APPENDIX 2 WOLFS FANG RUNWAY IEE

SOUTH POLE AND ATKA BAY VISITS INITIAL ENVIRONMENTAL ASSESSMENT

AUGUST 2017

CONTENTS

1 Introduction

This Appendix 2 Report has been prepared by White Desert and should be read in conjunction with the main report, Wolfs Fang Runway IEE Report. The IEE team which has completed the Appendix 2 Report comprises the following key staff:

Table 1.0:IEE Report Team	
Position	**Name /Role**
Author	Eleni Antoniades Snell Chartered Environmental Scientist EIA and Construction Environmental Management of Infrastructure White Desert Ltd Contact: eleni.antoniades.snell@gmail.com
Author /Checker	Stuart McFadzean Antarctic Operations Specialist Project Manager Wolfs Fang Runway, White Desert Ltd Contact: Stuart McFadzean [stuart@white-desert.com]
Approver	Patrick Woodhead, Director of White Desert White Desert Ltd Contact: Patrick@white-desert.com

2 Activities Considered

White Desert is proposing to manage the delivery of a number of existing activities and logistics operations which have previously been sub-contracted to TAC. Specifically, these relate to intercontinental flights from Cape Town, South Africa to Antarctica and client visits to Atka Bay and the South Pole.

Though the activities will remain largely unchanged, the existing permits and corresponding IEE reports will be superseded as our organisation will take over the delivery and management of these activities.

In support of the 2017 Permit Application, White Desert has prepared this Appendix 2 of the Wolfs Fang Runway and Logistics Plan IEE Report. This Appendix identifies the existing activities and logistics operations which White Desert will be taking over and how we propose to continue to manage, avoid and mitigate any potential environmental impacts.

The scope of Appendix 2 comprises the activities, supporting logistics and operations that White Desert will be responsible for, in order to carry out the client visits to Atka Bay Emperor Penguin Colony and visits to South Pole, as well as the client activities themselves.

3 Background

White Desert Ltd has been operating a commercial tourism operation in Queen Maud Land since 2005. The operation runs over the summer period only and is based out of the temporary '*Whichaway*' Camp located on the Schirmacher Oasis. Clients are flown into Whichaway Camp by air for short duration visits between November and January each year. The operation offers small-scale, bespoke experiences for clients with numbers limited to approximately 12-24 clients at any one time.

White Desert clients may undertake excursions to Atka Bay to view wildlife and/or to the South Pole. Travel to these locations is by ski-equipped aircraft such as DHC-6 Twin Otter or BT-67 Basler operated by TAC. These excursions may be supported by field camps run by TAC and IEEs have been previously submitted to assess the impact of these transitory camps.

Logistical support for the operation is dependent upon The Antarctic Company (TAC), which is the non-governmental arm of Antarctic Logistic Centre International (ALCI). TAC provides air transportation services between the nearby Novo Ice Runway and Cape Town, South Africa as well as intra-continental transfers. This support is essentially provided on an opportunity basis whereby White Desert is able to utilise free capacity on aircraft not required by the national programs participating in Dronning Maud Land Air Network project (DROMLAN).

In the 2017-8 season, White Desert is proposing to take over the management and delivery of the client visits to Atka Bay and the South Pole.

3.1 Proposed changes in operations

The anticipated numbers of clients, size of groups will remain unchanged and as set out in Table 6 of the Wolfs Fang Runway IEE. For ease of reference, this information is summarised in Table 2.0 below:

Table 2.0 Proposed Change in Operations		
	2016 Operations Anticipated/Indicative Numbers Range of values/ Projected maximum	2017 - Onwards Anticipated/Indicative Numbers Range of values/ Projected maximum

	As set out in Wolfs Fang Runway IEE Main Report	
Total number of clients per season	Anticipated- 150 Maximum- 200	Unchanged
Size of Groups	Anticipated-12 Maximum- 14	Anticipated-12 Maximum- 24
Total number of groups per season (rotations)	Anticipated 10 Maximum 20	Unchanged
Total number of days spent in Antarctica per group	Average 8 Maximum 10 Day trips and three day trips organised	Unchanged
International return flights per season	Anticipated- 10 Maximum- 20 (dedicated business jet)	Unchanged
Client destinations	Atka Bay South Pole Unchanged	Unchanged
Internal return flights (Clients)	Anticipated- 10 Maximum- 20	Anticipated 16 Maximum 20
Internal return flights (Logistical support)	Previously provided by TAC under separate permit regime and therefore outside scope of Wolfs Fang IEE	Anticipated 35 Maximum 45

4 Legislative context and screening

In 1991 in Madrid, the Antarctic Treaty Consultative Parties have signed the Protocol on Environmental Protection to the Antarctic Treaty (the Protocol), which put forward the environmental protection issues as the most critical obligations of the Parties of the Antarctic Treaty. The Protocol designates Antarctica "as a natural reserve, devoted to peace and science". In January 1998 the Protocol came into legal force after being ratified by all Consultative Parties. According to the requirements of the Protocol, any activity in the Antarctic has to be preceded by an Environmental Impact Assessment (EIA) before its commencement.

The activities under assessment are considered to require an Initial Environmental Evaluation based on the environmental evaluation of similar schemes in Antarctica and the requirements of the Protocol. Additional considerations are:

- White Desert will take over the management and implementation of two existing activities
- This environmental assessment considers two main existing activities which have been permitted outside the UK through a separate permitting regime, which include two IEE reports, and have undertaken by TAC on behalf of White Desert since 2010
- There are no fundamental changes proposed to the nature of these activities
- Seasonal nature of operations and activities which take place over the summer period November- completing by mid February
- The temporary nature and lack of permanent structures associated with these activities

The Wolfs Fang Runway Main Report IEE[1] (encompassing Appendix 1 Logistics and Operations) document was prepared by White Desert and submitted for consideration by the FCO in July 2016. Following the review of the 2016-2017 Permit application and review and approval of the IEE Report by the FCO, British Antarctic Survey (BAS) as well as the Norwegian Polar Institute (NPI), the activities were permitted by the FCO. The logistics operations required to support the Wolfs Fang Runway were implemented by the Project Manager, Stuart McFadzean in December 2016.

In June 2017, it was proposed by White Desert that the IEE assessment is prepared as an Appendix to the Wolfs Fang Runway Main Report IEE, as the internal activities under assessment are intrinsically linked to the Wolf Fang operation and logistics assessment already carried out in 2016. The approach was agreed with the FCO in July 2017. This approach allows the assessment of the impacts associated with internal flights and client visits to be presented within a single document. Though Appendix 2 can be read as a standalone document, it is recommended that the Main Report is used as reference and read in parallel.

[1] Wolfs Fang Runway IEE, Appendix 1 Logistics and Operations Assessment White Desert July 2016

The IEE has been prepared in accordance with the Recommendations and Measures adopted at the Antarctic Treaty Consultative Meetings (ATCM) and within the frames of the procedures of EIAs as per Annex 1 to the Protocol. The level of detail in the environmental assessment approach is considered appropriate for an IEE.

5 Environmental Impact Approach and Methodology

5.1 Consultation and Stakeholder Engagement

White Desert has undertaken consultation and stakeholder engagement with the FCO throughout the feasibility and IEE process. The South Pole and Atka Bay IEE follows the approach and methodology which had been established and developed by White Desert specifically for the Wolfs Fang Runway IEE Report.

The full descrciption of the Environmental Impact and Apprach is set out in the main section of the report. For ease of reference the overall assessment approach and tables are provided below.

The report has been carried out to meet the requirements set out in the Protocol on Environmental Protection to the Antarctic Treaty (1991). The overall approach to the assessment methodology is based on the Guidelines for Environmental Impact Assessment in Antarctica.

In addition to mandatory requirements, and the assessment of similar schemes in Antarctica, UK best practice and industry recognised, current and upcoming technical guidance in relation to EIA has been employed to inform the assessment process. These best practice guidelines include the UK Amended Circular on Environmental Impact Assessment[2], the Explanatory Memorandum to the EIA Regulations[3], IEMA Guidelines for EIA[4], DMRB Assessment and management of Environmental Effects[5] and the European EIA Directive 2011/92/EU.

In accordance with the Guidelines for EIA in Antarctica, the assessment process considers the *outputs of activities* associated with the client visits to Atka Bay and the South Pole. It also considers the *exposure of environmental elements* (environmental elements are often referred to as environmental resources/receptors in EIAs*) to the outputs of activities.*

The nature of each impact is assessed taking into consideration a number of factors, as required by the Protocol. This includes the impact's likelihood, potential consequences, whether the impact would be permanent or temporary, intensity, duration, reversibility spatial extent of the impact, and whether it is direct, indirect or cumulative. The magnitude of impacts can be described as negligible/ minor moderate/major.

The *overall significance* is then identified. In accordance with the Protocol and Guidelines, the overall significance of potential impacts is described using one of three levels:

- Less than minor or transitory

[2] Amended Circular on Environmental Impact Assessment, A Consultation Paper, Department for Government and Local Communities, 2006

[3]The Explanatory Memorandum to the Town and Country Planning (Environmental Impact Assessment) (Amendment) (England) Regulations 2008

[4] Institute for Environmental Management and Assessment Environmental Impact Assessment Guidelines.

[5] Design Manual for Roads and Bridges, Highways Agency, ,Department for Transport, Volume 11, Part 5 Assessment and management of environmental effects and Part 6 Reporting of environmental effects

- Minor or transitory or
- More than minor or transitory

The Protocol and Guidance do not prescribe a methodology for the determination of overall significance .There is no consensus agreement on the definition of the term "minor or transitory" and it is currently based on professional judgement, previous assessments and is considered on a case by case basis. To supplement this process an assessment methodology was developed during the preparation of the Wolfs Fang Runway IEE.

The approach takes into consideration the sensitivity of environmental elements and the nature of the potential impact in order to derive the overall significance, i.e. environmental elements which are designated are considered to be of very high sensitivity. The tables below describe the general categories used to identify the sensitivity of environmental elements, and was developed by Eleni Antoniades Environmental.

Table 3.0 General Guidance Developed for Assessment Process	
Value or sensitivity of environmental element	Description of criterion and examples relevant to assessment
Very High-High	Very high importance and rarity, international scale and very limited potential for substitution
	Designated sites Antarctic Special Protected Areas (ASPA), Antarctic Special Management Areas (ASMA) Historic Sites and Monuments (HSM) Ecosystem Monitoring Programmes (CEMP) sites
	Area of international or continent importance, loss would be significant for overall environment and ecology in Antarctica and on a wider scale (fauna)
	Very high wilderness and aesthetic value with absence of manmade structures or infrastructure
Medium	Habitat suitable for flora and fauna such as breeding, nesting or feeding sites such as freshwater lakes, coastal areas, ice-free ground and mountainous regions
	Area of regional wide importance and rarity, limited potential for substitution
	Areas which are of high sensitivity in terms of impacts on human activity such as research stations, infrastructure and traverse routes (human receptors)
	Area of high wilderness and aesthetic value
Low	Area does not provide a habitat suitable for flora and fauna. Natural environment across Antarctica is protected under Protocol
	Area of local importance
	Area of medium wilderness and aesthetic value reduced by presence of human activities such as abandoned sites

Guidance for description of magnitude	
Magnitude	**Description**

Negligible	No discernible impacts or impacts of very limited extent or duration, very minor loss to one or more characteristics, features or elements
Minor	Temporary short term disturbance to the physical status, dynamics or function of the receptor. A reduction in the receptor, but no significant habitat loss. Minor loss or alteration to one or more feature or element
Moderate	Partial loss of, temporary damage to or medium term disruption to physical status, dynamics or function of the receptor. Loss of resource but not adversely affecting integrity
Major	Complete loss of, permanent damage to, degradation of or long term disruption to integrity, physical status, dynamics or function of the receptor

Professional judgement is used to determine the overall significance of impacts, the table below has been developed as a general guideline or basis.

Table 4: 0 Determining Overall Significance of Impacts

	MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
VALUE / SENSITIVITY ENVIRONMENTAL ELEMENT RECEPTOR OR RESOURCE		**No change**	**Minor**	**Moderate**	**Major**
	Very High	*Less than minor or transient*	*Minor or transient*	*More than minor or transient*	*More than minor or transient*
	High	*Less than minor or transient*	*Minor or transient*	*More than minor or transient/ Minor or transient*	*More than minor or transient*
	Medium	*Less than minor or transient*	*Minor or transient / Less than minor or transient*	*Minor or transient*	*Minor or transient*
	Low	*Less than minor or transient*	*Less than minor or transient*	*Less than minor or transient Minor or transient*	*Minor or transient*

Source: Tables developed by Eleni Antoniades Environmental Ltd for Antarctica projects

Where potential impacts are identified, appropriate mitigation, enhancement measures or monitoring measures are described in order to reduce the likelihood or consequence. Mitigation measures which have already been incorporated into the design of the proposed scheme are also identified

5.2 Approach

As described above, the assessment considers two main existing activities, client visits to Atka Bay and client visits to the South Pole, along with the required supporting logistics and operations for each of these activities. The existing environment and the baseline conditions are described separately for these two distinct geographical regions.

It is proposed that White Desert manages and delivers these specific activities, which have been undertaken by external organisations, mainly TAC since 2010 under a separate

permitting and IEE regime. There are no changes proposed to the geographical areas being visited by clients and White Desert has been responsible for ensuring that client visits comply with International Association of Antarctic tour Operators (IAATO) requirements. White Desert is therefore already familiar with the geographical areas visited and the sensitivity of these areas. The assessment process will identify the additional environmental management and mitigation measures which need to be implemented by White Desert.

6 Description of Existing Environment and Baseline Conditions

6.1 Study Areas, Spatial and Temporal Scope

The two main acitvities assessed take place at Atka Bay and the South Pole. As these are two distinct geographical regions in Antarctica, each activitiy is considered and assessed separately:

- *South Pole* (90°00'S)*and Fuel Depot 83 location* (83°00'S 11°38'E) *and corresponding wider study areas* which encompass the Amundsen Scott South Pole Station landing site and wider study area as well as the Fuel Depot 83 landing site and wider study area.

- It should be noted that White Desert will take over the management and delivery of the flight activities to the South Pole during the *2017-2018 season.* In the *2018-2019 season*, White Desert will look to establish its own re-supply depot in order to refuel its internal flights to the South Pole. To minimise environmental impact, it is proposed to establish it in the immediate vicinity of Fuel Depot 83, which is currently managed by ALCI/TAC. The re-supply will be carried out by ground traverse.

- *The Atka Bay site* which is the location of the Emperor Penguin colony (70°36'45" S, 8°07'25" W), the landing site and corresponding wider study area.

- It should be noted that White Desert will take over the delivery and management of flight activities to Atka Bay during the *2017-2018* season.

The wider study areas and zone of influence vary according to the requirements of specific topics, in order to encompass the direct and indirect impacts of the activities.

The baseline conditions have been identified using published information and desk based research carried out in between June and July 2017.

In terms of temporal scope, the description of the baseline environment comprises the existing scenario of the 2016-2017 summer season.

The location of the study areas, designated sites and environmental features of interest identified in this section can be referred to in figures, which are presented in the Environmental Features section of this appendix.

6.2 South Pole and FD83

6.2.1 Land Use South Pole

The land use of the study area is associated with the Amundsen-Scott South Pole Station, a United States scientific research station and comprises a number of permanent and seasonal structures, facilities and activities.

This includes the Amundsen Scott Research Station structure itself (90°S, 0°) which is a permanent structure used throughout the year. Other external associated facilities and structures include[6]:

- Atmospheric Research Observatory (ARO), located approximately 500 m from the elevated station Summer Camp construction offices
- Air operations facilities including landing strip
- Fuel storage tanks
- National Science Foundation office.
- The IceCube Neutrino Observatory located approximately 500 m from the elevated station in the Dark Sector
- Aircraft snow landing strip (prepared each summer season for ski equipped aircraft)
- Fuel storage and refuelling area associated with aircraft landing strip
- Fleet of vehicles to support logistics
- Designated to manage multiple activities and protect the South Pole environment
- Extends 150 km from the geographic South Pole
- Covers an area of 26,283 km2
- Four sectors: Dark, Quiet, Clean Air and Downwind
- Five Zones: Scientific, Historic, Operations, Hazardous and De-motorized
- Amundsen-Scott South Pole Station accommodates up to 250 personnel in summer

During winter, about 50 scientists and support personnel live at the station to run experiments and maintain facilities, while in the summer this increases up to a maximum of around 250. The station is completely isolated between mid-February and late-October, as air and overland support to the Pole cannot be undertaken because conditions are so extreme.

[6] Source of information http://www.southpole.aq/

In terms of logistical operations, ski-equipped Hercules airplanes (LC-130) transport fuel, equipment, supplies, and personnel from McMurdo Station to inland sites, including Amundsen-Scott South Pole Station, and from New Zealand. During the austral summer, wheeled military transports (C-17s and C-130s) also bring equipment, personnel, and supplies to Antarctica from New Zealand. Ski-equipped Twin Otters and Basler aircraft also provide support to field teams during the austral summer.

Non-governmental organizations and individuals also visit the Pole on expeditions or as tourists. Over the five-year period between 2006-2011, an average of approximately 190 people per season visited the South Pole on private expeditions. The highest number to date was recorded in 2011-12 with 495 visitors, which is almost double the previous high of 266 recorded in 2010-11. This peak was driven by a surge of interest in the South Pole surrounding the centennial years of Amundsen's and Scott's expeditions.

Existing arrangements for visits to South Pole

The South Pole station is divided into five zones: Scientific, Historic, Operations, Hazardous and De-motorized zones. Each zones has specific guidelines which are to be followed for the conduct of activities. The management plan for the ASMA includes detailed requirements for each of these zones, as well as a code of conduct.

The operational zone is used for scientific support and is where human activity takes place, including tourism. The historical zone encompasses and preserves historical sites and is located within the operational zone. Human activities are restricted from the hazardous zone and the scientific zone is used for scientific research activities.

A small number of private companies operate organized tours and support expeditions to the South Pole, both overland and by air. White Desert currently organise client site visits to the South Pole per season which are currently operated and managed by TAC. The number of visits can vary between two to a maximum of ten depending on client requirements. The size total size of groups, including staff is between 10- 20.

Ski equipped aircraft used by TAC on behalf of White Desert include Basler BT-67. TAC is required to comply with the requirements set out within the management plan for ASMA 5: Amundsen -Scott South Pole Station, South Pole. Measure 2 (2007) -Annex A, in order to carry out the client site visits.

The White Desert client visits take place entirely within the operational zone and historical zone. The code of conduct relevant to White Desert activities include:

- Code of conduct for access and movement within the South Pole designated area (ASMA 5)
- Code of conduct for access to the area via aircraft- other expeditions

All flights and visits are schedule in accordance with the requirements of the South Pole station. Within the South Pole site, clients move around on foot.

