ANTARCTIC RESEARCH STATION

Student Briefing Pack

INTRODUCTION

In this design project your team will take on the role of a multi-disciplinary design team that has been chosen to enter the first round of a competition to design a new scientific research station for the British Antarctic Survey (BAS). Your team is made up of architects, civil, structural and environmental engineers. Together you must produce a response to the brief with the right mix of ingenuity, practicality and economy to satisfy the judges that you should be chosen to advance to the next stage in the competition.

BRIEF

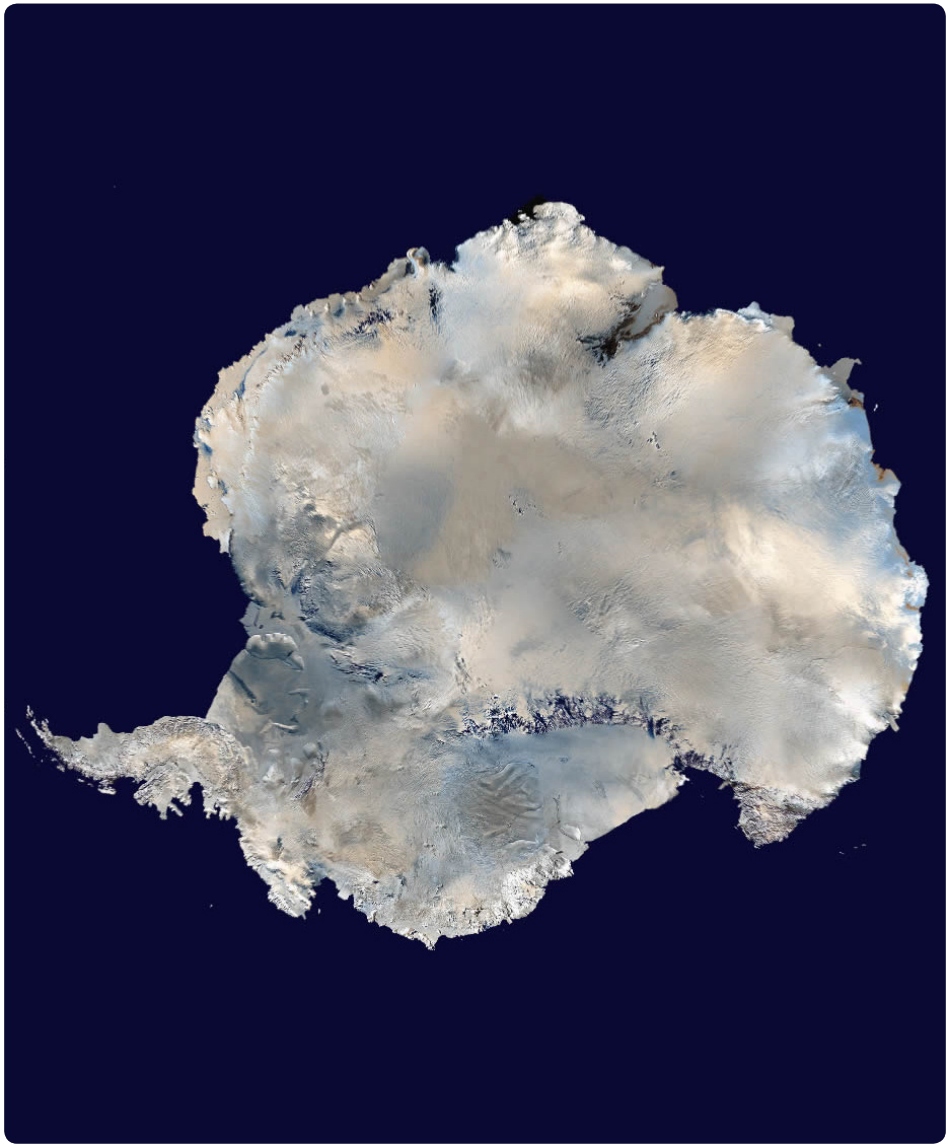
The objective is to design a British Antarctic Survey (BAS) scientific research station (Halley VI) that:

- Minimises environmental impact and complies with the Antarctic Treaty Environmental Protocol
- Is functionally efficient
- Is aesthetically stimulating
- Can withstand the extreme environmental conditions found on the Brunt Ice Shelf, Antarctica
- Has a lifetime maintenance strategy that takes into account the remoteness of the station and the limitations of logistic supply
- Utilises BAS knowledge and expertise in construction and working in a remote and hostile location
- Uses technology to reduce running costs and increase energy efficiency
- Is an exciting project to promote public engagement in science, engineering and technology.

