

## • Management Plan for Antarctic Specially Managed Area No. 5

### AMUNDSEN-SCOTT SOUTH POLE STATION, SOUTH POLE

#### 1. Description of Values to be Protected

The Amundsen-Scott South Pole Station (hereafter referred to as “South Pole Station”) is located on the polar plateau near the geographic South Pole, at 90° S. An area of approximately 26,400 km<sup>2</sup> encompassing the station and long-term research and monitoring sites is designated as an Antarctic Specially Managed Area (hereafter referred to as “the Area”) to manage human activities for the protection of scientific, environmental, and historical values.

The climate at the South Pole Station is extremely cold, windy, arid, and at a high physiological altitude. The mean annual temperature is -49.3°C; annual precipitation is about 7 cm (water equivalent). The elevation at the station is 2,835 m. The landscape of the region is characterized by the flat, white surface of the ice sheet, which rises 2,700 m above the continental landmass (elevation is 135 m above sea level). The ice sheet at the South Pole is constantly shifting, and moves the Area approximately 10 m each year towards the Weddell Sea.

The Area is located in a region of high scientific value and South Pole Station facilitates exceptional scientific research with extensive international collaboration. The unique environmental conditions at South Pole Station provide special opportunities for scientific observation. The air is considered to be the cleanest air on Earth, being far removed from pollution sources and human influence. As such, the Area is an important monitoring and research area for world background levels of natural and anthropogenic atmospheric constituents. Furthermore, conditions in Antarctica reflect global change as well as indicate the regional role of Antarctica in the global climate.

The South Pole’s position on the Earth’s axis, the Area’s climatic conditions and remoteness from light pollution facilitate extended astronomical and astrophysical observations of specific stellar objects. Also, the Area’s isolation from sound, vibration, and electro-magnetic interference (EMI) is important for seismological and astrophysical research. The geophysically stable location of the Area and the operation of the Station year-round allow for continuous research of upper atmosphere physics, including solar processes, effects of short term geomagnetic phenomena (auroras, induced electrical currents, and radio wave communications interference), and long term events (relating to the ozone layer, ultraviolet radiation, atmospheric composition, stratospheric winds, weather, and climate). The area also hosts one of the Earth’s most important seismic stations, critical for both its location and lack of background noise.

The unique ice conditions in the Area are of high scientific value. The thick ice serves as a storehouse of information about climate and atmospheric constituents. Also, the depth and the clarity of the ice make it an ideal medium for neutrino detection.

The unique community of people living at South Pole Station allows for specialized medical research on small, isolated groups.

The Area has significant historical value. The Ceremonial Pole (HSM No.1), surrounded by the flags of the twelve original Antarctic Treaty nations, commemorates the International Geophysical Year, and is symbolic of all expeditions that have reached the South Pole. Also, although the exact location is unknown today, Amundsen Tent (HSM No.80), is also located within the Area.

Activities conducted in the area include diverse scientific research endeavours, operations in support of science, media, arts, education, and tourism.

#### 2. Aims and Objectives

## II. Measures

The South Pole area requires special management to ensure that the scientific, environmental, and historical values of the Area are conserved. Increasing human activity has necessitated more effective management and coordination of activities in the Area.

The aim of management at South Pole is to coordinate activities in the Area such that the scientific and environmental values of the Area can be sustained indefinitely, and the historical values preserved to the greatest extent practicable. The specific objectives of management in the Area are to:

- Facilitate scientific research while maintaining stewardship of the environment;
- Prevent conflicts among activities, including different areas of scientific research, science support activities, and non-governmental activities;
- Promote coordination for future activities, including coordination with tour operators visiting the Area;
- Maintain a safe environment in the Area;
- Maintain the historic values of the Area;
- Minimize environmental impacts of human activities;
- Minimize release of pollutants;
- Allow for necessary modifications and expansion of Station facilities in a managed, well-planned manner.

