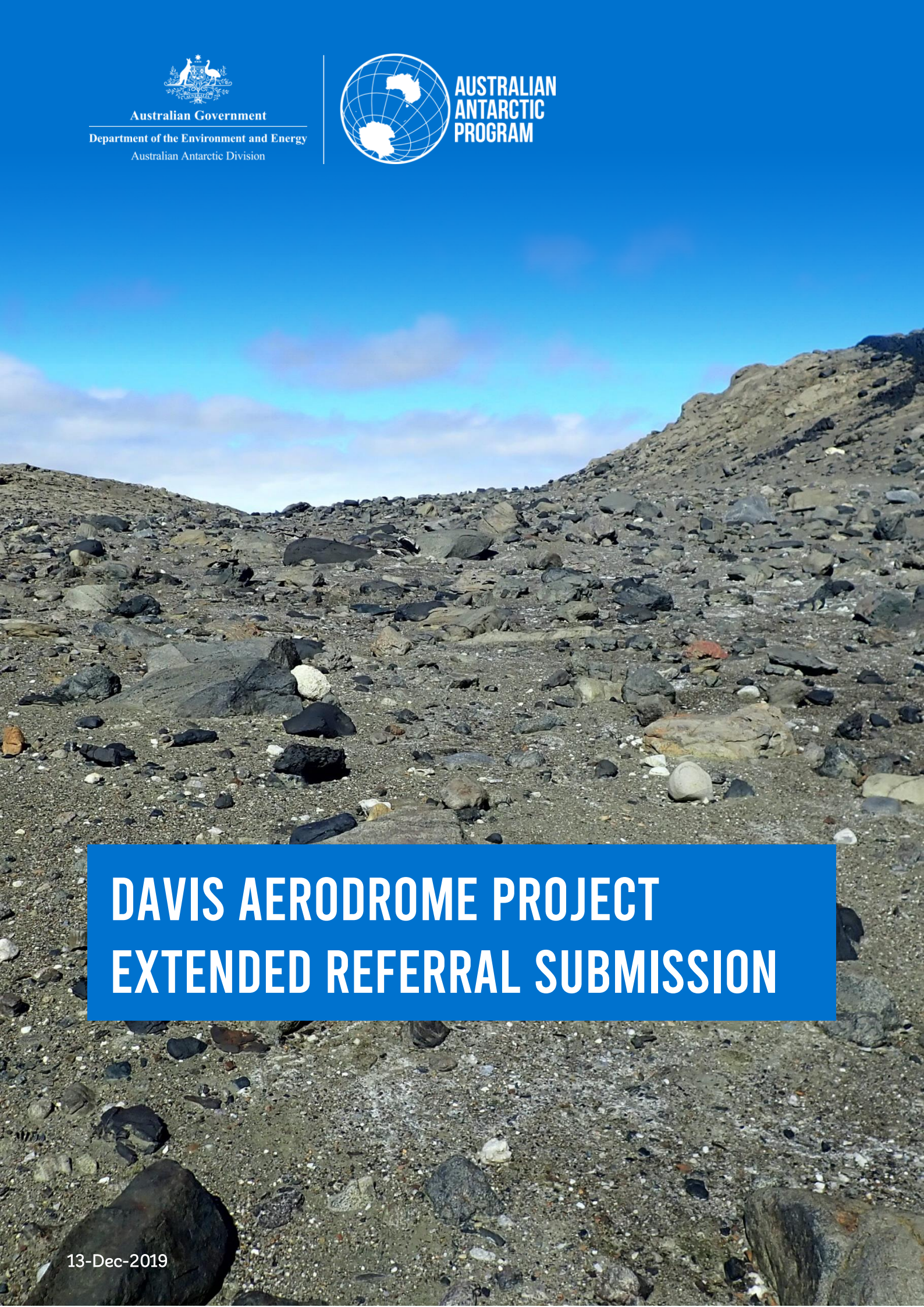
Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM



DAVIS AERODROME PROJECT EXTENDED REFERRAL SUBMISSION

13-Dec-2019

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

CONTENTS

1.0 SUMMARY OF PROPOSED ACTION

TITLE OF PROPOSAL

Davis Aerodrome Project

1.1 PROJECT INDUSTRY TYPE

The project is a Commonwealth development.

1.2 DETAILED DESCRIPTION OF THE PROPOSED ACTION, INCLUDING ALL PROPOSED ACTIVITIES.

The proposed action (the 'Davis Aerodrome Project') is the construction and operation of an aerodrome near Davis research station in the Vestfold Hills, East Antarctica, including a 2,700 m paved runway, an approximately 4.5 km access road, and associated aerodrome and station infrastructure.

1.2.1 BACKGROUND

The Australian Government Australian Antarctic Division (AAD) of the Department of the Environment and Energy leads and coordinates the Australian Antarctic Program (AAP), including operating Davis, Mawson and Casey research stations in East Antarctica and the sub-Antarctic Macquarie Island research station (Map 1).

The Australian Government is committed to the delivery of a modern Antarctic program that enables us to continue to lead a world-class Antarctic science program and maintain our position as a leading Antarctic nation well into the future. The Australian Government's 2016 *Australian Antarctic Strategy and 20 Year Action Plan* committed to various activities to support Australia's national Antarctic interests and enhance Australia's Antarctic science capability and standing in the Antarctic science community, including investigating year-round air access between Australia and Antarctica. In May 2018, the Australian Government announced its intention to construct a paved runway near Davis research station, subject to environmental and other Government approvals. In December 2019, the Australian Government committed additional funding over two and a half years to advance the design and environmental assessments required for the Davis Aerodrome Project.

Aviation is crucial to the AAP's activities in Antarctica. Australia's Antarctic aviation system currently consists of a summer-only link from Hobart to the Wilkins Aerodrome ice runway (approximately 70km from Casey), with interconnecting 'intracontinental' flights to other stations and field sites using aircraft such as DHC-6 Twin Otters, Basler BT-67 and helicopters. Intercontinental flights to Wilkins are limited to the beginning and end of summer, with an approximately six-week closure in mid-summer when warmer temperatures cause the ice surface to weaken. In winter, the stations are inaccessible by air or ship.

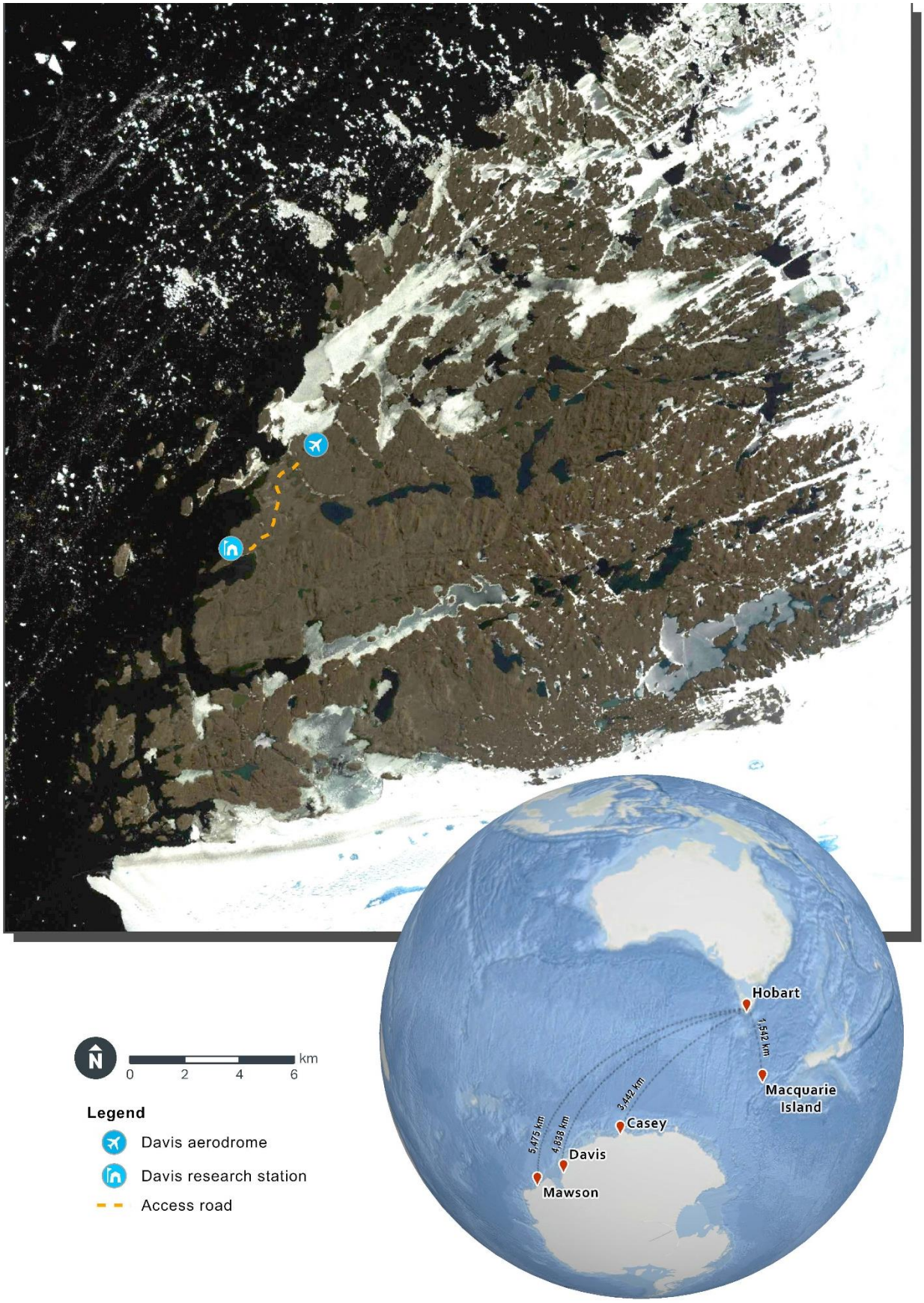
An aviation capability that regularly delivers scientists and equipment to Antarctica offers a number of significant science benefits, including unprecedented opportunities to monitor and understand changes, and improve the accuracy of forecast models, sea level rise predictions and climate change impacts.

Opening access to the continent across all seasons would allow scientists to directly investigate processes through the full cycle of changes, including during the colds and dark winter months. It will also provide the opportunity for scientists to study wildlife across the full annual lifecycle of key species including krill, penguins, seals and seabirds.

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

Map 1 Project location



1.2.2 PROJECT SUMMARY

The Davis Aerodrome Project includes a 2,700 m paved runway and associated infrastructure. Davis aerodrome would be the first aviation facility of its type on the Antarctic continent, enabling intercontinental flights between Australia and Antarctica all year.

Davis aerodrome would include a runway and supporting infrastructure, and expansion of the infrastructure at Davis research station to support a construction-phase station population of around 250, which would be required to house sufficient staff for construction of the aerodrome. Davis aerodrome would provide a second intercontinental air link to Antarctica in tandem with the existing summer-only Wilkins Aerodrome near Casey research station, approximately 1,400 km away.

Davis aerodrome would be the first paved runway in Antarctica. The infrastructure delivered by the project would include:

- A 2,700 m paved Code 4E runway suitable to accommodate all expected existing and future large aircraft capable of return flights from Australia without refuelling at the aerodrome, such as the Boeing 787 Dreamliner (B787), Airbus A330, and the Royal Australian Air Force-operated Boeing C-17A Globemaster III (C-17)
- Aviation infrastructure, including a taxiway, aircraft apron, runway lighting, intracontinental aircraft hangars, terminal building, storage building, fuel storage, and combined Aerodrome Rescue and Fire Fighting Services (ARFFS) station and air traffic services (ATS) centre
- An access road from the station to the aerodrome, and
- Davis research station supporting infrastructure to enable construction of the aerodrome.

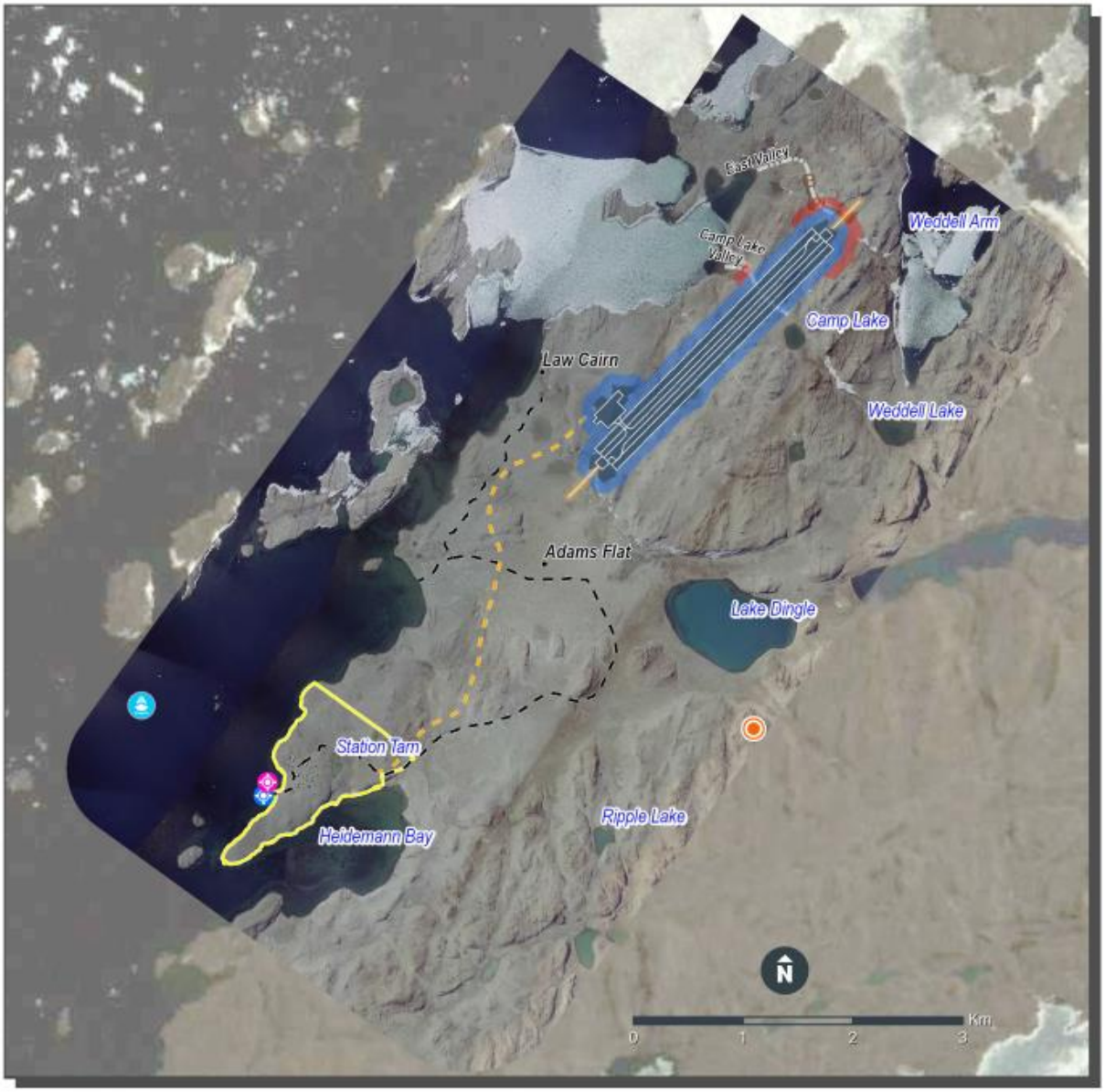
Once operations at Davis aerodrome commence, the year-round Davis aerodrome would become Australia's primary intercontinental and intracontinental aviation hub, with the existing Wilkins Aerodrome remaining an important air link to support Casey research station. The indicative operational tempo would be approximately three intercontinental flights per month between Australia and Davis between October and April, and approximately monthly flights between May and September, to support winter operations.

The Davis aerodrome would be used for intercontinental flights from Australia only. Intracontinental flights would be conducted from within Antarctica, including to support other nations activities in Antarctica.

Davis research station would be made available to support aerodrome construction. The population capacity of the station would be expanded to approximately 250 people during the construction period, to support a construction workforce (including environmental monitoring staff) of approximately 150 people and the associated station operations personnel. This expansion would require the establishment of new accommodation and supporting infrastructure, as outlined below. In addition to the station expansion, project-specific enabling infrastructure would be required including a new wharf and storage facility for explosives used in earthworks.

The indicative layout of the proposed infrastructure is shown on Map 2.

Map 2 Indicative project layout



Legend

- Aerodrome footprint
- Aerodrome buffer (100 m)
- Extended buffer for potential additional earthworks in valleys
- Approach lighting
- Access road
- Indicative explosives storage facility location
- Indicative new wharf location
- Existing wharf
- Anchorage location
- Dingle Road
- Station limits

Locations for accommodation and utilities, and construction hardstand and storage area are not shown - refer to Section 1.2.4 for general description of size and location.

1.2.3 DAVIS AERODROME

The project design and construction approach are described in the following sections.

Key features of the project include:

- The runway would be constructed from pre-cast concrete panels manufactured in Australia and shipped to Antarctica, where the pavement would be assembled on site
- Construction of the enabling infrastructure, access road and aerodrome requires more than three million cubic metres of earthworks, which would include balanced cut and fill volumes to avoid creating new quarries areas or the disposal of surplus material, and
- Modular and prefabricated techniques would be used for project buildings where practical to minimise construction time on site.

1.2.3.1 ACCESS ROAD

A permanent unsealed access road would be needed to provide access from Davis research station to the Davis aerodrome during construction and throughout the operational life of the aerodrome. The road includes a parking and laydown area at the aerohub. The access road would be an approximately 4.5 km two-lane gravel road to support operating speeds of up to 40 km/h. The Australian Road Research Board (ARRB) Unsealed Roads Manual were used as the design guideline for the geometric design of the access road. Construction of the access road would commence early in the construction program to provide access to the aerodrome site.

The proposed access road alignment preferentially follows areas of higher, stronger ground and avoids where possible areas of soft ground, wet areas or meltwater ponds, and active permafrost heave in Adams Flat. Where the road crosses Adams Flat it generally follows the identified moraine line, which is a naturally elevated embankment of coarse-grained material.

The concept design allows for blasted rock to be used in the proposed new wharf (Section 1.2.4.3). The concept design balances earthworks cut and fill quantities.

An indicative route is shown on Map 2.

1.2.3.2 NEW RUNWAY

The new runway would be a 45 m wide and 2,700 m long Code 4E runway, capable of servicing large aircraft such as the Boeing 787 Dreamliner (B787), Airbus A330 (A330) and the Royal Australian Air Force's (RAAF) Boeing C-17 Globemaster III (C-17). It would have a north-east to south-west orientation (41.8°/221.8° true north) giving the runway its 04/22 designation. The runway would be serviced by two end turning nodes and a short taxiway connecting to a new apron, as shown in the indicative layout in Figure 1. The end turning areas allow aircraft to turn at each end of the runway to taxi to the aerohub after landing or to prepare for take-off.

The runway would be supported by a new apron for aircraft parking where passengers would disembark and board aircraft, and cargo would be loaded and unloaded from aircraft. The apron would be suitable to accommodate a Code E aircraft alongside smaller intracontinental aircraft.

The runway infrastructure would also include aeronautical ground lighting and a truncated Category I prevision approach lighting system, which extends approximately 420 m from each end of the runway (with associated access tracks). The runway navigation systems would include a ground-based augmentation system (GBAS) and Precision Approach Path Indicator (PAPI).

The runway would be constructed from concrete pavers, approximately 5 m by 3 m and 220 mm thick, which would be manufactured in Australia before being transported to Davis research station. Each paver would weigh up to 10 t, and 11,500 pavers would be required for construction of the runway, taxiway and apron. Alternative pavement options, including asphalt and concrete poured in situ were considered, but not considered feasible (refer to Section 8.0 for more discussion on these options).

Once complete, the runway would be used by intercontinental aircraft flying between Australia and Davis and smaller intracontinental aircraft flying within Antarctica. Intercontinental aircraft would be limited to those chartered by the AAD or the Australian government, or operated by the RAAF to support the Australian Antarctic Program. While the runway is designed to cater for larger aircraft, intracontinental aircraft and helicopters, which are currently used within the Vestfold Hills and broader region, would also operate from the runway.

The aerodrome would be located on an elevated ridge, approximately 4.5 km from Davis research station. The topography of the site varies from around 19 m AMSL to 80 m AMSL. Earthworks would be undertaken to create a level surface for runway construction. As the site predominantly consists of hard to very-hard basement rock, drilling and blasting would be required to remove material from elevated areas. The blasted material would then be used to fill low areas and also to form the sub-layers of the runway pavement. It is estimated that approximately 85% of the blasted material would be placed without further processing, with approximately 15% being crushed and screened for use in the pavement layers.

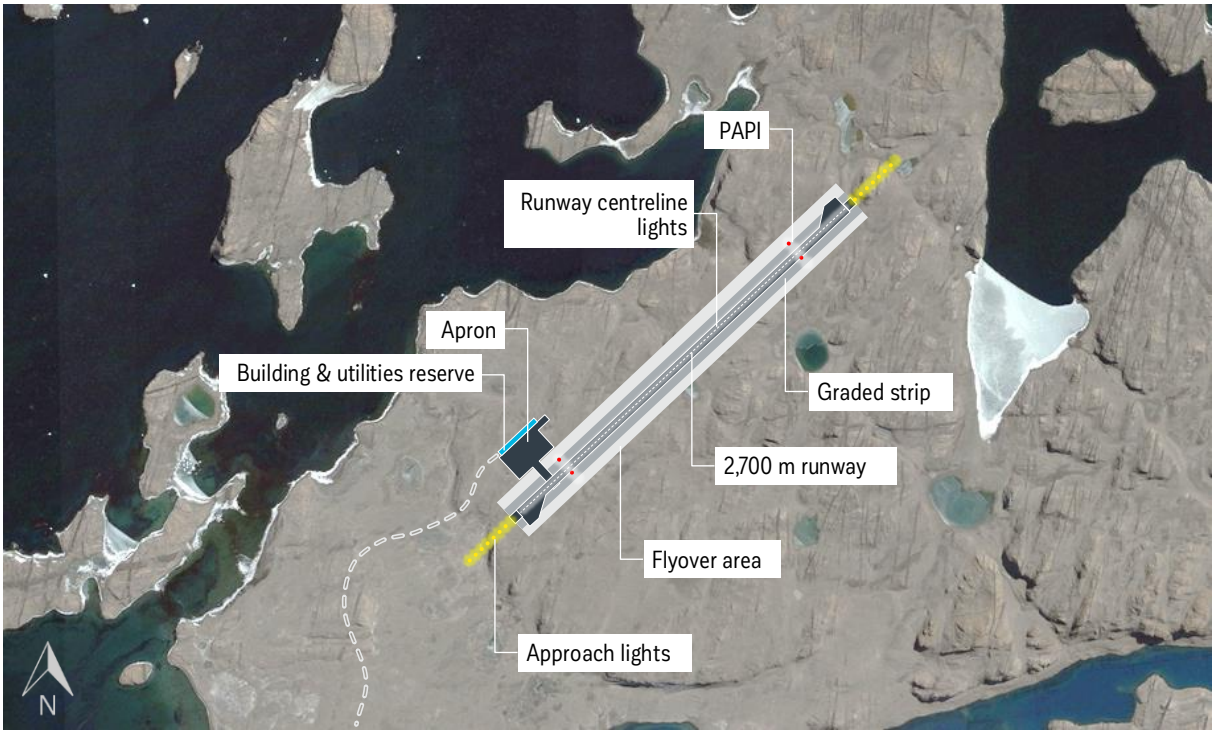
The aerodrome site is crossed by two small valleys (Camp Lake Valley and East Valley), which contain unconsolidated glacial sediments. The sediment in Camp Lake Valley and East Valley has a high potential to cause issues with heave and settlement on the runway once constructed. To address this, the concept design proposes to remove the sediment and permafrost layers from within the valleys beneath the runway earthworks embankment and replace that material with blasted rock.

Construction of the aerodrome would commence upon completion of the Davis enabling infrastructure (described in Section 1.2.4), and is expected to take a total of up to 10 years, with some activities occurring concurrently, as follows:

- Approximately ten seasons for completion of runway earthworks and placement of paving (including four years of early drilling and blasting trials)
- Approximately three years for construction of the aerodrome buildings and supporting infrastructure (which is described in Section 1.2.3.3), and
- Approximately one year for aerodrome testing and commissioning.

It is anticipated the aerodrome would be operational around 2040.

Figure 1 Proposed aerodrome layout



1.2.3.3 AEROHUB FACILITIES

A variety of facilities would be required at the runway to support operation of the aerodrome. All buildings would be designed to withstand the environmental conditions at the site, and several would be heated when operational, with the ability to be 'winterised' when not in use. For winterisation, most of the building is reduced to ambient temperature, with key areas (such as utilities rooms) maintained at 5°C. Buildings at the aerodrome would include:

A combined aerodrome rescue and firefighting services (ARFFS) and air traffic services (ATS) building	An ARFFS/ATS building would be developed for operation of the new runway. It is anticipated that the ARRFS/ATS building would have two storeys. The building would also house an air traffic services (ATS) viewing platform and communications room in the second storey of the building. The ARFFS station would be located adjacent to the apron and taxiway to allow visibility to both ends of the runway and rapid response to an airfield emergency. The majority of ARFFS training and testing would be conducted on the Australian mainland to minimise facility requirements and potential environmental risks.
Terminal	A building space would be provided to process arriving and departing passengers. It is anticipated that normally up to 50 passengers would arrive/depart on an intercontinental flight. The space would be a simple open space with moveable seating. Ablutions facilities would be provided for passengers and crew.

Hangars and storage facility	Two hangars would be provided for intracontinental aircraft adjacent to the apron. These open-span buildings would be used for minor aircraft maintenance, and storage to prevent damage from windblown snow and debris. The hangars would be sized to house one Basler and two Twin Otters. The hangars would also include small-parts workshop spaces and parts storage for intracontinental aircraft. Apron space would be available at the aerodrome for helicopter operations. A storage facility would be required to house assorted items to support the aerodrome operation and scientific activities. Storage would be required for snow clearing and ground support equipment, and for science project preparation.
Airfield lighting and equipment room (ALER)	An ALER would be required to house backup emergency generators, constant current regulators and the airfield lighting control system. The ALER would be collocated with other aerohub buildings.

A variety of other facilities and services would be required to support the construction and operation of the runway, including:

Power supply	A power supply would be required at the aerodrome to support construction and operations. The concept design solution is diesel powered generators located at the aerodrome. Renewable and alternative energy generation would be actively investigated in subsequent design phases.
Heating	A reticulated building heating system would be required to provide a suitable ambient temperature in the aerodrome buildings. Heating for hot water is likely to be provided by a diesel fuelled hot water boiler; however, alternative hot water supply systems would be investigated in subsequent design phases.
Communications	Communications links to the aerodrome would be provided by a fibre optic link (along the access road) and wireless connection to Davis research station. The ARFFS/ATS building would also have a UHF and satellite link between aircraft and ATS.
Water, wastewater and solid waste	Water would be sourced from the Davis research station water supply and trucked to a heated storage tank at the aerodrome. Wastewater would be collected at the aerodrome and trucked to Davis research station for treatment at the wastewater treatment plant. Solid waste would be collected at the aerodrome and transported to Davis research station for processing.
Vehicle parking	A vehicle manoeuvring and parking area would be provided adjacent to the terminal for passenger and cargo loading for transport to Davis research station.

Fuel storage

While renewable energy sources would contribute to power generation at the aerodrome, diesel would be required for site generators, heating, and to refuel site vehicles and equipment. The diesel is a Special Antarctic Blend (SAB) that has a lubricity additive to cope with the cold temperatures. SAB diesel would need to be stored at the aerodrome for the main and emergency power for the aerodrome facilities (including runway lighting), and heating for the aerodrome buildings.

JetA1 fuel is used by all aircraft operating in Antarctica. Fuel storage would be required at the aerodrome for refuelling intracontinental aircraft and C-17s.

SAB diesel and JetA1 is transported from Australia to Davis research station in bulk quantities on resupply vessels each year. The main fuel storage for SAB diesel and JetA1 would be at Davis research station, with smaller quantities delivered to the aerodrome fuel storage facility by road as required.