6.2.2 Land Use Fuel Depot Location 83

The Fuel Depot 83 location site (83°00'S 11°38'E), henceforth referred to as FD83, has been used as fuel storage depot and logistical base facility jointly by the Antarctic Logistic Centre International (ALCI) and The Antarctic Company (TAC) since 2010. The site is used during the austral summer, between November and January as a refuelling and rest stop location for onwards visits to the South Pole. It is used by TAC for refuelling in order to carry out visits on behalf of White Desert as well as other organisations.

Platforms of fuel have been dropped at the site using parachute drops in support of trips to the South Pole on an annual basis. The site includes storage of full and redundant fuel tanks as well as the storage of temporary plant and equipment. ALCI/ TAC have been responsible for the permit process for this activity, which included the preparation of an IEE Report[7] prepared in 2010. TAC currently carry out all logistical operations on behalf of White Desert for the client trips to the South Pole. The use of the site by TAC for other activities will continue.

For the 2017-8 season, White Desert will re-fuel its BT-67 aircraft at FD83 en route to the South Pole, but all management of the site, fuel and skiway will be exclusively the responsibility of TAC.

In future seasons, White Desert will establish our own re-fuelling facility, which we propose to located in close proximity to the existing location of Fuel Depot 83, in order to minimise environmental impact. The camp will be used as a stopping point, and refuelling location by White Desert during the 2018-2019 season.

The plant and equipment used at the site on a temporary basis includes[8]:

- New and redundant fuel storage tanks
- Power generation (Small (1,8-2,0 KW) portable generator 220 V and a generator 5 KW with spare fuel)
- Temporary accommodation for staff (large tent, dry toilets)
- Necessary climbing search-and-rescue equipment, first aid kit for the voyage and camp use
- Landing site for ski equipped aircraft and markers for parachute drops

6.2.3 Physical Environment Region Description

In terms of the published Environmental Domains of the Antarctic, both the South Pole Station and Fuel Drop 83 are located within the East Antarctic high interior ice sheet domain.

It is a large environment focused around the South Pole and covers the largest total surface area (3 709 111 km2) within the classification. Climatically the environment is extremely

[7] Fuel Depot Camp IEE, ALCI IEE 2010
[8] Fuel Depot Camp IEE, ALCI IEE 2010

cold, and holds a number of distinctions: it contains the coldest annual air temperature (–47.64°C) and largest seasonal range (–29.50°C). The environment also has the third lowest level of solar radiation (7.56 MJ/m2/day). The average wind speed (9.99 m/sec) is quite calm in comparison with the other environments. It is also quite flat, with an average slope of only 3.10°. Well-known locations the environment covers include the South Pole, Vostok and Dome C station areas and drill holes.

This environmental domain is comprised entirely of ice sheet land cover and contains no exposed geological features such as bedrock or soil.

6.2.4 Physical Environment South Pole

Information on the physical environment is available from published research undertaken at the Amundsen- Scott South Pole Station. The Amundsen-Scott South Pole Station has an elevation of 2835 meters on Antarctica's interior ice sheet, which is approximately 2700 meters thick at this location. The station, which is 850 nautical miles south of McMurdo Station, is drifting with the ice sheet at about 10 meters (33 feet) each year[9].

Meteorological data

The Amundsen-Scott South Pole Station includes the South Pole Atmospheric Research Observatory (ARO). Recorded temperature has varied between -13.6° C and -82.8° C. Annual mean is -49° C; monthly means vary from -28° C in December to -60° C in July. Average wind is 10.7 knots (12.3 miles per hour); peak gust recorded was 48 knots (55 miles per hour) in August 1989.

Snow accumulation is about 20 centimetres of snow (6-8 centimetres water equivalent) per year, with very low humidity

The temperature at the South Pole station consists of 6 months when it is fairly stable from April to September. After this, there is a 3 month period where the temperature rises to a peak and then drops again. This corresponds to light and dark. When it is permanently dark, the temperature is very stable. As the sun rises higher in the sky and has more heating power, so the temperature rises. After the longest day, December 21st, the sun falls again and so does the temperature.

Wind

Compared to the coastal areas, surface winds at South Pole are relatively light. Averaging about 11 knots annually, wind speeds rarely exceed 40 knots. The prevailing direction is from grid north. When wind speeds exceed 15 knots, blowing snow begins to significantly reduce visibility. Dangerous whiteout conditions (zero visibility with total loss of the horizon) usually occur when sustained winds exceed about 25 knots. The strongest gust ever recorded at South Pole is 48 knots. Orographically forced clouds and precipitation are common when the wind blows from the grid north or grid northwest, while down-slope conditions prevail when winds are from the grid northeast through grid southeast. Winds from the grid south and grid southwest are rarely observed.

[9] https://www.nsf.gov/geo/opp/support/southp.jsp

The sensitivity of the physical environment at the South Pole and immediate study area is considered to be **very high**-**high** and the sensitivity of the physical environment at FD83 is considered to be **low** and the wider area **medium**, in accordance with the General Guidance Developed for the Assessment Process table.

6.2.5 Flora and Fauna

Description of habitat

The South Pole and FD83 sites and their corresponding wider study areas are considered to have a similar environment in terms of ecological habitat. The sites are located in the interior of Antarctica, at a distance of approximately 300 km from the closest geological features and approximately 650 km inland from the coastal region.

The type of flora and fauna typically associated with surface geological features (such as nunataks[10]) and coastal regions of Antarctica are absent from the ice surface. Terrestrial invertebrates are present where there is soil to provide a water film and where there is productivity in the form of growth of plants such as algae, mosses or liverworts. They are also often found around the nests of birds that nest on nunataks.

As these features are absent from the South Pole and FD 83 locations, there is limited/no potential for terrestrial invertebrates to be present. In 2000 it was reported that microbial life had been detected living in the South Pole ice. In August 2014, scientists reported finding thousands of different types of microorganisms in a large lake 800 meters under the Antarctic ice sheet[11].Microbial life in the ice and life beneath the ice-shelf are considered to be outside the scope of this assessment due to the types of activities under assessment.

The South Pole and FD 83 are not considered to provide a suitable habitat for vegetation, avifauna or fauna and invertebrates associated with their presence. Off-course south polar skuas and snow petrels have been occasionally observed at the Amundsen-Scott South Pole Station.[12]

Designated Sites

The Antarctic Protected Areas database[13] has been searched in order to identify the location of the Antarctic Special Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA), as well as Important Bird Areas (IBA).

There are no ASPA or IBA at either the South Pole or the FD83 sites and their wider study areas. The South Pole research station area has been designated as an ASMA since 2007. Further information is provided in the cultural heritage section below.

The South Pole and FD83 do not provide an ecological habitat which is suitable for flora and fauna on the surface of the ice. The sensitivity of the environment at both locations in terms

10 Nunataks- isolated mountain peaks elevated from the surrounding ice.

11 A microbial ecosystem beneath the West Antarctic ice sheet, 2011

12 Antarctic Sun, United States Antarctic Program, January 2003

13 http://www.ats.aq/devPH/apa/ep_protected.aspx?lang=e, data obtained in July 2017

of flora and fauna is therefore considered to be **Low**, in accordance with the criteria set out in the General Guidance Developed for Assessment Process table.

6.2.6 Cultural/ Antarctic Heritage

Designated cultural/ Antarctic heritage sites and features of interest were identified through the list of Historic Sites and Monuments (HSM) database as well as the Antarctic Special Management Area database, which are published on the Antarctic Protected Areas database[14] website, accessed in July 2017.

South Pole

The South Pole site and wider study area are located within the Amundsen- Scott South Pole Station Antarctic Special Management Area, which has been designated as an ASMA (ASMA 5) since 2007. It has been designated in order to manage human activities for the protection of scientific, environmental and historical values. It is considered to be an area of high scientific and historical value. A management plan has been developed for the area, which includes a description of the values to be protected, a description of the area as well as the code of conduct and a set of detailed guidelines for all activities at the site, as described above. The historic and Antarctic heritage significance of this site forms the basis of White Desert's client visits.

In terms of the HSM records, there are two designated HSM features at the South Pole site and wider study area. These are the ceremonial South Pole Flag Mast (HSM1) and Amundsen's Tent (HSM80). HSM1 is the site of the ceremonial South Pole mast surrounded by the flags of the twelve original Antarctic Treaty nations. It also commemorates the International Geophysical Year and is symbolic of all expeditions which have reached the South Pole. It was first installed in 1965 by the first by the First Argentine Overland Polar Expedition. HSM80 is a symbolic dedication to the location of Amundsen's Tent, which was installed at 90° by the Norwegian group of explorers led by Amundsen on their arrival at the South Pole on 14 December 1911. The actual tent is currently buried underneath the snow and ice.

There are no other features designated for their historic or cultural significance in the wider study area of the South Pole site.

Taking the historic significance, unique nature and as the site is designated as an ASMA and HSM, the cultural heritage value of the South Pole is considered to be **very high**, in accordance with the criteria set out in the General Guidance Developed for the Assessment Process table.

Fuel Depot Location 83

There are no features designated for their historic or cultural significance at the location of FD83 or the wider study area.

6.2.7 Wilderness and Visual Amenity

South Pole Site

[14] http://www.ats.aq/devPH/apa/ep_protected.aspx?lang=e, data obtained in July 2017

The spatial scope and zone of influence in terms of wilderness and visual amenity is considered to be the South Pole site and the wider study area surrounding the site, encompassing Amundsen Scott South Pole Station, its associated structures and facilities. The site is visited by tourists and scientists due to its historical, cultural and scientific significance. Taking the historic significance, unique nature and as the South Pole site is designated as an ASMA and HSM, the visual amenity value of the site is considered to be **very high**, in accordance with the criteria set out in the General Guidance Developed for the Assessment Process table.

Fuel Depot location 83

The spatial scope and zone of influence in terms of wilderness and visual amenity is considered to be the FD83 site, encompassing all supporting plant and equipment storage as well as the aircraft landing location, and the wider study area surrounding the site.

The site is not visible from any designated ecological or heritage sites and is not located within a designated site. Due to the absence of other existing human visual receptors (such as research stations, or existing traverse routes) and the remoteness of the site, it is considered that no significant wilderness and visual impacts would be experienced outside the immediate study area.

Though the wider study area surrounding the FD83 location is undisturbed and is of high wilderness and aesthetic value, the presence of human activities is visible on site. The FD83 site is located at a distance of 800 km north of the South Pole and has been used as a stop off point and fuel storage location by TAC, as well as ALCI since 2010. The site includes storage of full and redundant fuel tanks as well as the storage of temporary plant and equipment, as described in more detail in the land use section.

Taking these factors into consideration, the value of the wilderness and visual amenity of the FD83 is considered to be **low** while with immediate study area is considered to be **high** in value or sensitivity.

6.2.8 Noise, Vibration and Local Air Quality

Introduction

In terms of noise, vibration and local air quality impacts associated with the use of aircraft, sensitive receptors which are potentially impacted by the flight path and landing sites have been identified using a 1000m buffer from the light aircraft landing site locations, as the worst case scenario.

The wider study area for noise, vibration and local air quality impacts arising from 4x4 vehicles (such as Toyota Hilux) used to access the FD83 site, is a 300m buffer from the traverse route. This distance takes into consideration the existing background noise levels, types of proposed activity and published guidelines used in the UK for the assessment of noise and vibration UK[15]. There are no vehicles used by White Desert at the South Pole site.

[15] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise Part 2: Vibration.

Sensitive receptor sites within the buffer zones have been identified from published base mapping of the area through the Antarctic Database Mapviewer website[16] and the ecological baseline information described above.

South Pole Site

The background noise, vibration and air quality levels on site and in the wider study area are mainly influenced by the logistics activities carried out at Amundsen-Scott South Pole Station, which is the central logistics hub for the area.

The background local air quality is considered to be high, as evidenced by the clean air sector, which carries out air quality monitoring. The background noise and vibration levels at the South Pole site and in the wider area, are considered to be generally low, with the exception of high peaks during landing and takeoff of the station's aircraft logistics and supply flights, and during the use of vehicles for logistics and research purposes. The station supply flights are currently carried out using Twin Otter, Basler BT67 as well as military (such as C-17s and C-130s). There are approximately 70 flights[17] scheduled each season for logistics purposes and in addition to the logistics and operations flights, there are flights scheduled for visitors and tourists activities. During the 2016-2017 season, White Desert scheduled four visits and due to weather restrictions, carried out a two client visits to the South Pole. Future seasons will have a similar scale in terms of the nature of site visits.

The closest human receptors comprise the staff of the Amundsen-Scott South Pole Station, which operates all year round and is located in close proximity to the landing site. In terms of ecology, there are no ecological receptor sites within the wider study area study area.

The requirements of the clean air sector, where over flight below 2000m and overland transit is prohibited except for essential purposes, are already taken into consideration during the planning and implementation aircraft activities by TAC. The sensitivity of the site and value of the site in relation to air quality is considered to be very high.

There are no vehicles used by White Desert at the South Pole site which would give rise to noise, vibration or local air quality impacts. All transport within the South Pole is carried out on foot.

Fuel Depot Location 83

The human receptors of noise, vibration and local air quality impacts at FD83 and the wider study area, comprise the White Desert staff and clients, and supporting site staff at the FD83. In terms of ecology, there are no sensitive ecological receptor sites at FD83 site or within the wider study area.

Due to the isolated location of FD83 and lack of human activities in the wider study area, the background noise levels are considered to be generally low and characterised by the current logistics and operations flights, as well as the use of vehicles (skidoos and tracked vehicles to

[16] http://www.add.scar.org/home/add7
[17] https://www.nsf.gov/geo/opp/support/southp.jsp

access the site). Fuel is currently dropped by parachute drops once a year during the summer season. The background local air quality is also considered to be high.

6.3 Atka Bay

6.3.1 Introduction

The wider study area of Atka Bay and Ekstrom Ice Shelf has been subject to extensive scientific research carried out by international research organisations since the 1950s. The first geological reconnaissance in this area was carried out by the Norwegian-British-Swedish Antarctic Expedition in 1949-1952. The installation of the German Neumayer station, which was first installed in the area in 1981, has contributed to ongoing detailed research and understanding of the environment. There are extensive and detailed scientific research papers and documents available in terms of the physical environment and biological environment.

A detailed desk based review of published information has been carried out in order to identify the baseline environment relevant to the specific activities being assessed within this IEE. The purpose of this section is therefore to summarise the findings of the research as opposed to presenting an in depth comprehensive description of the physical environment. However, scientific resources of information are readily available for the immediate and wider study area and can be consulted if required by White Desert throughout the operational phase.

6.3.2 Land Use

The land use of the wider study area is associated with scientific research station of Neumayer and comprises a number of permanent and seasonal structures, facilities and activities. This includes the Neumayer III Research Station structure itself (70°40´S, 008°16´W) which is a permanent structure used throughout the year. Other external associated facilities and structures include[18]:

- Power generating equipment (diesel generator and wind generator)
- Balloon launching container and meteorological observatory
- Air chemistry observatory
- Infrasound Station
- Hydro-acoustic observatory
- Radom for housing the satellite dish antenna for communication
- Ship landing location at the edge of the Ekstrom Ice Shelf and in Atka Bay
- Aircraft snow landing strip (prepared each summer season for ski equipped aircraft)
- Fuel storage and refuelling area associated with aircraft landing strip
- Fleet of vehicles to support logistics ("Pisten-bully" tracked vehicles, smaller "skidoo" vehicles, sledges)

[18] Information summarised from Georg Forster to Neumayer Station II -a Sustainable Replacement at Atka Bay

As of 2016-2017 there was a total of 77 staff working permanently or temporarily at the station.

Cargo is supplied to the station via shipping routes as well as aircraft during the austral season. During the 2016-2017 summer season[19], there were four shipping calls scheduled to provide cargo and supplies, including the Mary Arctica RRS Ernest Shackleton which called at Atka Bay. Atka Bay also provides an unloading site for the South Africa Regional Programme. In terms of aircraft, supplies were provided to the station using a Basler BT67 during the 2016-2017 summer season. Other light aircraft used in previous seasons include Twin Otter and Dornier 228.

In addition, existing visits to the Emperor Penguin Colony are carried out by TAC on behalf of White Desert, though this represents a very small proportion of the overall activities in the area, with eight visits per season, each last for a few hours. This currently includes landing at Atka Bay, clients walking or skiing a total distance of 1 km to visit the colony before returning to the aircraft. In the immediate study area of the Emperor Penguin Colony, there are no permanent human structures, though there is some potential for interaction with the scientific programme's supply vessels arriving at Atka Bay.

Land use of the wider study area includes the supply traverse to the German Kohnen research station, which is the southernmost structure associated with the Neumayer Research Station. This is via the Kottas Mountains, over a distance of 750km up to the inland plateau and is used by the Neumayer Research Station. Atka Bay is also used as an unloading site for supplying the South African Station SANAE IV, using a traverse route of a distance of approximately 300km.

6.3.3 Physical Environment Region Description

Atka Bay is located along the Princess Martha Coast, a coastal zone in the western area of Dronning Maud Land. Atka Bay (also referred to as Atka Iceport) is 440 square kilometres area of seasonal sea ice, adjacent to the Ekstrom Ice Shelf.

Atka Bay is located within the Dronning Maud Land Antarctic Conservation Bio-geographic Region ACBG 6.Dronning Maud Land ACBG 6 consists of a series of nunataks and mountain ranges separated by glaciers or ice covered terrain. In terms of the published Environmental Domains Analysis of the Antarctic Domain Analysis, it can be categorised as Domain I East Antarctic Ice Shelf. This Environmental Domain is comprised entirely of ice shelves and contains no exposed geological features such as bedrock or soil.

The closest nunataks to the site are the Kurze Mountains, located approximately 18km to the south and the Conrad Mountains 30km to the southeast.

Extensive research has been carried out and is on-going in relation to the physical environment at Atka Bay. The information presented in this section is summarised from a number of publications, as referenced in the bibliography section. Sea ice fastened to coasts, icebergs and ice shelves, also referred to as fast ice, is of importance to climate and ecosystems. Atka bay is covered for most of the year with fast ice reaching a thickness of 2 metres or more by late winter. Icebergs often run aground in the bay, and some remain in

[19] Information summarised from AWI - Expedition Program Antarctica (ANT-Land 2016/2017), November 2016

situ for a number of years before breaking up and drifting away. Drifting snow forms natural steep ramps from sea ice to ice shelf surfaces at many places when it is deposited in the protected zones of the ice edge.

The Ekstrom ice shelf is a small- medium sized ice shelf, with a total surface area of approximately 8,700 square kilometres. It is part of the Eastern Weddell Ice Shelves, a group of several small ice shelves in the Weddell Sea. The Ekstrom ice shelf is between 140 and 250 meters thick at the edge, where it rises between 10 and 40 meters above the sea level. The Ekstrom ice shelf is not free floating, but moves over ridges rising from the bottom of the sea. Grounded ice shelves form approximately 40 percent of the Antarctic coastline.