Proposals should optimally combine architectural & engineering creativity and excellence with functional efficiency in compliance with the British Antarctic Survey's objective of achieving world-class research with minimum environmental impact.

You are required to present your work on two A1 sheets of paper. One should illustrate the design process, while the other should illustrate the final proposal.

The aim of this project is to give you the opportunity to develop a logical response to a complex design brief. The site and environmental constraints on this project are highly unusual and so you will need to exercise your judgment to determine what a reasonable response to the brief should be. As such the ideas that you discard along the way are as important as the responses that you develop in the end.



SITE INFORMATION

Landsat Image Mosaic of Antarctica (LIMA) Project

Location

Halley Research Station is located on the Brunt Ice Shelf, Coats Land Antarctica. It lies within British Antarctic Territory.

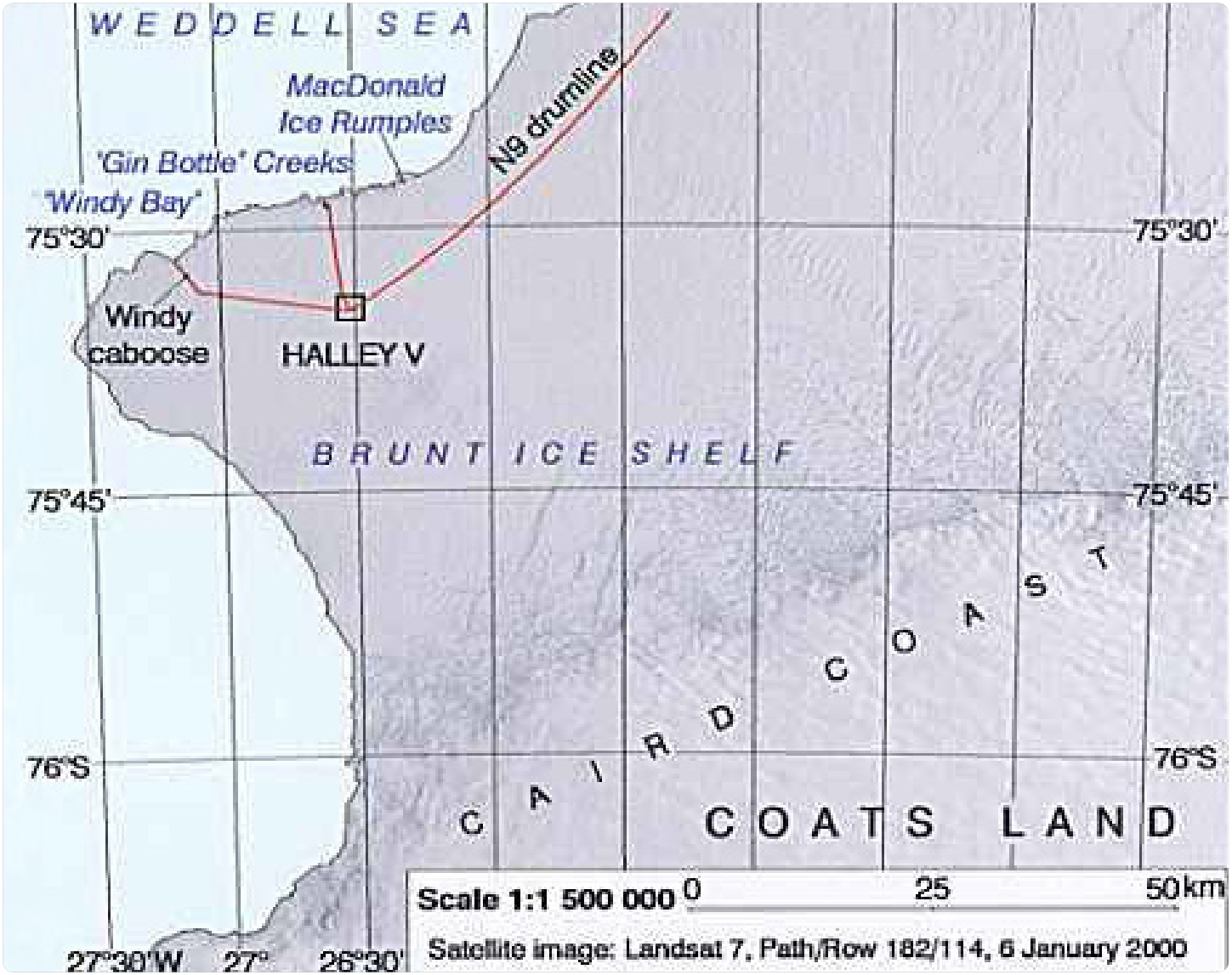
There have been five Halley Research Stations on the Brunt Ice Shelf since 1956. The annual snow build-up and the movement of the ice shelf towards the sea necessitate the periodic rebuilding of the station. A number of design options from simple huts to buildings on skis have been employed over this period.