1.2.4 ENABLING INFRASTRUCTURE

A range of infrastructure would be required at Davis research station to support the construction and operation of the runway.

During construction, the project would rely on Davis research station infrastructure to accommodate construction personnel, and during operation, the aerodrome operational staff would be accommodated at the research station. New infrastructure includes:

- Infrastructure to support a construction phase population of 250 (i.e. an additional 130 personnel)
- Mechanical workshop
- Bulk fuel storage for SAB diesel and JetA1
- A construction hardstand area and storage building
- A construction waste storage area, which would be co-located with the construction hardstand area
- Wharf (refer also to Section 1.2.4.3), and
- An explosives storage facility (refer also to Section 1.2.4.4).

Studies are currently underway to determine the location of the Davis enabling infrastructure. Consequently, specific locations have not yet been determined. The AAD's policy is to site infrastructure in previously disturbed sites where practical; this is to manage potential increases in the disturbed footprint associated with its activities. The anticipated footprint and general locations for key infrastructure are described below.

It is anticipated that elements of the enabling infrastructure would support the operation of the aerodrome after the completion of construction. Infrastructure not required at the completion of aerodrome construction would be decommissioned and the sites rehabilitated.

It is anticipated that construction of the enabling infrastructure would take up to seven years to complete.

1.2.4.1 ACCOMMODATION AND OTHER FACILITIES

The accommodation and other facilities would be located within the existing Station Limits (see Map 2). It is anticipated that the footprint associated with this infrastructure could be up to 3 ha; this could be in a single location, or in a number of smaller sites throughout the existing station. Permanent, and potentially temporary, infrastructure associated with supporting the increased construction phase population would be located in accordance with a station master plan, which is currently being developed (refer also to Section 1.16, which describes related projects).

This infrastructure is likely to include:

- Additional accommodation facilities and living quarters
- Additional water treatment, storage and reticulation
- Additional wastewater collection, treatment and disposal
- Power and heat generation and distribution
- Mechanical workshop, and
- Bulk fuel storage for SAB diesel and JetA1.

The bulk fuel storage facility would provide a safe and resilient system in accordance with the AAD's best-practice fuel storage guidelines. The new fuel storage and distribution systems would provide for safe operation and enhanced containment, leading to improved environmental management.

1.2.4.2 CONSTRUCTION HARDSTAND AND STORAGE BUILDING

The construction hardstand and storage building (and associated construction waste storage area), would require an area of approximately 3 ha. The location for the facility would be selected in consideration of environmental values, station operations, ease of access and topography. It is anticipated that a site would be selected along the access road or Dingle Road, not far from the station.

1.2.4.3 WHARF

A new wharf would be required at Davis research station to support ship to shore transfer of plant, equipment and materials, including concrete pavement units. Conceptually, a floating roll-on roll-off wharf with lift-off capacity is proposed. The wharf would require reclamation to achieve sufficient water depth for the pontoons and tugs required to transfer materials from ship to shore. An approximately 42 m wide reclamation would be constructed to accommodate wharf operations and allow a suitable manoeuvring area for road transport. The reclamation would be constructed from fill sourced from within the project footprint and would be protected by a rock armour revetment. A floating wharf would be assembled using a modular pontoon system.

1.2.4.4 EXPLOSIVES STORAGE FACILITY

It is anticipated that emulsion explosives would be used for blasting as part of runway earthworks and an explosives storage facility would be required. *Australian Standard AS2187.1 Explosives – Storage, transport and use* defines the separation distances required between the explosives storage facility and "protected works". It anticipated the facility would have a footprint of approximately 1 ha, and infrastructure would include:

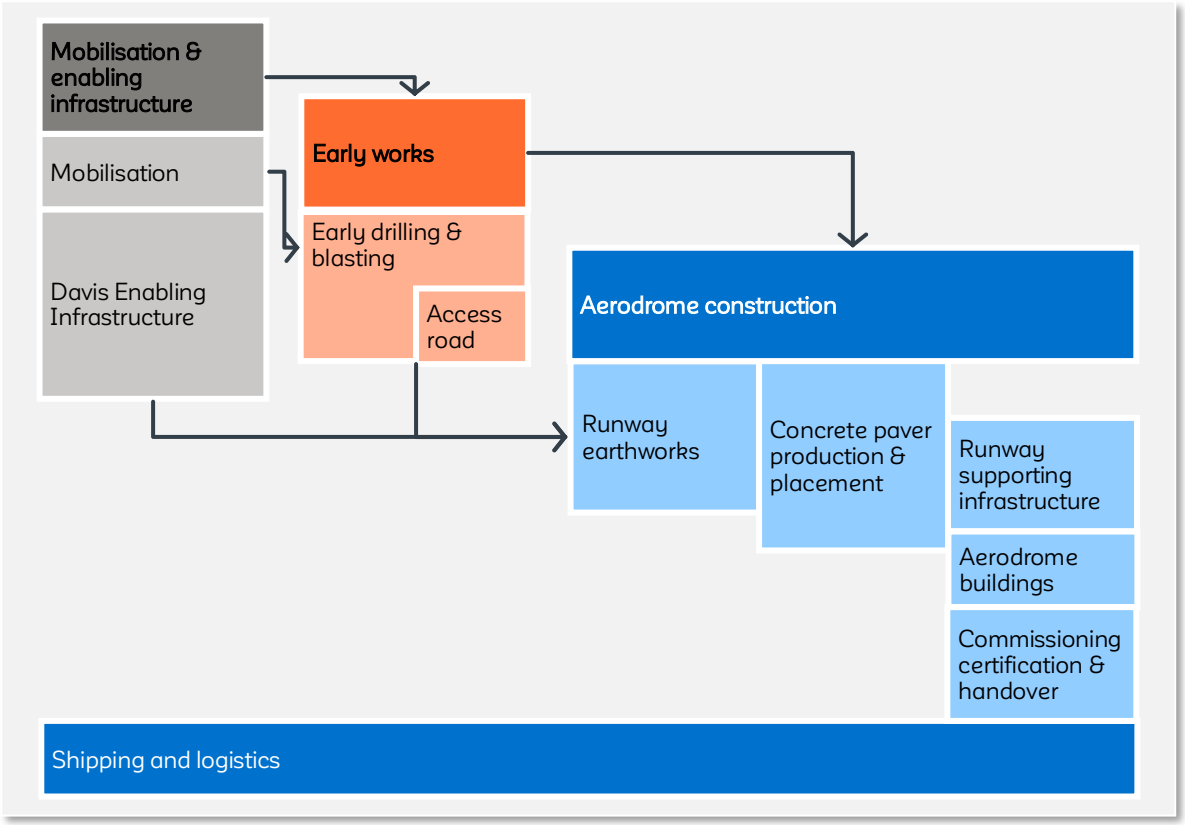
- Earthen bunding
- Storage buildings for gassing reagents, water injection chemicals and loading trucks
- Power supply for heating, and
- A hardstand area for insulated, heat-traced ISO containers which would be used to store the emulsion.

1.2.5 PROJECT CONSTRUCTION

An overview of the construction activities is presented in Figure 2, showing the general sequencing of construction activities from mobilisation through to completion. The various construction activities are introduced in the following sections.

Construction would occur on a seasonal basis, between October and April each year.

Figure 2 Overview of construction activities



1.2.5.1 SHIPPING AND LOGISTICS

Shipping and logistics support for the project would require a combination of large icebreaker and ice-strengthened cargo vessels. It is anticipated that one to two cargo deliveries would be required each year for up to 10 years.

Approximately six additional annual voyages using icebreaker vessels would be required to transport the required number of construction phase personnel (including station operational personnel) and station supplies at the beginning and end of each summer season.

The first voyages of the season would be undertaken in October, when sea ice is still present at Davis, and subsequent voyages would typically be undertaken from January, when sea ice has cleared from Davis harbour. As there is limited water depth at Davis, floating barges and tugs would be used to transport materials from the ocean-going vessel to the wharf.

1.2.5.2 MOBILISATION

The mobilisation effort for construction would include transporting plant and equipment required for construction from Australia to Davis research station. A variety of large and small plant and equipment would be used on the project, including large earthmoving machinery and drill rigs for bulk earthworks.

1.2.5.3 DAVIS RESEARCH STATION – ENABLING INFRASTRUCTURE

The initial effort at Davis research station would be to increase the station capacity to support a construction phase population of 250 personnel. Once this has been achieved, construction of the wharf and explosives storage facility would be completed. The infrastructure is anticipated to consist of a combination of permanent and temporary prefabricated and modular infrastructure.

Completion of the wharf and storage area would be required before major work commences on the aerodrome, as the wharf and storage building would be required to mobilise large items of construction plant and materials to Antarctica. Early production blasting at the aerodrome site would occur in parallel with construction of the Davis enabling infrastructure.

Construction of the wharf requires reclamation to achieve sufficient water depth. The reclamation would be constructed from fill material and rock sourced from the access road alignment. A floating wharf would be assembled using a modular pontoon system, which would be held in position using a combination of anchors and struts.

The explosives storage facility would require upgrading existing and constructing a new access track and construction of a building and hardstand area.

1.2.5.4 ACCESS ROAD

The access road would be constructed before major construction works commence at the aerodrome. Construction of the access road would require drilling and blasting of rock outcrops to achieve the required gradients. The concept design allows for blasted rock to be used in the proposed new wharf. Elsewhere along the access road, the concept design balances earthworks cut and fill quantities, assuming cut material can be spread into the fill areas, minimising haulage distances.

In areas of poor ground conditions, e.g. over soft ground or permafrost, additional subgrade treatment or an embankment may be required to ensure adequate strength and all-weather accessibility of the road.

1.2.5.5 RUNWAY EARTHWORKS

In the order of 3 million cubic metres of earthworks would be required for construction of the runway. Earthworks methods would include drilling and blasting rock, ripping to loosen material, breaking of oversized material, excavating and hauling. Most blasted rock would be used as coarse rock fill and placed without any additional processing. Crushing and screening would be undertaken on a small percentage of the blasted material to produce material suitable for use as pavement layers. Material would be placed and compacted in layers to reach the design height of the runway.

Early production blasting would commence once access to the aerodrome site has been achieved.

1.2.5.6 CONCRETE PAVER PRODUCTION AND PLACEMENT

The concrete pavers required for construction of the runway would be produced in Australia before being transported and stockpiled at Davis research station.

From the station laydown area, the pavers would be transported by road to the aerodrome site. This transport operation would be undertaken during winter months. At the aerodrome site, the pavers would be craned into position and grouted to the surrounding pavers.

1.2.5.7 RUNWAY SUPPORTING INFRASTRUCTURE

Additional runway infrastructure such as lighting, communication, navigation, movement area guidance signs and weather stations would be constructed to coincide with completion of the runway.

1.2.5.8 AERODROME BUILDING CONSTRUCTION

The aerodrome buildings would be completed for operation of the runway. Where practical, building construction would rely on prefabricated frames and panels to reduce the construction time required at the aerodrome site.

1.2.5.9 AERODROME FUEL FARM

The aerodrome fuel farm would be constructed at the completion of the aerodrome buildings and would consist of a number of bunded storage tanks.

1.2.6 AERODROME OPERATIONS

1.2.6.1 FLYING OPERATIONS

Australia's Antarctic aviation operations are based on a 'hub and spoke' system, with flights from Hobart to Wilkins Aerodrome, and intracontinental flights between the stations and field sites. The Davis aerodrome would provide a second intercontinental hub in Antarctica for flights from Hobart and intracontinental flights to other stations and field sites.

The Davis aerodrome would become operational around 2040, and Australia's Antarctic aviation model would be reviewed over time and closer to commissioning of the aerodrome to consider Australia's requirements and the contemporary circumstances of the aviation industry.

Australia's current Antarctic aviation operational model would become a dual hub and spoke model with the establishment of Davis aerodrome. Under this model, Davis aerodrome would become Australia's primary year-round intercontinental and intracontinental aviation hub and Wilkins Aerodrome would continue to support Casey research station in the summer season. Both aerodromes would provide collaborative opportunities for other national Antarctic programs.

The Davis aerodrome would be used for intercontinental flights from Australia conducted by aircraft under the charter of the Australian Antarctic Program or by the Australian government. There is no intention for the runway to be made available to other users from intercontinental locations outside Australia. As with current arrangements at Wilkins Aerodrome, Australia would offer available capacity on chartered aircraft for passengers and cargo to support ongoing collaborative arrangements with other national Antarctic programs.

Intracontinental flights would be conducted from within Antarctica by Australia and other national Antarctic programs. Flights would continue to be undertaken by the smaller intracontinental aircraft throughout the Vestfold Hills and broader region to support scientific and operational activities (e.g. delivering scientists and supplies to field huts).

While intercontinental civilian aircraft would carry adequate fuel to complete a return flight to Australia, the RAAF's C-17's would require refuelling at the aerodrome before returning to Australia. Intracontinental aircraft would be refuelled at Davis aerodrome.

1.2.6.2 FLIGHT FREQUENCY

To meet the forecast demand for expeditioner transport, approximately three intercontinental flights per month to Davis aerodrome carrying approximately 30 to 50 passengers is planned between October and April. Up to 80 passengers could travel on flights to support early season deployment and late season retrieval.

Approximately ten C-17 flights are expected at Davis aerodrome each year.

During winter, up to monthly intercontinental flights to Davis aerodrome would allow for scientific, operational, and emergency access to Antarctica. Intracontinental aircraft would be stationed at Davis over winter to support scientific and operational flights in the Vestfold Hills and broader region.

1.2.6.3 FLIGHT PATHS

Preliminary flight paths are being developed by a specialist consultant for the proposed Davis aerodrome, following preliminary consultation with Airservices Australia. These preliminary flight paths would be used to inform the detailed environmental impact assessment, with finalisation of the flight paths to occur closer to the commencement of aerodrome operations. At the time of finalisation, flight paths would also be validated as a standard part of quality assurance; this validation process would involve Airservices Australia and the Civil Aviation Safety Authority.

Preliminary flight paths are being developed for intercontinental and intracontinental aircraft taking into consideration environmental constraints, Antarctic guidelines, and legislative, technical and operational requirements. Hawker Island ASPA and Marine Plain ASPA are located approximately 12 km south and 8 km south east of the proposed runway site respectively and requirements for aircraft operations in these areas will be complied with through the flight path development process. Environmental considerations, although typically focused on intracontinental aircraft, are provided in various guidelines for aircraft operations, including those developed under the Antarctic Treaty System and for the Australian Antarctic Program. These guidelines apply in the region and the requirements of these will be complied with as far as practicable, with an objective to maximise horizontal and vertical separation from wildlife and human habitation.

Weather conditions are a key factor in determining the direction of runway use and the types of approach and departure procedures used.

Wind	Wind direction and speed are used by pilots and air traffic services to determine which direction to use for aircraft landing and taking off. Aircraft generally land and take-off into a headwind, as this reduces the distance required for accelerating and stopping. Prevailing winds at Davis are generally from the north-east and the runway alignment has been designed to align with these prevailing winds. While most approaches and departures to the runway will be from the south-west to north-east on Runway 04, calm conditions are common in summer and there would be some flexibility in approach and departure directions.
Visibility	Reduced visibility, caused by low cloud, fog or snow also affect flying operations. In low visibility conditions, pilots use instrumentation systems (in the aircraft and at the runway) to help guide the aircraft to a point where the pilot can see the runway. In cases of very poor visibility, the aircraft may divert from the runway rather than attempt to land.

Different flight paths would be flown by intercontinental and intracontinental aircraft. The larger intercontinental aircraft would fly well-defined flight paths for the approach and departures from the runway. The smaller intracontinental aircraft would fly recommended routes to and from the runway, in addition to continuing to conduct scientific and operational flights within the Vestfold Hills and broader region. Generally, intercontinental aircraft would fly in the area at higher altitudes and higher speeds than intracontinental aircraft.

Intercontinental aircraft would typically operate under Instrument Flight Rules (IFR), which use instrumentation systems to guide the aircraft to a point where the pilot can see the runway. These include instrument procedures that are supported by ground-based equipment and global positioning systems (GPS).

Smaller intracontinental aircraft and helicopters typically fly under Visual Flight Rules (VFR) where landmarks are used to guide the aircraft to a point where the pilot can see the runway. VFR are currently used across Antarctica at numerous runways and landing areas.

1.2.6.4 GROUND OPERATIONS

Typical aerodrome ground operations would include:

- Clearing snow and ice from the runway before aircraft operations
- Activating and operating navigation and runway lighting systems
- Aircraft ground manoeuvres such as taxiing and parking
- Storing fuel and refuelling intracontinental aircraft and C-17s
- ARFFS training and emergency response
- Minor intracontinental aircraft maintenance in the hangar
- Air traffic services
- Processing passengers (for both arrivals and departures)

- Preparing, loading, and unloading cargo (e.g. science equipment) and station resupply goods and equipment
- Transporting passengers and cargo between the station and aerodrome
- Servicing operations, such as:
  - Delivering water and fuel from the station to the aerodrome
  - Collecting solid and sanitary waste from the aerodrome for treatment and disposal through the station waste treatment facilities

Ground operations could also include emergency de-icing and emergency response (rescue and firefighting), but these are anticipated to be a rare occurrence.

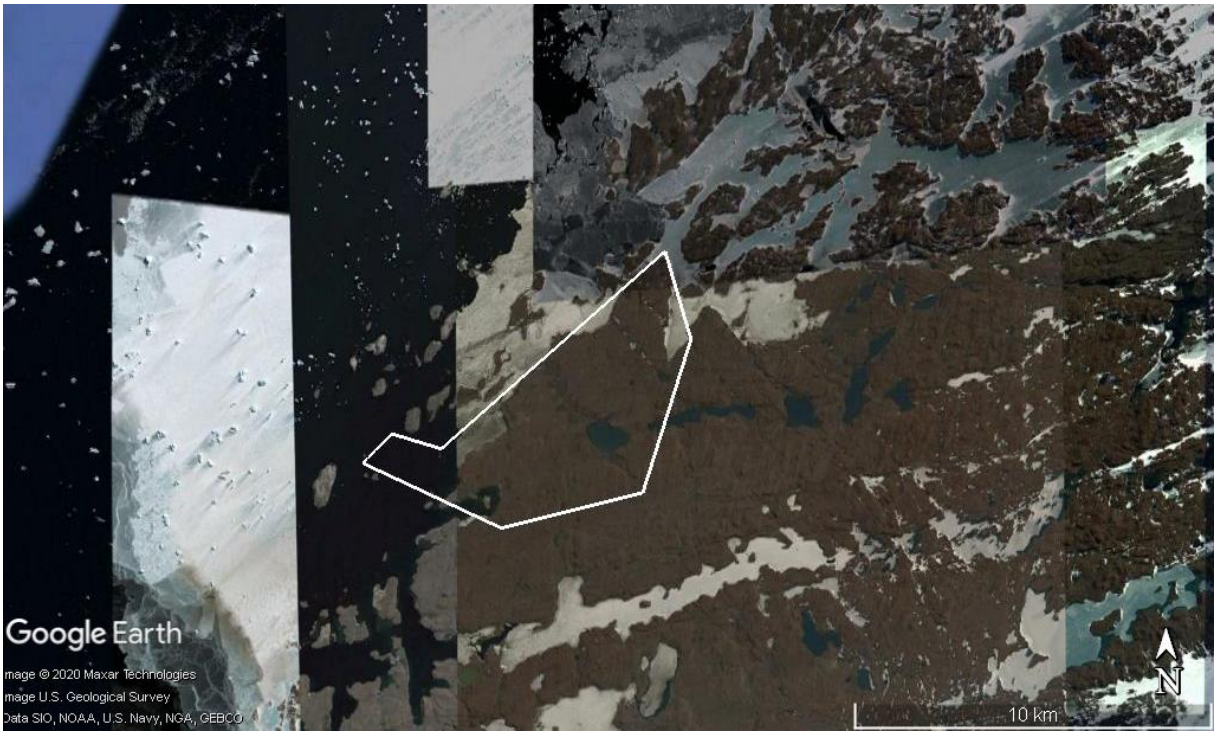
1.2.7 AERODROME DECOMMISSIONING

While it is intended to operate the Davis aerodrome in perpetuity, should there be a need to decommission the facilities, the modular design of the buildings and runway pavement would allow for the infrastructure to be disassembled and shipped from the site for reuse or recycling in Australia (or elsewhere). Once the infrastructure had been removed, some remedial earthworks could be undertaken to recreate a more natural ground profile at the aerodrome site.

1.3 EXTENT AND LOCATION OF PROPOSED ACTION

The extent and location of the proposed action is shown on Figure 3.

Figure 3 Indicative extent and location of the proposed action



1.4 UPLOAD IMAGES OF THE PROPOSED ACTION AREA (INCLUDING DISTURBANCE FOOTPRINT, AVOIDANCE FOOTPRINT [IF RELEVANT] AND MNES HABITAT AREA/S) AND IF AVAILABLE A COMPLIANT GIS FILE.

The proposed action area is shown on Map 2.

1.5 BRIEF PHYSICAL DESCRIPTION OF THE PROPERTY ON WHICH THE PROPOSED ACTION WILL TAKE PLACE AND THE LOCATION OF THE PROPOSED ACTION (E.G. PROXIMITY TO MAJOR TOWNS, OR FOR OFF-SHORE ACTIONS, SHORTEST DISTANCE TO MAINLAND).

The project includes works at and near Davis research station in the Vestfold Hills, East Antarctica. The proposed Davis aerodrome would be located approximately 4.5 km north-east of Davis research station.

The Vestfold Hills are a roughly triangular area of rounded rocky hills that are predominantly ice-free and cover an area of approximately 410 square kilometres.

The Vestfold Hills are bounded to the south by the Sørsdal Glacier, to the east by the Antarctic ice sheet and west and north by the Southern Ocean; they lie 4,800 km south and west of Hobart, 1,400 km from Casey research station (and Wilkins Aerodrome) and 600 km from Mawson research station. There are numerous offshore islands, including the Hawker Island Antarctic Specially Protected Area (ASPA) approximately 6 km south-west of Davis research station. A second ASPA, Marine Plain, is approximately 8 km south-east of the Davis aerodrome.

Davis research station is approximately 120 km northeast of the Larsemann Hills where the Zhongshan (People's Republic of China), Progress (Russia) and Bharati (India) research stations are located. Australia also has a summer-only field site at Law Base in the Larsemann Hills. There are no other year-round facilities within 250 km of Davis research station.

1.6 WHAT IS THE SIZE OF THE PROPOSED ACTION AREA DEVELOPMENT FOOTPRINT (OR WORK AREA) INCLUDING DISTURBANCE FOOTPRINT AND AVOIDANCE FOOTPRINT (IF RELEVANT)?

Approximately 220 ha for the project.

The project includes infrastructure and activities in the following locations:

- Davis aerodrome, located approximately 4.5 km north-east of Davis research station
- Access road, following an alignment between Davis research station and the aerodrome that crosses Adams Flat
- A new wharf, anticipated to be located adjacent to the existing wharf
- The existing anchorage and offshore areas, which would be used for shipping and logistics activities
- An explosives storage facility, which could potentially be located near Heidemann Valley, although further investigation is required to confirm a location
- Davis research station, where enabling infrastructure would be located, and
- Airspace of the proposed runway.

1.7 IS THE PROPOSED ACTION A STREET ADDRESS OR LOT?

No

1.7.3 DESCRIBE THE LOCATION

Davis research station is located in the Vestfold Hills, East Antarctica.

1.8 PRIMARY JURISDICTION

Australian Antarctic Territory

1.9 HAS THE PERSON PROPOSING TO TAKE THE ACTION RECEIVED ANY AUSTRALIAN GOVERNMENT GRANT FUNDING TO UNDERTAKE THIS PROJECT?

The AAD has not received any Australian Government grant funding to undertake this project.

The AAD is a division of the Australian Government's Department of the Environment and Energy and has been appropriated funds, through the budget process, to undertake the environmental assessment/impact and design works for the Davis Aerodrome Project.

1.10 IS THE PROPOSED ACTION SUBJECT TO LOCAL GOVERNMENT PLANNING APPROVAL?

The project is not subject to local government planning approval.

1.11 PROVIDE AN ESTIMATED START AND ESTIMATED END DATE FOR THE PROPOSED ACTION.

It is anticipated that construction of the Davis research station infrastructure would occur between 2023-24 to 2027-28, and completion of aerodrome construction would be around 2040.

An operational period of approximately 20 to 30 years would be considered following completion of construction.

1.12 PROVIDE DETAILS OF THE CONTEXT, PLANNING FRAMEWORK AND STATE AND/OR LOCAL GOVERNMENT REQUIREMENTS.

A range of Commonwealth Government legislation and requirements would apply to the Davis Aerodrome Project. The key legislative requirements which would apply to the Davis Aerodrome Project are outlined below.

1.12.1 ANTARCTIC TREATY (ENVIRONMENT PROTECTION) ACT 1980

The Protocol on Environmental Protection to the Antarctic Treaty (the Environment Protocol) establishes Antarctica as a 'natural reserve, devoted to peace and science,' prohibits mining, establishes environmental principles for the conduct of activities, and requires all proposed activities to undergo prior assessment of their environmental impacts. Australia's obligations under the Environment Protocol are implemented through the ATEP Act. The ATEP Act sets out the process to determine the environmental impact of an activity and circumstances under which an activity may be authorised. The ATEP Act also stipulates those activities that are offences, and in what circumstances, if any, an activity can be permitted. For an activity to be approved that would otherwise be an offence under the ATEP Act, the activity must be authorised and permitted. As such, to undertake the Davis Aerodrome Project, an environmental impact assessment (EIA) must be undertaken and authorised under the ATEP Act.

Under the ATEP Act the first stage of the EIA process is the development and submission of a Preliminary Assessment (PA). The AAD submitted a PA for the Project on 14 October 2019. On 28 November 2019 the AAD received a determination under section 12E of the ATEP Act that the proposed activity is likely to have more than a minor or transitory impact on the environment. Accordingly, the AAD is required to follow the requirements under section 12K of the ATEP Act for the preparation and submission of a draft and final comprehensive environmental evaluation (CEE) for the Project. The Draft CEE will be made available for public comment in Australia, to all Parties to the Environment Protocol, and to the Committee for Environmental Protection (CEP). Each Party will also make the Draft CEE available for public comment. The CEP will consider the Draft CEE and provide advice to the Antarctic Treaty Consultative Meeting (ATCM). The AAD will need to prepare and submit to the Minister a Final CEE, addressing all comments on the Draft CEE provided by other Parties, the ATCM and members of the public. The Minister will then decide whether or not to authorise the carrying on of the activity as proposed or with certain modifications.

Permits are also needed for certain activities under the ATEP Act, including disturbing a concentration of native birds/native seals, for example through noise from aircraft operations. The AAD anticipates that permits would also be required for some activities related to the Davis Aerodrome Project. The complete list of activities that require permits under the Act is presented below:

- 19(1A)(b)(i)-An act that causes death or injury to a native bird or a native seal
- 19(1A)(b)(ii)-An act that causes the taking of a native bird or a native seal
- 19(1A)(b)(iia)-An act that causes the taking of native invertebrates or native plants in the Antarctic
- 19(1A)(b)(iii)-An act that causes other interference with a native bird or a native seal
- 19(1A)(b)(iiia)-An act that disturbs a native bird or native seal
- 19(1)(b)-Gather or collect a native plant
- 19(1)(c)-Bring into, or keep in, the Antarctic an organism that is not indigenous to the Antarctic
- 19(1)(d)-Enter, or carry on any other activity in, an ASPA
- 19(2)(a)-Use an aircraft in such a manner as to disturb a concentration of birds or of seals
- 19(2)(b)-Use a vehicle or vessel in a manner that disturbs a concentration of birds or of seals
- 19(2)(c)-Use an explosive in a manner that disturbs a concentration of birds or of seals
- 19(2)(d)-Use a firearm in a manner that disturbs a concentration of birds or of seals
- 19(2)(e)-While on foot, disturb a concentration of birds or of seals
- 19(2)(ea)(i)-Carry on an activity that results in the habitat of any species of native seal, native bird, native invertebrate or native plant being adversely modified to a significant extent
- 19(2)(ea)(ii)-Carry on an activity that results in any population of native seals, native birds, native invertebrates or native plants being adversely modified to a significant extent
- 19AA(1)-Gather or collect a meteorite in the Antarctic
- 19AA(2)-Removes a rock or meteorite that was gathered or collected in the Antarctic
- 19AB(a)-Bring into the Antarctic a native seal, a native bird or a native plant

1.12.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian Government's central piece of environmental legislation. The EPBC Act establishes an environmental impact assessment (EIA) regime for the protection of matters of national environmental significance (MNES), and other measures for the conservation of biodiversity. The EPBC Act applies in the location of the proposed activity, which is a Commonwealth area for the purposes of the EPBC Act (section 525 of the EPBC Act).