Atka Bay Sea- Ice

The sea ice begins to break out in December-January each year via a process influenced by the Ekstrom ice shelf. This landfast sea ice exhibits two unique characteristics that distinguish it from most other sea ice:

1. Ice platelets form and grow in super cooled water masses, which originate from cavities below the ice shelves. These crystals rise to the surface, where they accumulate beneath the solid sea-ice cover. Through freezing of interstitial water they are incorporated into the sea-ice fabric as platelet ice.

2. A thick and partly multi-year snow cover accumulates on the fast ice, altering the response of the surface to remote sensing and affecting sea-ice energy- and mass balance.

The seasonal sea-ice cover of Atka Bay usually forms between March and April, reaching the maximum thickness by December. The extent of the sea-ice varies, and is dependent on a number of environmental factors such as grounded or passing icebergs and polynyas. Sea ice begins to break out once it is destabilized enough by higher water and air temperatures, tidal motion and wind forcing. These factors lead to an outbreak of floes starting in the eastern part of the Bay, usually between December and January. In the south-western part, sea ice may stay as long as early March, but in most years the Bay is completely ice free at the end of March[20].

The *Antarctic Fast Ice Network-Sea Ice Monitoring* in Atka Bay project (AFIN), which is run from Neumayer III has monitored the sea-ice thickness across a number of sample locations throughout the year. A cross section which indicates the thickness of the sea-ice throughout the year presents the findings of this research and can be referred to the Physical Environment figures on the Environmental Features section. The closest sampling location to the landing site of White Desert at Atka Bay is location ATK03, and the results of the monitoring indicates that during the client visits to Atka Bay, which typically take place in December, the sea-ice has a maximum thickness of 2 meters and is underlain by ice platelets.

The extent of the sea ice and therefore the sea ice conditions which will be encountered each season, vary each year. The extent of the sea ice and the lines of the fast ice edge, if required in advance of client visits, can be considered further using the information from the AFIN project.

[20] Field work on Atka Bay landfast sea ice in 2012/13 Field Report (see references for authors)

Meteorological data

Neumayer station provides operational weather forecasts for DROMLAN activities and has been carrying out meteorological forecasts for DROMLAN since 2002/2003. A meteorological observatory has been monitoring weather data continuously since 1981 when the first Neumayer station was installed. Weather observations carried out include air temperature, wind vector, cloud type ad cloud height, horizontal visibility, past and present weather as well as snow drift.

Average Weather conditions at Neumayer Station[21]:

- Air temperature (Gube-Lehnhard 1987 and various later sources):
- Annual mean -16.1°C
- August (coldest month) average -24.9°C
- January (warmest month) average -4.1°C
- Minimum -47.3°C
- Maximum + 4.5°C
- Summer (season) -23.0°C to +1.2°C (average min. to max. 15.12 to 10.03)

Wind velocities and snow drift (König 1985 and various later sources):

- Annual mean 9.1 m/s
- Maximum (max. 10 minutes mean, FF10) 36.5 m/s
- Maximum (max. 1 minutes mean) 39.9 m/s
- Maximum gust 50.0 m/s
- Days of snow drift 60%

The visits are likely to take place between November and January. Annual weather averages in Neumayer-Station III, based on weather reports collected during 2005–2015 for December are summarised below:

December Climate & Weather Averages in Neumayer-Station III

- High Temp: -2 °C
- Low Temp: -9 °C
- Mean Temp: -5 °C
- Precipitation: 18.9 mm

[21] https://www.awi.de/nc/en/science/long-term-observations/atmosphere/antarctic-neumayer/meteorology.html

- Humidity: 87%
- Dew Point: -7 °C
- Wind: 17 mph
- Pressure: 986 mbar
- Visibility: 24 km

The site of the Emperor Penguin colony is not inhabited by humans, and there are only occasional visits carried out to the colony for scientific research (for example the Single Penguin Observation and Tracking project) and occasional visits for tourism purposes (such as the visits carried out by White Desert clients). The physical environment is considered to be undisturbed by human impacts.

Overall, the physical environment and quality of ice is considered to be of **high** sensitivity, in accordance with the General Guidance Developed for Assessment Process table.

6.3.4 Flora and Fauna

Description of *ATKA BAY (SEA-ICE) AND EKSTROM ICESHELF HABITAT REGIONS*

The ecological habitat of Atka Bay has been identified from published ecological research papers and reports. Due to the coastal location and absence of surface geological features, the ecological habitat of Atka Bay differs to the Wolfs Fang Runway wider study area as described in the main section of the Wolfs Fang Runway IEE Report, which is associated with geological features and blue-ice fields.

The type of flora (moss cushion, fructose lichen, epilithic lichen) associated with nunataks are absent from areas of iceshelf. Terrestrial invertebrates found in Dronning Maud Land are often associated with mosses, lichens, cyanobacteria and green algae; and include nematodes, rotifers and terrestrial arthropods. These terrestrial invertebrates are likely to be absent from the iceshelf and sea-ice, though it is considered that mites may be present in areas with bird populations. Microbial life within the iceshelf is likely to be limited to cryogenic bacteria, though no specific published information has been found in relation to this area.

Due to the ecological habitat as well as the nature of activities being considered, microbial life, flora, and terrestrial invertebrates are not considered in more detail in this assessment.

The marine environment of Atka Bay provides a rich habitat for a diverse range marine flora and fauna. However, as the activities (client visit to Emperor Penguin Colony at Atka Bay) under assessment take place entirely on the surface of the sea-ice and there are no activities carried out beneath the sea-ice, the ecology of the purely marine aquatic environment and marine habitat beneath the ice is considered to be outside the scope of this assessment and is not considered in further detail within this IEE. Atka Bay and the coastal region do provide a suitable habitat for avifauna as well as seals. These are identified and described in detail below.

Designated Sites

The Antarctic Protected Areas database[22] and Commission for the Conservation of Antarctic Marine Living Resources (CCMALR) website[23] has been searched in order to identify the location of the ASPA, ASMA, CCAMLR sites, as well as IBA at Atka Bay and the wider study area.

ATKA ICEPORT, IBA ANT 109:

Important Bird Areas in Antarctica are part of a network of internationally protected sites. The Emperor Penguin colony site visited is designated as an IBA in Antarctica, with an identification number of *ANT109 Atka Iceport IBA*(70° 36'45'' S. 8° 07' 25''W).The IBA qualifies on the basis of the Emperor Penguin colony present and is entirely marine. The total population of Emperor Penguins at the colony has been estimated by a scientific research project, using satellite imagery taken in 2009, to be approximately 9657[24]. This is a greater population than the previous estimate of 8000 made in 1986[25].

In accordance with the IBA in Antarctica 2015 document, the site has qualified as an IBA on the basis of two criteria:

- IBA criterion A1: Globally A1: Globally threatened species.
  The site is known or thought regularly to hold significant numbers of a globally threatened species, or other species of global conservation concern
  The site qualifies if it is known, estimated or thought to hold a population of a species categorized by the IUCN Red List as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). In general, the regular presence of a CR or EN species, irrespective of population size, at a site may be sufficient for a site to qualify as an IBA. For VU species, the presence of more than threshold numbers at a site is necessary to trigger selection. The site may also qualify if it holds more than threshold numbers of species in the Near Threatened (NT) category. Thresholds are set regionally, often on a species by species basis. In the case of Atka Iceport, the site qualifies as it holds a Near Threatened population.

- IBA criterion A4ii: *The site is known or thought to hold, on a regular basis, 1% or more of the global population of a congregatory seabird or terrestrial species*

This designation, importance and sensitivity of the site are taken into consideration throughout the activity.

The closest IBA to the site is Muskegbukta (70°00' S, 1° 25 W, reference number IBA ANT 110) and is also designated for the presence of an Emperor Penguin Colony with a population of 3193 [26]. It is located along the same coastline, at a distance of more than 300 km east of Atka Bay and is therefore considered to be outside the wider study area, though

[22] http://www.ats.aq/devPH/apa/ep_protected.aspx?lang=e, data obtained in July 2017
[23] https://gis.ccamlr.org/home
[24] An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012, Fretwell et Al (see reference section)
[25] The Distribution and Abundances of Antarctic and Sub Antarctic Penguins, 1983
[26] An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012, Fretwell et Al (see reference section)

it's location will need to be taken into consideration during the planning of flight paths. Svarthamaren IBA is located at a distance of 500km east of the site and is considered in more detail within the main report.

The location of the Emperor Penguin colonies which have been mapped by scientific research undertaken by Fretwell *Et Al* 2012, can be referred to in the Environmental Features feigures.

Antarctic Special Protected Areas (ASPA), Antarctic Specially Managed Areas (ASMA) and CCMALR Sites

There are no other designated sites including ASPA, ASMA or CCMALR sites in the immediate study area at Atka Bay or the wider study area which could be directly or indirectly impacted by the activity of client visits to the Emperor Penguin Colony. The closest ASPA and ASMA designated area to the site is the Svarthamaren ASPA (ASPA Area No.142), and is located at a distance of approximately 500km east of the site. The Dakshin Gangotri Glacier ASPA (ASPA No 163) is located approximately 700km to the east of the site. The location of all designated ecological sites will continue to be taken into consideration during the planning of flight paths. Further information on these two designated sites is provided in the Wolfs Fang Runway IEE Main Report.

Fauna

ATKA BAY EMPEROR PENGUIN

The breeding distribution of the Emperor Penguin (*Aptenodytes forsteri)* is the most southerly of any penguin and is restricted to the Antarctic continent and Antarctic Peninsula, enduring the coldest conditions of any bird. Colonies occur in three main areas: the Weddell Sea and Dronning Maud Land, Enderby and Princess Elizabeth land and the Ross Sea. They are the only bird known to breed on the ice, with 44 of the 46 colonies located on sea-ice. The population of Emperor Penguins at Atka Bay has most recently been estimated using satellite imagery and was the first global, synoptic survey of a species from space[27] was estimated at 9657 and covered a total surface area of 10 355 m^2. The population at Atka Bay was first estimated in 1986 to be 8000, based on aerial footage. The closest Emperor Penguin colony to Atka Iceport is Muskegbukta, located to the east at SANAE station and has a population of 3193. The global population of Emperor Penguins is estimated to be 238 000 pairs[28].

The Emperor Penguin's reliance on sea-ice for breeding in combination with recent concerns over changed sea-ice patterns consequent on regional warming, has led to their designation as near threatened in the IUCN red list[29]. Current climate models predict that future loss of sea-ice around the Antarctic coastline will negatively impact emperor numbers. Recent

[27] An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012 Fretwell et Al (see reference section)
[28] An Emperor Penguin Population estimate: The first global, synoptic survey of a species from space, 2012 Fretwell et Al (see reference section)
[29] Emperor Penguins Breeding on Iceshelves Peter T. Fretwell, Phil N. Trathan, Barbara Wienecke, Gerald L. Kooyman

estimates suggest a halving of the population by 2052[30]. The discovery of this new breeding behaviour at marginal sites could mitigate some of the consequences of sea-ice loss.

Emperor penguins follow a complicated and unique breeding cycle where the eggs are laid early in the Antarctic winter, and chicks fledge in December, prior to sea-ice break. At this time, large parts of Atka bay become ice-free within a few days, and most of the adult and juvenile penguins have left, except for several hundred adults associated with groups of still moulting chicks that have hatched outside the optimal period. The social behaviour and complicated breeding cycle of the Emperor Penguin attracts the attention of scientists and visitors to the Antarctic:

- Breeding cycle begins in early winter, breeds on fast ice.
- Monogamous each season and female lays large egg in May/ June.
- Males incubate the egg whilst females forage at sea, returning to colony for chick emergency.
- Males then return to sea over a large distance to forage at sea before returning to chicks. Chicks moult into suite of down and fledge at approximately 150 days, when sea-ice begins to break up.
- Chicks usually return to the colony at 4 years, breeding the following year.

During the client visits to Atka Bay, which can take place between November and January, depending on the season, the Emperor Penguin chicks are observed in advance of fledgling, which usually takes place in advance of the sea-ice beginning to break-away. Photographs of fauna observed at Atka Bay by White Desert can be referred to the photographs of the Environmental Features section.

Table 5: Emperor Penguin Species Information

Species	Habitat	Distribution
Emperor Penguin *(Aptenodytes forsteri)*	• Population at Atka Bay: 9657 • Size: Male birds can reach 122 cm and 45 kg, and females 114 cm and 28-32 kg respectively. Chicks fledge at 9.9-14.8kg and some enter water with some down • Diet: Feeds mainly on fish, small cephalopods and crustaceans using pursuit diving. Can dive for 15-20 minutes at a time to depths of 50 meters or greater	• Distribution Coastal Zone of Antarctica between 66-78 °S, largely confined to pack ice, fast-ice and adjacent seas. • Conservation status- Near Threatened in the IUCN red list • Breeding cycle begins in early winter, breeds on fast ice. Monogamous each season and female lays large egg in May/ June. Males incubate the egg whilst females forage at sea, returning to colony for chick emergency. Males then return to sea over a large distance to forage at sea before returning to chicks. Chicks moult into suite of down and fledge at approximately 150 days, when

[30] Emperor Penguins Breeding on Iceshelves Peter T. Fretwell, Phil N. Trathan, Barbara Wienecke, Gerald L. Kooyman

		sea-ice begins to break up. Chicks usually return to the colony at 4 years, breeding the following year.

OTHER FAUNA OF ATKA BAY IMMEDIATE STUDY AREA

Following desk based research, there was no comprehensive species survey to cover all species which could potentially be present at Atka Bay. For the purposes of this assessment, other fauna with potential to be present at Atka Bay immediate study area have been identified based on the habitat type and species which are found at these habitat types, as well as published research undertaken at Atka Bay. Information on all potential fauna which could be present has been identified from publications as well as observations made by White Desert when visiting the site.

At Atka Bay there is potential to encounter avifuana which are known to inhabit the coastal zones of Dronning Maud land. These include the South Polar Skua, Antarctic Petrel and the Snow Petrel as well as potential to encounter the Adelie Penguin.

In terms of the marine environment, the potential species to be encountered in the coastal zones of Dronning Maud Land include the Leopard Seal, Weddell Seal, Crabeater Seal and Ross Seal. Acoustic recordings carried out by Neumayer research station in 2005-2006 had identified Weddell seals, Crabeater Seals, Ross Seals, Leopard seals, killer whales, blue whales, minke whales, along with several vocalizations which could not be assigned to a species. Additionally many non biological sounds were recorded, mainly generated by ice and some anthropogenic events such as ships passing by and activities on the ice[31].

Using the precautionary principle, it is assumed that there is potential for all these species to be encountered at the Emperor Penguin colony site.

During the clients visits carried out by White Desert to Atka Bay, Weddell Seals. Adelie Penguins and snow petrels have all been encountered on the sea-ice in addition to the Emperor Penguins (see photographs in the Environmental Features section).

Table 6: Potential Fauna Atka Bay and Immediate Study Area		
Species	Habitat	Distribution/Location
Adélie Penguin *Pygoscelis Adelie*	Conservation status Least Concern Despite the modelled projections suggesting future decline, there has actually been a recent population increase, particularly in East	• Feeds principally on crustaceans, some fish and cephalopods, caught by pursuit-diving. • Coastal Antarctica (including Peninsula and Enderby Land), South Sandwich, South Shetland, South Orkney, • Total population estimated at 2.4million

[31] PALAOA – an autonomous SAM device in the Atka bay Lars Kindermann, Alfred Wegener Institute for Polar and Marine Research Marine Observing Systems / OceanAcoustics, Am Alten Hafen 26, 27568 Bremerhaven, Germany

	Antarctica (where most of the world population breeds) and the Ross Sea (Southwell et al. 2015a,b, Lyver et al. 2014) and on the southern Antarctic Peninsula south of 66° S (Sailley et al. 2013). The net change in world population is now positive (Lynch and LaRue 2014) and qualify the species to be downlisted as Least Concern.	breeding pairs in 1990s. Currently 2.37 million pairs Increasing
Antarctic Petrel (*Thalassoica antarctic)*	• Nests openly on the ground • Feeds on cephalopods, crustaceans and small fish • Breeding season from late November in colonies on level snow free surfaces often on slopes and cliffs	• Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is exclusively on the Antarctic continent, breeding colonies are located up to 200km in land • Most abundant of Dronning Maud land breeding seabirds • Conservation status- not globally threatened currently
Snow Petrel (*Pagodroma nivea)*	• The Snow petrel is known to nest in crevices • Feeds on cephalopods, crustaceans and fish • Breeding season from November-December onwards in colonies on cliffs and steep slopes using crevices and clefts under boulders	• Feeding is confined to the pack-ice zone in the Antarctic seas • Breeding is on the Antarctic continent, breeding colonies are located up to 400km in land • Forms large concentrations of breeding birds • Conservation status- not globally threatened currently
South Polar Skua (*Catharcata maccormicki*)[32].	• Nests openly on the ground in mountain • Feeds mainly on fish, can prey on penguin and petrel eggs or chicks • Breeding season from November onwards • Can be aggressive if nests are approached	• When feeding inland known to prey upon eggs or chicks of petrels, and can be found adjacent to petrel colonies • Breeding is on the Antarctic Continent and adjacent islands • Conservation status- not globally threatened currently

[32] Nature Environment Map: Dronning Maud Land 1: 100,000, Gjelsvikfjella and western Muhlig-Hofmannfjella, Description, 1999

Weddell seals	Average Weight: 400 - 450 kg / 880 - 990 lb Average Length: 2,9m - 9.5 ft males / females up to 3.3m - 11ft Weddell seals can reach 600m in depth and spend as long as 82 minutes, the longest dives are undertaken when swimming under ice searching for new breathing holes.	• Feeding: Mainly fish, especially Notothenids known as "Antarctic cod", squid and invertebrates (inevitably including krill) in much lower quantities. • Predators: Killer whales, Weddell seals were taken as one of the main food sources for sledge dogs when these were used in Antarctica from 1899 to 1994, any local effects of population seem to have been reversed now • Conservation status: Least concern. Protected by the Antarctic Treaty and the Convention for the Conservation of Antarctic Seals.	Estimated world population: - 500,000 to 1 million. Very difficult to gauge the population size as the seals are circumpolar and many live in and amongst the pack ice. They do not form colonies as such other than loose associations of mothers and pups briefly after birth. The number of seals at sea during population estimates is a further unknown Breeding Season: Pups born from September to November, females become pregnant again very quickly as the males guard territories around breathing holes, there is an implantation delay of 2 months and then the female is pregnant for 11 months, typically 2 pups are produced every 3 years. Distribution: Circumpolar, the most southerly breeding mammal in the world, as far north as sub-Antarctic Islands and as far south as 78° in McMurdo Sound.

The overall sensitivity of the site and immediate study area is considered to be **very high-high** in accordance with the with the criteria set out in the General Guidance Developed for the Assessment Process table.

6.3.5 Cultural Heritage

Designated cultural heritage sites and features of interest have been identified through the list of Historic Sites and Monuments list published on the Antarctic Protected Areas database[33] website. As there are no designated cultural heritage sites or features located at the Atka Bay site or the wider study area, the Atka Bay site is not considered to be sensitive in terms of cultural heritage.

