent-R notation

APPENDIX 2

Table A2.1 SERCO Environmental Document Summary

Document(s)
Oil Record Book (Parts 1 & 2 and instructions)
Shipboard Oil Pollution Emergency Response Plan (SOPEP)
Sewage System Management Plan
Sewage Disposal Record Book
Garbage and Waste Management Plan
Garbage Record Book
MARPOL Placards
Ballast Water Management Plan (BWMP)
Ballast Water Management Manual
Ballast Water Record Book
Biofouling Management Plan
Bunkering plans, procedures and checklists (FO, LO and cargo)
Cargo Securing Manual
Cargo Operations Manual
Environmental Impacts & Aspects Register
Environmental Management Plan
RSV Nuyina Environment Policy
Fresh Water system management & operation - Loading & Generation
Ship Energy Efficiency Management Plan (SEEMP) Part 1
Ship Energy Efficiency Management Plan (SEEMP) Part 2
Carbon Management Site Classification Register
Carbon Management SOP

Table A2.2 Environmental Statutory and Class Certification Summary

Document
Safety Management Certificate (ISM)
Document of Compliance (ISM)
Polar Ship Certificate
International Oil Pollution Prevention Certificate
International Sewage Pollution Prevention Certificate
Sewage Treatment Plant Type Approval Certificate
International Air Pollution Prevention Certificate
International Energy Efficiency Certificate
Statement of Compliance – Fuel Oil Consumption Reporting
Incinerator Type Approval Certificate
International Ballast Water Management Certificate
Ballast Water Treatment Plant Type Approval Certificate
International Anti-fouling Certificate
Certificate of Class
Document of Compliance for the Carriage of Dangerous Goods
Certificate of Insurance - Bunker Liability
AMSA Bunker Blue Card