Under the EPBC Act, a person must refer an action that they think will, or is likely to have significant impact on a MNES to the Minister for Environment to determine whether it will, or is likely to, have such impacts and is subject to the EIA regime. The MNES include the environment broadly where an action is proposed to be taken on or impact Commonwealth area, or carried out by a Commonwealth agency.

The AAD has received advice that an authorisation is not required from Airservices Australia (or the Civil Aviation Safety Authority) for the design or implementation of new instrument flight rule procedures at the Davis aerodrome; consequently, section 160 of the EPBC Act, as it relates to “the adoption or implementation of a plan for aviation airspace management involving aircraft operations that have, will have or are likely to have a significant impact on the environment”, does not apply. Accordingly, this Referral has been submitted under section 68 of the Act to commence the environmental assessment and approval process, and considers the construction and operation of the proposed Davis aerodrome, including new instrument flight rule procedures.

1.12.3 ANTARCTIC MARINE LIVING RESOURCES CONSERVATION ACT 1981

The *Antarctic Marine Living Resources Conservation Act 1981* (AMLRC Act), and subordinate Regulations, gives effect to the *Convention on the Conservation of Antarctic Marine Living Resources*, which entered into force in 1982. The Act applies to the Antarctic marine living resources of the area south of 60° south latitude and to the Antarctic marine living resources of the area between that latitude and the Antarctic Convergence which form part of the Antarctic marine ecosystem (Article 1.1). Antarctic marine living resources include fin fish, molluscs, crustaceans, and all other species of living organisms, including birds, found south of the Antarctic Convergence ecosystem (Article 1.2).

The Act generally prohibits the harvesting of any marine organisms without a permit (section 8). In exercising powers related to permitting, the Minister must have regard to the principles under the Convention any harvesting and associated activities must be conducted in accordance with the following principles of conservation (Article 2):

a. Prevention of decrease in the size of any harvested population to levels below those that ensure its stable recruitment

b. Maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and the restoration of depleted populations, and

c. Prevention of changes in the marine ecosystem, which are not potentially reversible over two or three decades, with the aim of making possible the sustained conservation of Antarctic marine living resources.

As such, the AMLRC Act regulates the taking of seawater from the Antarctic, as it contains microorganisms that are covered under the Act. Seawater may be used as part of construction activities for the Davis aerodrome (e.g. as a source of reverse osmosis water), and permits would be required under the Act.

1.12.4 PROTECTION OF THE SEA LEGISLATION

Australia is a party to the International Convention for the Prevention of Pollution from Ships 1973 (MARPOL) and the International Convention on the Control of Harmful Anti-fouling Systems on Ships. The *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the *Navigation Act 2012* implement into domestic law Australia's obligations relating to the prevention of accidental and operational marine environment pollution from shipping. The *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* implements Australia's obligations under the International Convention on the Control of Harmful Anti-Fouling Systems on Ships. Together, these Acts are called the Protection of the Sea legislation.

Various shipping operations would be needed to support the construction of the Davis aerodrome, and these would be undertaken in accordance with the Protection of the Sea legislation.

1.12.5 BIOSECURITY ACT 2015

The *Biosecurity Act 2015* (Biosecurity Act) does not apply, except for Chapter 5 which relates to ballast water on vessels. Chapter 5 ratifies the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and is relevant to vessels that are used to transport construction materials or supplies for the aerodrome

The Biosecurity Act would not apply to flights to or from Davis aerodrome.

1.12.6 CIVIL AVIATION ACT 1988

The *Civil Aviation Act 1988* (CAA) establishes a regulatory framework for maintaining, enhancing and promoting the safety of civil aviation, with particular emphasis on preventing aviation accidents and incidents. The Act establishes CASA, which has primary responsibility for safe aviation operations in Australia and its Territories.

The CAA has a variety of delegated legislation:

- The Civil Aviation Regulations 1988 (CAR) and Civil Aviation Safety Regulations 1998 (CASR) provide regulatory controls over civil aviation safety. These regulations set out the safety standards required in relation to airworthiness of aircraft, licences and ratings of flight crew and maintenance personnel, air traffic control, rules of the air, dangerous goods and other safety issues.
- *Manuals of Standards* provide detailed technical material and requirements, which complement requirements set out in the CASR.
- *Civil Aviation Orders* (CAO) contain technical detail and requirements that complement those set out in the CAR.

The CAA and its delegated legislation apply to the planning, design, certification and operation of the Davis aerodrome.

1.12.7 AIRSPACE ACT 2007

The object of the *Airspace Act 2007* is to ensure that Australian-administered airspace, including the AAP's operations in Antarctica, is administered and used safely, taking into account:

a. Protection of the environment

b. Efficient use of that airspace

c. Equitable access to that airspace for all users of that airspace, and

d. National security.

The CASA Office of Airspace Regulation (OAR) exercises powers under the Airspace Regulations 2007 to regulate and administer Australian airspace, including prohibited, restricted and danger areas where certain activities take place that could present a risk to aviation.

1.12.8 AVIATION TRANSPORT SECURITY ACT 2004 AND AVIATION TRANSPORT SECURITY REGULATIONS 2005

The *Aviation Transport Security Act 2004* establishes a regulatory framework to safeguard against unlawful interference with aviation by establishing minimum security requirements for civil aviation in Australia and its Territories, by imposing obligations on persons engaged in civil aviation related activities. The Aviation Transport Security Regulations 2005 support the implementation of the Act by defining a range of matters relevant to the preparation, approval and implementation of transport security programs.

1.12.9 AIRPORTS ACT 1996

The *Airports Act 1996* applies to certain regulated airports that are owned by the Commonwealth and leased to commercial operators. The Davis aerodrome is not a regulated airport under the Act, and therefore this act does not apply.

1.13 DESCRIBE ANY PUBLIC CONSULTATION THAT HAS BEEN, IS BEING OR WILL BE UNDERTAKEN, INCLUDING WITH INDIGENOUS STAKEHOLDERS.

Following the release of the *Australian Antarctic Strategy and 20 Year Action Plan* in 2016, AAD has consulted with internal and external stakeholders through several forums and working groups. Consultation with these and other stakeholders would be ongoing during design development, planning and construction phases of the project.

A communication strategy, stakeholder management plan, and stakeholder register are being prepared as part of an ongoing process to identify and engage with stakeholders of the project to ensure that key stakeholders are identified and that strategies are put in place to engage with them and respond to any issues or opportunities raised.

Key stakeholders for this project include the following:

- The Australian public
- Commonwealth Government departments, agencies and authorities, from a policy and regulatory perspective (including the Civil Aviation Safety Authority and Airservices Australia)
- Tasmanian Government entities
- Commercial stakeholders, such as airports and air charter operators
- Scientific institutions' councils, academies and advisory bodies (including but not limited to those participating in the AAP)
- Other Antarctic Treaty parties and nations active in Antarctica and their stakeholders, and
- Domestic and international environmental non-government organisations.

In May 2018, the Australian Government announced its intention to construct a paved runway near Davis research station, subject to environmental approvals. Following this, a web page has also been developed to provide publicly accessible information on the project including a downloadable Fact Sheet and video (http://www.antarctica.gov.au/living-and-working/travel-and-logistics/aviation/New-Davis-Runway). The project has been reported on in various public media.

While there is no Indigenous heritage in Antarctica, Indigenous stakeholder consultation would be undertaken, as appropriate, as part of the environmental assessment and broader project development process. Indigenous Australians have participated in past and present Australian National Antarctic Research Expeditions (ANARE) expeditions and will continue to be an important part of the Australian Antarctic Program into the future.

As noted in Section 1.12, it has been determined that the Project is subject to the CEE provisions of the ATEP Act. Accordingly, the AAD will prepare a Draft CEE for submission to the Minister. The Draft CEE will then be made available for public comment in Australia, to all Parties to the Environment Protocol, and to the CEP. Each Party will also make the draft CEE available for public comment. The CEP will consider the Draft CEE and provide advice to the ATCM. The AAD will need to prepare and submit to the Minister a Final CEE, addressing all comments on the Draft CEE provided by other Parties, the ATCM and members of the public. The Minister will then decide whether or not to authorise the carrying on of the activity as proposed or with certain modifications.

1.13.1 ATTACH REPORT(S) ON ANY PUBLIC CONSULTATIONS UNDERTAKEN, INCLUDING WITH INDIGENOUS STAKEHOLDERS.

No attachments.

1.14 DESCRIBE ANY ENVIRONMENTAL IMPACT ASSESSMENTS THAT HAVE BEEN OR WILL BE CARRIED OUT UNDER COMMONWEALTH, STATE OR TERRITORY LEGISLATION INCLUDING RELEVANT IMPACTS OF THE PROJECT.

1.14.1 ENVIRONMENTAL IMPACT ASSESSMENT UNDER THE ATEP ACT

As noted in Section 1.12 of this Referral, to undertake the Project an environmental impact assessment (EIA) must be undertaken and authorisation obtained under the ATEP Act. On the basis of a Preliminary Assessment submitted on 14 October 2019, it was determined on 28 November 2019 that the Project is required to follow the requirements under section 12K of the ATEP Act for the preparation and submission a draft and Final CEE. Section 1.13 of this Referral outlines the process that will be followed for public and international comment on the Draft CEE, and the preparation of a Final CEE.

1.14.2 STATE LEGISLATION

State impact assessment does not apply to the proposed activity.

1.14.3 ATTACH COPIES OF COMMONWEALTH, STATE AND/OR TERRITORY GOVERNMENT APPROVALS AND CONSENT CONDITIONS.

No attachments.

1.15 IS THIS ACTION PART OF A STAGED DEVELOPMENT (OR A COMPONENT OF A LARGER PROJECT)?

The project is not part of a staged development or a component of a larger project.

1.16 IS THE PROPOSED ACTION RELATED TO OTHER ACTIONS OR PROPOSALS IN THE REGION?

The project is related to other proposals in the region.

1.16.1 IDENTIFY THE NATURE/SCOPE AND LOCATION OF THE RELATED ACTION (INCLUDING UNDER THE RELEVANT LEGISLATION).

The Australian Government, through the Australian Antarctic Division, is planning a variety of modernisation projects to enhance Australia's ability to undertake activities in Antarctica in line with the *Strategy* and *Action Plan*. These projects would enhance the logistics and infrastructure network that supports Australia's scientific endeavours, and include:

- The introduction of the new icebreaker *RSV Nuyina*, which will include the establishment of new or upgraded infrastructure to support shipping operations in Hobart and Antarctica.
- The Antarctic research station modernisation program, which is seeking to enhance the infrastructure at the three Antarctic stations and at Macquarie Island.
- The Million Year Ice Core Project, which is re-establishing a traverse capability to support the extraction of an ice core approximately 1,000 km from Casey research station.

The AAD is planning to undertake works at Davis research station in advance of the Davis Aerodrome Project, referred to as the Davis Stabilisation Project, to address identified capacity and/or condition concerns with existing infrastructure. As part of the Stabilisation Project, the station population capacity would be increased from 91 to 120 through the upgrade and repurposing of existing infrastructure. This work is required regardless of the Davis Aerodrome Project, and does not form part of the action proposed in this Referral. Separate environmental approvals will be gained for the Stabilisation Project.

Similarly, the AAD is planning the long-term modernisation of Davis research station (Davis Redevelopment). The Redevelopment would replace existing aging infrastructure with a modern, master planned station. The establishment of infrastructure to support the Redevelopment would occur in a staged manner, with environmental approvals gained as required. This long-term modernisation of the station is required regardless of the Davis Aerodrome Project, and does not form part of the action proposed in this Referral.

A summary of the various infrastructure projects proposed at Davis research station, their relationship, and whether they are within this Referral scope is presented in Table 1.

Table 1 Summary of AAD projects planned at Davis research station

Project	Key features and requirements	Within Referral scope?
Davis Stabilisation Project	• Repair, refurbishment, replacement and upgrade of existing station infrastructure as part of the AAD's existing capital works program • Provision of infrastructure to support a permanent population capacity at Davis research station of 120 people • It is anticipated that those works would be substantially completed before construction of Davis aerodrome enabling infrastructure commences	No
Davis Aerodrome Project – Davis enabling infrastructure	• The subject of this Referral, as described in Section 1.2.4 • Construction and operation of the Davis aerodrome requires new infrastructure at Davis research station, including the provision of infrastructure to increase the construction-phase population capacity at Davis research station to approximately 250 people (i.e. an additional 130 people) • Permanent (and potentially temporary) infrastructure would be developed in accordance with a station master plan (see Davis Redevelopment below)	Yes
Davis Redevelopment	• The Davis Redevelopment is part of the Antarctic research station modernisation program, which is seeking to enhance the infrastructure at the three Antarctic stations and at Macquarie Island • The long-term redevelopment of Davis research station would be developed in accordance with a station master plan, which is currently being prepared • A future permanent population capacity of 150 people is currently being considered; however, this would be confirmed during the master planning process • The long-term redevelopment of Davis research station would enhance the benefits of the Davis aerodrome, and would be considered in a cumulative impact assessment for the Davis Aerodrome Project • The Davis Redevelopment would be timed to coincide with completion of the Davis aerodrome or a short time after operations commence	No

2.0 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

2.1 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE VALUES OF ANY WORLD HERITAGE PROPERTIES?

The project is not likely to have any direct or indirect impact on the values of any World Heritage properties.

2.2 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE VALUES OF ANY NATIONAL HERITAGE PLACES?

The project is not likely to have any direct or indirect impact on the values of any National Heritage places.

2.3 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE ECOLOGICAL CHARACTER OF A RAMSAR WETLAND?

The project is not likely to have any direct or indirect impact on the ecological character of a RAMSAR wetland.

2.4 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE MEMBERS OF ANY LISTED SPECIES OR ANY THREATENED ECOLOGICAL COMMUNITY, OR THEIR HABITAT?

The project has the potential to have a direct or indirect impact on members of listed species or their habitat.

2.4.1 IMPACT TABLE

Table 2 Impact table for listed species and threatened ecological communities or their habitat

Species	Potential Impact
Southern Giant Petrel (*Macronectes giganteus*)	The Southern Giant Petrel is known to occur in the Vestfold Hills. Potential impacts from **construction and ground operations** for the Southern Giant Petrel are: a. Loss of foraging habitat: The Southern Giant Petrel is an opportunist scavenger and predator, with a broad foraging habitat that includes the sea, coastal areas and inland. It is not anticipated that the construction or ground operations of the aerodrome would have a significant impact on foraging habitat for the Southern Giant Petrel. b. Disturbance of breeding habitat: Construction is not anticipated to disturb breeding habitat for the Southern Giant Petrel, as the nearest breeding colony is located at Hawker Island over 6 km south-west of Davis research station. c. Potential impacts on birds from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices (refer Section 4.0) and are not considered to be significant.
Southern Giant Petrel (*Macronectes giganteus*)	Potential noise impacts from **aircraft operations** for the Southern Giant Petrel are: a. Disturbance from aircraft noise: There is the potential for the colony at Hawker Island to be affected by noise from

Species	Potential Impact
	aircraft, and further analysis is required to determine if this would be significant. Flights are not planned to pass directly over Hawker Island, in accordance with the Management Plan for ASPA No 167 Hawker Island. Potential indirect impacts of noise disturbance require further investigation during the detailed assessment. b. Loss of foraging habitat: The Southern Giant Petrel is an opportunist scavenger and predator, with a broad foraging habitat which includes the sea, coastal areas and inland. It is not anticipated that the aircraft operations would have a significant impact on foraging habitat for the Southern Giant Petrel. A precautionary approach has been applied in this Referral. The need for further detailed assessment has been recognised, and potential impacts and appropriate mitigation will be considered through the environmental assessment processes triggered under the ATEP Act and through this Referral.
There are no records report in the area of the other four species on the Department of Environment and Energy Protected Matters Search Tool (PMST): 1. (White-bellied Storm Petrel (Tasman Sea) (*Fregetta grallaria grallaria*), 2. Fairy Prion (southern) (*Pachyptila turtur subantarctica*), 3. Antarctic Tern (Indian Ocean) (*Sterna vittata vittata*), and 4. Black-browed Albatross (*Thalassarche melanophris*))	Given there are no records of the other four species in the area (White-bellied Storm Petrel [Tasman Sea], Fairy Prion [southern], Antarctic Tern [Indian Ocean] and Black-browed Albatross), no impact is anticipated.
The PMST Report identified five cetaceans listed as both threatened and migratory under the EPBC Act. These are: 1. Sei Whale (*Balaenoptera borealis*), 2. Blue Whale (*Balaenoptera musculus*), 3. Fin Whale (*Balaenoptera physalus*), 4. Southern Right Whale (*Eubalaena australis*), and 5. Humpback Whale (*Megaptera novaeangliae*).	Potential impacts from **construction and ground operations** cetaceans are: a. The potential impact of ship strike on whales associated with the increased shipping is not considered to be significant. 1. The AAP currently undertakes 3 voyages to Davis anchorage each year using the RSV Aurora Australis, and other nations' vessels also occasionally use the anchorage; there have been no recorded vessel strikes on marine mammals from AAP vessels in the last ten years. The number of vessels would increase, with up to 9 annual ship voyages (including the current resupply voyages), with the potential for short periods of two ships present in the area at one time. 2. Knowledge of whale occurrence in the nearshore environment is scant, however Orcas and Minke whales are known to inhabit inshore waters and have been sighted close to Davis Station. While there would also be an increase in the number of ship-to-shore loading and unloading movements, these nearshore movements would typically be slow with a relatively low risk of striking a cetacean. Controls,

Species	Potential Impact
	such as speed restrictions and the use of wildlife spotters, would be considered. b. Disturbance from underwater noise (construction works): The new wharf on the coast at the Davis research station would require physical works to be undertaken. These works would generate underwater noise (e.g. during piling), which has the potential to disturb marine mammals. c. Disturbance from underwater noise (vessel movement): While it is not considered to present a significant impact at a species level, localised and transitory noise from vessel operations (bulk cargo carriers, barges and tug boats) has the potential to cause disturbance to individual cetaceans that might be in the area near the loading and unloading operations. Further analysis would be undertaken through the detailed environmental assessment for the project. d. Potential impacts on cetaceans from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices (refer Section 4.0), and are not considered to be significant. The potential impacts on the listed cetacean species are not considered to be significant at the species level; nevertheless, the extent of potential impacts would be assessed through the detailed environmental assessment for the project.
The PMST Report identified five cetaceans listed as both threatened and migratory under the EPBC Act. These are: 1. Sei Whale (*Balaenoptera borealis*), 2. Blue Whale (*Balaenoptera musculus*), 3. Fin Whale (*Balaenoptera physalus*), 4. Southern Right Whale (*Eubalaena australis*) and 5. Humpback Whale (*Megaptera novaeangliae*).	Disturbance from aircraft noise: The potential impacts on the listed cetacean species **from aircraft overflights** are not considered to be significant at a species level, given there are planned to be approximately three intercontinental flights per month, and the existing regular use of the Davis area for intracontinental and scientific flights. Aircraft noise is considered to be localised and transitory. Potential indirect impacts of noise disturbance require further investigation during the detailed assessment.
Southern Elephant Seal (*Mirounga leonina*)	Southern Elephant Seal moulting wallows are located at Davis research station (Station Beach) and Old Wallow. Other wallows have been documented between Davis research station and Law Cairn, however the current occupancy of these wallows has not been well documented. At these locations they are currently exposed to the physical presence of people, machinery, infrequent intracontinental overflights, and helicopter operations. Potential impacts from **construction and ground operations** to Southern Elephant Seals are: a. Disturbance from movement of people, cargo and equipment in proximity to haul out areas: Further analysis is required to understand the potential impacts and identify mitigation for construction activities related to station infrastructure, cargo unloading and transport near the Southern Elephant Seal haul out areas, and would be undertaken for the detailed environmental assessment

Species	Potential Impact
	for the project. A precautionary approach has been applied in this Referral. There is the potential for the increased vehicle movements and construction activity to disturb this population of seals during the summer moult, and further analysis is required to determine if this would be significant. Potential impacts and appropriate mitigation will be considered through the detailed environmental assessment for the project. b. Potential impacts on Southern Elephant Seals from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices and are not considered to be significant.
Southern Elephant Seal (*Mirounga leonina*)	Disturbance from aircraft noise: Southern Elephant Seal moulting wallows are located at Davis research station (Station Beach) and Old Wallow. Other wallows have been documented between Davis research station and Law Cairn, however the current occupancy of these wallows is not well documented. At these locations they are currently exposed to the physical presence of people, machinery, infrequent intracontinental overflights, and helicopter operations. Further analysis is required to understand the potential impacts and identify mitigation of changes to aircraft noise during aircraft operation on the Southern Elephant Seal haul out areas, which would be undertaken for the detailed environmental assessment for the project. Potential indirect impacts of noise disturbance require further investigation during the detailed assessment.
There are no listed flora or threatened ecological communities near the project site.	N/A

2.4.2 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

Impacts on threatened species have the potential to be significant and would be assessed through the detailed environmental impact assessment.

2.5 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE MEMBERS OF ANY LISTED MIGRATORY SPECIES, OR THEIR HABITAT?

The project has the potential to have a direct or indirect impact on members of migratory species or their habitat.

2.5.1 IMPACT TABLE

Table 3 Impact table for listed migratory species or their habitat

Species	Potential Impact
Southern Giant Petrel (*Macronectes giganteus*)	The Southern Giant Petrel is known to occur in the Vestfold Hills. Potential impacts from **construction and ground operations** for the Southern Giant Petrel are: a. Loss of foraging habitat: The Southern Giant Petrel is an opportunist scavenger and predator, with a broad foraging habitat that includes the sea, coastal areas and inland. It is not anticipated that the construction or ground operations of the aerodrome would have a significant impact on foraging habitat for the Southern Giant Petrel. b. Disturbance of breeding habitat: Construction is not anticipated to disturb breeding habitat for the Southern Giant Petrel, as the nearest breeding colony is located at Hawker Island over 6 km south-west of Davis research station. c. Potential impacts on birds from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices (refer Section 4.0) and are not considered to be significant.
Southern Giant Petrel (*Macronectes giganteus*)	Potential noise impacts from **aircraft operations** for the Southern Giant Petrel are: a. Disturbance from aircraft noise: There is the potential for the colony at Hawker Island to be affected by noise from aircraft, and further analysis is required to determine if this would be significant. Flights are not planned to pass directly over Hawker Island, in accordance with the Management Plan for ASPA No 167 Hawker Island. Potential indirect impacts of noise disturbance require further investigation during the detailed assessment. b. Loss of foraging habitat: The Southern Giant Petrel is an opportunist scavenger and predator, with a broad foraging habitat which includes the sea, coastal areas and inland. It is not anticipated that the aircraft operations would have a significant impact on foraging habitat for the Southern Giant Petrel. A precautionary approach has been applied in this Referral. The need for further detailed assessment has been recognised, and potential impacts and appropriate mitigation will be considered through the environmental assessment processes triggered under the ATEP Act and through this Referral.
There are no records of the other species identified in the PMST Report, Black-browed Albatross (*Thalassarche melanophris*), in the area.	Given there are no records of Black-browed Albatross in the area, no impact is anticipated.

Species	Potential Impact
Wilson's Storm Petrel (*Oceanites oceanicus*)	Loss of nesting habitat: Preliminary surveys in 2017-18 and 2018-19 demonstrated that Wilson's Storm Petrels nest within the project site. Additional surveys are being undertaken as part of the 2019-20 field season, which will contribute to the understanding of the population estimate for the project site and surrounding areas. Construction would affect individual Wilson's Storm Petrels nests within the site and would reduce available habitat for this species; however, this is not anticipated to present a significant impact on the overall population of this relatively abundant species. Wilson's Storm Petrels have the potential to be affected by the change to aircraft operations at Davis aerodrome, and further analysis is required to determine if this would be significant. A precautionary approach has been applied in this Referral. The need for further detailed assessment has been recognised, and potential impacts and appropriate mitigation will be considered through the detailed environmental assessment for the project.
South Polar Skua (*Catharacta maccormicki*).	South Polar Skuas have the potential to be affected by the change to aircraft operations at Davis aerodrome, and further analysis is required to determine if this would be significant. A precautionary approach has been applied in this Referral. The need for further detailed assessment has been recognised, and potential impacts and appropriate mitigation will be considered through the detailed environmental assessment for the project.

Species	Potential Impact
The PMST Report identified eight cetaceans listed as migratory under the EPBC Act. These are: 1. Sei Whale (*Balaenoptera borealis*), 2. Blue Whale (*Balaenoptera musculus*), 3. Fin Whale (*Balaenoptera physalus*), 4. Southern Right Whale (*Eubalaena australis*), 5. Humpback Whale (*Megaptera novaeangliae*), 6. Killer Whale (*Orcinus orca*), 7. Antarctic Minke Whale (*Balaenoptera bonaerensis*), and 8. Sperm Whale (*Physeter macrocephalus*)	Potential impacts from **construction and ground operations** on cetaceans are: a. The potential impact of ship strike on whales associated with the increased shipping is not considered to be significant. 1. The AAP currently undertakes 3 voyages to Davis anchorage each year using the RSV Aurora Australis, and other nations' vessels also occasionally use the anchorage; there have been no recorded vessel strikes on marine mammals from AAP vessels in the last ten years. The number of vessels would increase, with up to 9 annual ship voyages (including the current resupply voyages), with the potential for short periods of two ships present in the area at one time. 2. 2Knowledge of whale occurrence in the nearshore environment is scant, however Orcas and Minke whales are known to inhabit inshore waters and have been sighted close to Davis Station. While there would also be an increase in the number of ship-to-shore loading and unloading movements, these nearshore movements would typically be slow with a relatively low risk of striking a cetacean. Controls, such as speed restrictions and the use of wildlife spotters, would be considered. b. Disturbance from underwater noise (construction works): The new wharf on the coast at the Davis research station would require physical works to be undertaken. These works would generate underwater noise (e.g. during piling), which has the potential to disturb marine mammals. c. Disturbance from underwater noise (vessel movement): While it is not considered to present a significant impact at a species level, localised and transitory noise from vessel operations (bulk cargo carriers, barges and tug boats) has the potential to cause disturbance to individual cetaceans that might be in the area near the loading and unloading operations. Further analysis would be undertaken through the detailed environmental assessment for the project. d. Potential impacts on cetaceans from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices (refer Section 4.0), and are not considered to be significant. The potential impacts on the listed cetacean species are not considered to be significant at the species level; nevertheless, the extent of potential impacts would be assessed through the detailed environmental assessment for the project.

Species	Potential Impact
The PMST Report identified eight cetaceans listed as migratory under the EPBC Act. These are: 9. Sei Whale (*Balaenoptera borealis*), 10. Blue Whale (*Balaenoptera musculus*), 11. Fin Whale (*Balaenoptera physalus*), 12. Southern Right Whale (*Eubalaena australis*), 13. Humpback Whale (*Megaptera novaeangliae*), 14. Killer Whale (*Orcinus orca*), 15. Antarctic Minke Whale (*Balaenoptera bonaerensis*), and Sperm Whale (*Physeter macrocephalus*)	Disturbance from aircraft noise: The potential impacts on the listed cetacean species **from aircraft overflights** are not considered to be significant at a species level, given there are planned to be approximately three intercontinental flights per month, and the existing regular use of the Davis area for intracontinental and scientific flights. Aircraft noise is considered to be localised and transitory. Potential indirect impacts of noise disturbance require further investigation during the detailed assessment.