SITE INFORMATION

Special Considerations

The Brunt Ice Shelf is 150 m thick, flows at a rate of 0.4 km per year northwest from Coats Land towards the sea where, at irregular intervals, it calves off as vast icebergs. Scientists predict a major calving event around 5 years time, after which the current flow rate of approximately 0.4 km per year is expected to increase to 1-1.5 km per year. There is a growing risk that the current research station could be lost due to a calving event in the next decade. It is necessary therefore to design and build a replacement station for initial operation in 4 to 5 years' time.

The movement of the ice shelf towards the sea, the annual 1.5 m build-up of snowfall, and significant snowdrift are challenging site conditions. To cope with the natural forces of this extreme environment a successful solution will require innovation and creativity in design, engineering and technology.



SITE INFORMATION

Environmental Conditions

Snow and ice accumulation is high on the Brunt Ice Shelf ranging on average from 1-1.5m in depth per year. Snow falls on around 175 days each year. Rain has never been reported but freezing drizzle may occur. The dynamic forces within the ice are multi-directional.

An ***ice shelf*** is the floating extension of the grounded ice sheet. It is composed of freshwater ice that originally fell as snow, either in situ or inland and brought to the ice shelf by glaciers. These are largely considered as permanent features.

Sea ice is frozen seawater that forms around the continent in the autumn, as a floating layer only a few metres thick. Most of it melts during the summer.
Temperatures range from -55°C in the Antarctic winter and +4.5°C during the summer. However, average mid-summer temperatures are around -5°C and average winter temperatures are around -30°C.

Wind conditions vary from periods of absolute calm to days of continuous storm.The extreme mean hourly wind speed is approximately 30 m/sec with extreme gust speeds up to 40 m/sec.The mean wind speed is 7 m/sec.The wind causes drifting snow on about 180 days each year, which becomes general blowing snow on about 175 days each year. Gales occur on average about 40 days per year.

Light conditions. There is 24 hr daylight during the Antarctic summer with sunshine on average for 1445 hours per year (approx 34% of the maximum possible).There is darkness for 55 days in winter and the sun does not appear above the horizon for 100 days.

SITE VISIT

Construction Challenges

Any structure built on the surface of the ice soon becomes buried by snow & ice and is eventually lost due to calving. Construction work can take place only during the Antarctic summer. *All* building materials and equipment must be suitably packaged for transportation by ship.

Logistics Challenges

Winter darkness and frozen sea makes access to the station possible during the Antarctic summer only. During this time the station is re-supplied once, and sometimes twice, by ship with all essential items (fuel, food, etc). Cargo is offloaded onto sea-ice from where it is transported by sledge and tracked vehicles (Sno-Cats) on to the thicker more stable shelf-ice. Sea-ice restricts cargo loads to a maximum of 6 tonnes in good conditions and only 1 tonne in poor conditions. The optimum re-supply distance with current modes of transport and re-supply method is approximately 12-20 km between the ship and station. However, several kilometres of this can be on sea-ice (The 2003/04 relief included an 8 km route over sea-ice).