### **3. Management Activities**

The following management activities are to be undertaken to achieve the aims and objectives of this plan:

- The National Program(s) operating in the Area shall promote the dissemination of information to all parties operating in the Area to ensure the implementation of the management plan.
- The National Program(s) operating in the Area shall in particular promote, to all parties operating in the Area, general education on safety, risks related to environmental conditions, medical emergencies and incidents, Zone and Sector guidelines, and airport safety issues.
- To prevent conflicts, parties intending to conduct research in the Area shall coordinate activities with the National Program(s) operating in the area well ahead of the planned activity. National Program(s) operating in the Area shall ensure that all personnel in their program visiting the Area have been briefed on the requirements of the management plan.
- Visitation by tour groups and any other non-governmental activities shall be coordinated with the National Program(s) operating in the Area, as outlined in Appendix A. Group leaders shall ensure that all visitors have been briefed on the requirements of the management plan.
- As the operator of Amundsen-Scott South Pole Station, the US has volunteered to take the lead in coordinating activities in the South Pole ASMA.
- Visits to the ASMA shall be made as necessary by the National Program(s) operating in the Area (no less than once every five years) to evaluate whether the management plan is effective and to ensure management measures are adequate.

Additional guidelines for the conduct of specific activities and for specific Zones within the Area are found in the Appendices.

### **4. Period of Designation**

Designated for an indefinite period, subject to periodic review by the Antarctic Treaty Parties, as required by Annex V, Article 6.

### **5. Maps and Photographs**

Due to the dynamic nature of the ice sheet and operations supporting science at the South Pole, persons intending to access the Area should contact the National Program(s) operating in the Area for the most current maps and information.

- Map 1 – general map of the Area, with full extent of Zones and Sectors, and location on the Antarctic Continent
- Map 2 – map with designated aerial approach paths
- Map 3 – map with detail of sector intersections
- Map 4 – detailed area map with Non-Governmental Organization (NGO) parking and camping area, access paths, buildings and zones specified

\*Note: “Grid North,” as represented on Map 4 is in reference to alignment with the Greenwich Meridian (0 Degrees Longitude).

## **6. Description of the Area**

### **6(i) Geographical coordinates, boundary markers, and natural features**

The boundary of the Area comprises all structures and areas of current and planned research at South Pole Station and a buffer area for the Clean Air Sector (CAS). The boundary of the Area is a circle around the South Pole Station with a radius of 20 km, and a wedge extending 150 km from the Atmospheric Research Observatory (ARO) building (approximately 0.5 km from the 2005 Geographic South Pole), bounded by 110° and 340° (grid) from the ARO building. The point of origin of the ASMA and sectors (other than the CAS) was designated as the circular aluminum tower staircase on the elevated station, as this is a readily recognizable feature on the maps and on the ground, and the elevated station is expected to be present in the Area longer than any other structure or landmark.

Pollutants from aircraft and other sources in polar regions can travel hundreds of kilometers, affecting measurements of boundary layer air, measurements of gasses and aerosols in the air column, and measurements of contaminants in the snow, thus requiring an extensive area be kept vacant to maintain a site for research on clean air. The ARO building is situated upwind of the station, and the 150 km outer radius of this sector provides the necessary buffer for ensuring accurate measurements.

Snow accumulation has been monitored intermittently at the South Pole since the International Geophysical Year (1957-1958). An extensive network of measurement locations to monitor long-term snow accumulation around the South Pole was established in 1992 (Mosley-Thompson et al. 1999). The network of measurement stakes extends out 20 km in all directions from the pole; it is essential for the research being conducted on snow accumulation that the stakes and the area around the stakes are not disturbed.

Due to the movement of the ice sheet in the area, the geographic location of the ASMA will move approximately 10 m per year; the area is centered on the elevated South Pole Station, and all sectors are relative to this location. Treaty parties may consider shifting the Area if it becomes appropriate in the future.