6.3.6 Wilderness and Visual Amenity

The spatial scope and zone of influence in terms of wilderness and visual amenity is considered to be the Atka Bay site and the immediate study area surrounding the site, encompassing the aircraft landing site. The closest human visual receptor is at Neumayer Station, which is located more than 5km away from the Atka Bay site, outside the zone of visual influence. Due to the absence of other existing human visual receptors at Atka Bay and in the immediate study area, it is considered that no significant wilderness and visual impacts would be experienced outside the immediate study area.

The closest man made structure is the Neumayer III Station and there are no permanent man-made structures at Atka Bay or within the immediate study area. The closest human activity is the shipment arriving at Atka Bay during the austral summer season, located 7km to the north of the Emperor Penguin colony. The Atka Bay site and immediate surrounding study area is therefore undisturbed and is of wilderness and aesthetic value.

Taking these factors into consideration, the value of the wilderness and visual amenity of Atka Bay site and the immediate surrounding area is considered to be of **very high-high**.

6.3.7 Noise, Vibration and Local Air Quality

Introduction

In terms of noise, vibration and local air quality impacts associated with the use of aircraft, sensitive receptors which are potentially impacted by the flight path and landing sites have been identified using a 1000m buffer from the light aircraft landing site locations, as the worst case scenario.

The wider study area for noise, vibration and local air quality impacts arising from the use of any ground vehicles would be 300m buffer from the route used. This distance takes into consideration the existing background noise levels and published guidelines used in the UK for the assessment of noise and vibration UK[34]. However, as the use of ground vehicles is not considered likely at Atka Bay this is not considered further in this assessment. Following landing, the distance from the aircraft to the site is carried out on foot or skis in order to minimise disturbance.

Sensitive receptor sites within the buffer zones have been identified from published base mapping of the area through the Antarctic Database Mapviewer website[35] and the ecological baseline information described above.

[33] http://www.ats.aq/devPH/apa/ep_protected.aspx?lang=e, data obtained in July 2017

[34] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise Part 2: Vibration.

[35] http://www.add.scar.org/home/add7

Atka Bay and Wider Study Area

The closest human receptors comprise the staff of the Neumayer III Station, which operates all year round and is located between 5-7km to the south west of the typical landing site. In terms of ecological receptors of impacts associated with noise, vibration and local air quality, the closest ecological receptor site is the Emperor Penguin Colony site, which is described in detail in the flora and fauna section above. In the wider study area, the Princess Martha Coastline is considered to be an ecological habitat suitable for a range of flora and fauna, as described in the flora and fauna section above.

The presence and location of ecological receptor sites is already taken into consideration during the planning and implementation aircraft activities, the final transfer is carried out using skis or on foot avoiding noise, vibration and local air quality impacts which would be caused by vehicle use.

The background noise and vibration levels on site are considered to be low and are associated with the penguin colony. The background local air quality is considered to be high.

The closest human activity, which could influence noise, vibration and air quality in the immediate study area includes the logistics operations to support the scientific research which take place at Atka Bay as well as client visits of White Desert which take place between November and January.

The background noise, vibration and air quality levels in the wider study area are mainly influenced by the logistics activities carried out at Neumayer III Station, which is the central logistics hub for the area. These supporting logistics activities take place mainly in the summer season, and some activities take place all year round at Neumayer III, the Neumayer seasonal skiway/ aircraft landing site, which is located to the north east at the edge of the Ekstrom ice shelf and the shipment landing location at Atka Bay. Further details of these activities can be found in the land use section. The activities which are likely to contribute to noise, vibration and local air quality include shipments arriving at Atka Bay, as well as the use of light aircraft (Basler BT-67, Twin Otter or Dornier 228), tracked vehicles and skidoos for the station logistics.

The background noise and vibration levels in the immediate study area are also considered to be generally. The flights are currently carried out using Twin Otter or Basler BT67 ski-equipped aircraft. However, as the total number of flights is low, the period which they take place is of a short duration and are of a temporary nature and already take into consideration the Guidelines for Operation of Aircraft in Relation to birds, the flights are not considered to have any long term adverse impact on human or ecological receptors in terms of local air quality, noise and vibration. The local air quality is also considered to be **high** and the sensitivity of the site in terms of noise and vibration is considered to be **very high-high**.

7 Analysis of potential impacts

7.1 Introduction

This section describes the potential environmental impacts which can arise during the client visits to Atka Bay and the South Pole, as well as during the logistics operations required to support these activities.

Potential impacts take into consideration proposed activities, the baseline environmental conditions and sensitivity of environmental features. The nature of each impact is assessed taking into consideration a number of factors, which are described in more detail in the Approach and Methodology section (Section 5 of main Wolfs Fang Runway IEE Report). This includes the impact's likelihood, spatial and temporal extent. The magnitude of impacts can be described as negligible/ minor moderate/major in accordance with the assessment table.

White Desert will take over the management and implementation of client visits to Atka Bay and the South Pole, along with the required supporting logistics as described in the earlier sections of Appendix 2. This section identifies the potential impacts of existing activities. Where there are changes proposed to existing activities and their potential impacts this is also identified.

7.2 FD83 and South Pole

7.2.1 Physical Environment- Snow and Ice Quality

SOUTH POLE STATION SITE

All client flight activities to the South Pole station site are currently carried out by TAC on behalf of White Desert, in accordance with the requirements set out in the *Management Plan for the ASMA 5.* White Desert tour guides are responsible for tour activities and comply with IAATO guidelines as well as the Amundsen Scott station requirements.

White Desert will take over the flight activity, as described above. The South Pole station is specifically organised to accept tourist visitors, as set out in the land use section. Flight landings take place at the designated aircraft landing area, which is operated and maintained by the station. This requires advance notification and agreement with the South Pole station organisation. The designated operational areas are set out in the figure below. Once on site, clients carry out the accompanied tour activities on foot, visiting the station and the South Pole flag mast.

The requirements asset out within the ASMA 5 Management Plan and the most up to date version of the station map[36] will continue to be followed by White Desert.

As there are no vehicles used at the South Pole by White Desert, potential impacts on snow and ice quality in relation to this activity are associated with the aircraft activity. Fuel spills are the greatest source of potential contamination. As White Desert will be not be refuelling at the station, the risk of accidental fuel spillage is considered to be low and there is a very risk of an accidental leak as aircraft are regularly maintained as required.

The physical environment at the South Pole requires protection as the entire environment in Antarctica benefits from protection under the Protocol and the South Pole is designated as an ASMA.

The potential impacts associated with an accidental spillage or leak would vary depending on the quantity released into the environment. With the implementation of appropriate mitigation measures, the likelihood of accidental spillage is reduced and associated impacts on the physical environment are reduced to minor and would be of a local scale and temporary. Appropriate mitigation measures in relation to protecting the physical environment set out in the mitigation section.

FD83 and Traverse

FD83 is currently used and will continue to be used as a refuelling location for aircraft en route to the South Pole. During refuelling and through storage and handling of fuels and oils, there is a risk of fuel spillage causing contamination of the physical environment.

It is proposed that during the 2018-2019 season, fuel will be resupplied to the site via land traverse. We envisage that the traverse will occur annually and delivery approximately

[36] http://www.southpole.aq/maps/station.html

42,000 l of drum fuel. The traverse will also recover empty drums from multiple previous seasons for return to Cape Town disposal (via the S.A. Cape Agulhas II).

PB300 'Piston Bulleys' will traverse up to the depot site. They will conduct seasonal maintenance on the storage berm and maintain the ski-way. When the PB300s are not on site, the ski-way will be maintained by light groomer pulled behind a 4x4 or skidoo.

The operation of the FD83 location and the seasonal traverse of supplies to the FD83 location will modify the physical surface of the snow and ice. The area of modification is a relatively very small proportion of the surrounding surfaces. The modifications are not permanent, and without ongoing modification / maintenance, the affected area will revert back to its original condition through natural processes.

The dispersal of soot, zinc rubber from tyres and pollutants from machinery operating at the site is likely to accumulate on the surface of the snow and ice locally. This will occur at the surface and is a very small proportion of the ice cap volumetrically.

Fuel spills are the greatest source of potential contamination. Minor fuel spills (less than 5 L) are an almost inevitable consequence of refuelling and vehicle servicing activities. The ability to contain and remediate these spills is fundamental to reducing the impact of these spills. Fuel absorbents will be used to contain minor spills. Spilt fuel and contaminated snow will be collected, separated and stored for future consumption in ground vehicles or backloading. The use of small containers (1500l IBCs) on the traverse and at the skiway of FD83 will reduce the likelihood of a larger fuel spill.

Potential impacts on water quality would be reduced with the use of filtration of grey water prior to disposal and it is considered that this impact would be minor and of a local scale. Further information is provided in the Fuels and Oils Storage and Handling and the Waste Management sections below.

The physical environment within the site requires protection as the entire environment in Antarctica benefits from protection under the Protocol. Potential impacts on the physical environment in terms of snow and ice quality would be of a local scale and temporary.

The potential impacts associated with an accidental spillage or leak would vary depending on the quantity released into the environment. With the implementation of appropriate mitigation measures, the likelihood of accidental spillage is reduced and associated impacts on the physical environment are reduced to minor. Appropriate mitigation measures are set out in the Fuels, Oils Storage and Handling Mitigation and the Environmental Impact of aircraft crashes.

Ice Free Surface Interference

The client visit activities to the South Pole, the use of FD83 and traverse route do not include the use of ice-free ground.

7.2.2 Flora and Fauna

Though the physical environment requires protection, the South Pole site and the FD83 location are not considered to provide a suitable ecological habitat as described in the baseline conditions section. It is considered that there are no potential impacts on flora and fauna at these locations.

The location of designated sites can be avoided through the careful planning of the traverse routes to FD83. Measures required for the protection of the physical environment are set out in the Fuels, Oils Storage and Handling mitigation section.

7.2.3 Cultural/ Antarctic Heritage

Potential direct impacts have been identified as:

South Pole

- *Beneficial view of South Pole station ASMA, and South Pole Ceremonial Flag (HSM1) mast and Amundsen's Tent site (HSM 80) by visitors to the site.* The cultural heritage value of the South Pole ASMA and the historic sites and monuments within it, is considered to be very high. The client visits to the South Pole take place due to the cultural/ Antarctic heritage and scientific value of the site. The visit to the South Pole site provides a unique opportunity for visitors to learn about the cultural heritage and scientific values of the South Pole. This is considered to be beneficial impact for the staff and visitors of the site. This is also in line with the ethos of White Desert eco-tourism activities, and furthering IAATO ambassador programme, which aim to increase environmental awareness of Antarctica.

FD83 and Traverse

- There are no potential impacts in relation to heritage due to the absence of cultural heritage features or designated sites in the immediate or wider study area at the FD 83 site. The Sites and Monuments Records would be checked for updates prior to the commencement of operations each season in order to ensure that the traverse routes do not impact on designated sites.

7.2.4 Wilderness and Visual Amenity

South Pole

- The site visits would not require the presence or installation of permanent or temporary structures at the South Pole. Impacts in relation to wilderness and visual amenity are considered under cultural heritage due to the intrinsic link with this aspect.

FD83 and Traverse

Potential direct impacts have been identified as:

- *Presence of existing plant and facilities associated with the FD 83 location in the landscape will be maintained with the continued use of the location.* Even though the immediate study area is not used for human activities and therefore has medium wilderness and aesthetic value, there is visual evidence of existing land-use on site, with the presence of equipment, and redundant fuel storage tanks (the site has been used as a fuel depot location since 2010 by ALCI), which reduces the wilderness and

aesthetic value of the site itself. The continued use of the runway and continued presence of plant, equipment and fuel storage associated with the operation of the depot will maintain human presence into the landscape. There are no existing visual receptors (accommodation, traverse routes) which look onto the site within the immediate study area and would be directly impacted by the human presence into the landscape. Visitation to the area is also considered unlikely. The magnitude of the impact taking the above factors into consideration is a **minor** adverse impact of temporary, seasonal and reversible nature.

7.2.5 Noise and Vibration

South Pole, FD 83 and Traverse

There are potential noise and vibration impacts arising from the following existing activities:

- Noise associated with aircraft flight path associated with client visits to the South Pole (This assessment considers intra-continental transfer flights between the Whichaway, the Fuel Drop Depot Location and the South Pole).
- Noise and vibration associated with aircraft use of skyway landing/take off during operation at the Fuel Drop Depot location and the South Pole
- Noise and vibration associated with use of snow vehicles, plant and equipment during fuel operation activities at the Fuel Drop Depot location site
- Noise and vibration associated with the use of snow vehicles off site in order to access the Fuel Drop Depot site during fuel operation activities and associated land traverse

Taking the noise sensitive receptor sites and proposed site activities into consideration, there will be no direct impacts from noise and vibration in terms of the following:

- There will be no direct impacts on designated ecological sites or permanent human residential receptor *associated with the aircraft use of the skiway at Fuel Drop Depot location*. This is due to the distance of the South Pole station from the site at more than 800km and the absence of designated ecological sites on site or within the immediate and wider study area.
- There will be no direct impacts on the closest designated ecological sites or permanent residential receptors (South Pole station) *associated with the use of vehicles, plant and equipment at the site during fuel operation and land traverse*
- There will no direct noise and vibration impacts on habitat or birds of the designated ecological sites in the wider study area during as this can be avoided though flight path planning.

There are potential impacts in terms of noise and vibration arising from:

- Medium potential disturbance at the South Pole station human receptors during takeoff and landing, as well as from flight path. The background noise levels at the station are considered to be characterised as generally low with peaks associated with takeoff and landing of aircraft. As an average of 70 logistics flights are scheduled for logistics purposes each season in addition to visitor flights, the flights operated by White Desert (an average of four per season) are considered to provide a small proportion of the overall peak noise level.

- Low potential for disturbance to avifauna (such as Antarctic Petrel, Snow Petrel, South Polar Skua) from noise, vibration and visual impacts arising from vehicles, plant and equipment during overland traverse used to access to FD83.

The implementation of appropriate mitigation measures would reduce the magnitude of potential impacts further and impact is considered to be **minor**, seasonal and its effects would be temporary in nature.

7.2.6 Local Air Quality and Atmospheric Emissions/Carbon

There are potential local air quality impacts or atmospheric emissions arising from the following proposed activities:

- Atmospheric and carbon emissions associated with use of aircraft
- Local air quality associated with aircraft use of skiways during landing/take off at the Fuel Drop Depot location and the South Pole site
- Local air quality associated with use of snow vehicles, plant and equipment during fuel operations on site at the FD83 site location
- Local air quality associated with the use of snow vehicles off site in order to access FD83 site during the overland traverse

The fuel operation activities at FD83 and overland traverse to FD83 are not considered to be significant in terms of local air quality. Dispersal of local pollutants downwind will occur quickly and the associated impacts are considered negligible.

Exhaust emissions from aircraft at FD83 and the South Pole station and are much greater source of pollutants however the vast majority of these are produced at altitude. The accumulation of these pollutants is likely to be extremely low due to the extremely large area over which they are produced and the resulting atmospheric dilution.

Atmospheric emissions and air quality impacts are assessed as minor. From a total system perspective, the proposed operation results in an estimated 6% reduction in emissions on a per client basis, compared with the current operation, based on worst case scenario.

In terms of emissions from ground vehicles, plant and equipment used during fuel operations at the FD83 site and off-site potential impacts associated with the traverse can be reduced with the implementation of appropriate mitigation measures and are considered to minor and of local extent.

Residual impacts are mainly associated with aircraft fuel use in terms of local air quality emissions and atmospheric emissions. These includes nitrogen dioxide, particulate matter (mainly $PM_{2.5}$) at ground level and carbon dioxide, nitrogen oxide emissions in the lower atmosphere which can contribute to ozone production. Carbon emissions will continue to be offset through an accredited scheme.

7.2.7 Environmental impact of aircraft crashes

Increased flying within Antarctic also increases risk of aircraft accidents and the associated environmental impacts of these. As this operation will be conducted under the jurisdiction of civil regulators, the flight risk profile is comparable to domestic charter aircraft operations. On this basis, crash statistics would suggest one crash is likely to occur every 200,000 departures. Despite the low likelihood, significant efforts in mitigating this risk are to be implemented, including crash recovery capabilities.

In the event of a crash, it is unlikely that local resources will be able to adequately remediate the site and a multi-season clean-up expedition would be required. Despite these limitations, the environmental risks associated with an aircraft accident are considered minor.

7.2.8 Waste

As the nature of the activities carried out at FD83 and the South Pole Station and the total number of clients will remain the same, it is considered that there would be no additional impacts associated with waste on the physical environment and no increase in the overall quantity of waste produced as a result of White Desert taking over the management of these activities.

The activities carried out at FD83 currently result in waste fuel and oil drums and containers, which are classified as hazardous waste, in addition to grey water waste. Hazardous waste streams are required to be disposed of outside Antarctica. White Desert would implement the White Desert Waste Management Strategy in relation to White Desert fuel and oil drums, in order to reduce the potential impacts on the physical environment. There is also the opportunity to remove redundant fuel/ oil drums used historically at the site as part of the traverse process. With the implementation of these measures the likelihood of impacts is reduced to low and potential impacts would be **minor**, of a local scale.

During client visits to the South Pole station site, the station requirements in relation to storage of litter will continue to be implemented.

There would be no additional impacts associated with waste on the physical environment in the wider study area, including designated areas or ecological habitat areas (nearby nunataks) along the traverse routes as waste would be removed and appropriately stored at the FD83. In addition, there is an opportunity for the improvement of the physical environment through the implementation of the White Desert Waste Management Strategy at FD83.

7.3 Atka Bay

7.3.1 Physical Environment

Snow and ice quality

All client flight activities to the Atka Bay site are currently carried out by TAC on behalf of White Desert, in accordance with the requirements set out in *the Guideline for the operation of aircraft near concentrations of birds in Antarctica.* White Desert guides are currently and will continue to be responsible for tour activities. White Desert will take over the flight activity, as described above, with the use of a Basler BT-67.

There are no changes proposed to total number of client visits or the size of the group, as set out in client Number and activities table. Clients typically spend a few hours touring the site with the capacity of camping overnight should the need arise on safety grounds.

Flight landings take place at a safe location either on the sea-ice at Atka Bay. The location is identified in advance of the client visits at the beginning of each season and is selected based on safety grounds and to avoid potential impacts on the Emperor Penguin Colony and other avifauna. The landing location is located at a distance of at least 2km from the location of the Emperor Penguin colony, in accordance with guidelines. Once on site, clients carry out the accompanied tour activities on foot.

The physical environment at the site is considered to be of a very high value and sensitivity. As there are no vehicles used on site by White Desert at Atka Bay, potential impacts on snow and ice quality in relation to this activity are associated with the aircraft activity. Fuel spills are the greatest source of potential contamination. As White Desert will be not be refuelling at Atka Bay, the risk of accidental fuel spillage is considered to be negligible, though there is a risk of an accidental leak of oils and fuels from the aircraft.