2.5.2 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

Impacts on threatened species have the potential to be significant and would be assessed through the detailed environmental impact assessment.

2.6 IS THE PROPOSED ACTION TO BE UNDERTAKEN IN A MARINE ENVIRONMENT (OUTSIDE COMMONWEALTH MARINE AREAS)?

The proposed action would be undertaken in a marine environment (including outside Commonwealth marine areas).

2.6.1 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE COMMONWEALTH MARINE ENVIRONMENT?

The project has the potential to have a direct or indirect impact on the marine environment outside of a Commonwealth marine area.

2.6.2 DESCRIBE THE NATURE AND EXTENT OF THE LIKELY IMPACT ON THE WHOLE OF THE ENVIRONMENT.

The activities that would occur in the marine environment relate to shipping from Australia where it occurs outside Commonwealth marine areas. The potential impacts associated with this activity are considered to be negligible, as there would be only 18 vessel movements per season in the Southern Ocean, which already experiences considerable shipping activity.

The project does not include activities within an existing or proposed Commonwealth Marine Reserve or Antarctic Marine Protected Area.

Activities within Commonwealth marine areas are described in Section 2.13.

2.6.3 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

It is not anticipated that the project would have a significant impact on the marine environment outside Commonwealth marine areas.

2.7 IS THE PROPOSED ACTION TO BE TAKEN ON OR NEAR COMMONWEALTH LAND?

The project is located on Commonwealth land.

2.7.1 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON THE COMMONWEALTH LAND?

The project has the potential to have a direct or indirect impact on Commonwealth land.

2.7.2 DESCRIBE THE NATURE AND EXTENT OF THE LIKELY IMPACT ON THE WHOLE OF THE ENVIRONMENT.

The following briefly describes the potential impacts to the whole of environment for the construction and operation of the Davis aerodrome, in accordance with Significant Impact Guidelines 1.2.

Preliminary mitigation measures for identified impacts on whole of environment values are provided in Section 4.0.

Further analysis, including reviewing previous studies and additional field survey is required to understand the significance of potential impacts and develop mitigation measures for particular values of the whole of the environment, and would be undertaken as part of a detailed environmental assessment for the project. A precautionary approach has been taken in this Referral, and in the current absence of detailed analysis to demonstrate otherwise, there remains the potential for a significant impact on:

- Landscapes and soils
- Coastal landscapes and processes
- Ocean forms, ocean processes and ocean life
- Water resources
- Plants, and
- Animals.

While the potential impacts on the following values of the whole of the environment are not considered to be significant, the extent of potential impacts would be assessed through the detailed environmental assessment for the project:

- Pollutants, chemicals and toxic substances
- People and communities, and
- Heritage.

2.7.2.1 LANDSCAPES AND SOILS

The project would require earthworks during construction. At the aerodrome site, an exposed rock outcrop, these earthworks are required to create a level area for construction of the runway and aerodrome buildings. The design levels for the runway range from approximately 27 m above mean sea level (AMSL) at the southwest end to approximately 43 m AMSL at the northeast end, with grades between 0.1% and 1.1%. Natural ground levels within the construction footprint vary between approximately 20 m AMSL in Camp Lake Valley to approximately 80 m AMSL at Camp Knoll. Approximately 3 million cubic metres of earthworks would be needed for the establishment of the runway and other aerodrome facilities, and approximately 150,000 cubic metres of earthworks for the construction of the access road. The project footprint is shown on Map 2.

The earthworks would include drilling and blasting of high points in the aerodrome footprint, with the excavated material being used to fill low points, such as gullies and a small lake (discussed in further detail below). The project is planned to have a cut and fill balance, so that importation or disposal of material off site would not be needed. The project would therefore permanently alter the natural landscape feature of the aerodrome site. There would also be permanent changes associated with construction of the aerodrome access road across Adams Flat.

Studies are currently underway to determine the location of the Davis enabling infrastructure, and therefore, specific locations have not yet been determined. Nevertheless, major earthworks are not anticipated. The AAD's policy is to site infrastructure in previously disturbed sites where practical; this is to manage potential increases in the disturbed footprint associated with its activities. The anticipated footprint and general locations for key infrastructure are described in Section 1.2.4.

The change in the landform and the introduction of additional vehicles, equipment, structures, hard surfaces associated with the construction of the project would affect the visual amenity from some viewpoints within the local area. The significance of this impact would be addressed further through the impact assessment process when a detailed assessment of landscape values of the area and the impact of the project would be undertaken.

Given the nature of the site's topography and planned earthworks the project is unlikely to cause subsidence, instability, or substantial erosion during construction and once complete.

Based on the permanent alteration of a natural landscape feature, the project has the potential to have a significant impact on the local landscape.

2.7.2.2 IMPACTS ON COASTAL LANDSCAPES AND PROCESSES

The project would use the new wharf, and existing boat ramp, on the coast at the Davis research station. The new wharf requires land reclamation and piled foundations for crane beams, wharf struts, anchoring and ramp supports. Floating pontoons would allow cargo units to be lifted using ship's gear and placed on trailers. On arrival at the wharf, the cargo would be rolled off (on trailers towed by tractors) the pontoon onto land.

The construction of the wharf would have the potential to locally affect coastal processes, wave action, or water circulation patterns, and this would be considered in the detailed environmental assessment.

2.7.2.3 IMPACTS ON OCEAN FORMS, OCEAN PROCESSES AND OCEAN LIFE

The project activities occurring in the marine environment, which is a Commonwealth marine area, are shipping, and the transport of pavers and equipment from ships, anchored at the Davis anchorage, to the shore at the new Davis wharf and existing boat ramp.

The new wharf on the coast at the Davis research station requires physical works to be undertaken (see coastal landscapes and processes). It therefore has the potential to alter local water circulation patterns and alter benthic community composition and distribution, and this would be considered in the detailed environmental assessment.

Shipping and logistics support for the project would require a combination of icebreaker and ice-strengthened cargo vessels. To transport the required plant, equipment and materials for aerodrome construction, it is anticipated that 2 to 3 cargo deliveries each year for up to 10 years would be required; additional shipping might be required for the Davis research station infrastructure. To transport the required number of construction phase personnel (including station operational personnel), it would be necessary to use two passenger vessels at the beginning and end of the summer season. It is anticipated that the *RSV Nuyina* would transport personnel as part of its annual resupply voyage to Davis research station. The remaining personnel would be transported on a chartered vessel.

The first voyages of the season would be undertaken in October, when sea ice is still present at Davis. Subsequent voyages would typically be undertaken from January, when sea ice has cleared from Davis harbour. It is anticipated that the final departure from Davis research station for construction personnel would be at the end of April.

Currently the *RSV Aurora Australis* visits Davis research station up to three times each summer season between October and March. During the main resupply voyage in late October or early November, the vessel typically parks against fast ice near the station for approximately two weeks while loading and unloading occurs over ice, and no anchor is required. Subsequent visits are typically shorter in duration and require the vessel to anchor. This resupply activity would continue during aerodrome construction, with the new icebreaker *RSV Nuyina*. This means that the highest anticipated number of voyages to Davis in any one season (between October and March) would be eight (including the annual resupply of *RSV Nuyina*). It is likely that there could be short periods (two weeks or shorter) where two vessels (resupply and project cargo) are stationed near Davis.

ANCHORAGE

The proposed anchor site for project vessels is located south of Anchorage Island and halfway between Hobby Rocks and Davis research station, as shown on Map 2. The total anchorage area is approximately 40 ha in size, and generally has a depth of greater than 22 m, with an isolated shallower area of approximately 12 m depth.

This is the same area where Australian vessels currently anchor (as required) for station resupply, and it is also used by other nations on occasion to anchor ice breakers and other vessels (e.g. China's *Xuelong*), which means there is likely to already be disturbance to the sea floor. The existing and proposed Australian icebreakers have a draught of 7.8 m and 9.3 m respectively. Ice-strengthened bulk cargo vessels have a draught ranging between approximately 6 m and 10 m, so are similar to the existing vessels using the area and would have at least 10 m clearance from the sea floor at the anchorage site.

Anchoring of cargo vessels involves dropping a large steel anchor to the sea floor, which is connected to the vessel by a large, heavy chain. Large anchors have the potential to affect the seabed by scouring into the sediments, and also from the anchor chains, which can be dragged across the seabed as the ship swings in the wind/currents or the anchor is deployed or retrieved. This has the potential to affect marine invertebrates located on or near the sediment surface, depending on what is located at or near the anchor point. Early in the summer season, when adequate sea ice is still present, ships are not required to anchor as the sea ice works as a dock (with engines engaged) to prevent ship movement.

With increased shipping and multiple anchors deployed and retrieved throughout a season, the extent of this activity would increase from that currently experienced. Indirect effects of anchoring are also possible if sediment is stirred from the seabed, potentially creating a plume that could reduce light levels and potentially cover benthic fauna which may be present.

Project vessels would typically be anchored using a single anchor, with the vessel able to move with the prevailing winds and currents to reduce the likelihood of the anchor dragging. Barges and tugs used for ship-to-shore operations would be anchored close to the Davis research station and could be moored to the wharf. Where possible, the vessels would be anchored in areas of previous disturbance. To reduce the potential impacts noted above, the benefits of the development of a single mooring point for vessels at the anchorage would also be investigated.

Further analysis of the benthic communities and mitigation measures for the anchorage area would need to be undertaken through the detailed environmental assessment for the project.

Given the use of a previously disturbed site and the potential for mitigation to be applied to reduce further impacts, this activity is not considered to reduce biological diversity in the medium to long term or have an impact on a large area of ocean habitat, and is therefore considered not to be significant.

IMPACTS ON MARINE MAMMALS

The potential impacts on marine mammals, as described below, are not considered to be significant.

There is the potential for marine mammal interactions at sea and closer to shore as part of the shipping required for the project. There is potential for some increased risk for ship strike on cetaceans from the increased number of bulk cargo vessels (from 3 up to 9 per annum during construction) anchoring offshore from Davis research station, and the associated increased ship-to-shore loading and unloading movements ; however, given the information below, it is not considered likely to be significant.

The Draft National Strategy for Mitigating Vessel Strike of Marine Mega-fauna identified that in 89% of incidences where a whale was severely hurt or killed by a vessel, the vessel was travelling at speeds greater than 14 knots, and the chance of a lethal injury increased significantly, as vessel speed increases up to 13 to 15 knots (DEE, 2016). While cargo vessels would typically travel at up to 16 knots in the open sea, speed would be considerably slower when approaching the Davis anchorage, and therefore present a low risk of ship strike. Vessel speeds during ship-to-shore movements would also typically be slow, with a low potential for a strike. This is supported by the AAD's successful annual resupply operations, where no vessel strikes on marine mammals have been recorded from AAP vessels in the last ten years.

The new wharf on the coast at the Davis research station would require physical works to be undertaken (see coastal landscapes and processes). These works would generate underwater noise (e.g. during piling), which has the potential to disturb marine mammals. Further analysis would be undertaken through the detailed environmental assessment for the project.

While it is not considered to present a significant impact at a species level, localised and transitory noise from vessel operations (bulk cargo carriers, barges and tug boats) has the potential to cause disturbance to individual cetaceans that might be in the area near the loading and unloading operations. Further analysis would be undertaken through the detailed environmental assessment for the project.

WASTEWATER

Wastewater at Davis research station is currently treated at an advanced wastewater treatment plant to produce water that exceeds Australian Drinking Water Guidelines. This water is then discharged into the marine environment. It is anticipated that a similar treatment system and discharge standard would be implemented to manage wastewater associated with the additional construction personnel.

Wastewater generated on the cargo vessels would be managed in accordance with MARPOL requirements (the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978) and Australia's Protection of the Sea legislation, which stipulate no-dumping zones, water treatment requirements, and minimum vessel speed during discharge.

POLLUTION

The transport of heavy fuel oil would not be carried out as part of construction as it is banned within the Antarctic area (south of latitude 60°S) under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*.

It is highly unlikely that a fuel spill would occur as vessels used for the project would have appropriate polar certification and would comply with MARPOL requirements and Australia's Protection of the Sea legislation. In addition to this, containment and response procedures would be implemented to reduce potential impacts in the unlikely event of a spill.

Additional resupply deliveries of special Antarctic blend (SAB) diesel may be required during construction to fuel construction plant and equipment. These deliveries would be undertaken by the AAD's new icebreaker *RSV Nuyina*, which will be in operation, and following the AAD's standard operating procedures for fuel resupply. With these procedures it is unlikely that a fuel spill would occur, and with appropriate containment and response, it is not expected that fuel would be released into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes.

With appropriate management processes and measures, it is not anticipated that the project would have a significant impact related to pollution from fuel, oil or other toxic substances in the marine environment.

Potential impacts on marine life from waste generated by construction and operation would be mitigated and managed through the implementation of the AAD's environmental management practices and are not considered to be significant. In addition to existing and revised AAD policies and procedures, a comprehensive environmental management plan (EMP) would be developed for the road and aerodrome construction activities.

DUST

Aeolian transport of sediment across the project area (and Vestfold Hills more broadly) occurs as a result of natural processes. It is anticipated that the project would generate additional localised sources of dust from runway earthworks and the movement of vehicles between Davis research station and the aerodrome. The prevailing wind direction is from the north-east, and therefore dust would mostly be transported to areas to the south-west. Dust has the potential to be transported to the marine environment, either onto sea ice or open water. Satellite images indicate that this transport currently occurs naturally, and further analysis is required to understand the potential contribution from project-generated dust and the associated impacts.

2.7.2.4 IMPACTS ON WATER RESOURCES

GROUNDWATER

Groundwater is present within the project footprint in some areas where sediment overlays the rock. This includes Camp Lake Valley, which would be intersected by the eastern end of the runway. Soil warming, combined with seasonal snow melt, allows groundwater flow (at less than 1 m deep) in this area.

Field investigations undertaken in 2018-19 identified groundwater in Camp Lake Valley, which is described further under *Surface water*.

The alignment and design for the access road across Adams Flat has been developed to minimise the footprint in permafrost areas and reduce potential impacts on drainage patterns and groundwater flow. With this approach, construction of the road is not anticipated to have a significant impact on groundwater (including permafrost).

SURFACE WATER

Precipitation at Davis research station is very low at approximately 70 mm per year, entirely as snowfall, and there is reportedly little or no meltwater, as snowfall typically sublimates (at the station). Numerous snow drifts, referred to as "blizz tails", occur throughout the aerodrome site mainly on south-west facing slopes, which form the lee side from the prevailing wind. Blizz tail melt behaviour varies from season to season depending on snow depth, wind, humidity, and temperature. For example, during 2017-18, several of these remained throughout the entire summer season with accumulated snow depths greater than 3 m.

The Vestfold Hills is a lake-rich area of Antarctica, characterised by the presence of hundreds of lakes, ranging in salinity from amongst the most saline to the freshest in the world. These lakes range in size from small, shallow pools that freeze entirely in winter, to large, deep lakes that remain largely unfrozen. Other, unmapped, waterbodies are likely to appear in depressions during wetter periods.

Camp Lake is fed by melt water from snow accumulation on the lee side of Camp Knoll and other snow accumulation from a relatively small catchment east of the proposed runway location. Camp Lake is known to occasionally overtop and drain via Camp Lake Valley (this does not occur annually), and this drainage path is likely to be blocked or diverted by the runway, depending on the final earthworks design.

Field investigations undertaken in 2018-19 indicated that groundwater and sediment flow down Camp Lake Valley into the marine environment between Plough Island and the coastline, referred to locally as West Bay. The substrate in the bay adjacent to Camp Lake Valley is understood to be terrigenous and marine sediment, and initial results of the 2018-19 field season indicate the biology of the area consists of holothuroids.

Halfway Lake is a small lake, approximately 6,300 square metre in area and approximately 1 m deep. A 2018 study found that small lakes rarely have unique fauna, as their ephemeral nature leads to a much less stable environment, with any organisms living in these lakes required to withstand dramatic changes in water salinity through both evaporation, winter freezing, and desiccation.

Map 2 shows the locations of the various hydrological features described above.

Construction of the runway requires earthworks to remove high points, including Camp Knoll, and filling low points, including Halfway Lake and a 250 m long section of Camp Lake Valley, which would be intersected by the eastern end of the runway. Other minor drainage paths may be truncated by the runway earthworks, which could lead to the creation of new low points and potentially new permanent or ephemeral lakes.

As a result of the project, over time, less run-off and sediment from the Camp Lake Valley would drain into the marine environment. It is anticipated that the project would reduce the quantity of water flowing in Camp Lake Valley, and alter drainage patterns in the immediate area. Further analysis, including reviewing previous studies, is required to understand the significance of potential impacts and develop mitigation measures for changes to the Camp Lake Valley hydrology, which would be undertaken as part of a detailed environmental assessment for the project. Further analysis is also required to understand the significance of any associated potential biological impacts of the hydrological changes. In the current absence of detailed analysis to demonstrate otherwise, there remains the potential for a significant impact from these hydrological changes.

With appropriate consideration given to the alignment, design and construction of the access road, it is anticipated that significant impacts to drainage paths in Adams Flat can be avoided.

2.7.2.5 POLLUTANTS, CHEMICALS AND TOXIC SUBSTANCES

This section considers potential impacts from dust and vehicle emissions, wastewater, pollution and contamination, and aircraft emissions.

DUST AND VEHICLE EMISSIONS

Aeolian transport of sediment across the project area (and Vestfold Hills more broadly) occurs as a result of natural processes. It is anticipated that the project would generate additional localised sources of dust from runway earthworks and the movement of vehicles between Davis research station and the aerodrome. The prevailing wind direction is from the north-east, and therefore dust would mostly be transported to areas to the south-west.

Dust has the potential to be transported to the marine environment, either onto sea ice or open water. Satellite images indicate that this transport currently occurs naturally, and further analysis is required to understand the potential contribution from project-generated dust and the associated impacts. With appropriate management, the generation of dust from construction is not anticipated to substantially reduce local air quality. The potential impacts on sensitive receptors associated with the release of dust are discussed in the sections *Impacts to plants* and *Impacts to animals*. Construction would require the use of a range of plant and equipment, which would generate exhaust emissions over several seasons.

While there would be increased generation of vehicle emissions from plant and equipment at the construction site, and movement of vehicles along the alignment of the proposed access road, and emissions from cargo vessels and ship to shore movements, these are not expected to substantially reduce local air quality.

WASTEWATER

The project would require the construction of a new wastewater treatment plant for an additional 130 personnel at the station. Details of this treatment plant, and associated discharge requirements (volume, frequency, etc.) are currently unknown and potential impacts are uncertain. Wastewater at Davis research station is currently treated at an advanced wastewater treatment plant to produce water that exceeds Australian Drinking Water Guidelines. This water is then discharged into the marine environment. It is anticipated that a similar treatment system and discharge standard would be implemented to manage wastewater associated with the additional construction personnel. The details and potential impacts associated with additional wastewater would be addressed in the detailed environmental assessment.

POLLUTION AND CONTAMINATION

The project would implement procedures (through the development of a project specific EMP) during construction and operation to reduce the likelihood of spills and ensure rapid and effective response procedures to contain and minimise impacts on the environment and biota.

Construction activities require the transport, storage and use of fuel, oils, lubricants, grout, drilling fluids, adhesives and blasting agents. In the unlikely event of an accidental release, these materials, particularly liquids, have the potential to result in pollution of soil and water and represent a toxicity risk to biota. The potential impacts on biota are discussed in the sections *Impacts on plants* and *Impacts on Animals*. Accidental releases would be mitigated and managed through the implementation of environmental management practices to prevent, respond to and remediate fuel and chemical spills.

Construction activities could potentially generate small amounts of wastewater (e.g. rinse water); these liquid wastes would be managed in accordance with current practices and may require containment and transport to Australia for final disposal.

Fuel storage and handling

A new bulk fuel storage facility at Davis research station would be required to store:

- Special Antarctic blend (SAB) diesel for power generation and heating the Davis enabling infrastructure during the aerodrome construction
- SAB for construction plant and equipment
- SAB for power generation and heating the Davis aerodrome during operations, and
- JetA1 for aircraft refuelling at the aerodrome.

Smaller storage facilities would be provided at the aerodrome for SAB and JetA1, with regular refilling from the main storage location at Davis research station by tanker truck.

Jet A1 fuel is currently used for aviation at Australian Antarctic stations, and is composed of petroleum (kerosene) and additives. As with current operations at Australian Antarctic airfields, smaller intracontinental aircraft would be refuelled at the Davis aerodrome. Globemaster C-17As would also require refuelling at the aerodrome. While civilian intercontinental aircraft would carry sufficient fuel to undertake a return flight, an allowance for emergency refuelling would be made in the quantity of Jet A1 stored at Davis research station and the aerodrome.

Minor fuel spills have the potential to occur through overfilling, and splashes, when refuelling equipment. The AAD has developed bulk fuel storage guidelines, Fuel Transfer Standard Operating Procedures and Fuel Spill Contingency Plans for all station and field refuelling operations, and these protocols would be updated as required for the project and implemented during construction and operation. The aerodrome apron design includes a containment system for the unlikely event of a fuel spill.

With the development and implementation of handling procedures and emergency response, the potential for pollution and contamination during the operation of the aerodrome, which relate to storage and transfer of fuel, are not anticipated to present a significant risk to the environment.

De-icing

De-icing, the process of removing snow, ice or frost from an aircraft, may be required from time to time. The method of de-icing is currently under investigation with both liquid and mechanical options being considered. If chemical de-icing is required, the potential for environmental impacts would be assessed, and containment and handling facilities and procedures would be established to minimise potential environmental impacts. The aerodrome apron containment system would be used for the containment and management of de-icing liquid if required.

Aircraft emissions

Emissions generated from aviation operations are not expected to increase to an extent that they substantially reduce local air quality or increase atmospheric concentrations of greenhouse or ozone gases. Existing aviation activity to, from and around Davis research station is described in Section 3.7; current annual aircraft movements at Davis are currently around 600, including fixed wing turboprop planes and helicopters. During operation of the new runway, there would be an increase in flight numbers as the aerodrome becomes a year-round operation, including up to approximately 26 intercontinental return flights and increased intracontinental and scientific flights.

2.7.2.6 IMPACTS ON PLANTS

The flora relevant to the project area is described in Section 3.1.

The ice-free areas of Antarctica support sparse vegetation, as vegetation must contend with temperatures below zero for months, low availability of water, poor nutrient status of soils such as they exist, sand and ice abrasion and a saline environment. Vegetation at the site is limited to algae and lichens, and these species hold intrinsic value in the Antarctic environment. Mosses have not been observed at the site. Some of these species have the potential to be unique to the project area and surrounds, although this requires further assessment. No vegetation identified at the site is listed under the EPBC Act as threatened.

PHYSICAL DISTURBANCE

Earthworks associated with construction would involve the removal of terrestrial algae and lichens within the footprint for construction of the aerodrome, access road and Enabling infrastructure. Further analysis, including reviewing previous studies, is required to understand the significance of the populations, the significance of potential impacts and to develop mitigation measures for vegetation species that occur within the project footprint, and would be undertaken as part of a detailed environmental assessment for the project. In the current absence of detailed analysis to demonstrate otherwise, there remains the potential for a significant impact on vegetation from physical disturbance.

The use of chemicals to kill or stunt the growth of vegetative species on site is not proposed and no burning is proposed as part of construction (open burning is not permitted in Antarctica).

DUST EMISSIONS

Natural aeolian transport of sediment occurs across the project area (and Vestfold Hills more broadly), particularly as the surface soils and sediments are almost completely exposed. It is anticipated that the project would generate localised additional dust from earthworks and vehicle movements, and there is the potential for associated impacts on plants, such as wind scour of lichen communities and the reduced ability of terrestrial vegetation to photosynthesise. In the current absence of detailed analysis to demonstrate otherwise, there remains the potential for significant impacts on vegetation from dust. Further assessment, including the modelling of baseline and project-related dust, is required to determine the significance of impacts.

POLLUTANTS

Emissions from vehicle and aircraft exhaust during ground-based manoeuvres, and potential accidental release (and possible subsequent transport in meltwater or dust), has the potential to be adsorbed or absorbed by plants. The ecotoxicological effects of various contaminants on Antarctic ecology is not well understood, with the type and quantity of contaminant likely to determine the biological effect.

INTRODUCTION OF NON-NATIVE SPECIES

It is anticipated that, with the AAD's extensive experience in biosecurity, the additional risk of introducing non-native species through the pathways described below can be effectively managed and therefore is not anticipated to have a significant impact. While biosecurity risks are relevant to all expeditions to the area, the increased number of ships and personnel, and the amount of cargo, and the use of commercial ships (ice-strengthened bulk carriers), would require additional biosecurity protocols both in Australia and Antarctica.

Potential biosecurity impacts are associated with the transport of personnel, equipment, materials and pre-cast pavers to the site. Non-native species have the potential to be introduced through passive entrainment on clothing, boots, equipment, machinery and materials. Translocation of endemic flora within the area also has a potential to introduce species to other local ecosystems.

2.7.2.7 IMPACTS ON ANIMALS

The fauna relevant to the project area is described in Section 3.1. The locations of known wildlife populations are shown on Map 3. This map was produced in 2018 by the AAD data centre to show all previously identified wildlife populations; these populations will be ground-truthed as part of a detailed environmental assessment and an updated map will be produced.

PHYSICAL DISTURBANCE

Preliminary surveys in 2017-18 and 2018-19 demonstrated that Wilson's Storm Petrels nest within the project site. Additional surveys are being undertaken as part of the 2019-20 field season, which will contribute to the understanding of the population estimate for the project site and surrounding areas. Nests were typically located in cavities in terrain with dry soil with boulders, and in higher, north-west slope areas. . Nests from other species are not known to occur within the project site. Construction would affect individual Wilson's Storm Petrels nests within the site and would remove some available habitat for this species; however, this is not anticipated to result in a significant impact to the overall population of this relatively abundant species. Wilson's Storm Petrels are one of the most abundant seabirds in the Antarctic; surveys carried out in 2017-18 and 2018-19 identified Wilson's Storm Petrel nests in all areas surveyed, including Broad Peninsula and islands adjacent to the airstrip, Long and Mule Peninsulas, coastal islands, and Trajer Ridge (AAD, unpublished data).

During construction, there is potential for bird strike on ships, as birds, particularly petrels, are attracted to lighting on the vessels; with appropriate mitigation, this is not anticipated to have a significant impact on species that occur in the area. Similarly, aerodrome approach lights during operation may attract birds. Although the risk of bird strike during ground and aircraft operations at the Davis aerodrome is considered low, it remains a possibility.

Further analysis is required to understand the significance of other potential direct impacts to terrestrial fauna, including:

- Direct impacts on invertebrates and microbial communities within the construction site, and
- Disturbance of seabird, penguin and seal species that may be sensitive to human presence during construction and operation.

As there is uncertainty in the potential for a significant impact on fauna from physical disturbance, a precautionary approach has been applied in this Referral. Further detailed assessment of potential impacts and development of appropriate mitigation would be required through the detailed environmental assessment for the project.

DUST EMISSIONS

As discussed in the sections on *Pollutants, chemicals and toxic substances* and *Impacts on plants*, there is potential for construction activities to generate localised additional dust (to that transported naturally across the Vestfold Hills by aeolian processes).

The closest downwind bird and mammal receptors include:

- Wilsons Storm Petrels, which are known to nest at the aerodrome site and Adams Flat
- Snow Petrels, which may nest within the surrounding areas
- Southern Elephant Seal moulting wallows approximately 2 km south-west of the runway, and on the coast of Adams Flat, and
- Adélie Penguins and the occasional Emperor Penguin, which use the coastline west and south-west of the project during their moult.

Weddell Seals breed on the sea ice approximately 500 m to the west, and upwind 1.2 km to the north and 700 m east of the project site. Seals to the west may be affected by the dust transported by the prevailing north-east winds, with seals to the north and east affected by construction dust on occasion.

With the implementation of dust management practices, dust is not anticipated to have a significant impact on the species listed above, although dust emissions have the potential to reduce the quality of individual sea bird nesting cavities close to construction activities.

Further analysis to understand the quantity and distribution pathways of dust would be undertaken through the detailed environmental assessment for the project.