### **6(ii) Restricted and managed zones within the area**

This management plan establishes four types of managed zones within the Area: Operational Zones, Scientific Zones, Historic Zones, and a Hazardous Zone. The objective of this zoning concept is to manage for multiple uses of and activities in the Area. The Operational Zones encompass areas where science support and the majority of human activity (including tourism) occur, the Scientific Zones bound areas where scientific research occurs, the Historic Zones encompass and preserve historical sites, and the Hazardous Zone restricts all human activity for safety reasons. Each zone has specific guidelines for the conduct of activities, discussed in general in the sections below and in detail in the Appendices.

#### *6ii(a) Operational Zone*

The Operational Zone has been established to contain primary human activity in the Area, including science support activities, main station services (e.g. living facilities), ski-way operations, and tourism. Scientific activities may be conducted in the Operational Zone if they will not be in conflict with operational activities.

## II. Measures

The following management activities should be undertaken for the Operational Zone:

- Waste management should be considered in the planning, maintenance and decommissioning of facilities within the Operational Zone;
- Standard operating procedures for activities in the Operational Zone by the National Program(s) operating in the Area should be adopted and made available to persons visiting the area where deemed appropriate by the National Program(s) operating in the Area;
- Contingency plans for emergencies in the Operational Zone should be adopted where deemed appropriate by the National Program(s) operating in the Area;
- The installation of any new structures or modernization of existing structures in the Operational Zone may from time to time be necessary. The National Program(s) operating in the area should review and coordinate any plans for construction or installations to ensure that the impact on scientific activities is minimized. Any change is subject to environmental assessment as required by Article 8 of the Protocol on Environmental Protection to the Antarctic Treaty.
- Specific guidelines for visitors not associated with a National Program are described in Appendix A of this management plan.

Map 3 shows the location of the Operational Zone.

### *6ii(b) Scientific Zone*

The Scientific Zone has been established to protect certain types of scientific activity from disturbance. The unique scientific values of South Pole Station require special protection from the interference from sound, light, vibration, EMI, snow drifting, and visual obstruction. South Pole Station has been designed so that scientific activities of particular sensitivity are strategically located and protected from activities causing interference.

The following management activities should be undertaken for the Scientific Zone:

- Standard operating procedures for activities in the Scientific Zone should be adopted and updated as deemed necessary by the National Program(s) operating in the Area.
- The Scientific Zone has been divided into Sectors to address specific scientific requirements. The Scientific Zone Sectors are listed in Appendix B with locations, boundary descriptions and guidelines for conduct in the individual Sectors. Detailed Standard Operating Procedures for some of the sectors are available upon request from the United States Antarctic Program (USAP).

Maps 1 and 2 display the location of the Scientific Zone Sectors. Entry to these Sectors should not interfere with scientific activities.

### *6ii(c) Historic Zone*

The Historic Zone encompasses sites designated for their historic value. Management of this Zone aims to recognize and protect the values of the sites while allowing for visitation to the Zone. The Historic Zone includes the site of the Ceremonial South Pole, located near the Geographic South Pole and is clearly marked. In addition, although the exact location or depth is unknown today, Amundsen's Tent (HSM No.80) and other relics from the 1911-12 era, are also located in the Area. The Historic Zone is located within the Operational Zone. Searching and/or removal of said relics is strictly prohibited within this zone and/or within the historic geographic confines of this zone, unless authorized by the Treaty Parties. In the future, the Treaty Parties may consider expansion of the Historic Zone; there are no restrictions on where the Historic Zone may be designated within the ASMA.

Historic Site and Monument No. 1 (HSM No. 1) is the flag mast at South Pole 90°S, the flag mast was erected in December 1965 at the geographic South Pole by the first Argentine Overland Polar Expedition. The precise location of HSM No. 1 is not currently known due to ice sheet movement, therefore could not be identified on the management plan maps.