With the implementation of appropriate mitigation measures and the use of well maintained aircraft, the likelihood of accidental leak is reduced and associated impacts on the physical environment are reduced further. Appropriate mitigation measures in relation to accidental leaks are set out in the Fuels and Oils Storage and Handling mitigation section

The activities at Atka Bay do not include the use of exposed geological features, ice-free ground or sea water beneath the ice.

7.3.2 Flora and Fauna

The area used for the aircraft landing to visit Atka Bay is located at a distance of at least 2km from the outer perimeter of Emperor Penguin colony site. Suitable landing site locations are selected each season, based on the requirements to avoid sensitive habitats for environmental as well as safety reasons. A suitable landing location is identified in advance of each season by the aircraft pilot. This is selected in order to avoid potential impacts and interactions with the Emperor Penguin colony, in accordance with the Guidelines for operating aircraft in close proximity to birds, and takes into consideration sea-ice thickness, obstacle clearance and sea-ice surface. The site can be located on the sea-ice or ice-shelf.

The assessment of the potential impacts of the activities at Atka Bay takes into account both on-site impacts and ecological features that may occur in the immediate or wider study area. In order to characterise the potential impacts on flora and fauna, the following parameters are taken into account:

- The magnitude of the impact
- The spatial extent over which the impact would occur
- The temporal duration of the impact
- Whether the impact is reversible and over what timeframe and
- The timing and frequency of the impact

The nature of the activity will not change from the existing scenario, the potential impacts on flora and fauna have been identified as set out below.

Taking the baseline environment and existing site activities into consideration, there will be *no direct impact* on flora and fauna in terms of the following:

- There are no direct impacts on the habitat of the marine aquatic environment, as the activities take place entirely on the sea-ice, when sea ice is at the greatest thickness and there are no activities carried out below the sea-ice
- Due to their distance from Atka Bay, there are no direct impacts on designated ecological sites and habitats (ASPAs or ASMA)
- There is no foreseeable fragmentation or isolation of a designated habitat areas as a result of the activities at Atka Bay

The potential direct impacts, prior to mitigation measures, have been identified as follows:

- *High potential for disturbance to Emperor Penguin and other fauna on site and the immediate* study area, from noise, vibration and visual stimuli arising from aircraft during takeoff/ landing. This is assessed in further detail in the section below.
- *Medium potential for disturbance of Emperor Penguin Colony and Important Bird Area, due to human presence.* There is a medium potential for disturbance of the large population of the Emperor Penguin colony due to human presence. Due to the nature of the tourist activities, there is no requirement for direct physical contact with penguins, or disturbance of their habitat and the potential for physical disturbance is considered to be medium. In addition to physical disturbance of the Emperor Penguins, there is potential to impact through ingestion of litter or entanglement with plastic waste. There are no permanent structures associated with the visits to Atka Bay and if there is an emergency requirement to stay overnight due

to adverse weather conditions, tents would be located away from the Emperor Penguin colony.

- *Medium potential for disturbance to fauna on site, due to human presence.* There is a medium potential for disturbance of fauna on the surface of the sea-ice, due to human presence. Weddell seals and Adelie penguins have also been observed at the site during previous visits. Taking the information which is available for designated sites, habitats and species within wider study area into consideration, there is also potential to encounter individuals of three bird species (Antarctic petrel, Snow petrel, South Polar skua) and seals on site. Due to the nature of the tourist activities, there is no requirement for direct physical contact with fauna, and the potential for disturbance is considered to be Medium. In addition to physical disturbance of fauna, there is potential to impact through ingestion of litter or entanglement with plastic waste.

- *High potential for strike risk which would give rise to collision or strike injuries of bird and other fauna on sea-ice*. There is potential for the movement of Emperor Penguins, birds and other fauna, (as described above) across the Atka Bay sea-ice which could result in a collision or strike injury with aircraft during landing and takeoff. Due to the size of the Emperor Penguin Colony population and density of other fauna at the site, the potential risk is considered to be High if not managed appropriately.

- *Introduction of non-native species*. The risk of introducing non-native species is assessed taking into consideration the source-pathway- receptor principle. With the conduct of flights and access to the Atka Bay site, there is potential for seeds, spores, and other biological matter (source) to act as a pathway for introduction into Antarctica. Organisms can be introduced in clothing, baggage, on shoes, and in cargo of staff and visitors. The fauna at the site are potential receptors. There is a High potential of introduction of non-native species in the absence of appropriate mitigation measures.

- *Low potential for changes to key habitat features of the Atka Iceport Important Bird Area arising from use of aircraft*. This is associated with the potential impact on the physical environment and is assessed in the section above.

- *Limited changes to local air quality arising from emissions* aircraft during take -off and landing impacting ecological receptors, penguins and other fauna. This is assessed in further detail in the section below.

With the implementation of appropriate mitigation measures, the potential impact is considered to be reduced to **minor,** temporary, short-term disturbance and of a local scale.

7.3.3 Cultural Heritage

- There are no potential impacts in relation to cultural heritage associated with the Atka Bay activities, due to the absence of cultural heritage features or designated sites in the immediate or wider study area.

7.3.4 Wilderness and Visual Amenity

In terms of the potential impacts on wilderness and visual amenity associated with the activities at Atka Bay, the potential direct impacts have been identified as follows:

- *Beneficial view of wilderness and natural landscape from the site for the staff and visitors to Atka Bay.* The wilderness and visual amenity of Atka Bay Emperor Penguin Site is considered to be very high. The client visits to the site take place due to the wilderness and visual amenity value of the site. The visit to the Emperor Penguin colony site provides a unique opportunity for visitors to learn about the environment and importance of the ecology in Antarctica, as well as the impacts of sensitivity of the environment in relation to climate change. This is considered to be a beneficial impact for the staff and visitors of the site whilst at the site. This is also in line with the ethos of White Desert eco-tourism activities, and furthering IAATO ambassador programme, which aim to increase environmental awareness of Antarctica.
- *It is considered that there are no potential impacts on human visual receptors in the immediate study area.* There are no permanent existing visual receptors, (the closest is Neumayer station is located at a distance of 7km away) which look onto the site within the immediate study area and would be directly impacted by the temporary human presence into the landscape. There are no temporary or permanent structures required for this client activity.

7.3.5 Noise and Vibration

Introduction

Currently visits to Atka Bay are undertaken by TAC through use of a Twin Otter or Basler BT-67. White Desert will take over these activities with the use of a Basler. The background noise levels in the immediate study area are characterised by the Emperor Penguin colony during the summer season. In the wider study area the background noise level is considered to be generally low with the exception of flight take off and landing for logistics of Neumayer station, ground vehicles for logistics of Neumayer station and the four return flights to Atka Bay carried out by TAC on behalf of White Desert. However, the existing measures which are used to ensure that the Emperor Penguin individuals and the other fauna on site are not adversely affected by the noise levels will be implemented by White Desert. Measures will continue to be taken to ensure that noise, vibration impacts arising from aircraft take off, landing and flight path are minimised as far as possible to avoid potential impacts on the Emperor Penguin and other fauna at Atka Bay, the immediate and wider study area It will be ensured that the background noise levels at the site are not altered by the use of aircraft through use of a 2000m no fly zone.

Taking the noise sensitive receptor sites and site activities into consideration, there will be no direct impacts from noise and vibration in terms of the following:

- There will be no direct impacts on the closest designated ecological sites (Muskegbukta IBA, Svarthamaren ASPA, Dakshin Gangatotri Glacier ASPA) or

permanent human residential receptors (Neumayer Station III) *associated with the aircraft use of the landing site at Atka Bay*. This is due to their distance from the site

There are potential noise and vibration impacts arising from the following existing activities:

- Noise associated with the aircraft flight path associated with client visits to Atka Bay. This assessment considers intra -continental transfer flights between airbase at Novo and Atka Bay
- Noise and vibration associated with aircraft landing/take off at Atka Bay during the client visits to Atka Bay

The following potential impacts in terms of noise and vibration would arise in the absence of appropriate mitigation measures:

- High potential for disturbance of individual Emperor Penguins, and other fauna species (including Weddell Seals, Adélie Penguin, Antarctic Petrel, Snow Petrel, South Polar Skua) on site and in the immediate study area, from noise and vibration arising *during takeoff and landing and landing of aircraft*
- High potential for disturbance of the Atka Bay IBA ecological receptor site and of other designated habitats, such as Muskegbukta IBA and non designated habitats, such as nunataks, in the wider study area *through flight path*
- High potential for disturbance of human receptors at Neumayer III station *through flight path*

The continued implementation of appropriate mitigation measures would reduce potential impacts and impact is considered to be **minor**, seasonal and its effects would be temporary in nature.

7.3.6 Local Air Quality and Atmospheric Emissions/Carbon

There are potential local air quality impacts or atmospheric emissions arising from the following proposed activities:

- Atmospheric and carbon emissions associated with use aircraft
- Local air quality associated with aircraft during landing/take off at the site
- Local air quality associated with the use of skidoos at Atka Bay

Residual impacts are mainly associated with aircraft fuel use in terms of local air quality emissions and atmospheric emissions and are considered to be *minor and temporary.* These include nitrogen dioxide, particulate matter (mainly $PM_{2.5)}$ at ground level and carbon dioxide, nitrogen oxide emissions in the lower atmosphere which can contribute to ozone production. Carbon emissions will be offset through an accredited scheme.

7.3.7 Fuels, Oils Storage and Handling

There are no activities associated with fuels or oil storage or handling associated with the client visit to Atka Bay. There is no refuelling, aircraft maintenance, or maintenance of vehicles carried out at Atka Bay. There is a low risk associated with fuel leaks of aircraft when stationary and this is considered in the physical environment section above.

7.3.8 Environmental impact of aircraft crashes

Increased flying within Antarctic also increases risk of aircraft accidents and the associated environmental impacts of these. As this operation will be conducted under the jurisdiction of civil regulators, the flight risk profile is comparable to domestic charter aircraft operations. On this basis, crash statistics would suggest one crash is likely to occur every 200,000 departures. Despite the low likelihood, significant effort in mitigating this risk are to be implemented, including crash recovery capabilities.

In the event of a crash, it is unlikely that local resources will be able to adequately remediate the site and a multi-season clean-up expedition would be required. Despite these limitations, the environmental risks associated with an aircraft accident are considered minor.

7.3.9 Waste

As the nature of the activities carried out at Atka Bay and the total number of clients will remain the same, it is considered that there would be no additional impacts associated with waste on the physical environment and no increase in the overall quantity of waste produced as a result of White Desert taking over the flight activities at Atka Bay.

All food consumed on site is minimal and all food packaging and human waste is taken off-site and stored on the aircraft. The physical and ecological receptor site is of very high to high sensitivity and there would be a risk to fauna at the site associated with direct ingestion of litter or entanglement in debris in the absence of appropriate mitigation measures.

An appropriate waste management strategy and site specific mitigation measures have been identified in order to reduce the potential impacts on the physical environment and wildlife (these are identified in the mitigation section below). With the implementation of these measures the likelihood of impacts is reduced to low and potential impacts would be minor, of a local scale.

8 Mitigation Measures

8.1 FD83, South Pole and Atka Bay

8.1.1 Introduction

Existing mitigation measures are currently implemented by TAC for the flight activities carried out on behalf of White Desert. White Desert will take over the management and implementation of activities in the upcoming season, as well as the implementation of the mitigation measures on site. This section identifies the appropriate mitigation and monitoring measures which will be undertaken during the activities at the South Pole, FD83 and Atka Bay, for the potential impacts identified in the section above. White Desert is responsible and will continue to be responsible for the tour activities carried out to Atka Bay and the South Pole. A number of the mitigation measures have already been identified in the main IEE Report and are summarised here for reference. The additional mitigation measures identified take into consideration relevant legislation, the latest updates to published guidance as well as site- specific requirements and best practice measures.

There are a number of scientific research projects which are relevant to the White Desert activities at Atka Bay and the South Pole, the findings of which could be used to inform the activities. These include:

- **Antarctic Fast Ice Network-Sea Ice Monitoring in Atka Bay**. This project is run from Neumayer III. Attached is the latest report, which will be useful for planning where to land. This will be useful for your potential pilots
- The **Meteorological Observatory** provides the latest met. data which can be used to plan flights, traverse and client visits (https://www.awi.de/nc/en/science/long-term-observations/atmosphere/antarctic-neumayer/meteorology.html
- **The Operational weather forecast service for DROMLAN** is also run out of Neumayer and can provide weather forecasts for flights
- The **Single Penguin Observation and Tracking**- tracks Emperor Penguin Huddles at Atka Bay so should be able to tell us which stage the penguins are at each year

8.1.2 Physical Environment

FD83, South Pole Site and Atka Bay

There is no refuelling proposed at Atka Bay, there is a negligible risk of leaks. This can be monitored, regular maintenance if aircraft and in case ensure that a spill kit which absorbs oils is available for use in case of incident.

The mitigation measures required to reduce the risk of contamination of the physical environment and minimise the potential impacts as far as reasonably practical are related to the safe storage and handling of fuels and oils, as well as the appropriate waste management. These measures are identified below.

8.1.3 Flora and Fauna

Potential Impact

- *Medium potential for disturbance of Emperor Penguin Colony and Important Bird Area, due to human presence at Atka Bay*
- *Medium potential for disturbance to other fauna on site, due to human presence at Atka Bay*.

Relevant Legislation

- Antarctic Treaty (1959) Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex II Conservation of Antarctic Fauna and Flora. This is the key legislation in relation to the protection of the environment. It prohibits harmful interference by flying aircraft in a manner that disturbs concentrations of birds, wilfully disturbing breeding or moulting birds or concentrations of birds by persons on foot.
- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex V Area Protection and Management, Environmental Protection
- The Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) (1982)
- Important Bird Areas in Antarctica
- Protocol on Environmental Protection to the Antarctic Treaty, Regulation XVIII-1 Tourism and Non-governmental Activities

Relevant Guidelines

- At the 2011 Antarctic Treaty Consultative Meeting (ATCM XXXIV, Buenos Aires), Treaty Parties adopted new general guidelines for visitors to the Antarctic (Resolution 3).
- Guidelines for Visitors to the Antarctic which include recommended measures to Protect Antarctic Wildlife, Respect Protected Areas, Respect Scientific Research, Be Safe, Keep Antarctica Pristine
- IAATO General Information for Wildlife Watching, updated October 2016
- IAATO Bird Watching Guideline, updated October 2016
- IAATO Emperor Penguin Colony Visitor Guidelines, updated 2016
- IAATO Cetacean Watching Guidelines (updated 2016)
- IAATO Seal Watching Guidelines (updated 2016)
- IAATO Bird Watching Guidelines (updated 2016)
- IAATO Leopard Seal Watching Guidelines (updated 2016)

Mitigation measures

Minimise potential impacts from human presence as far as reasonably practical through the implementation of the following measures

- Improve knowledge transfer between scientific research carried out in Atka Bay, in relation to wildlife population
- Reduce and avoid the use of food packaging during visits to Atka Bay in order to avoid potential impacts from litter. Should any waste arise at Atka Bay, ensure that there is appropriate storage of all waste and materials in enclosed containers to reduce potential impact from entanglement or ingestion of litter and debris,

particularly plastic debris. It would be preferable to store waste on aircraft during visit. Set up temporary food/ warmth camp at least 1km away from colony and ensure that all waste is removed at the end of each visit.

- Operate any ground vehicles using appropriate speed in areas where fauna are likely to be present on the ground in order to reduce risk of collision and strike injuries of birds.
- Last 1km distance to Emperor Penguin Colony is carried out on foot
- Use of designated paths across Atka Bay by clients, staff and any ground vehicles to avoid penguin paths
- Implement measures to reduce impacts on fauna and the environment arising from noise , vibration and local air quality (set out in the sections below) associated with operation of aircraft
- Identification sheets and guidance notes for fauna will be distributed or displayed to staff and clients along with copies of the IAATO Guidelines.
- Implement measures to minimise disturbance of wildlife by visitors and staff. Disturbance can also arise through stress reactions. These measures include maintaining an appropriate distance from wildlife, no feeding, maintaining low noise levels, minimising visual disturbance and no interference with wildlife behaviour.
- White Desert tour guides will continue to implement the IAATO Guidelines Wildlife Watching as well as the IAATO Guidelines Emperor Penguin Colony Visitor Guidelines [37].
- The IAATO Guidelines includes the following measures in relation to Emperor Penguin Colony watching and visitation:
  - When visiting a colony, walk slowly and carefully and maintain a precautionary distance of 5 metres from penguins. Increase distance from wildlife if any changes in behaviour are observed. Always give wildlife the right of way.
  - Keep 15m away from areas adjacent to colonies facing the ice edge where the penguins commute to and from the ocean.
  - Visitors should stop moving when a commuting penguin is approximately 15m away to allow it to decide the direction it wants to follow.
  - Do not surround Weddell seals, go between adult and pup or between a seal and its breathing .
  - On approach to an Emperor penguin colony the following precautions should be taken: Establish a passenger stopping point within 25 to 30 meters of a colony of emperor penguins with chicks, all passengers and staff must stop at the established point for a minimum of 5 minutes assess penguin behaviour. If there are no nervous reactions from the chicks such as repeated or continual flipper flapping slowly move the group 10 to15 meters closer to the colony. Repeat the assessment and approach every 5-10 minutes. Continually assess the behaviour of the penguins and retreat if there are any signs of disturbance. Never approach closer than 5 meters .
  - Do not circle an emperor penguin colony. Keep all passenger and staff activity to one side of the colony.
- Best practice guidelines in relation to seal watching measures in order to minimise disturbance of seals. Best practice will depend on the species of seal.

[37] https://iaato.org/wildlife-watching-guidelines

- A number of international and domestic guidelines have been established concerning approaching seals on ice.
- True seals are far less aggressively territorial towards humans.
- In the case of Weddell Seals many animals will remain motionless even if an observer approaches closely.
- Keep at least 10 meters from Weddell Seals.
- Very placid and almost docile, ignores human presence.