LAND-BASED NOISE EMISSIONS

Noise during construction would predominantly be generated by earthworks (activities include drilling, blasting, ripping, excavating and hauling) and vehicle movements at the aerodrome site and along the access road, and also from shipping activities and occasional helicopter use. Noise characteristics would vary depending on the activity and the location. Construction noise may result in wildlife disturbance, and further analysis, including noise modelling, is required to understand the significance of potential impacts on fauna.

During operation of the aerodrome, there would be noise and vibration emissions from ground-based aircraft, including taxiing, manoeuvres on the apron, and movements on the runway for take-off and landing. Intracontinental turboprop aircraft currently undertake these activities in the Vestfold Hills at the sea ice landing areas and Davis plateau ski landing area. The location, duration and intensity of these activities would change with the introduction of the Davis aerodrome. Ground-based operational noise from the aerodrome has the potential to cause wildlife disturbance, and further analysis, including noise modelling, is required to understand the significance of that disturbance.

During operation of the aerodrome, noise would also be generated through vehicle movements on the access road between Davis research station and the aerodrome to transport passengers and cargo. Noise emissions associated with these movements are not anticipated to have a significant impact.

As there is uncertainty in the potential for a significant impact on fauna from land-based noise emissions, a precautionary approach has been applied in this Referral. Further detailed assessment of potential impacts and development of appropriate mitigation would be required through the detailed environmental assessment for the project.

AIRCRAFT FLIGHT NOISE EMISSIONS

Aircraft noise emissions during operation would be dependent on a range of factors including engine type, flight stage, aircraft height and prevailing meteorological conditions.

Existing fixed wing and helicopter operations already occur in and around Davis station and the wider Vestfold Hills region, including fjords, and aircraft overfly many of the species mentioned above. The impacts from these existing intracontinental operations on wildlife was assessed in the Initial Environmental Evaluation for Australia's Antarctic Air Transport System 2015-2020 and was considered to have the potential to cause only minor disturbance to breeding colonies of birds or seals. There would be changes to the aircraft noise in the area, in terms of aircraft type, location, frequency and intensity; during operation aircraft noise would be along the approach and departure flight paths to the south-west and north-east of the runway respectively.

Migratory and marine species with known breeding colonies in the area that have the potential to be affected by the change to aircraft operations at Davis aerodrome include Weddell Seals, Adélie Penguins, Southern Giant Petrel, Wilson's Storm Petrel, Snow Petrel, Cape Petrel and South Polar Skua. Non-breeding colonies of Southern Elephant Seals, Crabeater Seals and Leopard Seals are also known to occur in the area. Map 3 shows the known wildlife populations (as at 2013) in the Vestfold Hills.

Preliminary flight paths have been designed with consideration of legislative, technical and environmental constraints. These preliminary flight paths would be used to inform the detailed environmental impact assessment, with finalisation of the flight paths to occur closer to the commencement of aerodrome operations. Environmental considerations, although typically focused on propeller intracontinental aircraft, are listed in Table 4; the restrictions of the ASPA management plans were complied with fully in the preliminary flight path design, with other restrictions applied as far as practicable. Similar to several existing Antarctic runways, it is expected that operation of the Davis aerodrome would be unable to fully adhere to the non-mandatory recommendations outlined in Item 3 below for horizontal and vertical separation from the coastline.

Table 4 Flight guidelines

	Reference	Restriction
1	Hawker Island Management Plan, ASPA 167	Overflight of island is prohibited
2	Marine Plain Management Plan, ASPA 143	Overflight of lakes should be kept to the minimum to achieve scientific or management requirements
3	Antarctic Treaty Resolution 2, 2004. Guidelines for the operation of aircraft near concentrations of birds in Antarctica, ATCM XXVII	Maintain >460 m horizontal separation from wildlife concentrations Maintain >600 m vertical separation from wildlife concentrations Maintain >610 m vertical and 460 m horizontal separation from the coastline Cross coastlines at 90° and >610 m vertical separation
4	Flight path guidelines: Avoiding wildlife in Antarctica, 2016, AAD	Maintain >750 m overall separation (birds and seals)
5	National Airports Safeguarding Framework, Guideline I	In absence of runway specific Public Safety Area, adopt Queensland SPP PSA
6	General principles	Maximise horizontal and vertical separation from wildlife and human habitation

Given the extensive nature of Weddell Seal pupping areas and their proximity to the proposed runway, overflight of some of these areas is unavoidable. Where overflights would be unavoidable, flight paths have been designed to try to overfly the areas of lowest seal pupping density and are designed to provide the shortest possible overflight trajectory. The implementation of these flight paths minimises the spatial extent of potential noise emissions, as aircraft movements would be limited to a defined area.

Impacts on fauna, particularly seals and birds, from aircraft noise in the Antarctic are generally poorly understood. Attempting to predict fauna behavioural responses is particularly difficult as there are many variables to consider including the type of species, its life-cycle stage, terrain hazards and the size, type, distance and profile of the aircraft. Harris (2005) concluded that "there remains insufficient knowledge of the interactions between aircraft and birds in Antarctica, and the consequent impacts on individual birds and on bird populations".

Further analysis, including detailed noise modelling, opportunistic field observations of existing overflights on wildlife and reviewing previous studies, is required to understand the significance of potential aircraft noise impacts on fauna and to develop mitigation measures; this would be undertaken as part of a detailed environmental assessment for the project.

INTRODUCTION OF NON-NATIVE SPECIES

It is anticipated that, with the AAD's extensive experience in biosecurity, the additional risk of introducing non-native species through the pathways described below can be effectively managed and therefore is not anticipated to have a significant impact. While biosecurity risks are relevant to all expeditions to the area, the increased number of ships and personnel, and the amount of cargo, and the use of commercial ships (ice-strengthened bulk carriers), would require additional biosecurity protocols both in Australia and Antarctica.

Potential biosecurity impacts are associated with the transport of personnel, equipment, materials and pre-cast pavers to the site. Microinvertebrates can present the most significant biosecurity threat as they are numerous, difficult to detect, robust and, unlike most potential pests, can survive in the extreme Antarctic conditions. Non-native species have the potential to be introduced through passive entrainment on clothing, boots, equipment, machinery and materials, or animals climbing or building nests in cargo.

Marine non-native species have the potential to be introduced through attachment to vessels (biofouling) and through ballast water exchange. The introduction of invasive marine species through ballast water is avoided through the implementation of *The Practical Guidelines for Ballast Water Exchange in the Antarctic Treaty Area*.

Translocation of endemic invertebrates, and microorganisms within the area also has a potential to introduce species to other local ecosystems. This particularly applies to lake systems, which have unique assemblages based on their age, location and origin. Introduction of invertebrates and microorganisms into lake systems (e.g. through introduction of seawater) may change the local ecosystem.

POLLUTION

Emissions from vehicle and aircraft exhaust, and potential accidental release (and possible subsequent transport in meltwater or dust), has the potential to be inhaled or ingested by animals. The ecotoxicological effects of various contaminants on Antarctic ecology is not well understood, with the type and quantity of contaminant likely to determine the biological effect.

2.7.2.8 IMPACTS ON PEOPLE AND COMMUNITIES

The population of Davis research station would be increased during the construction phase of the project. Typically, the peak of construction personnel, and therefore the Davis research station population, would occur over summer, with reduced personnel over winter. This reflects the current trend in station population changes each year, with the majority of science occurring in summer.

Additional accommodation facilities would be constructed to accommodate 130 people, giving the station a total population capacity of 250. During construction, the accommodation at the station would be used for operational staff, construction personnel and environmental monitoring personnel, in addition to staff required for maintaining existing long-term science and meteorology programs.

There would be very limited capacity at Davis research station for new science projects under the Australian Antarctic Science Program during construction, as the focus of the available station resources (beds etc) would be on supporting personnel associated with the project, including those involved in environmental monitoring. It is anticipated that this would be somewhat counteracted by science projects being undertaken in other areas of interest, such as Macquarie Island, Mawson and Casey research stations and new science capabilities offered by *RSV Nuyina* once fully commissioned. While there would be a restriction in expeditioner accommodation at Davis research station during construction, there would not be a displacement of permanently situated individuals or communities. Following construction, the aerodrome would facilitate an increased level of scientific research in East Antarctica. The environmental assessment would consider the potential impacts of increased access to the area on scientific values, including the capability to conduct scientific research year-round.

The proposed Davis enabling infrastructure include facilities designed to modernise Davis research station as well as support the construction and operation of the aerodrome. These include living quarters, utilities (wastewater treatment plant, water treatment plant, powerhouse, waste), workshop, fuel store, water storage tanks.

It is not anticipated that the project would have a significant impact on people and communities.

AIRCRAFT FLIGHT NOISE EMISSIONS

Overflights from fixed wing and helicopter operations already occur in and around Davis research station (see Section 3.7 for more details) and are considered an important means of supporting the AAP's research and operational activities. There would be infrequent additional noise at Davis research station from intercontinental aircraft operations, which is not likely to affect the health, safety, welfare or quality of life of the Davis population, as accommodation and other facilities at Davis are well-insulated to withstand the Antarctic climate. New facilities developed as part of a longer-term modernisation of Davis research station, independent to the Davis Aerodrome Project, would be designed in consideration of potential aviation noise.

2.7.2.9 IMPACTS ON HERITAGE

There are no heritage features listed on the World Heritage List or National Heritage List. There are two heritage features with an indicative listing on the Commonwealth Heritage List:

- Davis Station Group, Davis Station
- Mikkelsen Cairn, Davis Station (approximately 25 km north-east of the project)

An indicative listing means that no formal nomination has been made; however, information has been provided to or obtained by the Australian Department of Environment and Energy Heritage Branch and has been entered into the heritage database. Further information on the Davis station group indicative listing is provided in Section 3.8.

It is not anticipated that the remaining buildings, structures, sites and objects within the Davis research station limits that are included on the Commonwealth Heritage List indicative listing would be affected by the construction of the project as new infrastructure is likely to be constructed on a new footprint. However, appropriate records (e.g. photos) would be made of potentially affected heritage features.

Law Cairn is the nearest known listed heritage structure to the aerodrome, approximately 300 m from the proposed access road and 1 km north-west of the aerodrome site. Law Cairn is included within the Davis Station group indicative listing on the Commonwealth Heritage List. It would not be disturbed by the project and access to this site would not be required.

Several artefacts were discovered at Camp Lake in the 2017-18 and 2018-19 field seasons, which are likely to be evidence of the second visit to the Vestfold Hills by Australian Antarctic scientist and explorer, Phillip Law, in January 1955. Artefacts discovered include wooden pallet lids, soap and wire, the impression of a tent site, vehicle tracks, and a rock cairn. Separate to this project, these artefacts are being subject to an assessment of heritage significance. In accordance with Guidelines for handling of pre-1958 historic remains (ATS, 2001), these artefacts are given interim protection until the assessment has determined significance and appropriate management arrangements.

The closest artefact is located approximately 100 m from the earthworks buffer and 150 m from the earthworks footprint. It is anticipated that, if required pending the outcome of the external heritage assessment, impacts on these artefacts could be avoided and, therefore, there would be no significant impact on heritage.

2.7.3 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

Impacts on Commonwealth land have the potential to be significant and would be assessed through the detailed environmental impact assessment.

2.8 IS THE PROPOSED ACTION TAKING PLACE IN THE GREAT BARRIER REEF MARINE PARK?

The project is not in the Great Barrier Reef Marine Park.

2.9 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON A WATER RESOURCE RELATED TO COAL/GAS/MINING?

There is an indefinite ban on mining under the Protocol on Environmental Protection to the Antarctic Treaty, which prohibits any activity relating to mineral resources, other than scientific research. The project would not have any direct or indirect impact on a water resource related to coal/gas/mining.

2.10 IS THE PROPOSED ACTION A NUCLEAR ACTION?

The project does not include a nuclear action.

2.11 IS THE PROPOSED ACTION TO BE TAKEN BY THE COMMONWEALTH AGENCY?

The project is proposed to be undertaken by a Commonwealth Agency, the Australian Antarctic Division.

2.11.1 DESCRIBE THE NATURE AND EXTENT OF THE LIKELY IMPACT ON THE WHOLE OF THE ENVIRONMENT.

Refer to response to Section 2.7.

2.11.2 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

Impacts on the whole of the environment have the potential to be significant and would be assessed through the detailed environmental impact assessment.

2.12 IS THE PROPOSED ACTION TO BE UNDERTAKEN IN A COMMONWEALTH HERITAGE PLACE OVERSEAS?

The project is not in a Commonwealth Heritage Place overseas.

2.13 IS THE PROPOSED ACTION LIKELY TO HAVE ANY DIRECT OR INDIRECT IMPACT ON ANY PART OF THE ENVIRONMENT IN THE COMMONWEALTH MARINE AREA?

The project has the potential to have a direct or indirect impact on the Commonwealth marine area.

2.13.1 DESCRIBE THE NATURE AND EXTENT OF THE LIKELY IMPACT ON THE WHOLE OF THE ENVIRONMENT.

Activities in the Commonwealth Marine Area would involve the construction of a new wharf, transport of construction materials, equipment, and personnel during the construction period, carried on bulk cargo vessels as they traverse between Australia and the anchorage point located approximately 1 nm off-shore from Davis research station. These vessels would use existing shipping routes to reach this location.

Once at the anchorage point, as described in Section 1.2, ship-to-shore operations using barges and tug boats would be undertaken to transport cargo and personnel between the ships and the new wharf at Davis research station.

The Commonwealth Marine Area also has the potential to be affected by changed hydrology at the project site.

The potential impacts on the marine environment are described in Section 2.7, Impacts on coastal landscapes and processes (Section 2.7.2.2); Impacts on ocean forms, ocean processes and ocean life (Section 2.7.2.3); Impacts on water resources (Section 2.7.2.4); and Impacts on animals (Section 2.7.2.7).

2.13.2 DO YOU CONSIDER THIS IMPACT TO BE SIGNIFICANT?

Impacts in the Commonwealth marine area have the potential to be significant and would be assessed through the detailed environmental impact assessment.

2.14 UPLOAD ANY TECHNICAL REPORTS RELEVANT TO THE ASSESSMENT OF IMPACTS ON PROTECTED MATTERS THAT SUPPORT THE ARGUMENTS AND CONCLUSIONS IN THE REFERRAL.

The Department of Environment and Energy Protected Matters Search Tool (PMST) was used to whether matters of national environmental significance or other matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* are likely to occur in the area of interest. The PMST report, dated 2 December 2019, is attached in Appendix A.

3.0 DESCRIPTION OF THE PROJECT AREA

3.1 DESCRIBE THE FLORA AND FAUNA RELEVANT TO THE PROJECT AREA.

Antarctic terrestrial ecosystems are isolated with less complex floral and faunal communities than at lower latitudes. The terrestrial ecosystem of the Vestfold Hills has been described as sufficiently young (geologically) and isolated to be species poor (Ferris, 1984). Visible life is predominately confined to lower altitude areas in coastal regions (Klekociuk & Wienecke, 2017) and more than 99 per cent of Antarctica's biodiversity is concentrated in areas that are permanently ice-free. The following sections provide information on the existing environment in the project area. The status and occurrence of fauna relevant to the project area is provided in Table 5. Further descriptions of each species are also provided below. The locations of known wildlife populations are shown on Map 3.

Table 5 Status and occurrence of fauna in the project area

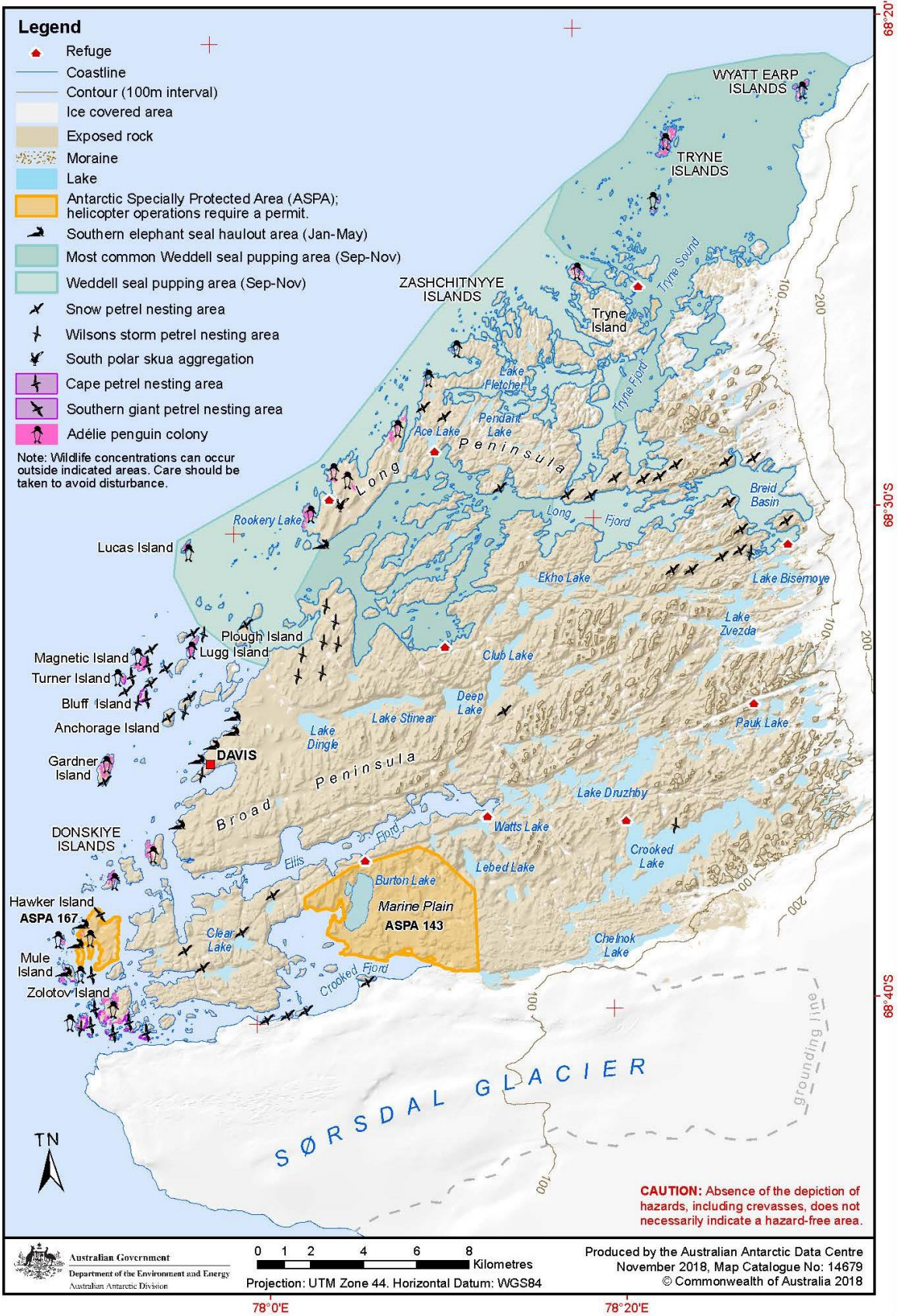
Common name	Scientific name	EPBC Act status	Occurrence
Southern Giant Petrel	*Macronectes giganteus*	Endangered, marine, migratory	Known (breeding)
Adélie Penguin	*Pygoscelis adeliae*	Marine	Known (breeding)
Emperor Penguin	*Aptenodytes forsteri*	N/A	Known (non-breeding)
Wilson's Storm Petrel	*Oceanites oceanicus*	Migratory, marine	Known (breeding)
South Polar Skua	*Catharacta maccormicki*	Migratory, marine	Known (breeding)
Cape Petrel	*Daption capense*	Marine	Known (breeding)
Snow Petrel	*Pagodroma nivea*	Marine	Known (breeding)
Subantarctic Skua (Southern)	*Catharacta lonnbergi lonnbergi*	Marine	Known (non-breeding)
Antarctic Petrel	*Thalassoica Antarctica*	Marine	Known (non-breeding)
Southern Fulmar	*Fulmarus glacialoides*	Marine	Known (non-breeding)
Sei Whale	*Balaenoptera borealis*	Vulnerable, cetacean, migratory	Likely
Blue Whale	*Balaenoptera musculus*	Endangered, cetacean, migratory	Likely
Fin Whale	*Balaenoptera physalus*	Vulnerable, cetacean, migratory	Likely
Southern Right Whale	*Eubalaena australis*	Endangered, cetacean, migratory	Likely
Humpback Whale	*Megaptera novaeangliae*	Vulnerable, cetacean, migratory	Likely
Antarctic Minke Whale	*Balaenoptera bonaerensis*	Cetacean, Migratory	Likely
Killer Whale (Orca)	*Orcinus orca*	Cetacean, Migratory	Likely
Southern Bottlenose Whale	*Hyperoodon planifrons*	Cetacean	Likely
Sperm Whale	*Physeter macrocephalus*	Cetacean, Migratory	Likely
Southern Elephant Seal	*Mirounga leonina*	Vulnerable, marine	Known (non-breeding)
Weddell Seal	*Leptonychotes weddellii*	Marine	Known (breeding)
Crabeater Seal	*Lobodon carcinophagus*	Marine	Known (non-breeding)
Leopard Seal	*Hydrurga leptonyx*	Marine	Known (non-breeding)

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

Map 3 Vestfold Hills wildlife (2013)

Vestfold Hills and Davis - main wildlife concentrations



3.1.1 BIRDS

Birds that use ice-free areas in East Antarctica for nesting include Adélie Penguins (*Pygoscelis adeliae),* and flying seabirds such as Cape Petrels (*Daption capense*), Southern Giant Petrels (*Macronectes giganteus*), Snow Petrels *(Pagodroma nivea),* Wilson's Storm Petrels *(Oceanites oceanicus)*, Antarctic Petrels *(Thalassoica antarctica)* and South Polar Skuas *(Catharacta maccormicki)*. Adélie Penguins breed along the coast of the Vestfold Hills region and on offshore islands, while Emperor Penguins *(Aptenodytes forsteri)* have only ever been observed transiting through the hills using occasional moulting sites. Wilson's Storm Petrel nest within the aerodrome site and adjacent to the coast at Adams Flat. Snow Petrels and South Polar Skuas may possibly nest within the area surrounding the aerodrome site. The sea bird breeding season typically occurs from October to March for most species, but can extend into April for some. Bird species that regularly occur in the area, including listed species are described below. The locations of known bird populations are shown on Map 3.

ADÉLIE PENGUIN

Adélie Penguins *(Pygoscelis adeliae)* breed along the Vestfold Hills coastline and on 27 offshore islands from the Vestfold Hills, including Hawker Island, Kazak Island, Gardner Island, Magnetic Island and Tryne Islands. Approximately 50% of breeding age Adélie Penguins within the Vestfold Hills occur within 10 km of the aerodrome site. The total global population of Adélie Penguins is estimated to be 14 to 16 million birds, of which approximately 9.5 million are breeding age (Southwell, et al., 2017). The species is listed as 'least concern' by the IUCN due to its large range and large, stable population.

Along the Vestfold Hills coastline and on offshore islands, eight breeding sites for the Adélie Penguin have been identified as important bird areas (IBA, as listed below) (Harris, et al., 2015). The IBA programme was originally established by BirdLife International more than 35 years ago to provide a means of identifying sites of international conservation significance for the world's birds. The IBA sites include the Donskiye and Gardner Islands where approximately 188,000 breeding age birds are located (Southwell, et al., 2017). On the western edge of Long Peninsula, the Rookery Lake/West Long Peninsula colony contains more than 1% of the global population of Adélie Penguins (>90,000 breeding birds) (Harris, et al., 2015). There is also an Adélie Penguin colony on Hawker Island; this colony is currently located near a small hill midway on the western side of the island and is estimated to be home to 5,000 pairs in 2009-10 (ATS, 2016), below the trigger criteria for IBA for the Adélie penguin. Adélie Penguins usually appear at Vestfold Hills offshore breeding sites in mid-October with two eggs laid, up to four days apart, in November. Moulted adults typically depart the area by the end of March (ATS, 2016).

Local operational activities, with particular reference to oil spills and aircraft operations, have been identified as potential concerns for the conservation of wildlife at IBA sites 133 to 136 (Harris, et al., 2015).

The IBA sites in the Vestfold Hills are:

- IBA132 - Kazak Island/Zolotov Island: Trigger - Adélie Penguin (Criteria A4iii)
- IBA133 - Unnamed island at Donskiye Islands: Trigger - Adélie Penguin (Criteria A4iii)
- IBA134 - Warriner Island, Donskiye Islands: Trigger - Adélie Penguin (Criteria A4iii)
- IBA135 - Gardner Island: Trigger - Adélie Penguin (Criteria A4iii)
- IBA136 - Magnetic Island and nearby islands: Trigger - Adélie Penguin (Criteria A4iii)
- IBA137 - Lucas Island: Trigger - Adélie Penguin (Criteria A4iii)
- IBA138 - Rookery Lake/West Long Peninsula: Trigger - Adélie Penguin (Criteria A1, A4ii, A4iii)
- IBA139 - Tryne Islands: Trigger - Adélie Penguin (Criteria A4iii)

EMPEROR PENGUIN

There are no known Emperor Penguin *(Aptenodytes forsteri)* breeding colonies near the project area (BirdLife International, 2018a); however, individuals have been recorded visiting the Vestfold Hills. The closest breeding colony is Amanda Bay, located approximately 90 km west of Davis research station.

The global population is estimated at 238,000 breeding pairs (Fretwell, et al., 2012). The species is listed as Near Threatened by the IUCN, as the population is projected to undergo a moderately rapid decline over the next three generations owing to the predicted effects of climate change (BirdLife International, 2018a). Emperor Penguins prey on fish, krill and squid, diving at average depths of 150 m to 200 m (AADC, 2018). Emperor Penguins breed during the Antarctic winter, the only warm-blooded animal that does so (AADC, 2018).

SOUTHERN GIANT PETREL

The Southern Giant Petrel (*Macronectes giganteus*) is listed as 'endangered' under the EPBC Act Threatened Species List, as well as a designated 'marine' and 'migratory' species. The species is included in the *National Recovery Plan for threatened albatrosses and giant petrels 2011-2016*. The Plan identifies a range of threats to albatross and petrel species, such as incidental catch resulting from fishing operations and competition with fisheries for marine resources, which are not related to the threats arising from this project. In addition to the National Recovery Plan, there are a number of Threat Abatement Plans which describe broad threats to the Southern Giant Petrel:

- Threat abatement plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (2018)
- Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018)
- Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares (2009).

The Plan for fishing operations is not relevant to this project. Marine debris and the introduction of non-native species would be avoided by the project, and the development and implementation of appropriate project-specific mitigation measures for these matters would consider the relevant threat abatement plan.

The global population size of the Southern Giant Petrel is estimated, with low reliability, to consist of 47,800 to 54,000 pairs (BirdLife International, 2019). The total population of Southern Giant Petrels in East Antarctica represents less than one per cent of the global breeding population (ATS, 2016). A breeding colony of Southern Giant Petrel is known to inhabit Hawker Island (designated as an ASPA, primarily to protect this colony, refer Section 3.4). Approximately 10 % (~30 breeding pairs) of the known East Antarctic population is located at Hawker Island, which is the southernmost breeding location of this species and is the only breeding colony below the Antarctic Circle.

The breeding season for Southern Giant Petrel on Hawker Island is mid-August to mid-April. Eggs are laid during the second half of October and hatching occurs from mid-December to mid-January. Fledglings then leave the colony between mid-late April (Otovic, et al., 2018). In the southern Antarctic zone, Southern Giant Petrels nests in exposed snow- and ice-free coastal areas, open gravel areas rocky bluffs, outcrops, ridges, slopes, mounds, raised beaches, open flats, edges of plateaux or offshore rocks from five to 120 m above sea level, and often nest near a steep drop or on slope (DoEE, 2019). The foraging distribution of the species is unknown but is considered likely to remain in the wider region, with females tending to feed in open seas while males tend to feed locally.

The Management Plan for Hawker Island prohibits overflights of the island except where essential for scientific or management purposes and authorised by a permit (ATS, 2016). During the Southern Giant Petrel breeding season additional permit requirements apply.