The Ceremonial South Pole commemorates the International Geophysical Year (IGY) as well as all expeditions that have achieved the South Pole. At the site is the Ceremonial Pole marker surrounded by the flags of the original twelve Antarctic Treaty nations.

There are no restrictions on visitation to the Historic Zone. However, visitors must abide by guidelines in this management plan and take all appropriate safety precautions.

Map 4 shows the location of the Ceremonial South Pole.

#### *6ii(d) Hazardous Zone*

The Hazardous Zone is designated to safeguard hazardous sites found in and around the original (1957) South Pole Station. For reasons of human safety, entrance to the Hazardous Zone is prohibited at all times, except for essential management activities.

The following management activities should be undertaken for the Hazardous Zone:

- The National Program(s) operating in the Area or 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.
- Visits to the Hazardous Zone may only be made for essential management purposes.

Map 3 shows the location of the Hazardous Zones.

#### **6(iii) Location of structures within and adjacent to the site**

Structures within the Area are identified on Map 4. Various structures have been installed in the Area since the 1950s; all were constructed by the United States. No building should be entered without permission from the National Program(s) operating in that building. For restrictions on access to specific structures and their surrounding areas, see detailed descriptions of Zones and their Sectors in the Appendices of this plan. A new US station facility is being constructed in the Area. The 1975 US dome station and other facilities that are beyond their useful life will be removed from the Area when practicable.

When the current phase of construction is completed at the South Pole Station, the footprint of buildings remaining on site will total approximately 14,800 m<sup>2</sup>, in the following divisions:

- Elevated Station: 5,575 m<sup>2</sup>
- Sub-surface Arches: 5,575 m<sup>2</sup>
- Ancillary Science Buildings: 3,715 m<sup>2</sup>

#### **6(iv) Location of Antarctic Specially Protected Areas within or around the Area**

None.

### **7. Code of Conduct**

#### **7(i) Access to and movement within the Area**

All approaches to the Area should be made along a route approximately 204° east of grid north to avoid restricted sectors. Access to the Area is usually by ski-equipped fixed-wing aircraft, but may be by overland vehicle traverse. Occasional access to the Area is made by helicopter, on foot, or by ski. Entry into the Area is permissible, but notification must be given to the National Program(s) operating in the Area prior to entering the Area, and specific requirements are provided below for access to the area via aircraft.

Coordination with National Program(s) operating in the Area in no way implies liability of any Treaty Party or National Program for any accident or injury incurred at any time during the expedition. Pilots should refer to the Antarctic Flight Information Manual (AFIM) for specific details regarding access to the area via aircraft and requirements for prior approval for ski-way use.

## II. Measures

Care should be taken when approaching on the ground to avoid the Very Low Frequency (VLF) antenna. Movement within the Area is usually by foot or by vehicle. Vehicles and pedestrians should stay on marked trails as much as practicable. The ski-way should not be crossed unless absolutely necessary and all crossings should be made at the designated crosswalks, adjacent to, and in accordance with the status indicated by the “crossing beacons.” The ski-way shall not be crossed when the beacons’ rotating lights are on, signaling an imminent aircraft landing or take-off. Restrictions exist for access into and movement within some of the Zones within the Area; refer to the Appendices of this management plan for additional movement and access guidelines in the Zones.

### *7i(a) Access to the Area via aircraft – National Programs*

National Program(s) intending to fly into the Area should coordinate with National Program(s) operating in the area to ensure there will be no conflicts with ongoing activities. Advance planning and communication, consistent with the Antarctic Treaty’s Information Exchange requirements, with confirmation at least 24 hours prior to arrival, is necessary to avoid conflicts. Pilots approaching the area should notify South Pole communications (COMMs) 30 minutes prior to landing at the South Pole to allow time to clear the ski-way, and should confirm again their approach 10 minutes before landing. Pilots should observe the flight-restricted areas defined in this management plan to preserve the integrity of the Clean Air Sector research.