Potential Impact

- *High potential for strike risk which would give rise to collision or strike injuries* for *bird and other fauna on sea-ice,*
- *High potential for disturbance to Emperor Penguin and other fauna on site and the immediate* study area, from noise, vibration and visual stimuli arising from aircraft during takeoff/ landing
- *Low potential for changes to key habitat features of the Atka Iceport Important Bird Area arising from use of aircraft*.
- *Low potential for disturbance of penguins and other fauna arising from landing and take-off* of aircraft at Atka Bay

Relevant Guidance

- Antarctic Treaty Resolution 2 (2004) Guidelines for the operation of aircraft near concentrations of birds in Antarctica
- IAATO General Information for Wildlife Watching , updated October 2016
- IAATO Bird Watching Guidelines ,updated October 2016
- IAATO Emperor Penguin Colony Visitor Guidelines, which sets out additional guidelines for aircraft in relation to Emperor Penguin colonies

Mitigation Measures

White Desert to continue to implement the guidelines in relation of operation of aircraft near concentrations of birds in Antarctica, as well as measures for operation of aircraft near Emperor Penguin Colony, as set out in IAATO guidance, with strict adherence. Ensure that all pilots are responsible for the implementation of the guidance and undergo any relevant training required. These measures will help reduce potential impacts arising from noise and vibration associated with aircraft, as well as direct physical impacts associated with the operation of aircraft and include:

- Set a 2000m no fly zone around Atka Bay IBA and other sensitive habitats of the immediate and wider study area. This will need to be carried out in conjunction with the aircrew as part of the initial proving flights. This will ensure that aircraft approaches and departures, where potential impacts are greatest, are controlled.
- Aircraft flight path above 6000 feet is not considered to give rise to noise and vibration impacts on the ground
- Penguin, albatross and other bird colonies are not to be over flown below 2000ft (~ 610 m)
- Above Ground Level, except when operationally necessary for scientific purposes.

- Landings within 1/2 nautical mile (~ 930 m) of penguin, albatross or other bird colonies should be avoided wherever possible.
- Never hover or make repeated passes over wildlife concentrations or fly lower than necessary.
- Maintain a vertical separation distance of 2000 ft (~ 610 m) AGL and a horizontal separation of 1/4 nautical mile (~ 460 m) from the coastline where possible.
- Cross the coastline at right angles and above 2000ft (~610 m) AGL where possible.
- Location of aircraft operations (other considerations)
- Where practical, avoid overflying concentrations of birds.
- Be aware that concentrations of birds are most often found in coastal areas. Snow petrel and Antarctic petrel colonies are also frequently found inland on nunataks. Minimum vertical separation distances should be maintained in these areas.
- Where practical, landings near to concentrations of birds should be downwind and/or behind a prominent physical barrier (e.g. hill) to minimise disturbance.
- Avoid Antarctic Specially Protected Areas (such as Svarthamaren ASPA), unless authorised to over-fly and/or land by a permit issued by an appropriate national authority. For many ASPAs there are specific controls on aircraft operations, which are set out in the relevant Management Plans.
- Follow aircraft flight heights, preferred flight paths and approach paths contained in the Antarctic Flight Information Manual (AFIM), in station aircraft operation manuals and on relevant charts, maps and any Wild Life and Low Flying Avoidance Maps
- Particularly avoid flying toward concentrations of birds immediately after take-off and avoid steep banking turns in flight as these significantly increase the amount of noise generated.
- Aircraft operations should be delayed or cancelled if weather conditions (e.g. cloud base, winds) are such that the suggested minimum vertical and horizontal separation distances given in these guidelines cannot be maintained.
- Discourage presence of birds in close proximity through appropriate management of the site, including appropriate and secure storage of food and litter within enclosed containers
- Cross coastlines at right angles and above 2000ft (~610m) AGL on flight approach.
- Maintain a vertical separation distance of 2000ft (~ 610m) AGL and a horizontal separation of 0.25 nautical mile (~ 460m) from coastlines where possible.
- Do not over fly emperor penguin colony (including major traffic pathways of penguins), or seals.
- Observe tide cracks and nearest ice edge on approach to colony to estimate security of landing areas.
- Land a minimum of 0.75 nautical mile (~ 1km) from colony or seals.
- Select a landing site behind a prominent physical barrier (e.g. iceberg) and if possible downwind to minimise colony and seal disturbance.
- Make minimum number of passes to inspect and/or drag skiway consistent with safe landing operations.
- Check skiway is clear of wildlife regularly before start-up and take-off

Potential Impact

- Introduction of non-native species. This would present a risk of non-native species becoming established in Antarctica. There is no ice free ground or flora at, FD83 or the South Pole Site, though there is a greater potential risk when visiting the Atka Bay wildlife site.

Relevant Guidance and Legislation

- Non-native species manual, Committee for Environmental Protection, Secretariat of the Antarctic Treaty[38]
- IAATO guidelines on bio-security

Mitigation Measures

- Best Practice mitigation measures which are currently used by White Desert operations to reduce the risk of the introduction of non-native species into Antarctica will continue to be implemented through all activities
- These measures take the above guidance into consideration and are based on the prevention, monitoring and response.
- Measures would include, and would not be limited to:
  - Intercontinental aircraft are checked and treated as necessary where applicable to ensure they are insect free
  - Informing clients and training of site staff in relation to the risks associated with the introduction of non-native species to ensure awareness
  - Check client luggage and cargo to ensure it is visibly clean of contamination
  - Cleaning of foot-wear prior to departure and between sites within Antarctica
  - Decontamination measures for boots, clothing and equipment prior to arrival
  - Regular inspection of ground vehicles which are used off-site
  - Monitoring measures and measures to be put in place in order to report any non native species found, early warning system would be implemented
  - No poultry food products are taken to Atka Bay
  - Set caches, emergency stores and camp a minimum of 1km from colony or basking seals

[38] Non-Native Special Manual, Committee for Environmental Protection, Secretariat of the Antarctic Treaty, Edition 2011

8.1.4 Cultural/ Antarctic Heritage

- *Beneficial view of South Pole station ASMA 5, and South Pole Ceremonial Flag (HSM 1) mast and Amundsen's Tent site (HSM 80) by client to the site, in relation to polar cultural heritage*
- No potential impacts have been identified in relation to cultural/Antarctic heritage at Atka Bay and the FD83

Relevant Legislation

- Register of Historic Sites and Monuments and ASMA
- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex V Area Protection and Management, Environmental Protection

Relevant Guidelines

- South Pole Station Management Plan ASMA 5
- The South Pole ASMA is designated for an indefinite period, subject to periodic review by the Antarctic Treaty Parties, as required by Annex V, Article 6.

Mitigation Measures

- Compliance with the guidelines for visitors set out within the South Pole Station Management Plan ASMA 5, APPENDIX A Additional Guidelines for Non-Governmental Organizations at the South Pole. These include
  - Expedition leaders from all other groups visiting the ASMA should ensure that all visitors to the Area are educated on the boundaries, purpose, and entrance prohibition of the Hazardous Zone
  - Tour operators and other non-governmental visitors to the Area should provide visitation schedules to National Program(s) operating in the Area in advance of their visits
  - There are no restrictions on visitation to the Historic Zone. However, visitors must follow guidelines in the management plan and take all appropriate safety precautions
  - Except for emergency situations, unescorted guests are expected to stay within the designated camping area, the NGO parking area, or the area immediately surrounding the Pole markers, unless otherwise authorized by the National Program operating in the area
  - The ideal timeframe for visits to the South Pole Station is on Sunday from 13:00 to 17:00 South Pole Station Time [00:00 to 04:00 GMT/UTC]. This time period is recommended to minimise disruption to station science, construction, and operational activities

- Prior to each operational season, the List of Historic Sites and Monuments will be consulted in order to ensure that there are no new listings located along the routes used to access FD83 and all traverse routes, which should be taken into consideration

8.1.5 Wilderness and Visual Amenity

Potential Impact

- *Presence of existing plant and facilities associated with the FD83 location in the landscape will be maintained with the continued use of the location*
- *Beneficial view of wilderness and natural landscape from the site for the visitors and staff to the Atka Bay site*
- *Impacts in relation to wilderness and visual amenity at the South Pole are considered under polar cultural heritage due to the intrinsic link with this aspect*

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991), Article 3 Environmental Principles, "Protection of the Antarctic environment and dependent and associated ecosystem and the intrinsic value of Antarctica, including its wilderness and aesthetic values..."

Mitigation Measures

- The overall footprint of the operational elements associated with the FD83 location site (staff accommodation, fuels, plant and equipment store) has been reduced as far as reasonably practical in order to reduce potential impacts on the wilderness and visual amenity of the immediate study area. This has already been incorporated into the design of the site
- Ensure that the amount of waste drums and waste tanks stored at FD83 is kept to the minimum required and any disused drums are removed from the site regularly through the traverse
- Maintain a clean, organised and tidy site through appropriate materials and fuels storage and handling
- It will be ensured that there is no littering off site or on site at FD83 through appropriate enclosed waste storage containers. In the event of accidental dispersal of litter, it would be removed immediately.

8.1.6 Noise and Vibration

Potential Impact

- High potential for disturbance of the Atka Bay IBA ecological receptor site and of other designated habitats, such as Muskegbukta IBA, and non designated habitats, such as nunataks, in the wider study area *through flight path*
- High potential for disturbance of individual Emperor Penguins, and other fauna species (including Weddell Seals, Adélie Penguin, Antarctic Petrel, Snow Petrel, South Polar Skua) on site and in the immediate study area, arising from noise and vibration arising *during takeoff and landing of aircraft*
- High potential disturbance to South Pole station human receptors, during take-off and landing, as well as from flight path
- High potential for disturbance of human receptors at Neumayer III station *through flight path*

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex II Conservation of Antarctic Fauna and Flora. This is the key legislation in relation to the protection of the environment. It prohibits harmful interference by flying aircraft in a manner that disturbs concentrations of birds, wilfully disturbing breeding or moulting birds or concentrations of birds by persons on foot.

Relevant Guidance

- Guidelines for the operation of aircraft near concentrations of bids in Antarctica
- South Pole Station ASMA Management Plan

Mitigation Measures

Measures will continue to be taken to reduce impacts from noise and vibration arising from the operation of aircraft in order to ensure that the Emperor Penguin colony is not disturbed. These requirements for the operation of aircraft near concentrations of birds are set out in the flora and fauna section above. In addition the following measures will be taken:

- Select landing location to be e 2km away from Emperor Penguin colony. A suitable landing location will be identified.
- No aircraft left idling at the aircraft landing locations
- No ground vehicles left idling at FD83, traverse route, South Pole or Atka Bay when in use
- Compliance with the South Pole Station ASMA 5 Management plan at the South Pole

Potential Impact

- Low potential for disturbance to Antarctic Petrel, Snow Petrel, South Polar Skua from noise, vibration and visual impacts arising from vehicles, plant and equipment during overland traverse used to access FD83.

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex II Conservation of Antarctic Fauna and Flora.

Mitigation Measures

- Plan traverse routes used to access the site to avoid being within 1000 meters of designated ecological sites
- When planning traverse route, avoid other non designated nunataks which may provide suitable habitat for birds as far as possible and remain at least 300 meters away from potential bird habitat, (unless require for health and safety reasons)
- Ensure that there is no unnecessary idling of snow vehicles or plant to reduce noise levels during traverse to FD83
- Maintain appropriate speed for snow vehicles on as well as off-site to reduce risk of bird strike from ground vehicles.

8.1.7 Local Air Quality Atmospheric Emissions/ Carbon

Potential Impact

- Atmospheric and carbon emissions associated with aircraft to carry out internal flight activities
- Local air quality associated with aircraft use of landing sites landing/take off during operation, at South Pole, FD83 and Atka Bay location

Mitigation Measures

The following measures have been integrated into the design of the operations in order to reduce these impacts:

- Basler BT 67 aircraft selected for intra-continental flights have been selected for fuel efficiency with low smoke emissions and are considered to be more efficient than current aircraft used for intercontinental flights
- All carbon emissions associated with proposed air travel and camp operations will be offset by White Desert using the Carbon Neutral Company. White Desert has been a fully accredited member of this company since May 2007 and will continue to offset emissions for all new operations at Wolfs Fang runway.

Potential Impacts

- Local air quality associated with use of snow vehicles, plant and equipment during fuel operations on site at the FD83 site location and also for transport from the Aircraft landing site at Atka Bay to closer proximity to the Emperor Penguin Colony
- Local air quality associated with the use of snow vehicles off site in order to access the Fuel Drop Depot site during the overland traverse

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991), Article 3 Environmental Principles, (2) (b) "activities in the Antarctic Treaty area shall be planned and conducted so as to avoid (ii) significant adverse effects on air or water quality (iii) Significant changes in the atmospheric, terrestrial (including aquatic) glacial or marine environments

Mitigation Measures

- Plan routes used during the overland traverse to FD83 and the client transfer using skidoos within Atka Bay to avoid being within 500 meters of designated ecological sites
- Traverse works plan to be prepared in advance which will maximise efficiency in fuel-use and therefore reduce emissions and local air quality impacts
- When planning traverse route, avoid other non designated nunataks such as nunataks and coastal regions which may provide suitable habitat for birds as far as possible and remain at least 300 meters away from potential bird habitat (unless require for health and safety reasons)
- Ensure that there is no unnecessary idling of snow vehicles or plant to reduce emissions during construction , operation and maintenance
- Regularly inspect and maintain vehicles, plant and equipment to ensure good working order and air emissions are appropriate

8.1.8 Emergency Preparedness and Response

Potential Impact

- Potential direct impacts on the quality of the physical environment resulting from a aircraft crash of incident
- Potential incident involving clients and staff during visits to Atka Bay and South Pole

Relevant Legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991), Annex VI Liability Arising from Environmental Emergencies

Mitigation Measures

- Preventative controls will stem from the aviation regulatory system under which all flight and runway operations are conducted. This includes provisions for:
    - documentation of procedures
    - local operating procedures
    - staff and aircrew training
    - emergency response capabilities
- Emergency response equipment will include fire suppression equipment, and fuel spill containment and clean-up equipment.
- Preparation of a search, rescue and emergency plan in advance of each season. This is submitted with FCO Permit on annual and identifies specific measures and plans in place in case of an accident or emergency. This plan can be referred to for the most up to date information in relation to emergency preparedness and response
- Obtain the most up to date weather forecast prior to flights to South Pole, FD83 and Atka Bay, to minimise risk as far as possible.

8.1.9 Waste Management

Potential Impact

- Potential direct impacts on the quality of the physical environment in the immediate study area from waste fuel and oil drums at FD83
- Low potential direct impacts on individual birds at the site associated with direct ingestion of litter or entanglement in debris at Atka Bay

Relevant legislation

- Protocol on Environmental Protection to the Antarctic Treaty (1991) Annex III Waste Disposal and Waste Management

Relevant guidance

- White Desert Waste Management Strategy

Mitigation Measures

- Implementation of a waste management strategy. The waste management strategy at the site would be based on the principles of eliminate, reduce- re-use-and recycle, as described in the Sustainability of White Desert section. The table below summarises the proposed waste management strategy. The strategy considers relevant legislation and the White Desert environmental policy.
- The strategy will form the basis of the waste management plan, (as required by Article 8 Waste Management Planning of Annex III Waste Disposal and Waste Management) and will be part of the White Desert operating procedures across all activities.

Table 7: Waste Management Strategy

Waste Stream Description Category According to Protocol	Storage/ Handling	Legislative Requirement Management / Final Disposal
Grey Water (shower water, urine, kitchen waste water) Group 1- sewage and domestic liquid waste	There will be no filters or biolan at skiways or traverse, therefore waste would be collected during traverse. The aircraft toilets will be used at FD83, South Pole and Atka Bay At other White Desert sites, oil residues from kitchen waste water are removed using grease trap Grey water (excluding urine) is filtered using biofilter (Biolan filter)	*Deep ice-pits can be used where such disposal is only practical option*
Blackwater Group 1- sewage and domestic liquid waste	There will be no dry toilets at the skiway or traverse, therefore waste would be collected during the traverse. The aircraft toilets will be used at FD83, South Pole and Atka Bay	*Deep ice-pits can be used where such disposal is only practical option*

Food waste Non recyclable plastic bags used for food Group 3- Solids to be combusted	Stored in enclosed containers, to reduce risk of dispersal and potential impacts to wildlife and taken off site for disposal	*Combustible waste can be incinerated off site* Waste disposal by incineration Permissible plastics disposed of in high specification incinerator (refer to Sustainability of White Desert Operations section)
Packaging waste Recyclable materials aluminium Plastic (excluding plastics banned from Antarctica)	Stored in enclosed containers, to reduce risk of dispersal and potential impacts to wildlife	*Combustible waste can be incinerated* Food is re-packaged into vacuum packed plastic bags prior to arrival, reducing amount and volume of recyclable materials imported to Antarctica Any residual recyclable materials are returned to Cape Town for recycling
Food packages	Food within vacuum packed plastic bags is transported in reusable plastic boxes	Re-use of plastic boxes Returned to Cape Town for re-use
Incinerator Ash- dry ash residue Group 4 other solid waste	Stored in an appropriate enclosed container and treated as hazardous waste	*Dry ash residue is required to be removed from Antarctic Treaty Area*
Empty fuel drums Group 2 Other liquid wastes including fuels and lubricants	Remaining oil is siphoned off, containers sealed to minimise risk of spillage	*Required to be removed from Antarctic Treaty Area*
Waste oils, waste lubricants and waste fuels Group 2 Other liquid wastes including fuels and lubricants	Stored in appropriate secured containers	*Required to be removed from Antarctic Treaty Area*
Materials contaminated with waste oil/ fuels Group 4 Other solid wastes	Stored in appropriate enclosed containers to prevent contamination or dispersal	*Required to be removed from Antarctic Treaty Area*
Hazardous waste Light bulbs, electrical batteries Waste containing harmful metals or persistent compound Group 4 Other solid wastes	Stored in appropriate enclosed containers Stored on an impermeable base to prevent contamination or dispersal	*Required to be removed from Antarctic Treaty Area*

8.1.10 Fuels Oils and Materials Storage and Handling Mitigation Measures

Following approval, a site specific Fuel, Oil and Materials Storage and Handling Plan would be prepared as part of the Operating Procedures for the FD 83 site as well as the traverse route used to access the FD83.This would include as a minimum, appropriate storage and handling measures such as:

- Fuel and oils to be stored in 1500l IBC containers or 205 l drums.
- Remove all penetrations below full supply level of storage containers. Alternatively, provide bunding with 110% capacity.
- Traversing inland from the coast is to only use IBC containers and fuel drums
- Ullage space should be provided at each fuel storage location so that a damaged storage container can be emptied.
- Storage on an impermeable base where possible.
- Use of mat or drip dray to collect drips during re-fuelling activities.
- No refuelling to be carried out outside designated areas.
- Regularly inspect and maintain fuel handling equipment, vehicles, plant, equipment to ensure that there are no leaks.
- Twice daily inspection of bulk fuel tanks for leaks and water accumulation.
- Spill kits will be provided within close proximity to fuel and oil storage areas and operators will be trained in their use.
- Containers will be maintained in good condition, fitted with lids, seals and labelled to indicate the contents.
- Provide snow melter and fuel/water separator.

- Fuel and oil spill contingency plan and spill response strategy with measures for:
- Containing the spill (use of a spill response kit/ absorptive materials indoor)
- Removal of contaminated snow or other material
- Storage of contaminated material within appropriate drums for disposal off-site
- Spill prevention measures when refuelling
- Site staff training

9 Environmental Enhancement Opportunities

9.1 Removal of Redundant Equipment

As a result of the use of the Fuel Drop Depot Location 83 since 2010 by ALCI and TAC, a number of waste fuel drums have been left in situ and are visible above the surface. In accordance with the Article 2 of Annex III of the Protocol on Environmental Protection to the Antarctic Treaty, abandoned work sites of Antarctic activities are required to be cleaned up by the generator of the waste and the user such sites. It considered that that there will be an opportunity to remove the redundant drums from site as part of White Desert overland supply route. This would be a beneficial impact in terms of the physical environment at FD83, as the risk of spillage and contamination from redundant drums would be reduced. The Committee for Environmental Protection Clean up Manual would be referred to for additional guidance.