WILSON'S STORM PETREL

The global population of Wilson's Storm Petrel *(Oceanites oceanicus)* is estimated to be in the order of 12 million to 30 million birds and is considered stable (DoEE, 2018g). There are an estimated 40,000 – 240,000 breeding birds present in the Vestfold Hills (AAD, unpublished data). Wilson's Storm Petrels are a designated 'marine' and 'migratory' species under the EPBC Act.

Preliminary surveys in 2017-18 and 2018-19 demonstrated that Wilson's Storm Petrels nest within the project site. Additional surveys are being undertaken as part of the 2019-20 field season, which will contribute to the understanding of the population estimate for the project site and surrounding areas. The species is also known to occur sporadically in the Marine Plain ASPA between November and February (ATS, 2013).

The breeding season is from November to May, with the species typically spending the non-breeding season in the northern hemisphere (DoEE, 2018g). Wilson's Storm Petrels nest in snow and ice-free areas, and use cliffs, scree slopes, moraines, rocky headlands, hills, and broken or boulder-strewn low-lying ground, fissures or crevices.

Habitat loss or modification and human disturbance around Antarctic scientific bases are recognised as a potential threat to the species (DoEE, 2018g).

CAPE PETREL

A small breeding colony of approximately 10 pairs (AAD, unpublished data) of Cape Petrels *(Daption capense)* has been recorded on Hawker Island on the southern tip of the south western peninsula (ATS, 2016). Approximately 660, 179 and 54 breeding pairs of Cape Petrel were recorded on Bluff, Turner and Magnetic Islands, respectively, during a census in 2017/18 (AAD, unpublished data). The approximately 1,500-2,000 breeding pairs in the Vestfold Hills (AAD, unpublished data) is less than 0.2% of the estimated 2 million individuals globally (Brooke, 2004), although there is some uncertainty regarding the global estimate.

Cape petrels are a designated 'marine' species under the EPBC Act. They are absent from their breeding colonies in winter. They begin visiting their breeding colonies in August-September and return to nesting sites during October. Cape Petrels lay eggs from late November to early December and chicks fledge in late February and early March (ATS, 2016).

SNOW PETREL

Population estimates of Snow Petrel *(Pagodroma nivea)*, both globally (over four million individuals) (Brooke, 2004) and in the Vestfold Hills (60,000 to 220,000 individuals) (AAD, unpublished data), are uncertain. There are no Snow Petrels known to be breeding within the aerodrome site; however, several thousand breeding birds are located on the islands immediately west, and north on Long Peninsula. Several breeding Snow Petrel colonies are known to occur on offshore islands, including Gardner Island, Turner Island, Lugg Island and several of the unnamed smaller islands in the Magnetic Group (Harris, et al., 2015). Other colonies are located on Anchorage Island and Plough Island. Snow Petrels are also known to occur sporadically within the Marine Plain ASPA area between November and February (ATS, 2013).

Snow Petrels are a designated 'marine' species under the EPBC Act. Nesting occurs in colonies on cliff sites near the sea and inland in November, with chicks fledging in late February to mid-May. During the winter months, Snow Petrels disperse to pack ice, ice floes and adjacent Antarctic seas.

SOUTH POLAR SKUA

The global population of South Polar Skua *(Catharacta maccormicki)* is estimated, with low confidence, to be between 10,000 and 20,000 individuals (BirdLife International, 2018b), of which approximately 50 to 150 breeding pairs are estimated to be in the Vestfold Hills (AAD, unpublished data). South Polar Skuas are a designated 'marine' and 'migratory' species under the EPBC Act.

Observations at Davis research station indicate that 10 non-breeding individuals are often observed at Station Beach, and that the aerodrome site is a possible breeding location for less than 10 individuals. Hawker Island supports breeding colonies of South Polar Skua (ATS, 2016). A non-breeding colony of South Polar Skua is located on Long Peninsula and the species is known to nest on the Marine Plain and occasionally around the water's edge. Surveys undertaken in the 2018-19 field season identified a breeding area, containing 32 breeding pairs, near Rookery Lake on Long Peninsula close to an Adélie Penguin breeding colony (AAD, unpublished data). These surveys also identified four significant non-breeding aggregations sites, two in the Rookery Lake area, one at Heidemann Bay, and one at Adam's Flat (AAD, unpublished data). South Polar Skua begin visiting their breeding colonies in October and lay eggs in November. The chicks fledge in February and the last adults leave the colonies in the second half of April (Johnstone, et al., 1973).

ANTARCTIC PETREL

Antarctic Petrels *(Thalassoica Antarctica)* are found in open water with scattered icebergs, ice floes and in open pack ice. Antarctic petrels are infrequent visitors to the Vestfold Hills in the summer months (ATS, 2016). The estimated global population is between 10 to 20 million individuals (BirdLife International, 2018d). Antarctic petrels are a designated 'marine' species under the EPBC Act.

SUBANTARCTIC SKUA (SOUTHERN)

The populations of Subantarctic Skua (Southern) *(Catharacta lonnbergi lonnbergi)* within Australian jurisdiction only breed at two locations, Heard Island and Macquarie Island, from the coast up to several kilometres inland (DoEE, 2018j). A small number of individuals (<5) have been observed at sea in the Vestfold Hills region (approximately 15 km from Davis research station) in the past. The species is generally migratory and during the winter months, breeding localities are largely abandoned. The Subantarctic Skua (Southern) relies on penguin and seal colonies for food, and nests are generally located close to these colonies (DoEE, 2018j).

SOUTHERN FULMAR

The global population of Southern Fulmar *(Fulmarus glacialoides)* is estimated to be 4 million individuals (Brooke, 2004), occupying a range throughout the Southern Ocean (BirdLife International, 2018c). Breeding occurs from November, on rocky slopes and precipitous cliffs (BirdLife International, 2018c).

Southern fulmars are infrequent visitors to the Vestfold Hills in the summer months (ATS, 2016). There are no records of breeding near Davis research station, with the closest known breeding sites in the Rauer Group (Antarctic Division, 2006). Southern Fulmars are a designated 'marine' species under the EPBC Act.

3.1.2 CETACEANS

The PMST Report identified five cetaceans listed as both threatened and migratory under the EPBC Act (refer Section 2.4). Three additional cetaceans, which are not threatened, are also listed as migratory species. Southern Bottlenose Whales, which are not listed as threatened or migratory, may also be present. Knowledge of whale occurrence in the nearshore environment is scant, however Orcas and Minke whales are known to inhabit inshore waters and have been sighted close to Davis Station. Descriptions of each of these species are included below.

SEI WHALE

The Sei Whale (*Balaenoptera borealis*) is listed as 'vulnerable' in the EPBC Act Threatened Species List, as well as a designated 'migratory' species. The movements and distributions of Sei Whales are unpredictable and not well documented; however, it is thought that the species has the same general pattern of migration as most other baleen whales, although limited to lower latitudes. They feed mostly between the Antarctic and subtropical convergences on a mixture of copepods, amphipods and Antarctic krill (*Euphausia superba*). The Australian Antarctic waters are considered important feeding grounds for Sei Whales (DoEE, 2018b). Breeding occurs in tropical and subtropical areas. The *Action Plan for Australian Mammals* (2012) identifies climate variability and whaling as threats to the species.

ANTARCTIC BLUE WHALE

The Antarctic Blue Whale (*Balaenoptera musculus*) is listed as 'endangered' in the EPBC Act Threatened Species List, as well as a designated 'migratory' species. Antarctic Blue Whales are thought to generally migrate to Antarctic waters in early summer and migrate to lower latitudes for feeding, breeding and calving in autumn. However, Blue Whale calls have been detected year-round, suggesting some individuals may be present during winter (DoEE, 2018c).

Worldwide, the Blue Whale is rare and the distribution of the species is not fully understood. The global population of Antarctic Blue Whales is estimated at 2,280 individuals (Branch, 2007). Sightings are very rare and observations are typically linked with the sea ice edge, a zone of high krill abundance and high plankton production. In Antarctic waters, the Blue Whale feeds on krill species *E. superba* and *E. crystallorophias* and has also been known to feed on fish and squid. The *Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999* (2012) identifies whaling, climate variability, noise interference and vessel disturbance as threats to the species.

FIN WHALE

The Fin Whale (*Balaenoptera physalus*) is listed as 'vulnerable' in the EPBC Act Threatened Species List, as well as a designated 'migratory' species. Fin Whales are a cosmopolitan species ranging from polar to tropical waters. Most populations undertake annual long-distance migrations between polar feeding grounds and temperate breeding grounds. The Australian Antarctic waters are considered important feeding grounds for the species, where they primarily feed on krill (*E. superba*). In the Antarctic, this species is often found in areas of complex and steep bathymetry, such as deep ravines where fish and other prey species are also known to concentrate. They are generally found to the north of the pack ice. *The Action Plan for Australian Mammals* (2012) identifies climate variability, resource depletion and whaling as threats to the species.

SOUTHERN RIGHT WHALE

The Southern Right Whale (*Eubalaena australis*) is listed as 'endangered' in the EPBC Act Threatened Species List, as well as a designated 'migratory' species. Southern Right Whales are distributed in the southern hemisphere generally between 20°S and 60°S. They migrate annually between high latitude feeding grounds in the austral summer and mid to lower latitude calving grounds in the austral winter and early-mid spring. The feeding habitat of Southern Right Whales is very poorly known and there have been no dedicated studies in feeding areas. The main feeding areas are thought to occur between 40°S and 55°S. Southern Right Whales exhibit a latitudinal variation in diet, preying primarily on krill (euphausiids) south of 50° S in Antarctic waters (DoEE, 2018d).

The *Southern Right Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999* (2011) identifies whaling, climate variability, noise interference and vessel disturbance as threats to the species.

HUMPBACK WHALE

The Humpback Whale (*Megaptera novaeangliae*) is listed as 'vulnerable' in the EPBC Act Threatened Species List, as well as a designated 'migratory' species. The Humpback Whale population that inhabits the Antarctic waters in the Prydz Bay region is Breeding Stock D (BSD), one of 15 distinct Humpback Whale populations recognised globally (DoEE, 2018f). This population migrates annually between summer feeding grounds in Antarctica and winter tropical breeding grounds off the Western Australian coast. The exact timing of the migration varies annually depending on water temperature, sea ice, predation risk, prey abundance and the location of the feeding ground. The most recent estimate for the BSD population, ~30,000 individuals, was determined in 2008 (Hedley, et al., 2011) (Salgado Kent, et al., 2012). The population is increasing at over 12% each year (Hedley, et al., 2011) (Salgado Kent, et al., 2012).

Humpback Whale feeding primarily occurs in summer in Antarctic waters south of about 55°S with krill (*E. superba*) forming the major part of their diet. Feeding appears to be related to krill density rather than bathymetric features, and peaks in mid-January to February (DoEE, 2018f). The BSD population feeds between 70°E and 130°E (Chittleborough, 1965). The *Conservation Advice Megaptera novaeangliae humpback whale'*, identifies whaling, climate variability, noise interference, habitat degradation and vessel disturbance as threats to the species.

ANTARCTIC MINKE WHALE

The Antarctic Minke Whale *(Balaenoptera bonaerensis)* is a designated 'migratory' cetacean species in the EPBC Act. Antarctic Minke Whales are found throughout the Southern Hemisphere from 55°S to the Antarctic ice edge during the austral summer. Individuals have been recorded to over-winter in the Antarctic; however, most retreat to sub-tropical to tropical breeding grounds. The population in the southern hemisphere is estimated to be approximately 515,000 individuals (IWC, 2019). Mature Antarctic Minke Whales feed primarily on the Antarctic Krill (*E. superba*), although some smaller krill species (*E. spinifera* and *E. crystallorophias*) and occasional copepods are also consumed (DoEE, 2018a). Whaling, pollution and vessel disturbance are considered to be threats to the species (DoEE, 2018a).

KILLER WHALE (ORCA)

The Killer Whale *(Orcinus orca)* is a designated 'migratory' cetacean species in the EPBC Act. Three different 'ecotypes' of Killer Whale have been described in the Antarctic (DoEE, 2018h). Type A occurs mainly offshore and preys on Minke Whales. Type B inhabits inshore waters, pack ice and the Antarctic Peninsula Area, and preys on seals. Type C inhabits inshore waters of East Antarctica and is thought to feed primarily on Antarctic Toothfish. The most recent combined population estimate is 80,400 individuals south of the Antarctic convergence (DoEE, 2018h).

Current evidence suggests that Type A is probably migratory, moving to Antarctica during the southern summer to prey on Antarctic Minke Whale, then moving back to lower latitudes during the southern winters. Less is known about the movements of Types B and C; however, these types have been frequently observed in nearshore environments (Kelly, et al., 2009).

The diet of Killer Whales varies seasonally and regionally, and may include fish, squid, dolphins, whales, dugongs and sea lions. Threats to Killer Whales include pollution, targeted hunting and illegal killing, and interactions with fisheries, including the potential for incidental capture (DoEE, 2018h).

SPERM WHALE

The Sperm Whale *(Physeter macrocephalus)* is a designated 'migratory' cetacean species in the EPBC Act. The Sperm Whale is a cosmopolitan species, occurring in all oceans and seas, ranging from the equator to the polar pack-ice. Approximately 3,200 to14,000 Sperm Whale individuals are estimated in Antarctic waters, south of 60°S. The majority of these individuals are thought to be mature males, with females and young males restricted to warmer waters, generally north of approximately 45°S (DoEE, 2018i). Sperm Whales typically inhabit deep offshore areas and are uncommon in waters less than 300 m deep. The species typically feeds at depth on oceanic cephalopods, primarily large and medium sized squid. Potential threats to the species are considered to include vessel collision, seismic operations, entanglement in fishing gear, whaling, pollution, and disturbance by loud or unfamiliar noise (DoEE, 2018i).

SOUTHERN BOTTLENOSE WHALE

Southern Bottlenose Whales (*Hyperoodon planifrons*) have a circumglobal distribution in the Southern Hemisphere, from 29°S to the edge of the polar pack ice. The species is seldom observed over continental shelves but is common in deep oceanic waters. There are no estimates of population size, although Southern Bottlenose Whales are not considered abundant as sightings and strandings are rare (DoEE, 2018e). Prey, recorded in stomachs of the species in Antarctic waters, includes squid and some krill (*E. superba*). Potential threats to the species are considered to include entanglement in nets, competition for prey by commercial fisheries, and pollution (DoEE, 2018e).

3.1.3 SEALS

Under the EPBC Act all seals and sea lions occurring within Australian waters are listed as marine species. Four seal species are found locally:

- Southern Elephant Seals (*Mirounga leonina*) which is a summer visitor. *M. leonina* moulting wallows are located at Davis station and Old Wallow. Other wallows have been documented between Davis research station and Law Cairn, however the current occupancy of these wallows is not well documented. *M. leonina* is listed under the EPBC Act as Vulnerable
- Weddell Seals (*Leptonychotes weddellii*) which breed in Tryne and Long Fjords. *L. weddellii* are common in Long Fjord during the summer (in particular at Weddell Arm and Shirokaya Bay).
- Crabeater Seals (*Lobodon carcinophagus*) which have been sighted off shore of Davis research stations on ice floes, but do not breed there.
- Leopard Seals (*Hydrurga leptonyx*) which are a summer predator. Leopard Seals have been observed throughout the area, and in particular near penguin colonies.

The locations of known seal haul out and pupping areas are shown on Map 3 and are described below.

WEDDELL SEALS

The global population estimate of Weddell Seals *(Leptonychotes weddellii)* is estimated at between 200,000 and 1 million individuals (Hückstädt, 2015). The population in the Vestfold Hills is estimated at approximately 200 to 300 breeding females (AAD, unpublished data). They are a coastal ice-specialist, breeding on the fast ice attached to the Antarctic continent and inhabiting nearby pack-ice close to the coast.

Weddell Seals breed in the fjords of the Vestfold Hills and occasionally near the south-east part of Hawker Island (ATS, 2016). It is estimated that 41% of pups born in Prydz Bay are born in the Vestfold Hills area (Green, et al., 1995), with approximately 50% of the Vestfold Hills Weddell Seal population located in Long Fjord (AAD, unpublished data).

Weddell Seals typically haul out onto the ice from late September, with pupping occurring from mid-October until late November. Throughout summer (December-March), moulting Weddell Seals continue to frequent stable fast ice and occasionally haul out onto land (ATS, 2016).

Adult Weddell Seals display strong site fidelity, with both males and females returning to the same general breeding areas (Hückstädt, 2015); however, there can be some variation in specific breeding location from year-to-year depending on the sea ice conditions.

SOUTHERN ELEPHANT SEALS

Southern Elephant Seals (*Mirounga leonina)* are listed under the EPBC Act as Vulnerable and Least Concern by the IUCN, with a population of approximately 740,000 individuals. This population is thought to be stable, or slightly increasing (McMahon, et al., 2005).

It is estimated that there are approximately 800 to 1,000 males in East Antarctica. Male Southern Elephant Seals haul out onto land in only two locations in East Antarctica: Vincennes Bay, Wilkes Land in the Casey area (~500 male seals) and the Vestfold Hills, Princess Elizabeth Land near Davis research station (~300 male seals).

In the Vestfold Hills, non-breeding groups of Southern Elephant Seals, mostly males, haul out during the summer months to undertake their annual moult. Moulting is carried out at specific wallows, located at 14 sites along the coast and nearby islands on the western edge of the Vestfold Hills (Johnstone, et al., 1973). These wallows include locations near the south-western peninsula on Hawker Island (~50 to 100 males) (ATS, 2016), and at the western end of Broad Peninsula (near Davis research station, also known as Station Beach) (100 to 150 males) (Harris, et al., 2015). The Southern Elephant Seals moulting in East Antarctica originate from Heard and Kerguelen Islands.

Southern Elephant Seals are predominantly marine and spend most of their time at sea foraging (Hofmeyr, 2015). Adult males feed on benthic prey at higher latitudes, including the Antarctic continental shelf, while juvenile males typically feed in the pack ice (TSSC, 2016).

CRABEATER SEALS

Crabeater seals *(Lobodon carcinophagus)* are considered as one of the most abundant pinnipeds on the globe, with millions inhabiting the Antarctic. They have a circumpolar distribution, spending their entire lives in the pack-ice zone (Perrin, et al., 2009). Small numbers of Crabeater Seals have been sighted offshore from Davis research stations on ice floes, and coastal areas, but do not breed there. The species breeds and pups in the pack ice (Antarctic Division, 2006).

LEOPARD SEALS

Leopard seals *(Hydrurga leptonyx*) have a circumpolar distribution ranging from Antarctic to sub-Antarctic waters. Small numbers of Leopard Seals have been sighted offshore of Davis research stations on ice floes, but do not breed there. The species breeds and pups in the pack ice (Antarctic Division, 2006). Leopard Seals have been observed throughout the area, particularly near penguin colonies.

3.1.4 TERRESTRIAL INVERTEBRATES AND MICROBIAL COMMUNITIES

Studies have found that many of the terrestrial invertebrates found in Antarctica are endemic, and in some cases endemic to particular ice-free regions. Although the species richness of insects is low in Antarctica, invertebrates are relatively well represented.

The Vestfold Hills belong to a biogeographic region of high invertebrate diversity including mites, tardigrades, nematodes and rotifers. Abundance of invertebrates in the Vestfold Hills has been found to be lower when compared to sites sampled in the Windmill Islands (near Casey research station). There is some evidence that some sites at the aerodrome site have a higher abundance of nematodes and tardigrades compared to the other Vestfold Hills sites; however, there is considerable uncertainty around this. The mite species *Nanorchestes antarcticus*, *N. bellus* and *Tydeus erebus*, are found scattered throughout the Vestfold Hills and are likely to be present at the aerodrome site.

Microbial communities include cyanobacteria, bacteria, and protozoa. Bacterial communities at the aerodrome site are largely dominated by Actinobacteria and Proteobacteria, similar in composition to four other Vestfold Hills sites (Adams Flat, Heidemann Valley, Rookery Lake, and Old Wallow) (Zhang & Ferrari, 2018). Similar to invertebrates, species identified in the Vestfold Hills have lower taxonomic richness than the Windmill Island (Casey region) sites.

Recent studies have proposed that microbial communities at Adams Flat, between Davis research station and the aerodrome site, have the ability to conserve energy through the oxidation of the atmospheric trace gases hydrogen and carbon monoxide (Ji, et al., 2017). This specialisation allows the microorganisms to live in dormant states, with metabolic energy directed towards cell maintenance rather than growth, in the extreme Antarctic environment (Ji, et al., 2017). It is possible that these communities are also present at the aerodrome site.

3.1.5 MARINE MICROORGANISMS

Four main types of marine microorganisms are likely to be present in the project area (AAD, 2014):

- Algae (phytoplankton), which are single celled drifting plants
- Protozoa (zooplankton), which are single celled drifting animals
- Bacteria
- Viruses, which are biological agents in seawater that infect phytoplankton, protozoa and bacteria.

3.1.6 MARINE PELAGIC INVERTEBRATES

Within the marine pelagic zone approximately 85 species of free-swimming, open-ocean crustaceans (known as krill or 'euphausiids') occur in the Southern Ocean, of which five species are found in Antarctic waters. The most dominant krill species in these waters is the Antarctic krill (*Euphausia superba*). *E. superba* are mainly herbivorous, feeding mostly on phytoplankton and, to a lesser extent, zooplankton. In winter, the species also use additional food sources including algal growth on the underside of pack ice and detritus on the sea-floor. *E. superba* aggregate in schools or swarms, in densities as high as 30,000 individuals per cubic metre. Female *E. superba* lay up to 10,000 eggs at a time, sometimes several times a season (AAD, 2018a). Most of the larger Antarctic animals, including seals, whales, seabirds, fish and squid, feed on *E. superba*, ice krill (*E. crystallorophias*) and *E. spinifera,* and as such krill is an important base for food webs in the region.

3.1.7 MARINE BENTHOS

Benthic marine ecology in the broader Vestfold Hills area is diverse and several surveys have been carried out since 1982. A variety of benthic marine communities exist at the Davis anchorage and in the broader marine environment offshore of the Vestfold Hills, as discussed below.

WEST BAY

Photoquadrat surveys undertaken in 2010 classified the benthic communities offshore of West Bay as an infaunal dominant basin. This biotype includes assemblages found under ice in sedimentary, muddy basins, where there is a very thick layer of diatoms forming an almost continuous mat, and a range of infaunal and epifaunal invertebrates including *Laternula*, *Abatus*, *Pennatulacea* (sea pens) and mobile gastropods, asteroids, ophuroids, holthurians, and ascidians.

A 2018-19 field survey by remote operated vehicles (ROV) identified this location as a flat sediment plain, mostly covered in diatoms with little to no epifauna, sea pens were recorded at low densities, as well as patches of sponges, ascidians and holothurians concentrated on small rocks. These surveys reinforced the heterogeneity of the West Bay region in regard to the presence and distribution of benthic communities.

DAVIS RESEARCH STATION

Photoquadrat surveys undertaken in 2010 classified the benthic communities offshore from Davis research station into three biotypes (or a combination of the following):

- Algae 1/boulder: Dominated by red macroalgae which occur in dense patches. Some invertebrates and overall moderate biological cover. Occurs in shallow water (<10 m) with mixed substrate of sand, boulders and cobbles. Found generally in shallow embayments and between islands and bedrock outcrops close to shore
- Algae 2/bedrock-slope: Dominated by a mixed assemblage of brown and red macroalgae, with a variety of invertebrates on the seabed in the understory. Biological cover is moderate to high. Occurs on shallow (generally < 20 m) gently sloping bedrock or the tops of outcrops, as well as on exposed bedrock in areas of pediment and embayments.
- Barren plains: Very few obvious taxa, predominantly mobile invertebrates such as occasional gastropods, asteroids or ophuroids. Low biological cover and low diversity. Macroalgae fragments common. Occurs on shallow (<20 m) flat plains and consists of sandy substrate, with pebbles in some areas. Possibly areas of high currents.

DAVIS ANCHORAGE

Surveys of the sea floor surrounding the anchorage area (currently used for annual resupply vessels) are limited and consist of samples taken at four nearby sites, including a survey in the 2009-10 season (three sites) and a survey in 1982 (one site). Surveys of the anchorage site itself have not yet been undertaken, and are required to determine the presence and abundance of species at the site. The anchorage area is a sedimentary basin consisting of fine grained muddy to sandy sediments. The existing surveys indicate diverse communities of marine benthic invertebrates, of which some notable features include:

- High densities of sea pens (*Pennatulacea),* which have not been observed elsewhere in the Vestfold Hills marine ecosystem
- High densities of the giant isopod *Glyptanotus antarcticus*, which have been observed in low densities at other Vestfold Hills locations
- A range of sea stars (*Asteroidea*), including *Diplasterias brucei*
- Giant nemertean worms *Parborlasia corrugatus*
- Communities of infaunal (sediment dwelling) macroinvertebrates including high densities of crustaceans (amphipods, isopods, ostracods, tanaids), polychaete worms and a range of other phyla
- High densities of the large burrowing bivalve *Laternula eliptica*.

LONG AND ELLIS FJORDS

Fjords are very rare in Antarctica and mainly found on the Antarctic Peninsula, but the Vestfold Hills have a unique concentration of fjords.

Extensive living reefs formed by the tube building worm *Serpula narconensis* have only been found in two locations in Antarctica; in Ellis Fjord (>8 km long) in the Vestfold Hills (Kirkwood & Burton, 1988) and in deep water on the South Georgia Shelf (Ramos & San Martin, 1999).

Surveys carried out in 2010 around Long Fjord revealed a high degree of biodiversity and habitat heterogeneity. Polychaete reefs have been found in the mouth of Long Fjord and it is suspected that they may also be very extensive. Preliminary photoquadrat surveys have revealed a high degree of biodiversity associated with the polychaete reefs, with a host of different marine invertebrates living in and on them, as well as providing habitat to many fish.

HEAD OF HEIDEMANN BAY

At the head of the bay is an area of intertidal mud flat, a habitat which is extremely rare in Antarctica and has not been previously described. It consists of sandy sediments and boulders, with a diverse community of macroalgae (seaweed) and associated invertebrates.

3.1.8 TERRESTRIAL FLORA

The ice-free areas of Antarctica support sparse vegetation, as vegetation must contend with temperatures below zero for months, low availability of water, poor nutrient status of such soils as exist, sand and ice abrasion and a saline environment. Vegetation at the site is limited to algae and lichens.

The PMST Report did not identify any threatened flora or threatened ecological communities within the area of interest. No vegetation identified at the site is listed under the EPBC Act (or other act) as threatened.

The species richness of vascular plants is low in Antarctica; however, plants such as mosses and lichens are relatively well represented (Klekociuk & Wienecke, 2017). Terrestrial flora in the Vestfold Hills is generally representative of other regions of continental Antarctica and is not considered to be unique (Seppelt & Broady, 1988), although further survey is required to confirm that vegetation within the project footprint is distributed across the broader area. At least 82 species of terrestrial algae, six moss species and at least 23 lichen species have been recorded in the Vestfold Hills (Antarctic Division, 2006), distributed chiefly in the eastern and inland Vestfold Hills area (Seppelt & Broady, 1988). Most of the Vestfold Hills with an elevation of less than 9.5 m has been directly affected by salt and salt-sensitive flora, including lichens and mosses, are sparse or absent in this area. Mosses are noticeably absent in the western part (i.e. the project area) of the Vestfold Hills (AAD, 2018b) and there have been no observations of mosses at the project site.

ALGAE

Visible vegetation appears to be uncommon on the aerodrome site, although sublithic algae occurs in sheltered moist areas under quartz stones. The Vestfold Hills, including the aerodrome site, is also home to a range of endolithic algae (algae that lives underneath or in the interstices of rocks. The composition and richness of these communities are currently not well known (Friedmann & Campo, 1976). Earlier studies suggested that Chasmoendolithic algae was likely to be present in rock fissures and cracks in the area (Seppelt & Broady, 1988), and searches in 2018 confirmed their presence in the project area. Endolithic, green algae was detected under 67 quartz rocks along the aerodrome site and additional plants recorded along Dingle Rd in the 2018/19 surveys.

Epilithic algae are found in most areas that have surface flowing water and/or associated with bird colonies, where nutrients are available from guano. Two species, *Nostoc commune* and *Prasiola crispa*, are found in areas both at the aerodrome site and surrounding areas.