SITE VISIT

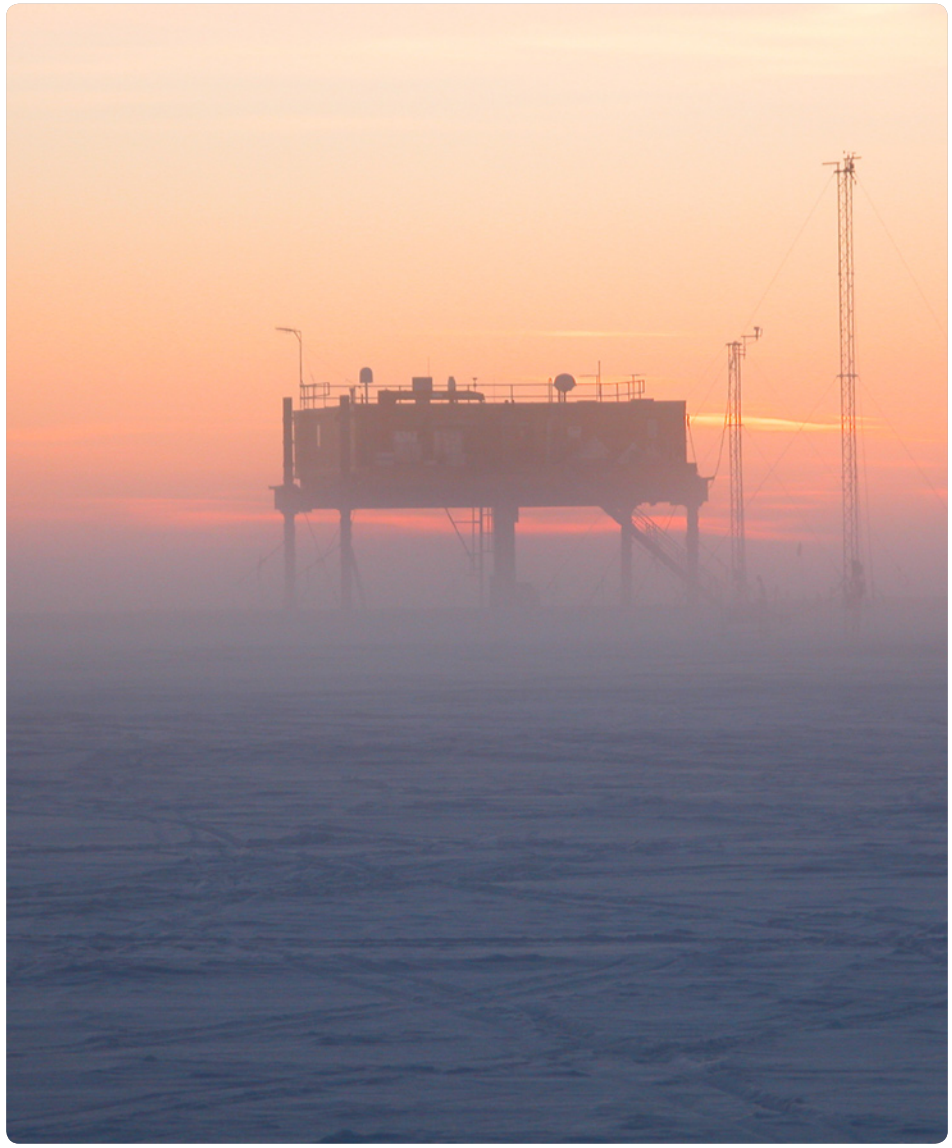
BAS Environmental Policy

British Antarctic Survey's Environmental Policy is to undertake a programme of world-class scientific research with the minimum environmental impact. The design, construction of the new Halley Research Station will be subject to an Environmental Impact Assessment as required under the Antarctic Treaty's Environmental Protocol. The station will be designed to minimise the amount of fossil fuels consumed and greenhouse gases produced, as well as maximise energy efficiency and the amount of power produced from renewable energy resources.