9.2 Sustainability of White Desert Operations

White Desert operates environmental policies which aim to minimise environmental impacts and apply to all aspects of its direct operations in Antarctica. Taking over the implementation and management of the existing internal flight activities would enable the environmental policies to be rolled out to the flight operations. Previously, flight operations were not within the direct management or control of White Desert and changing this would provide a beneficial environmental impact above the current baseline. The policies aim to go beyond minimum legislative compliance, apply international best practice and are based on sustainability principles. The current policies which would rolled out to the activities are identified in the Wolfs Fang Runway IEE Main Report, which was prepared in July 2016.

All carbon emissions associated with this proposed air travel client operations will be offset by White Desert using the Carbon Neutral Company. White Desert has been a fully accredited member of this company since May 2007 and will continue to offset emissions for all operations.

Following the successful use of the solar powered fans in the last season, White Desert have commissioned the manufacture of new solar heated fans for use at the Whichaway Camp as well as new solar heated water panels.

In addition to these environmental credential, White Desert Ltd in partnership with Eleni Antoniades Environmental Ltd has been Commended for two awards at the ENDS Environmental Impact Awards in May 2017, for two categories: Wolfs Fang Runway IEE, Project of the Year[39] (Built Environment) 2017 and Wolf Fang Runway IEE ,Partnership of the Year 2017, for the work undertaken last year with the Wolfs Fang IEE Report.

[39] http://www.endsawards.com/winners-2017/

10 Cumulative Impacts

10.1 Whichaway Camp Skiway

Clients currently access Whichaway Camp after being flown to the Novo runway, located approximately 7 km south of the Whichaway Camp, the flights are currently operated by TAC on behalf of White Desert. In the upcoming season, it is proposed that for the purposes of internal ferry flights, clients will be flown to a ski-way located in close proximity to the Whichaway Camp by White Desert. Satellite mapping has been obtained through the THINK Institute to help identify appropriate location options in terms of ground conditions and safety in relation to crevassing. The location of the skiway will be selected based on the suitability of ground conditions and a site survey that will be carried out in advance of the commencement of the flying season.

The location of the skiway will be selected to meet the following criteria:

- The Whichaway Camp skiway will be located within 7km of Whichaway Camp and will be located within the same wider study area in terms environmental baseline conditions
- The skiway will be located on snow covered blue ice and will not require the use of ice-free ground
- The site will be selected in accordance with the safety requirements as set out within the White Desert Skiway Procedures and the location will be regularly reviewed throughout the season and relocated if required on safety grounds

In comparison to the current baseline and the information presented and assessed in the Wolfs Fang Runway IEE Main Report 2016:

- There is no increase in client numbers at Whichaway Camp proposed and therefore there are no new associated cumulative impacts associated with client numbers at Whichaway Camp activities
- There is no increase in clients numbers, size of groups or frequency of client visits off site, therefore there are no new cumulative impacts associated with off site visits
- There is no potential increase in use of ground vehicles for client transfers, though the route will change to ferry clients from Whichaway Camp skiway instead of the Novo Runway
- The Cumulative Impacts section of the Wolfs Fang Runway IEE Main Report should be referred to for more details

Analysis of potential impacts in relation to Whichaway Skiway

As the Whichaway skiway is located within the same study area as the Novo runway, it is considered that there will not be a significant change from the existing baseline conditions.

White Desert's temporary accommodation facility is located at Whichaway Camp, 70 ^{0} 46 'S, 11^{0} 37'E within the Schirmacher Oasis. The environmental baseline conditions at Whichaway Camp are described in detail within the Whichaway Camp IEE Report, produced in 2011[40]. The location of the key environmental constraints can be referred to in the Environmental

[40] Whichaway Camp Activity, Initial Environmental Evaluation , White Desert, 2011

Features section, Location Of Designated Features In Immediate and Wider Study Area. The designated features are summarised below.

Physical Environment

- Dakshin Gangotri Glacier ASPA (ASPA No 163) is located approximately 1km north of Whichaway Camp, within the immediate study area of Whichaway Camp and is not visited. All guides have to be familiar with management plan of the ASPA and a copy of this plan can be found in an easy accessible location at the camp. All visitors will be instructed by the guides not to enter the area and will be informed about its location. The ASPA is designated for scientific research purposes. As the location of the ASPA will also be taken into consideration during the planning of the proposed skiway location and avoided, there will be no impacts on the Dakshin Gangotri ASPA.

- The physical environment at the site is considered to be of a high value and sensitivity. It is not anticipated that that there will be a requirement to store fuel at the skiway. As White Desert will be not be refuelling at the Whichaway skiway, the risk of accidental fuel spillage is considered to be negligible, though there is a risk of an accidental leak of oils and fuels from the aircraft.

- With the implementation of appropriate mitigation measures and the use of well maintained aircraft, the likelihood of accidental leak is reduced and associated impacts on the physical environment are reduced further. Appropriate mitigation measures in relation to accidental leaks are set out in the Fuels and Oils Storage and Handling mitigation section.

- There will be no requirement for the storage of waste at the Whichaway skiway, as all waste will be taken to Whichaway Camp and stored in accordance with the White Desert waste management strategy

Flora and Fauna

- The Schirmacher Oasis is considered to be a sensitive ecological habitat and is described in further details within the Whichaway Camp IEE. It is located ice free plateau, characterised by freshwater lakes.

- In terms of designated flora and fauna features, the closest designated ecological sites to Whichaway Camp are located within the wider study area. IBA ANT 113 Gruber Mountains which is located 90km south of Whichaway Camp, Svarthamaren ASPA 142 (which is also designated as an Important Bird Area IBA 112) located approximately 200km south of Whichaway Camp. These will need to taken into consideration during the flight path planning.

- In terms of fauna, it is anticipated that avifauna found in Dronning Maud Land may be present including the Antarctic skua, Antarctic petrel, Snow Petrel, and the Wilson's storm petrel and occasionally of-course Adelie penguins.

- There are no impacts on designated flora and fauna features associated with the Whichaway skiway.

- There is a low potential for bird strike risk and low potential for disturbance of individual birds (Antarctic Petrel, Snow Petrel, South Polar Skua) arising from landing and take-off of aircraft at the Whichaway skiway during operation. This would be a Low risk, Minor impact and in the case of direct bird strike -permanent localised

Mitigation measures

- Discourage presence of birds on site through appropriate management of the site, including removal of all waste to Whichaway Camp and no food to be stored at skiway

Cultural Heritage

- HSM 44 Daskhin Gangotri Plaque is located within the immediate study area approximately 1km north of Whichaway camp and is not visited by White Desert.

- Within the wider study area this includes the HSM79 78 Ninth Indian Expedition Plaque which is located approximately 100km south of Whichaway Camp.

- There are no impacts on designated cultural heritage features associated with the Whichaway skiway

Noise, Vibration and Local Air Quality

- The closest human receptors in the immediate study area include the Whichaway Camp and within the wider study area comprise Maitri research station, and Novolazarevskaya research station. Within the wider study area this includes the ALCI/ TAC Novo runway which is located 7km to the south of the Whichaway Camp.

- There is a potential for disturbance to Maitri research station and Novolazarevskaya research station human receptors, during take-off and landing, as well as from flight path. However, this is considered to be similar to the existing baseline conditions and any impacts are anticipated to be low, temporary, local and seasonal

- There is a potential for local air quality from use of ground vehicles for transfer of clients to Whichaway camp. However, this is considered to be similar to the existing baseline conditions and any impacts are anticipated to be low, temporary, local and seasonal

Mitigation measures

- Ensure that there is no unnecessary idling of snow vehicles to reduce emissions during operation
- Regularly inspect and maintain vehicles, plant and equipment to ensure good working order and air emissions are appropriate

10.2 Interactions with other activities

The cumulative impact assessment has considered the potential interactions with other known or planned activities. There are no known or planned activities within the wider study area which have potential adverse interactions with the White Desert activities. Any opportunities for collaboration in terms of logistical activities are being considered to reduce the environmental footprint in Antarctica as far as possible. The traverse routes used will consider the location of designated ecological sites and sensitive ecological sites in order to avoid these areas.

11 Outline Environmental Management Plan

The mitigation measures set out within Appendix 2 will be incorporated into White Desert's overall Environmental Management Plan, which as outlined in the Wolfs Fang Runway IEE Main Report and can be referred to for more detail. Staff training will be carried out in advance of season commencement to include all mitigation measures outlined within this report.

12 Conclusion

While the proposed activity has the potential to cause adverse environmental impacts the nature of the risks are well understood and controllable. The likely impacts of the proposal are “minor or transitory” in character and it is therefore recommended that that the activity proceed, in the manner described and with adherence to the identified measures for mitigation.

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GUIDELINES FOR THE OPERATION OF AIRCRAFT NEAR CONCENTRATIONS OF BIRDS IN ANTARCTICA

In addition please refer to main report bibliography

Environmental Features

Appendix 2 Wolfs Fang Runway IEE Study Areas

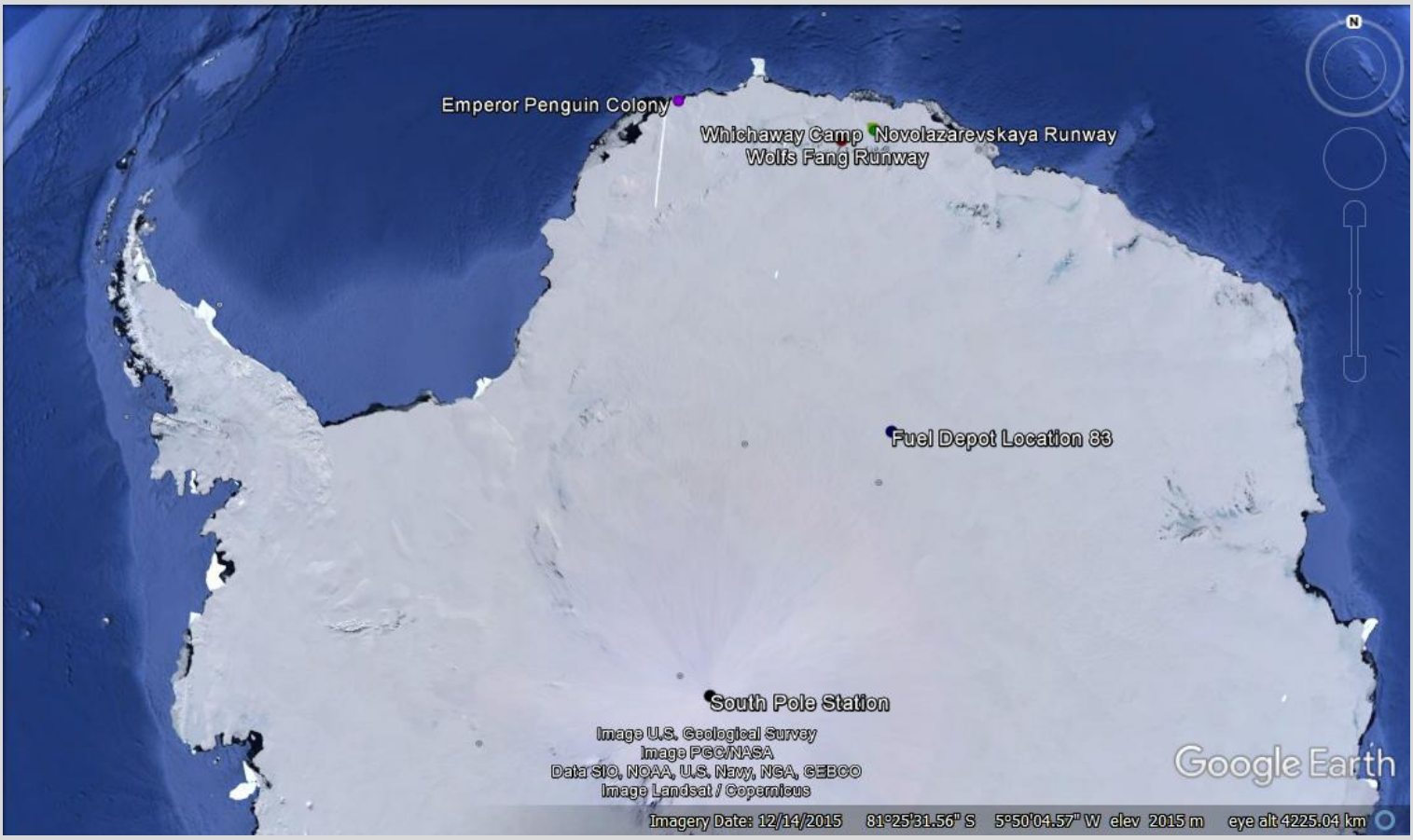

Figure 1.0 Location of Main Activity Areas Under Assessment Atka Bay Emperor Penguin Colony, South Pole, Fuel Depot Location 83

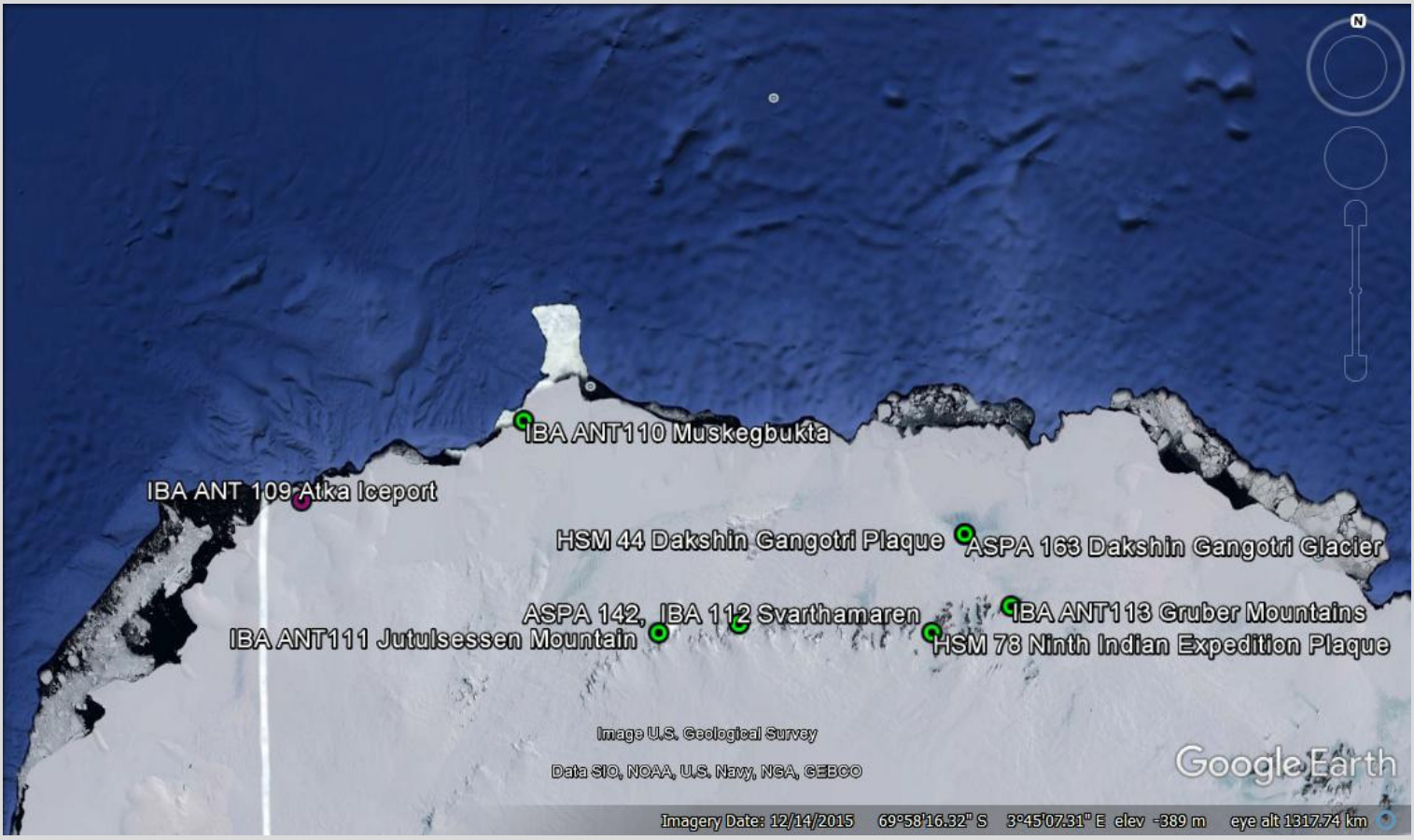

Figure 2.0 Atka Bay: Location Of Designated Features In Immediate and Wider Study Area

Environmental Features

Appendix 2 Wolfs Fang Runway IEE Study Areas

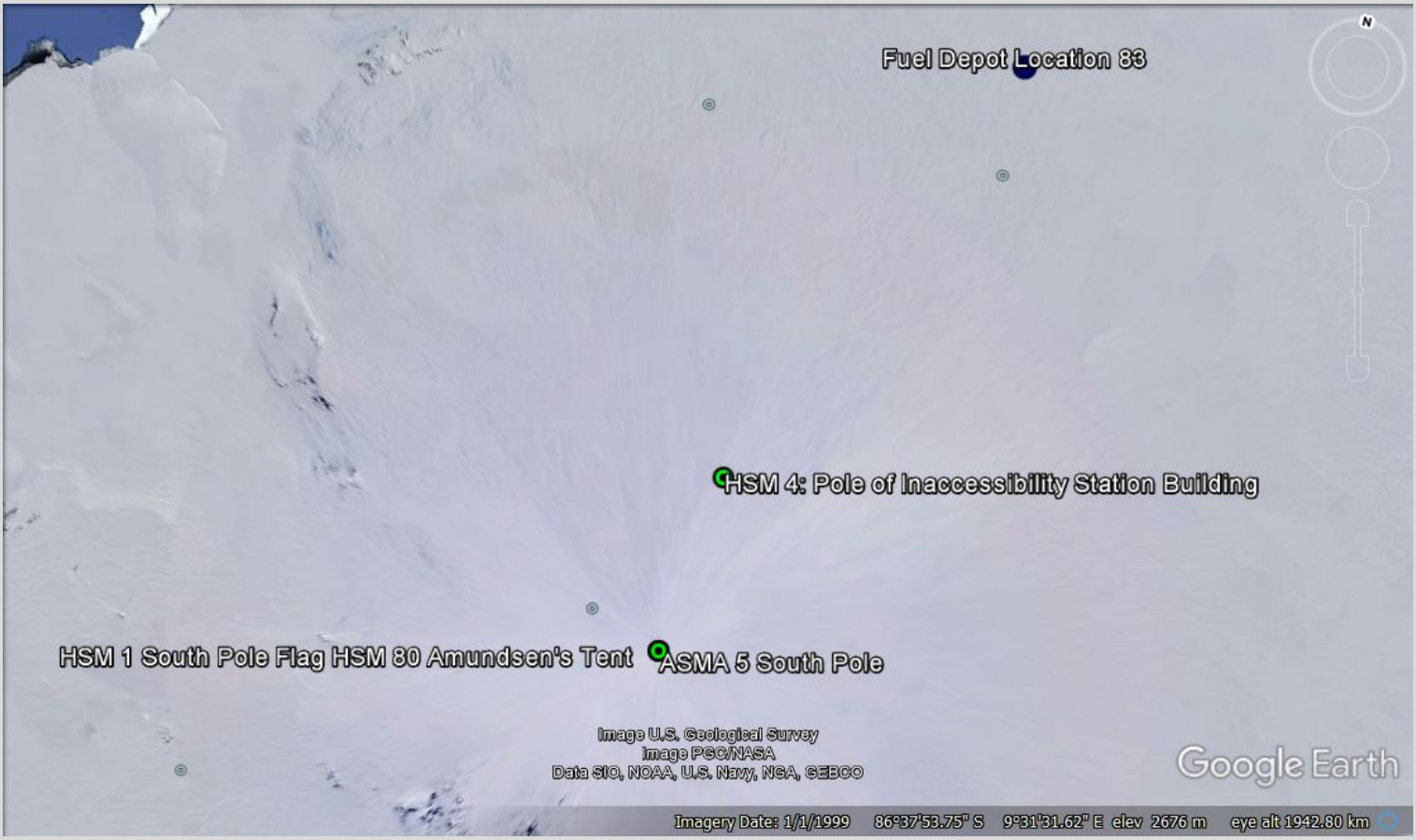

Figure 3.0 South Pole and Fuel Depot Location 83: Location Of Designated Features In Immediate and Wider Study Area