LICHENS

Very few lichens have been recorded in surveys at the aerodrome site historically (Seppelt & Broady, 1988), or in field surveys undertaken in the 2017-18 season. This is likely to be due to the arid nature of the area and the limited availability of meltwater for lichen growth. Genetic connections between Antarctic regions is limited and an unknown portion of taxa would be regionally unique (regionally endemic). Aeolian transport of sediment may also inhibit colonisation by slow growing lichens and mosses (Seppelt & Broady, 1988). The intertidal lichen (*Verrucaria psychrophila*) is known to occur along the shoreline near Davis research station (Antarctic Division, 2006). The coast north and south of Davis research station was surveyed opportunistically during the 2018-2019 field season and the lichen was found to be relatively abundant within a very limited habitat zone (the almost constantly wet intertidal zone) along much of the surveyed coast.

FUNGI

Fungal communities at the aerodrome site are predominately comprised of *Ascomycota* and *Basidiomycota*, as well as *Peronomsporomycota* and *Chytridiomycota*. This is similar to fungal communities in the broader Davis area, although the aerodrome site has a greater prevalence of *Peronomsporomycota* and *Chytridiomycota* than sites near Casey research station (Windmill Islands) (Zhang & Ferrari, 2018).

3.1.9 LAKE ECOLOGY

The Vestfold Hills is biologically unique because of its freshwater and hyper-saline lakes, which support microscopic invertebrates (AAD, 2011b). Meromictic lakes are rare on a global scale, but are more common in Antarctica, in particular the Vestfold Hills. Meromictic lakes are of great scientific interest because the water column is permanently stratified, influencing lake physics, chemistry, biology, and sedimentology. Meromictic lakes are often inhabited by species able to persist in extreme environments that are representative of phases through the evolution of the Earth. Some of the lakes in the Vestfold Hills have been studied extensively (e.g. Ace, Deep, Organic lakes) but most have had little or no scientific investigation.

The biota of the lakes studied consists of bacteria (including abundant cyanobacteria in benthic microbial mats), archaea, algae (particularly diatoms), ciliates and metazoa (nematodes, tardigrades, mites and rotifers). The bacteria, archaea, plants and animals occur in two distinct habitats within the lakes: the water column and the microbial mats that cover the base of the lakes.

Many of the organisms appear to be marine species that have been able to survive in saline lakes, although some organisms have colonised the lakes from freshwater environments elsewhere in the Vestfold Hills. A 2018 study considered these organisms to be typically ancient Antarctic species that have not had a marine source. The Vestfold Hills saline lakes do not have very diverse phytoplankton communities (Ferris, 1984).

The biota in Camp Lake, immediately east of the proposed runway, includes:

- Dinoflagellates: *Polarella glacialis*
- Ciliates: *Mesodinium rubrum*
- Algae: *Geminigera* sp.
- Diatoms: *Amphora veneta*, *Chaetoceros* sp., *Fragilaria* sp., *Fragilariopsis cylindrus*, *Navicula admin*, *Navicula cf detenta*, *Navicula cf salinarium*, *Navicula directa*, *Navicula glacei*, *Navicula mutica*, *Nitzschia lecointei*, *Pinnularia microstauron*, *Pinnularia viridis*, *Stauroneis salina*, and *Stauroneis* sp.

A sample collection program was conducted during the 2016-17 summer, before which the biota of the lakes in the project area was considered to be poorly known. Further analysis is required to understand the relative diversity of lakes in the project area compared to the broader Vestfold Hills.

3.1.10 ATTACH COPIES OF ANY FLORA AND FAUNA INVESTIGATIONS AND SURVEYS (IF APPLICABLE).

Refer to the attached Protected Matters Search Tool Report.

3.2 DESCRIBE THE HYDROLOGY RELEVANT TO THE PROJECT AREA (INCLUDING WATER FLOWS).

3.2.1 SURFACE WATER

The Vestfold Hills is a lake-rich area of Antarctica, characterised by the presence of hundreds of lakes, ranging in salinity from amongst the most saline to the freshest in the world. These lakes range in size from small, shallow pools that freeze entirely in winter, to large, deep lakes that remain largely unfrozen. Other, unmapped, waterbodies are likely to appear in depressions during wetter periods.

Lake formation in the Vestfold Hills reflects the combination of ice retreat from a low-lying area, which was then partially flooded by the sea (Ferris, 1984). The altitude of the lakes ranges from 50 m below sea level (the lowest lake in Antarctica, Deep Lake) to over 40 m AMSL. A 2018 investigation found that, given the historic sea levels, it is likely that most of the lakes with surface below 10 m AMSL were invaded by seawater in the mid-Holocene. Consequently, lower lying lakes are usually saline, with the relative concentration of major ions up to eight times that of seawater. Higher lakes, above the marine high stand (10 m AMSL), are less likely to be saline, and the ion concentrations markedly different to seawater.

Less saline lakes are ice covered for most of the year, with the most saline lakes typically remaining ice-free (Ferris, 1984).

Lakes of interest in the project area include Camp Lake, immediately east of the proposed runway, and several small unnamed lakes; there are also a number of low-lying ephemeral lakes present on Adams Flat. Camp Lake has a relatively small catchment that is fed by snow melt that accumulates on the leeward side of Camp Knoll and other geographical features.

The Vestfold Hills has limited precipitation, averaging 70 mm/y (BOM, 2019), which falls entirely as snow. Snow in the area is a blend of snow blown off the ice sheet and falling locally. In the Vestfold Hills, snow accumulates on the leeward side of hills and other elevated areas, and in summer snow melt can flow along valleys for a period of approximately four to six weeks in summer. The runway alignment is crossed by several small drainage lines and two larger valleys, including those locally referred to as Camp Lake Valley and East Valley.

Snow melt accumulates in Camp Lake Valley, which in summer flows north-west into the marine environment. It also occasionally receives overflow from Camp Lake, although this is not an annual event. East Valley is unlikely to receive significant snow accumulation, as it is generally aligned with the prevailing wind direction; therefore, the amount of snow melt in summer is likely to be small in volume.

Adams Flat is undulating terrain consisting of glacial deposits, rock outcrops, melt-lakes and major melt-water drainage channels. Snow-drifts that accumulate during the winter along these slopes, and along the hills and gullies over the high ground to the east, melt during the summer, with the melt-waters draining down over the lower lying areas and coastal regions. This forms broad melt-water streams and shallow melt-ponds. Some melt-ponds remain during the whole summer and start freezing by the end of February.

3.2.2 GROUNDWATER

Groundwater in the Vestfold Hills has not been well studied before consideration of this project, and as such there is a paucity of data in the project area. The local groundwater assessment has therefore been based on field programs undertaken in 2012-13, 2016-17, and 2018-19.

Initial findings from the 2018-19 field season indicate that melt water flows along Camp Lake Valley as a combination of groundwater and surface water. It is likely that soil warming, combined with seasonal snow melt, could allow groundwater flow (at less than 1 m deep) and discharge to sea. Similar groundwater flows may also occur in the smaller drainage lines in the project area.

Field observations indicate groundwater recharge and flow are limited in Adams Flat and Heidemann Valley. There is limited groundwater movement and groundwater is unable to be flushed by fresh surface water recharge. This has resulted in hypersaline groundwater underlying the area, including depressions and lakes.

The depth of thaw on the moraine has been measured between 0.3 m and 1.3 m below the surface. The moraine is thought to start thawing in late November, with parts of its surface refreezing in February. The salt content of groundwater samples ranges from 0.3 to 11.3% (average 5.8%), whereas ground ice can have a much lower salt content of 0.013 to 0.17%.

Permafrost in the soil is present at Adams Flat, with frozen solid ground typically intercepted between 0.8 and 2.0 m. The active layer above these depths typically experiences seasonal freeze-thaw action that is affected by salinity; where there is hypersalinity a solid state may not be present.

3.2.3 ATTACH COPIES OF ANY HYDROLOGICAL INVESTIGATIONS.

No attachments.

3.3 DESCRIBE THE SOIL AND VEGETATION CHARACTERISTICS RELEVANT TO THE PROJECT AREA

3.3.1 SOILS AND GEOLOGY

The aerodrome site is an area of exposed rock outcrop with a thin substrate of gravel and pebbles, approximately 4.5 km northeast of Davis research station. The area is underlain by basement rock typically composed of Archean granulite-grade orthogneisses with an east-west foliation, dipping to the north. The site itself consists of an outcropping mass of weak-moderately foliated tonalite (referred to as 'meta-tonalite') that is considered to be part of the Crooked Lake Group ~2475 Ma. This rock varies from mafic to felsic composition. The gneisses have been intruded by Proterozoic basaltic dykes of varying width (from a few centimetres up to 20 m), with dominant trends of north-south or northeast-southwest.

Surface conditions on the aerodrome site consist of outcropping basement rock on slopes and hilltops, with poorly sorted boulder fields and lesser amounts of consolidated sediments in valleys and low-lying areas.

Outcropping meta-tonalite bedrock is variably covered by unconsolidated sand, gravel and poorly sorted boulders, which are inferred to represent aeolian and glacial deposits. The depth of this cover was interpreted to be typically less than 5 m except for Camp Lake Valley, where the sediments are thicker. Ground conditions vary from frozen ground to soft mud depending on the freeze/thaw state over the season. Permafrost was only intersected within and to the north of Camp Lake Valley during the 2017-18 field season.

The four main mapped units occur in repeated, narrow east-west-aligned bands that extend across the area. Mafic dyke swarms, which were probably emplaced during separate events in the late Archaean and Proterozoic, are obvious features of the landscape (AAD, 2018b). Davis research station is built on frozen moraine deposits and sand (AAD, 2011a) that lie upon the Archean Mossel Gneiss bedrock.

Adams Flat is an area of undulating terrain consisting of glacial deposits, rock outcrops, melt-lakes and major melt-water drainage channels. Most of the rock outcrops are part of the ridge which bounds the lower lying coastal area. This ridge, which in most areas rises sharply to about 15 metres forms part of the belt of high, hilly ground. In the northern part of Adams Flat the distance between this ridge and the sea is approximately 100 metres.

The subsurface materials in this area consist of gravelly sand, overlying a material generally grading with depth from a gravelly, silty sand to a gravelly, silty clay-sand mixture. Intermixed with this underlying material are occasional small lenses of sand and silty clay, and bands of gravel. Cobbles and small boulders are scattered throughout these soils. The presence of an occasional larger boulder is also likely.

Adams Flat forms part of the Death Valley system. Glaciation has eroded valleys along lines of weakness developed in the landscape, including the Death Valley system. This valley system passes through Deep Lake, Lake Stinear and Lake Dingle where it splits and meets the ocean at Adams Flat and Heidemann Valley. This valley system preserves the history of the evolution of the Vestfold Hills and the geological and climatic evolution for Eastern Antarctica. Parallel valley systems are now partially flooded and form Long, Ellis and Crooked Fjords.

Permafrost is present in the soils, and is discussed under groundwater in the section below on hydrology.

3.3.2 VEGETATION

A description of the vegetation in the Vestfold Hills and project area is provided in Section 3.1.

3.4 DESCRIBE ANY OUTSTANDING NATURAL FEATURES AND/OR ANY OTHER IMPORTANT OR UNIQUE VALUES RELEVANT TO THE PROJECT AREA.

3.4.1 AESTHETIC AND WILDERNESS VALUES

Antarctica is characterised by a range of wilderness and aesthetic values, which are defined under the '*Guidance for assessing an area for a potential Antarctic Specially Managed Area designation*' (ATS, 2017):

- **Wilderness values** apply to an area that contains characteristics that are particularly unique or representative components of the Antarctic environment (e.g. remoteness, few or no people, an absence of human-made objects, traces, sounds and smells, untraveled or infrequently visited terrain).
- **Aesthetic values** apply to an area that contains features or attributes that contribute to people's appreciation and sense or perception of an area (e.g. beauty, pleasantness, inspirational qualities, scenic attraction and appeal).

The Vestfold Hills, including the aerodrome site, has a range of physical attributes that contribute to senses of beauty (aesthetic), solitude (wilderness), remoteness (wilderness), discovery (wilderness) and scale (wilderness), including (AAD, 2018b):

- The number, patterning and diversity of shapes and intensity of colouring of its lakes
- The presence and contrast of the plateau
- The formation and retreat of sea ice
- The clarity of the near-shore water and the Hills' intersecting fjords
- The patterns of dark stripes and criss-crossing of black dolerite against a paler brown base
- The abundance of iconic species of wildlife
- The variety, texture and colour of individual rocks, and
- The qualities of the Vestfold Hills environment, in totality, are not reproduced elsewhere (AAD, 2018b).

3.4.2 ANTARCTIC SPECIALLY PROTECTED AREAS

There are two Antarctic Specially Protected Areas (ASPA) within the Vestfold Hills area, as shown on Map 3.

3.4.2.1 HAWKER ISLAND (ASPA 167)

Hawker Island is located 12 km south from the aerodrome site. It was designated as an ASPA in 2006 following a proposal by Australia, primarily to protect the southernmost breeding colony of Southern Giant Petrels (ATS, 2016). Hawker Island also supports breeding colonies of Adélie Penguins, South Polar Skuas and Cape Petrels. Southern Elephant Seals also occasionally haul out on the southern beaches. The Management Plan for Hawker Island prohibits overflights of the island except where essential for scientific or management purposes and authorised by a permit (ATS, 2016). During the Southern Giant Petrel breeding season additional permit requirements apply.

3.4.2.2 MARINE PLAIN (ASPA 143)

Marine Plain (ASPA 143) is located 8 km south-east of the aerodrome site. It was designated as an ASPA in 2003 following a proposal by Australia. It is "representative of a major Antarctic terrestrial ice-free ecosystem" and is primarily designated to protect outstanding fossil fauna and rare geological features. It is of exceptional scientific interest because of its relevance to the palaeoecological and palaeoclimatic record of Antarctica" (ATS, 2013). The Management Plan for Marine Plan stipulates that overflights of lakes should be kept to the minimum necessary to achieve specific research or management requirements.

3.4.3 ICE-FREE AREAS

The Vestfold Hills are a roughly triangular area of rounded rocky hills that are predominantly ice-free and cover an area of approximately 410 km^2. The total area of the Antarctic landmass is 14 million km^2 (compared to that of Australia at 7.6 million km^2), of which the ice-free area is estimated between 21,745 km^2 (Burton-Johnson, et al., 2016) and 54,274 km^2 (Brooks, et al., 2019). The Vestfold Hills is the largest coastal ice-free area in East Antarctica (Seppelt & Broady, 1988). Other ice-free areas in East Antarctica include the Larsemann Hills (40 km^2) (ATS, 2015) and Bunger Hills (952 km^2) (Wisniewski, 1983). The largest ice-free area in Antarctica are the McMurdo Dry valleys, at approximately 4,800 km^2. Ice-free areas typically have higher diversity and numbers of wildlife compared to the ice-covered parts of the continent.

3.4.4 SEA ICE

Fast ice begins to form offshore from Davis research station in early to mid-March and surrounds the area during the winter months. Fast ice forms as a continuous band of stationary sea ice, fixed to the land by grounded icebergs or in sheltered embayments. The extent and quality of sea ice varies from year to year.

Sea ice plays an important role in the life-cycle of several species including penguins and seals and marine communities on the sea floor. Sea ice cover in the marine environment also affects physical factors such as light and water column mixing, which influences the ecological community present beneath the ice (Ferris, 1984).

3.4.5 FJORDS

Fjords are uncommon in Antarctica and mainly found on the Antarctic Peninsula, but the Vestfold Hills have a unique concentration of fjords (AAD, 2018b). Long Fjord and Tryne Fjord are located approximately 1.2 km north-east of the proposed aerodrome. It is likely that these fjords were created through glacial movement across lines of geological weakness, and therefore, are not 'fjords' in the correct geomorphological sense as they were not channels along which ice flowed (Adamson, et al., 1986). Meltwater from the Antarctic plateau drains into these fjords.

A 1999 bathymetric survey recorded a minimum depth of 3 m, and a maximum depth of 222 m in the middle basin of Long Fjord (Lake & Heil, 1999). This survey also reported that the far basins of both tidal fjords are well mixed even with large volumes of meltwater draining from the Antarctic plateau.

The fjords of the Vestfold Hills remain ice covered for longer than the coastal waters off Davis research station. Weddell Seals breed in the fjords of the Vestfold Hills (ATS, 2016), with the long duration of ice cover in Long and Tryne Fjords offering protected breeding and moulting sites in spring and early summer (Ferris, 1984) and as such, it is an important area for this species.

3.5 DESCRIBE THE STATUS OF NATIVE VEGETATION RELEVANT TO THE PROJECT AREA.

Terrestrial flora (algae, lichens, mosses and fungi) are described previously in Section 3.1. The ice-free areas of Antarctica support only sparse vegetation, as vegetation must contend with temperatures below zero for months, low availability of water, poor nutrient status of such soils as exist, sand and ice abrasion and large concentrations of salt. Terrestrial flora in the Vestfold Hills is considered to be generally representative of other regions of continental Antarctica and was not considered to be unique by earlier studies (Seppelt & Broady, 1988). However, recent surveys (2018-19 field season) have revealed hitherto unrecorded species of lichens and mosses from the area, suggesting that further surveys are required to adequately characterise the flora of the region.

3.6 DESCRIBE THE GRADIENT (OR DEPTH RANGE IF ACTION IS TO BE TAKEN IN A MARINE AREA) RELEVANT TO THE PROJECT AREA.

The proposed runway would be located on an elevated rock outcrop in the Vestfold Hills. The gently undulating to steep exposed hills that form the landform predominately are oriented north-east to south-west, and are truncated by minor valleys that grade from the south-east to north-west to the ocean.

Key topographical features within the project footprint are:

- Camp Knoll, the highest point within the project footprint, with a maximum elevation of approximately 80 m AMSL, and
- Camp Lake Valley, adjacent to Camp Knoll and the lowest point within the project footprint, with an elevation of approximately 20 m AMSL.
- Adams Flat, which would be crossed by the access road, which is a low lying area with elevations less than 20 m AMSL and below 5 m AMSL in places.

Within the Vestfold Hills more broadly, elevations range from various peaks with elevations up to approximately 160 m AMSL, and a number of lakes that are below sea level, for example Deep Lake at approximately -50 m below MSL. The islands along the coast of the Vestfold Hills reach elevations of up to 60 m AMSL, although peaks of approximately 40 m are more common.

The bathymetry near Davis research station is shallow (less than 10 m) out to approximately half a kilometre from shore. Beyond this, the sea bed drops to approximately 25 m at Davis anchorage approximately 1.5 km from shore. The new wharf would require reclamation to achieve sufficient water depth for the pontoons and tugs required to transfer materials from ship to shore (Section 1.2.4.3).

3.7 DESCRIBE THE CURRENT CONDITION OF THE ENVIRONMENT RELEVANT TO THE PROJECT AREA.

The current condition of the environment in the Vestfold Hills is associated with the location of existing human activities, which are described in Section 3.11. Human presence, and associated impacts, is focussed at Davis research station where most buildings and infrastructure are located. The footprint area encompassed within of the Davis research station limits is approximately 110 ha and includes, buildings, infrastructure, roads, modified and unmodified landscape.

The areas outside the Davis research station limits that are proposed for the activity are generally undisturbed by human activity beyond foot traffic, vehicle traverse and helicopter operations. There are no obvious signs of human activity in many of these areas. The preliminary site selected for the proposed explosives storage facility was chosen to use the existing Dingle Road where possible to lessen the disturbance footprint; nevertheless, an extension of the road would be required.

3.8 DESCRIBE ANY COMMONWEALTH HERITAGE PLACES OR OTHER PLACES RECOGNISED AS HAVING HERITAGE VALUES RELEVANT TO THE PROJECT AREA.

There are no places on the World Heritage List or National Heritage List in the Vestfold Hills.

Two sites in the Vestfold Hills are listed as indicative places on the Commonwealth Heritage List:

- Davis Station Group, Davis Station (Place ID 105269)
- Mikkelsen Cairn, Davis Station (Place ID 105217). Mikkelsen Cairn is also included in the list of Antarctic Historic Sites and Monuments (HSM), which are protected under the Environment Protocol (Annex V, Article 8).

An indicative listing means that no formal nomination has been made; however, information has been provided to or obtained by the Australian Department of Environment and Energy (DoEE) Heritage Branch and has been entered into the heritage database.

3.8.1 DAVIS STATION GROUP

Davis research station was established in 1957 and is the second oldest Australian Antarctic station after Mawson research station. A *Heritage Assessment of Buildings and Other Structures and Sites in The Davis Area* was undertaken in 1996 (Rando & Davies, 1996). This study assessed the cultural significance of 48 buildings, structures, sites and objects in the Davis area which, with one exception, predate the commencement of the 1978 rebuilding program. Of these 48 buildings, structures, sites and objects assessed, 32 are included within the indicative Davis Station Group listing on the Commonwealth Heritage List. Eighteen of the buildings within station limits have been removed, and several other buildings have been repurposed. The remaining buildings include the paint store (now 'post office'), old balloon hut (now 'old met building'), remote transmitter hut, electrical and scientific stores (now 'hobby hut'), magnetometer hut, biology laboratory (now unoccupied), and emergency powerhouse.

Three field refuges and three cairns, located outside station limits, are included in the indicative listing and remain in place:

1. Mikkelsen Cairn (also indicative listing #105217 and HSM #72) (approximately 25 km north-east of the aerodrome site)
2. Walkabout Rocks (also HSM #6) (approximately 22 km north-east of the aerodrome site)
3. Law Cairn (approximately 220 m west of the proposed access road)
4. Platcha Hut (approximately 17 km east of the aerodrome site)
5. Brookes Hut (approximately 4 km east of the aerodrome site)
6. Watts Hut (approximately 9 km south-east of the aerodrome site).

3.8.2 OTHER HERITAGE FEATURES

Several artefacts were discovered at Camp Lake in the 2017-18 field season, which are likely to be evidence of the second visit to the Vestfold Hills by the Australian National Antarctic Research Expedition (ANARE) in January 1955. Artefacts discovered include wooden pallet lids, soap and wire, the impression of a tent site, vehicle tracks, and a rock cairn. In accordance with the *Guidelines for handling pre-1958 historic remains whose existence or present location is not known* (Resolution 5 (2001)), Australia notified the Committee for Environmental Protection (CEP) of the discovery of these artefacts at the 2019 Antarctic Treaty Consultative Meeting. Separate to this project, these artefacts are being assessed for heritage significance. These artefacts are given interim protection until the assessment has determined significance and appropriate management practices. The closest artefact is located approximately 150 m from the earthworks footprint.

3.9 DESCRIBE ANY INDIGENOUS HERITAGE VALUES RELEVANT TO THE PROJECT AREA.

There are no indigenous heritage values relevant to the project area. Human presence commenced with early exploration, with first landings in the early 19th century.

3.10 DESCRIBE THE TENURE OF THE ACTION AREA (E.G. FREEHOLD, LEASEHOLD) RELEVANT TO THE PROJECT AREA.

The project area is Commonwealth land under the EPBC Act (section 525 of the EPBC Act).

3.11 DESCRIBE ANY EXISTING OR ANY PROPOSED USES RELEVANT TO THE PROJECT AREA.

Scientific research is the main activity on the Antarctic Continent. The purpose of Davis research station and associated infrastructure is to conduct and support the conduct of scientific investigations. Article 2 of the Environment Protocol designates Antarctica as "a natural reserve, devoted to peace and science." The project is intended to support and augment Australia's scientific investment in Antarctica. Scientific programs include studies of geology, glaciology, climatology, human interaction with the environment, and biological/behavioural interactions (terrestrial, lake and marine, from microorganisms to higher order vertebrates). The results of these programs have been used, in part, to inform this document.

There are currently 85 single bed rooms plus a surge to 93 beds total for expeditioners over summer, and about 18 over winter, that can be accommodated at Davis research station (AAD, 2011a). These expeditioners carry out a broad range of physical and biological scientific programs. Many of these programs have been conducted over a number of field seasons.

Aviation is used extensively to support Davis research station operations and scientific activities. The total number of aircraft movements in the Davis area is typically between 500 and 700 aircraft movements per annum including both fixed-wing and rotary aircraft. In terms of operational ice runways, there is an existing sea ice ski landing area offshore from Davis research station located north-east of O'Gorman Rocks. This operates between October and early December each year, when the sea ice is of adequate strength. Another snow airstrip operates at Davis plateau ski landing area, located approximately 35 km inland and north-east from Davis research station. Casey and Davis are approximately 1,400 km apart, and are within different climatic zones; consequently, it is common for flights between Casey and Davis to be delayed by poor weather.

Smaller fixed wing propeller aircraft (Basler BT-67 and DHC-6 Twin Otter) are used regularly to support personnel transfer between the stations and to support field activities. A Basler is usually based at the plateau ski landing area from December to February each year. In 2017-18, there were 56 fixed wing propeller flight movements associated with Davis research station, with destinations including Casey research station, Mawson research station, the plateau ski landing area, and for science purposes. In 2018-19, there were 30 fixed wing movements.

Helicopters are used for transporting passengers, cargo and fuel between Davis research station and the plateau ski landing area approximately 35 km inland from the station. Given the distance between the station and landing area, it is common for two aircraft to travel together to meet operational and safety requirements. Helicopters also operate regularly from the station in support of scientific work, transporting personnel and equipment to field sites. There were between 500 and 600 helicopter movements in 2017-18 and 2018-19, to and from the plateau ski landing area and to support science and operational activities. A number of helicopter landing areas are distributed across the Vestfold Hills.

More broadly, the AAP operates an ice runway at Wilkins Aerodrome, near Casey research station, during the months between October to March, which is currently the intercontinental hub for Australia's aviation operations in Antarctica.

In addition to Australia's Antarctic activities, other nations have established stations and field camps within East Antarctica. Princess Elizabeth Land is an area of particular scientific interest, and there are multiple stations and nations active in this area, including India, Russia and China. China is also proposing to develop a new ice runway to support their Zhongshan station in the Larsemann hills, approximately 120 km south-west of Davis. There are also various emergency shelters, tracks, masts, traverses and helicopter landing areas across the Vestfold Hills.

4.0 MEASURES TO AVOID OR REDUCE IMPACTS

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

4.1 DESCRIBE THE MEASURES YOU WILL UNDERTAKE TO AVOID OR REDUCE IMPACT FROM YOUR PROPOSED ACTION.

In preparing the environmental impact assessment, more details would be developed for the project scope, construction methodology and operational activities; alternatives (e.g. materials or methodologies) for particular elements would be considered with the intention of reducing potential environmental impacts associated with the delivery and ongoing operation of the project.

This project would develop a comprehensive set of environmental mitigation and monitoring measures to reduce, mitigate and offset impacts as required and appropriate under the EPBC Act and ATEP Act. These measures would be applied to the planning, construction and operational phases of the project. A long-term environmental monitoring program would be required to assess the effectiveness of implemented mitigation measures, with an adaptive management framework to allow for adjustments as the understanding of the environment, and its interaction with the project, increases.

It is expected that completion of a detailed impact assessment would enhance the existing knowledge of the local environment and the project implications and enable mitigation measures to be reviewed and refined over the course of the project and into operation. Preliminary mitigation measures that have been identified at this early stage are described below for key environmental aspects.

4.1.1 EXISTING PRACTICES AND POLICIES

The AAD has established a variety of procedures and management plans to reduce the potential environmental impacts of its operations in Antarctica. These procedures address matters such as fuel handling, biosecurity and quarantine, waste management, activities near wildlife, and aviation and shipping operations.

AAD procedures are regularly reviewed and would be updated as required to ensure suitability for the project to mitigate and manage potential environmental risks associated with construction and operation. This process would commence with the development of draft environmental management plans as part of the detailed environmental assessments for the project.

4.1.2 LANDFORMS AND HYDROLOGY

The earthworks required for the construction of a functional runway would have direct impacts to landforms and hydrology that would be largely unavoidable. Reducing engineering risks associated with ground conditions was an important consideration during the site selection process (see Section 8.0 *Proposed Alternatives*), and the proposed alignment balances this with other factors such as geological stability, avoidance of the Hawker Island ASPA and operational requirements to minimise crosswinds on take-off and landing. Further analysis would be undertaken to:

- Assess view lines and visual impacts from key vantage points (including from the ocean) to better understand impacts and any further mitigation.
- Assess the potential impacts of truncating Camp Valley on hydrology and the downstream marine environment.