Technology

Concept proposals should seek to develop innovative engineering and technology solutions for the station. However, design teams need to be aware that an element of standardisation is required to ensure easy maintenance and procurement of replacement parts to provide failsafe systems in Antarctica.

STATION REQUIREMENTS



The Halley VI station will operate year round and be of sufficient size and capacity to accommodate 52 men and women in summer, reducing to 16 during winter. Over-wintering staff live and work on site for periods of up to two years.The station will comprise domestic, technical and scientific facilities.

Domestic accommodation will consist of sleeping, kitchen, restaurant, medical surgery & leisure facilities. Technical accommodation will consist of stores, workshops and field support facilities. Science accommodation will consist of fully serviced buildings, which BAS will fit out with scientific equipment. The facility will be constructed at, or above ground level.

The expected life of the facility is 20 years and the component parts of the facility must be capable of being removed from the Antarctic in their entirety at the end of their design life to meet legal requirements of the Antarctic Treaty.
The final station design will operate with a minimal environmental footprint and minimal fossil fuel consumption, and be designed for simple, easy operation and maintenance allowing staff resources to be optimised for science rather than survival. Interior spaces, whilst being functional and comfortable, must be stimulating. Concepts for building services installations must be justified in relation to wholelife costs (from inception to installations through to operation, overhaul and, ultimately, replacement) both financially and environmentally. The goal is a cost-benefit optimisation in its widest sense.

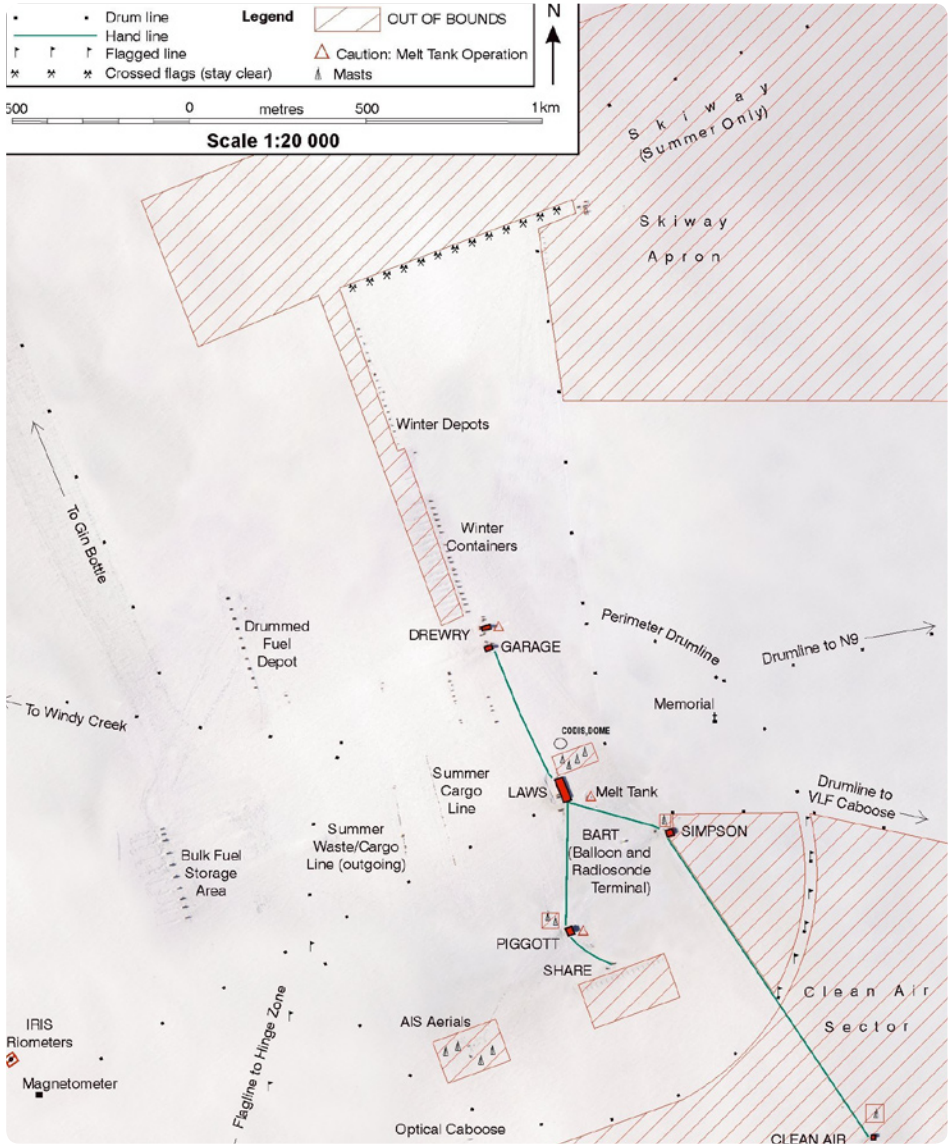
British Antarctic Survey science programmes are planned on a 5-year cycle and because of this, specific facilities required to support the science after 2010 are unknown at present. It is possible that future scientific experiments will be carried out using remote/automated technologies. For this reason detailed requirements for science facilities will be excluded from the concept proposal brief.