Environmental Features

Atka Bay Ecological Features

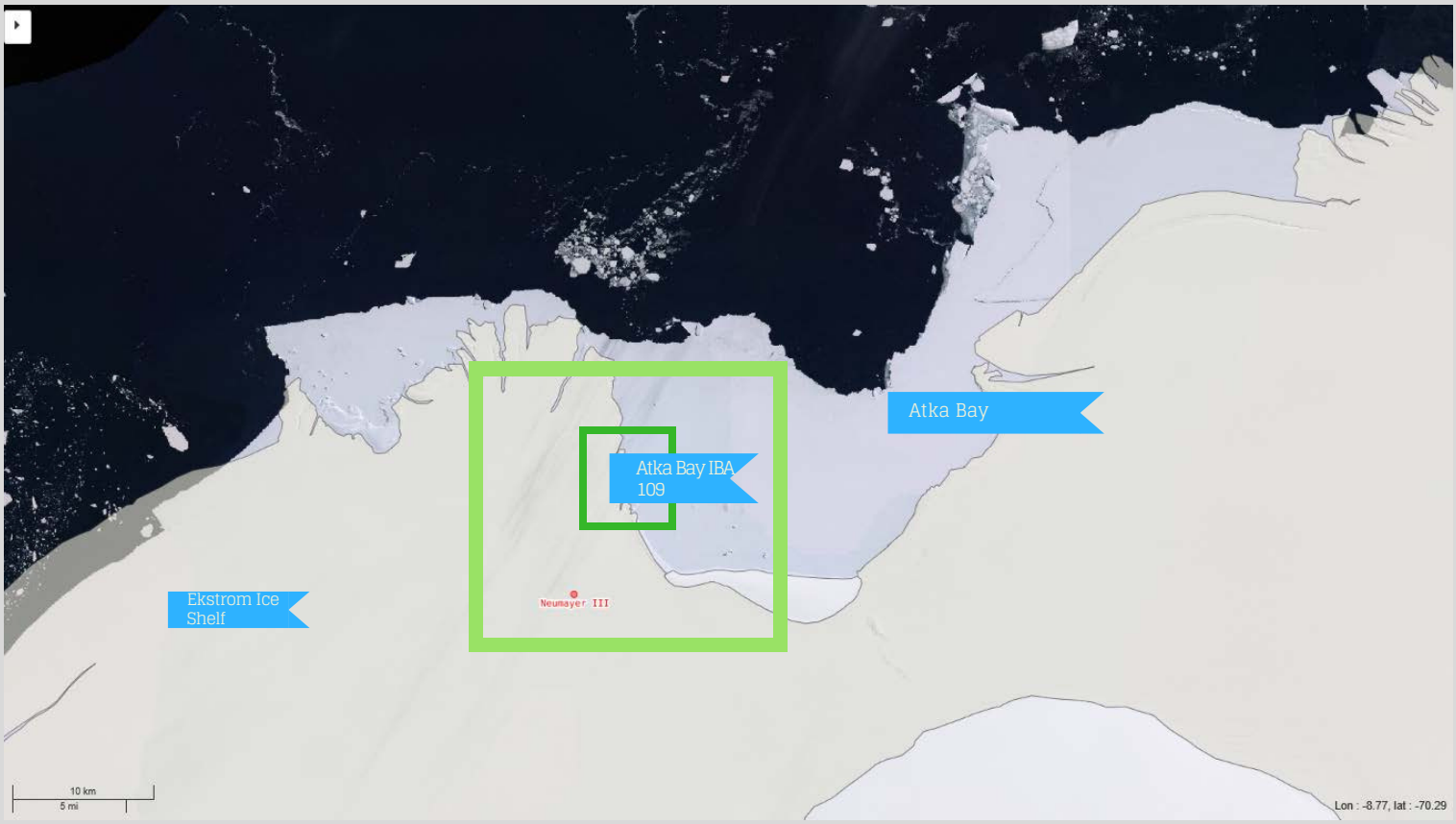

Figure 4.0 Location of Emperor Penguin Colony at Atka Iceport Important Bird Area (IBA Ant 109) And extent of Wider Study Area

Environmental Features

Atka Bay Ecological Features

Figure 5: Location of Important Bird Areas in Antarctica Source: Important Bird Areas in Antarctica 2015

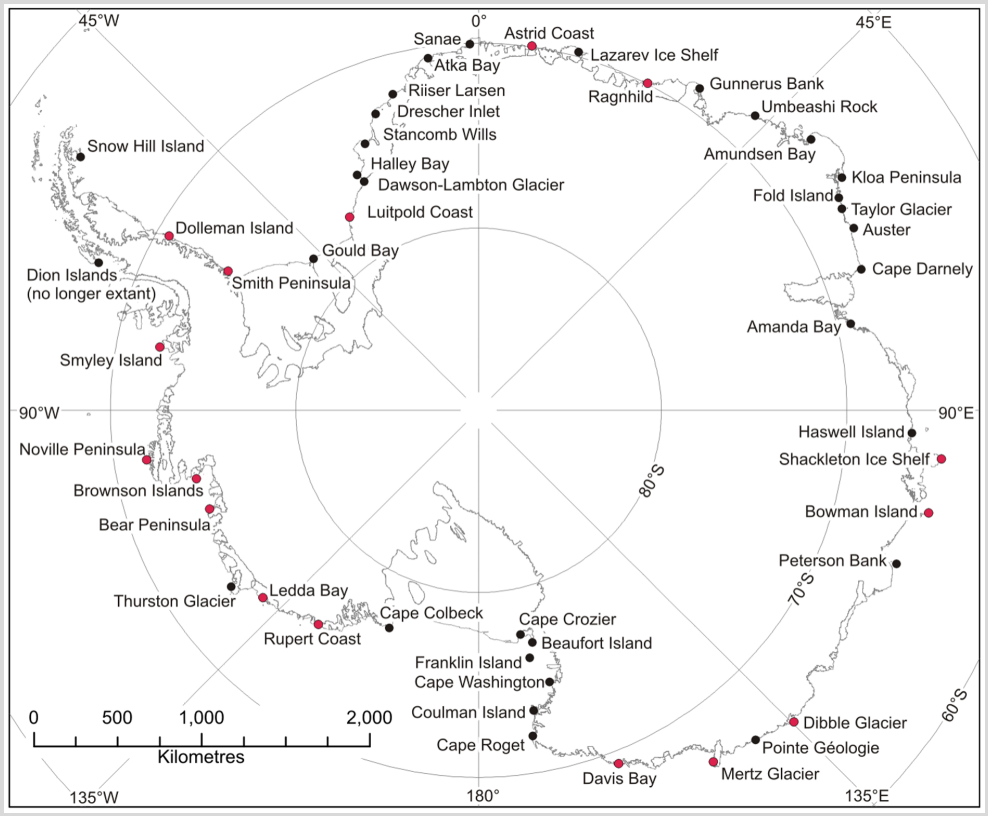

Figure 6: Location of Emperor Penguin Colonies Across Antarctica Source: The First Global, Synoptic Survey of a Species from Space, Fretwell et All

Environmental Features

Atka Bay Ecological Features : Fauna Observed at Atka Bay By White Desert

Photograph 1: Aerial view of Emperor Penguin Colony at Atka Bay Photograph: White Desert Ltd

Photograph 2: Emperor Penguin Colony at Atka Bay During Client Visit Photograph: White Desert

Environmental Features

Atka Bay Ecological Features : Fauna Observed at Atka Bay By White Desert

Photograph 3: Emperor Penguin Adults with Chick Atka Bay Photograph: White Desert Ltd

Photograph 4: Seal with pup observed at Atka Bay Photograph: White Desert

Environmental Features

Atka Bay Ecological Features : Fauna Observed at Atka Bay By White Desert

Photograph 5: Emperor Penguin Chick at Atka Bay Photograph: White Desert

Photograph 6: Seal at Atka Bay Photograph : White Sert

Environmental Features

Atka Bay Ecological Features : Fauna Observed at Atka Bay By White Desert

Photograph 7: View of Atka Bay Emperor Penguin Colony

Photograph 6: Emperor Penguin Colony View from Atka Bay Photograph: White Desert

Environmental Features

Atka Bay Ecological Features : Fauna Observed at Atka Bay By White Desert

Avifauna found in Atka Bay include Snow Petrel, South Polar Skua and Anartic Petrel Photographs: Getty Images

Environmental Features

Atka Bay Physical Environment Features

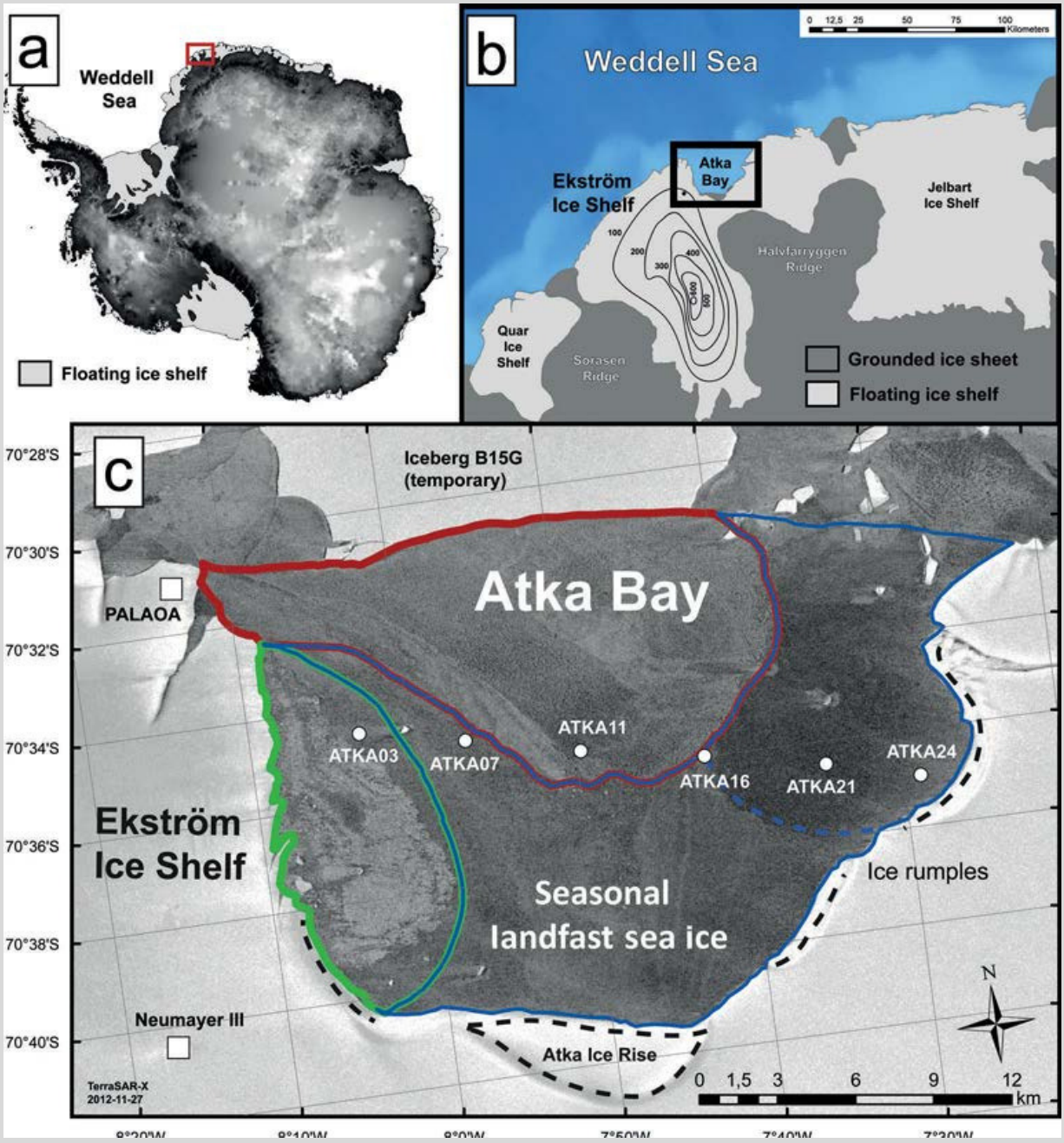

Figure 7: Location of Atka Bay sea-ice thickness investigation sampling locations, as carried out by Hoppmann Et Al Source: Ice platelets below Weddell Sea landfast sea ice, Hoppmann Et All

Environmental Features

Atka Bay Physical Environment Features

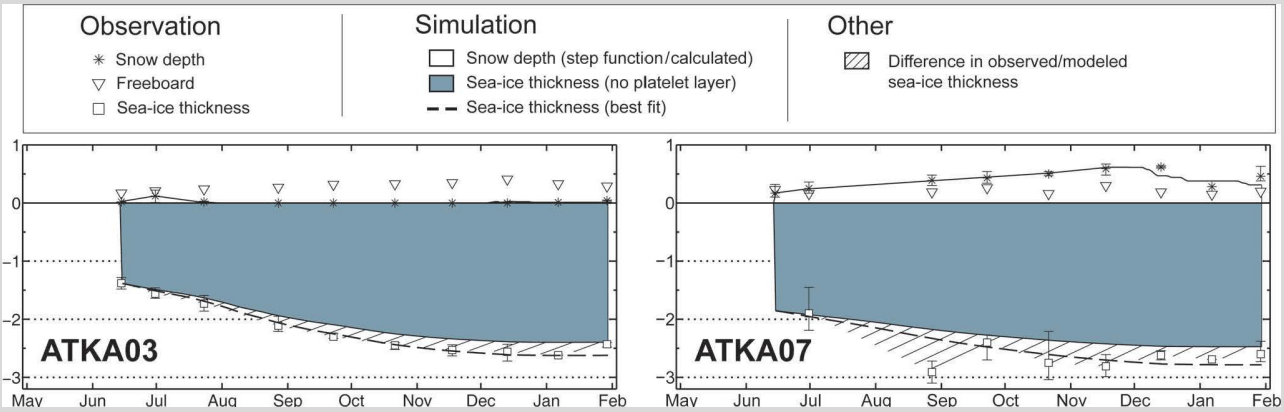

Figure 8: Sea -ice thickness at location ATKA03 though out season. ATKK03 is considered to be the closest to landing site at Atka Bay. The sampling location can be referred to in Figure 7.0 above. This information has been taken from the investigation and study carried out by Hoppmann and others.

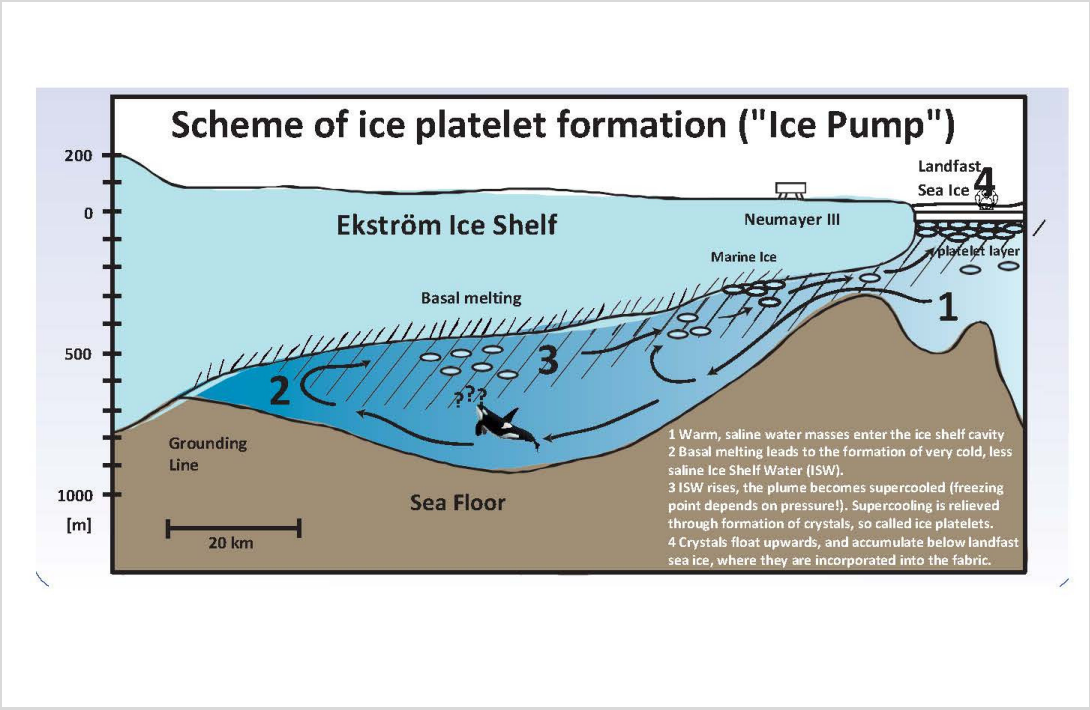

Figure 9: The cycle of sea-ice platelet formation at Atka Bay, as identified by study carried out by Hoppmann and others. Source : Sea-Ice Mass Balance Influenced by Ice Shelves , Hoppmann et Al