Potential mitigation measures to reduce direct impacts to landforms and hydrology would include:

- Balancing earthworks as practical to avoid long-term stockpiling
- Reducing the construction footprint and impacts on existing surface drainage features and any identified downstream environmental values as far as practicable

4.1.3 FLORA AND FAUNA

The following additional assessment of existing flora and fauna values is proposed:

- Review of baseline scientific research on relevant terrestrial and lake ecosystems, as well as higher order animals (birds and marine mammals) and benthic assemblages, to inform the impact assessment, and establishment of longer-term monitoring programs.
- Ecological surveys (including setting up control sites) to provide further baseline information on presence, abundance, distribution, and seasonal variability for key species, which include lichens, mosses, algae, microbiota, birds, seals and benthic assemblages. These surveys would inform the impact assessment for the project and the longer-term monitoring program. There are considerable limitations for the conduct of field surveys in the Antarctic including the weather, safety and access.

Mitigation measures for flora and fauna for the key environmental aspects may include those described below.

Physical disturbance	• Limiting the disturbance footprint of the aerodrome, access road and supporting infrastructure to the extent practicable • Barricading work areas to prevent access by penguins and/or seals • Locating stockpile areas to reduce disturbance of haul out or other areas where wildlife are known to congregate • Rehabilitating terrestrial flora if appropriate (e.g. temporary relocation from the construction area and replacement at the completion of construction).
Air quality, dust and light emissions	• Reducing the release of dust and particulates into the air through containment, entrapment and/or wetting if appropriate. • Restricting certain activities (e.g. crushing, hauling, screening, and spreading) during high winds • Maintaining all machinery in good condition and compliant with relevant emission standards • Complying with ICAO aircraft engine emissions standards, where applicable to aircraft • Design of flightpaths which required precision flying (i.e. use of RNP or Required Navigation Paths) which reduce fuel burn and consequential emissions • Designing, using and maintaining the access road in a manner that reduces dust generation • Reducing visible light from anchored ships to reduce bird strike
Noise Emissions	• Construction of noise attenuating earth berms to reduce the transmission of noise towards sensitive populations during construction • Minimising noisy construction activities near wildlife populations, or during sensitive periods, to the extent practicable • Appropriately maintaining vessels to reduce noise output

- Reducing the impact of operational noise through planning, design and operational constraints based on initial and ongoing monitoring and review including the possible use of electric propulsion systems.

Preliminary flight paths have been designed with consideration of legislative, technical and environmental constraints. Lateral and vertical separation between aircraft and wildlife concentrations have been maximised to the largest extent possible, while also considering aviation safety rules and navigation criteria.

Potential additional mitigation measures include the development and implementation of an airspace management plan which requires aircraft using visual flight procedures (i.e. intracontinental aircraft) to fly a specific route (vertical and horizontal) which minimises the spatial extent of potential noise emissions, as aircraft movements would be required to fly a defined route.

Pollution and Contamination

- Reviewing and updating existing procedures and operational controls
- AAD 2019 bulk fuel storage design guidelines would be applied for the design, construction and certification of all new bulk fuel storage and reticulation facilities at Davis research station
- Bunding refuelling areas, providing appropriate petroleum spill kits and training personnel
- The aerodrome apron design includes a containment system for the unlikely event of a fuel spill
- Maintaining all vehicles, plant and equipment and using appropriately qualified operators
- Consideration of the use of electric vehicles for aspects of the construction and operations
- Developing and implementing project-specific waste management plans that provide for the nature and scale of the construction works, and reviewing and updating the AAD Waste Management Plans for Davis research station to consider construction waste

Introduction of Non-native Species

The AAD has established biosecurity procedures and management plans to reduce the potential environmental impacts of its operations in Antarctica. Additional measures to restrict the introduction of non-native species and diseases are outlined in Article 4 of Annex II to the Environment Protocol and supported by the *Non-Native Species Manual* (CEP, 2017). The introduction of invasive marine species through ballast water is avoided through the implementation of *The Practical Guidelines for Ballast Water Exchange in the Antarctic Treaty Area*. For this project, biosecurity management would include:

- Developing project-specific biosecurity procedures and requirements, particularly for shipping concrete pavers and large plant and equipment and building materials.
- Developing and implementing project-specific biosecurity incident response plans
- Training and educating all project personnel on biosecurity
- Incorporating biosecurity implications of packaging and sourcing into procurement

4.1.4 SOCIAL AND ECONOMIC ENVIRONMENT

The following mitigation measures are proposed:

- Implementing thorough selection processes for construction personnel to ensure suitability of employees for working in a remote and isolated environment
- Appropriate records (e.g. photographs) would be made of potentially affected heritage features.
- Designating Law Cairn and artefacts identified at Camp Lake as a 'no go area' and marking appropriately within the EMP.
- Heritage inductions for construction personnel, including protocols in the event of a chance find of potential heritage items.

A strategy is being developed to ensure resources are allocated to maintain core science programs at Davis station during the planning and construction phase. Where possible science projects may be undertaken at Mawson or Casey research stations, or from the *RSV Nuyina*.

4.2 FOR MATTERS PROTECTED BY THE EPBC ACT THAT MAY BE AFFECTED BY THE PROPOSED ACTION, DESCRIBE THE PROPOSED ENVIRONMENTAL OUTCOMES TO BE ACHIEVED.

To date, the project has sought, where possible, to avoid and reduce impacts to MNES and other environmental values through the selection of the preferred location for the Davis aerodrome. The project will seek to achieve an environmental outcome where residual impacts to MNES are reduced to an acceptable level.

The process of further reducing impacts would remain a key driver for the project. To achieve this, the project would go through further, more detailed, design and environmental assessment processes (under the EPBC and ATEP Acts), delivering more detail regarding baseline data (on which to base environmental assessment, proposed mitigation and ultimately environmental outcomes).

Key aspects to be addressed include:

- Confirmation of the location and likelihood of occurrence of MNES and other environmental values in and around the project area.
- Further analysis of the potential indirect impacts on birds and marine mammals.
- Determination of species presence and significance of populations, through targeted ecological investigations, in accordance with relevant Commonwealth survey guidance in the context of access and logistics in Antarctica
- Further definition of habitat, vegetation and aesthetic impacts, through iterative design and environmental assessment.
- Design development to avoid, reduce or manage impacts to identified environmental values
- Understanding the need for and scope of potential environmental offsets in the Antarctic context if residual impacts are identified for MNES and other environmental values.

4.3 ATTACH COPIES OF ANY SUPPORTING DOCUMENTS.

No attachments.

5.0 CONCLUSION ON THE LIKELIHOOD OF SIGNIFICANT IMPACTS

A checkbox tick identifies each of the matters of National Environmental Significance you identified in section 2 of this application as likely to be a significant impact.

Review the matters you have identified below. If a matter ticked below has been incorrectly identified you will need to return to Section 2 to edit.

5.1 IN SECTION 2 YOU INDICATED THE BELOW CHECKED BOXES TO BE OF SIGNIFICANT IMPACT AND THEREFORE YOU CONSIDER THE ACTION TO BE A CONTROLLED ACTION.

The project has the potential to have a significant impact on the following matters:

- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine environment
- Protection of the environment from actions involving Commonwealth land
- Protection of the environment from Commonwealth actions

The potential for a significant impact would be assessed through the detailed environmental impact assessment.

5.2 IF NO SIGNIFICANT MATTERS ARE IDENTIFIED, PROVIDE THE KEY REASONS WHY YOU THINK THE PROPOSED ACTION IS NOT LIKELY TO HAVE A SIGNIFICANT IMPACT ON A MATTER PROTECTED UNDER THE EPBC ACT AND THEREFORE NOT A CONTROLLED ACTION.

Not applicable.

6.0 ENVIRONMENTAL RECORD OF THE PERSON PROPOSING TO TAKE THE ACTION

6.1 DOES THE PERSON TAKING THE ACTION HAVE A SATISFACTORY RECORD OF RESPONSIBLE ENVIRONMENTAL MANAGEMENT? PLEASE EXPLAIN IN FURTHER DETAIL.

Yes. The AAD is committed to the comprehensive protection of the Antarctic environment in accordance with Australia's international obligations, and is responsible for fulfilling that commitment on behalf of the people and government of Australia. The AAD is responsible for protecting and managing the Territory of Heard Island and McDonald Islands, and managing the environmental aspects of Australia's other activities in the sub-Antarctic. The AAD does so in accordance with the ATEP Act and is guided by the *AAD's Environmental Policy 2018 – 2022*, which is included in Appendix B.

The AAD maintains an Environmental Management System (EMS) which is consistent with the Australian/New Zealand Standard AS/NZS ISO 14001:2016. The AAD's EMS is a systematic means of managing interaction with the environment and implementing the AAD's environmental management policy and processes.

The EMS identifies and addresses all environmental aspects and impacts associated with the Australian Antarctic Program's activities in Antarctica, Macquarie Island and the Southern Ocean, Australian facilities, and science laboratories and facilities.

6.2 PROVIDE DETAILS OF ANY PAST OR PRESENT PROCEEDINGS UNDER A COMMONWEALTH, STATE OR TERRITORY LAW FOR THE PROTECTION OF THE ENVIRONMENT OR THE CONSERVATION AND SUSTAINABLE USE OF NATURAL RESOURCES AGAINST EITHER (A) THE PERSON PROPOSING TO TAKE THE ACTION OR, (B) IF A PERMIT HAS BEEN APPLIED FOR IN RELATION TO THE ACTION – THE PERSON MAKING THE APPLICATION.

The AAD has no past or present proceedings against them.

6.3 IF IT IS A CORPORATION UNDERTAKING THE ACTION WILL THE ACTION BE TAKEN IN ACCORDANCE WITH THE CORPORATION'S ENVIRONMENTAL POLICY AND FRAMEWORK?

The action is not being undertaken by a corporation.

6.4 HAS THE PERSON TAKING THE ACTION PREVIOUSLY REFERRED AN ACTION UNDER THE EPBC ACT, OR BEEN RESPONSIBLE FOR UNDERTAKING AN ACTION REFERRED UNDER THE EPBC ACT?

The AAD has previously referred an action under the EPBC Act.

6.4.1 EPBC ACT NO AND/OR NAME OF PROPOSAL.

Previous EPBC Act referrals by the Department of the Environment and Energy include:

- 2018/8306 Macquarie Island Research Station Modernisation Project, Tas
- 2010/5657 Mawson's Huts Historic Site - Transit Hut Conservation 2010 - 2013 29/09/2010
- 2006/2890 Repair and conservation of Biscoe Hut 23/06/2006
- 2004/1330 Removal of Old Donga Line Buildings
- 2002/904 Thala Valley Tip
- 2002/802 Mawson's Huts Expedition 2002
- 2002/801 Antarctic Air Transport System

7.0 INFORMATION SOURCES

7.1 LIST REFERENCES USED IN PREPARING THE REFERRAL (PLEASE PROVIDE THE REFERENCE SOURCE RELIABILITY AND ANY UNCERTAINTIES OF SOURCE).

In the preparation of this Referral, findings of the 2018-19 field season have been incorporated into the description of the existing environment where appropriate; however, the full reports of these studies have not been published and are referred to as (AAD, unpublished data). The outcomes of the 2018-19 field season (and other seasons) will be reported as part of the detailed environmental assessments for the project. Published references have been used in the preparation of this Referral, they are considered to be reliable.

AAD, 2011a. *Location of Davis station.* [Online]
Available at: http://www.antarctica.gov.au/living-and-working/stations/davis/living/location
[Accessed 03 09 2018].

AAD, 2011b. *Surrounding areas.* [Online]
Available at: http://www.antarctica.gov.au/living-and-working/stations/davis/living/location/surrounding-areas
[Accessed 03 09 2018].

AAD, 2014. *Microscopic organisms.* [Online]
Available at: Microscopic organisms
[Accessed 18 09 2018].

AAD, 2018a. *Antarctic krill.* [Online]
Available at: http://www.antarctica.gov.au/about-antarctica/wildlife/animals/krill
[Accessed 18 09 2018].

AAD, 2018b. *Initial Environmental Evaluation Year Round Aviation Access Project 2018-19 Field Activities AAS Project 5097,* Hobart: Department of the Environment and Energy.

AADC, 2018. *Taxon Profile: Aptenodytes forsteri.* [Online]
Available at: https://data.aad.gov.au/aadc/biodiversity/taxon_profile.cfm?taxon_id=100000
[Accessed 19 09 2018].

Adamson, D. A. et al., 1986. *Antarctic Oasis Terrestrial environments and history of the Vestfold Hills.* North Ryde: Academic Press.

Antarctic Division, 2006. *Initial Environmental Evaluation Quarry Operations in the Australian Antarctic Territory at Casey and Davis Stations,* s.l.: Australian Government.

ATS, 2013. *Management Plan for Antarctic Specially Protected Area No. 143,* s.l.: Secretariat of the Antarctic Treaty.

ATS, 2015. *Larsemann Hills, East Antarctica Antarctic Specially Managed Area Management Plan.* Brasilia, Brazil, Secretariat of the Antarctic Treaty.

ATS, 2016. *Management Plan for Antarctic Specially Protected Area No. 167,* s.l.: Secretariat of the Antarctic Treaty.

ATS, 2017. *Resolution 1 (2017) Annex A: Guidance for assessing an area for a potential Antarctic Specially Managed Area designation.* s.l., Secretariat of the Antarctic Treaty.

BirdLife International, 2018a. *Species factsheet: Aptenodytes forsteri.* [Online]
Available at: http://datazone.birdlife.org/species/factsheet/emperor-penguin-aptenodytes-forsteri/distribution
[Accessed 19 09 2018].

BirdLife International, 2018b. *Species factsheet: Catharacta maccormicki..* [Online]
Available at: http://datazone.birdlife.org/species/factsheet/south-polar-skua-catharacta-maccormicki/details
[Accessed 05 10 2018].

BirdLife International, 2018c. *Species factsheet: Fulmarus glacialoides.* [Online]
Available at: http://datazone.birdlife.org/species/factsheet/southern-fulmar-fulmarus-glacialoides/text
[Accessed 18 09 2018].

BirdLife International, 2018d. *Species factsheet: Thalassoica antarctica.* [Online]
Available at: Species factsheet: Thalassoica antarctica
[Accessed 18 09 2018].

BirdLife International, 2019. *Macronectes giganteus.* [Online]
Available at: http://datazone.birdlife.org/species/factsheet/Southern-Giant-Petrel
[Accessed 22 08 2019].

BOM, 2019. *Climate statistics for Australian locations: Davis.* [Online]
Available at: http://www.bom.gov.au/climate/averages/tables/cw_300000.shtml
[Accessed 07 March 2019].

Branch, T. A., 2007. Abundance of Antarctic blue whales south of 60oS from three complete circumpolar sets of surveys. *Journal of Cetacean research and management,* Issue 9, pp. 253-262.

Brooke, M. D., 2004. *Albatrosses and Petrels Across the World.* Oxford: Oxford University Press.

Burton-Johnson, A., Black, M., Fretwell, P. T. & 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. *The Cryosphere,* Volume 10, pp. 1665-1677.

CEP, 2017. *Non-Native Species Manual,* Buenos Aires: Committee for Environmental Protection.

Chittleborough, R. G., 1965. Dynamics of two populations of the humpback whale, Megaptera novaeangliae (Borowski). *Marine and Freshwater Research,* Issue 16, pp. 33-128.

DoEE, 2018a. *Balaenoptera bonaerensis — Antarctic Minke Whale, Dark-shoulder Minke Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=67812
[Accessed 18 09 2018].

DoEE, 2018b. *Balaenoptera borealis — Sei Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=34
[Accessed 18 09 2018].

DoEE, 2018c. *Balaenoptera musculus — Blue Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=36
[Accessed 18 09 2018].

DoEE, 2018d. *Eubalaena australis — Southern Right Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=40
[Accessed 18 09 2018].

DoEE, 2018e. *Hyperoodon planifrons — Southern Bottlenose Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=71
[Accessed 18 09 2018].

DoEE, 2018f. *Megaptera novaeangliae — Humpback Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=38
[Accessed 18 09 2018].

DoEE, 2018g. *Oceanites oceanicus — Wilson's Storm-Petrel.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1034
[Accessed 17 09 2018].

DoEE, 2018h. *Orcinus orca — Killer Whale, Orca.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=46
[Accessed 18 09 2018].

DoEE, 2018i. *Physeter macrocephalus — Sperm Whale.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59
[Accessed 18 09 2018].

DoEE, 2018j. *Stercorarius antarcticus lonnbergi — Brown Skua (Lonnberg's).* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=67023
[Accessed 17 09 2018].

DoEE, 2019. *Macronectes giganteus — Southern Giant-Petrel, Southern Giant Petrel.* [Online]
Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1060
[Accessed 15 03 2019].

Ferris, J., 1984. Preface. In: J. M. Ferris, H. R. Burton, G. W. Johnstone & I. A. Bayly, eds. *Biology of the Vestfold Hills.* The Netherlands: Kluwer Academic Publishers.

Fretwell, P. T. et al., 2012. An Emperor Penguin Population Estimate: The First Global, Synoptic Survey of a Species from Space. *PLoS ONE, 7,* pp. 1-11.

Friedmann & Campo, 1976. Endolithic Blue-Green Algae in the Dry Valleys: Primary Producers in the Antarctic Desert Ecosystem. *Science.*

Green, K., Burton, H. R. & Watts, D. J., 1995. Studies of the Weddell seal in the Vestfold Hills, East Antartica. *ANARE Research Note, 93,* p. 72.

Harris, C. M. et al., 2015. *Important Bird Areas in Antarctica 2015,* Cambridge: BirdLife International and Environmental Research & Assessment Ltd.

Hedley, S. L., Bannister, J. L. & Dunlop, R. A., 2011. Abundance estimates of southern hemisphere Breeding Stock 'D' humpback whales from aerial and land-based surveys off Shark Bay, Western Australia, 2008. *Journal of Cetacean Research and Management (Special Issue), 3,* pp. 209-221.

Hofmeyr, G. J., 2015. *Mirounga leonina.* [Online]
Available at: http://www.iucnredlist.org/details/13583/0
[Accessed 19 09 2018].

Hückstädt, L., 2015. *Leptonychotes weddellii.* [Online]
Available at: http://www.iucnredlist.org/details/11696/0
[Accessed 19 09 2018].

IWC, 2019. *International Whaling Commission: Whale Population Estimates.* [Online]
Available at: https://iwc.int/estimate
[Accessed 22 08 2019].

Ji, M. et al., 2017. Atmospheric trace gases support primary production in Antarctic desert surface soil. *Nature,* pp. 400-403.

Johnstone, G. W., Lugg, D. J. & Brown, D. A., 1973. The biology of the Vestfold Hills, Antarctica.. *ANARE Scientific Report Series B (1) (ANARE Publ. No. 123)..*

Kelly, N., Peel, D., Bravington, M. V. & Gales, N., 2009. *A description of killer whales (Orcinus orca) observed in Vincennes Bay, Eastern Antarctica.* Madeira, Portugal, s.n.

Kirkwood, J. M. & Burton, H. R., 1988. Macrobenthic species assemblages in Ellis Fjord, Vestfold Hills, Antarctica. *Marine Biology, 97,* pp. 445-457.

Klekociuk, A. & Wienecke, B., 2017. *Australia state of the environment 2016: Antarctic environment,* Canberra: Department of the Environment and Energy.

Lake, S. E. & Heil, P., 1999. *Bathymetric data of Long and Tryne Fjords at Vestfold Hills, Antarctica, collected in December 1999 ,* s.l.: Australian Antarctic Data Centre .

McMahon, C. R. et al., 2005. Population status, trends and a re-examination of the hypotheses explaining the recent declines of the southern elephant seal Mirounga leonina. *Mammal Review, 35,* pp. 82-100.

Otovic, S. et al., 2018. The annual cycle of southern giant petrels Macronectes giganteus in East Antarctica. *Marine Ornithology, 46,* pp. 129-138.

Perrin, W. F., Wursig, B. & Thewissen, J. G. M., 2009. *Encyclopedia of marine mammals. Second edition. In: PERRIN, W. F., WURSIG, B. & THEWISSEN, J. G. M. (eds.) Encyclopedia of marine mammals. Second edition.* New York: Academic Press.

Ramos, A. & San Martin, G., 1999. On the finding of a mass occurrence of Serpula narconensis Baird, 1885 (Polychaeta, Serpulidae) in South Georgia (Antarctica). *Polar Biology, 22,* pp. 379-383.

Rando, S. & Davies, M., 1996. *Heritage Assessment of Buildings and Other Structures and Sites in the Davis Area,* Hobart: Australian Antarctic Division.

Salgado Kent, C. et al., 2012. Southern Hemisphere Breeding Stock D humpback whale population estimates from North West Cape, Western Australia. *Journal of Cetacean Research and Management, 12,* pp. 29-38.

Seppelt, R. D. & Broady, P. A., 1988. Antarctic terrestrial ecosystems: The Vestfold Hills in context. *Hydrobiologia,* pp. 177-184.

Southwell, C. et al., 2017. Large-scale population assessment informs conservation management for seabirds in Antarctica and the Southern Ocean: A case study of Adélie penguins. *Global Ecology and Conservation, 9,* pp. 104-115.

Summerson, R., 2013. *Wilderness and Aesthetic Values of Antarctica.* Christchurch, SCAR Social Sciences Action Group, pp. 22-47.

TSSC, 2016. *Conservation Advice Mirounga leonina,* Canberra: Department of the Environment.

Wisniewski, E., 1983. Bunger Oasis: the largest ice-free area in the Antarctic. *Terra,* Volume 95, pp. 178-187.

Zhang, E. & Ferrari, B. C., 2018. *Microbial Profile of The Ridge Soil Communities,* Sydney: School of Biotechnology & Biomolecular Sciences, UNSW.

8.0 PROPOSED ALTERNATIVES

DO YOU HAVE ANY FEASIBLE ALTERNATIVES TO TAKING THE PROPOSED ACTION?

Alternatives to the project that were considered are described below.

8.1 AERODROME LOCATION

The Australian Government's 2016 *Australian Antarctic Strategy and 20 Year Action Plan* committed to various activities to advance Australia's national interests in Antarctica and enhance Australia's Antarctic science, including investigating year-round air access between Australia & Antarctica. In May 2018, the Australian Government announced its intention to construct a paved runway near Davis research station, subject to environmental and other Government approvals.

Possible sites near Davis research station have been considered for a future runway since at least 1983. In addition to the ridge site (the location of the proposed action), two alternative locations for a runway were considered near Davis research station at Heidemann Valley and a coastal site near Adams Flat.

The Heidemann Valley and coastal sites were not feasible, primarily because of the significant engineering risks associated with constructing a runway in an area of extensive potential frost heave. The ridge site's more favourable geotechnical conditions make it the only feasible option; it also has an associated reduced construction risk and environmental impact compared to the other options.

8.2 RUNWAY LENGTH

Several runway lengths were considered for the Davis aerodrome. A 2,700 m paved runway is the only feasible option that meets the operational requirements for year-round aviation access.

8.3 RUNWAY MATERIAL

Alternative pavement options to concrete pavers, including asphalt and concrete poured in situ were considered, but not considered feasible. The transport of bitumen products to Antarctica by ship is prohibited under MARPOL requirements (the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978).

A semi-prepared surface (gravel) was considered but would not be suitable for intercontinental aircraft to fly directly between Australia and Davis.

Therefore, a paved runway using pre-cast concrete pavement was considered the only feasible option that meets the operational requirements for year-round aviation access.

8.4 WHARF

Several wharf options were considered including: upgrade the existing lift-on lift-off wharf; mobile crawler crane operating on a self-elevating platform; fixed ramp for roll-on and roll-off using landing craft; floating roll-on and roll-off wharf, and lift-on and lift-off wharf with floating berthing structure.

With consideration of bathymetry, impact on existing resupply operations, ease of operation, and maintenance requirements, it was assessed that only a floating roll-on and roll-off wharf, or a lift-on and lift-off wharf with floating berthing structure were feasible. Both options have similar reclamation footprints, and require similar rotary piling effort; both remain under consideration for the project.

8.5 NOT CARRYING OUT THE ACTIVITY

This alternative involves sustaining Wilkins Aerodrome only and presents no change in current capability to access Antarctica (i.e. only in summer). It is anticipated that over time, the effects of climate change would increase the period of the summer shutdown of the Wilkins runway (noting that the likely timing and extent of that impact is unknown), which would reduce aviation access to Australian facilities in Antarctica.

This option does not meet the operational requirements for year-round aviation access.

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

APPENDIX A

PROTECTED MATTERS SEARCH TOOL REPORT

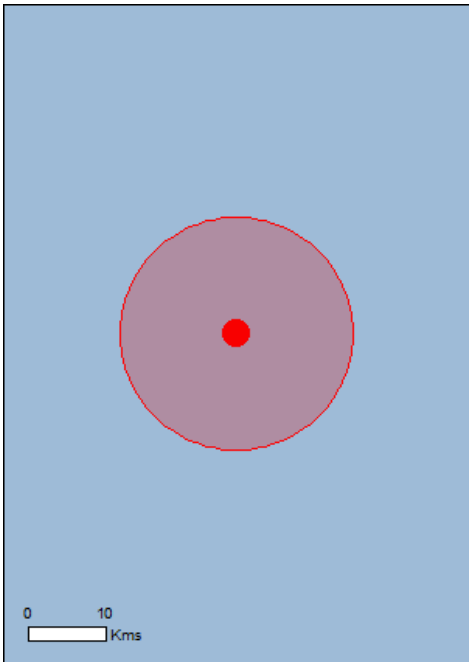
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

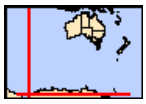
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/12/19 08:18:16



Coordinates
Buffer: 15.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	3
Whales and Other Cetaceans:	7
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	2
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Breeding known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Sterna vittata vittata Antarctic Tern (Indian Ocean) [64452]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Foraging, feeding or related behaviour may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Breeding known to occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Balaena glacialis australis		
Southern Right Whale [75529]	Endangered*	Foraging, feeding or related behaviour may occur within area
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Breeding known to occur within area
Pachyptila turtur		
Fairy Prion [1066]		Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Foraging, feeding or related behaviour may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area

Commonwealth ReservesTerrestrial [Resource Information]

Name	State	Type
Hawker Island	EXT	Antarctic Specially Protected
Marine Plain	EXT	Antarctic Specially Protected

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-68.5686 77.9415

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government
Department of the Environment and Energy
Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

APPENDIX B

ENVIRONMENTAL POLICY

Australian Government

Department of the Environment and Energy

Australian Antarctic Division

AUSTRALIAN ANTARCTIC PROGRAM

ENVIRONMENTAL POLICY

The Australian Antarctic Division will demonstrate leadership in environmental protection across all its activities in Australia and Antarctica.

To improve our environmental performance we will:

- comply with applicable environmental laws and agreements and ensure that all who visit us, or work for, or on behalf of us, also comply
- provide environmental education and training for participants in the Australian Antarctic Program
- commit to undertake all reasonable measures to reduce pollution, waste and other human impacts, where practicable, in all our areas of operation
- where practicable, address the environmental impacts of our past activities and minimise further impacts
- use energy and resources efficiently and seek opportunities to improve environmental outcomes when planning the renewal of infrastructure capabilities and the conduct of operations
- conserve, where practicable, our significant Antarctic heritage items, places and values
- conduct and support research that contributes to the protection of the Antarctic environment
- ensure our environmental decision-making is transparent and responsive to emerging issues and challenges
- monitor and report our environmental performance against objectives and targets
- work with other national operators, organisations and individuals to understand and comply with our shared environmental obligations

Everyone working with or on behalf of the AAD has a responsibility for protecting the environment. All managers are responsible for implementing the AAD environmental policy and are accountable for environmental performance in their areas of responsibility.

We will review this policy every four years and communicate it to AAD staff and the public.

Dr Nick Gales
Director, Australian Antarctic Division
July 2018