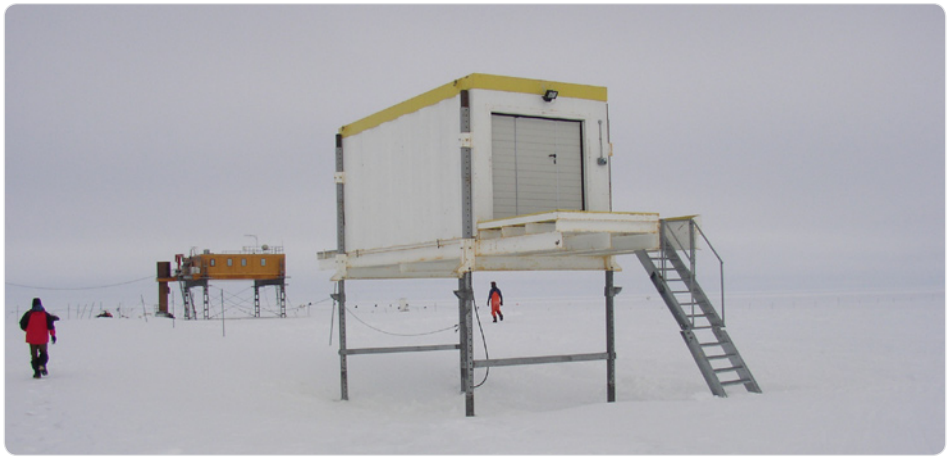
THE EXISTING STATION

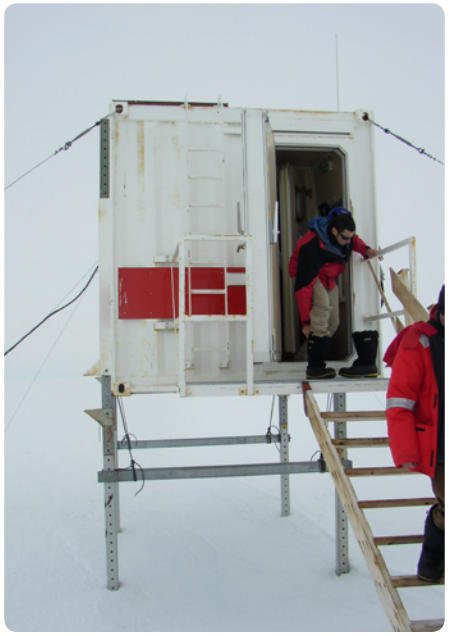
The present Halley V Research Station is a series of science and accommodation platforms raised above the ice surface on jackable legs. There are also two moveable structures on giant skis. The station is the most successful so far in terms of its longevity, use of technology and living experience.

However, annual re-supply and maintenance are major challenges requiring significant logistics and human resources, because specialist teams are required to visit the station each austral summer to clear accumulated snow and raise the structures.

THE EXISTING STATION







Expedition
Morley House
First Floor
320 Regent Street
London W1B 3BB

T +44 (0) 20 7307 1000
F +44 (0) 20 7307 1001
E info@expedition.uk.com
W www.expedition.uk.com

www.expeditionworkshed.org