### *7i(b) Access to the Area via aircraft – Other Expeditions*

The ski-way and infrastructure are maintained by the National Program(s) in the Area and use of these resources is generally restricted to activities supported by them. Access to the South Pole ASMA via any type of aircraft is limited to activities supported by National Programs and activities granted prior approval by the National Program(s) that maintain the ski-way and associated air traffic control facilities. The ski-way is essential to the operations and safety of researchers in the Area. Use of wheeled aircraft on the ski-way or an airplane crash would have substantial deleterious impacts on the scientific research being conducted in the Area and threaten the safety of all personnel in the Area.

Approval of ski-way use for an activity not associated with a National Program does not need to include a full safety review of an expedition or its flight plan, and in no way implies liability of any Treaty Party or National Program for any accident or injury incurred at any time during the expedition. If a person or organization not associated with a National Program intends to request prior approval to access to the Area via aircraft or use of the ski-way, they should refer to the requirements and procedures for approval in the AFIM and contact the appropriate National Authorities.

### **7(ii) Activities that may be conducted in the Area**

All activities in the Area should be conducted in a manner that will preserve the values of the Area to the greatest extent practicable. There are no restrictions on types of activities that may be conducted in the Area; however, all activities in the Area should be conducted in accordance with the guidelines in this management plan. Activities should be conducted in as energy efficient manner as possible, and renewable energy should be used as much as practicable to minimize fuel usage.

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. All visitors to the Area that are not sponsored by a National Program should be educated on and follow the guidelines in this management plan, especially Appendix A.

### **7(iii) Installation, modification, or removal of structures**

The installation of new structures, or modification or removal of existing structures should be reviewed by the National Program(s) operating in the Area. Any change is subject to environmental assessment as required by Article 8 of the Protocol on Environmental Protection to the Antarctic Treaty.

### **7(iv) Field camps**

- For visitors to South Pole not sponsored by a National Program, field camps in the Area should be located at the designated site described in Appendix A.
- All materials and equipment should be removed from field camps upon departure.

- Solid wastes, including human wastes should be brought out of field camps to the maximum extent practicable.

#### **7(v) Taking or harmful interference with native flora or fauna**

Not applicable.

#### **7(vi) Collection or removal of material found in the Area**

Aside from removal of snow and ice for scientific purposes or for drinking water supply and cooking water during expeditionary activities, nothing should be removed from the Area that was not brought in by the visiting party, unless approved by the National Program(s) operating in the area or mandated (i.e. for environmental protection purposes).

#### **7(vii) Waste management**

- For the National Program(s) operating in the Area,
  - All waste should be removed from the Area with the following exceptions: human waste and liquid from bathing, laundry and dishwashing.
  - Human waste, garbage disposal waste, liquid from bathing, laundry and dishwashing may be deposited into deep sewer bulbs, or disposed of by other methods in accordance with the Protocol.
- For other expeditions to the Area,
  - All waste brought in or generated is to be containerized and removed from the area upon departure.

#### **7(viii) Requirements for reports**

The National Program(s) operating in the Area shall provide a record of visitations to the Area to the depository Nation annually.

### ***8. Provisions for the Exchange of Information in Advance of Proposed Activities***

Prior notification of a visit to the ASMA by visitors not sponsored by a National Program must be provided to the appropriate National Authorities. In addition to the normal exchange of information by means of the annual national reports to the Parties of the Antarctic Treaty, Scientific Committee on Antarctic Research (SCAR), and Council of Managers of National Antarctic Programs (COMNAP), Parties operating in the Area will exchange information annually. All National Programs, NGOs, and other individuals or organizations intending to visit or conduct research in the ASMA should contact the National Program(s) operating in the Area sufficiently in advance of the activity to allow for coordination of planned activities with ongoing activities in the Area.

### ***9. Supporting Documentation***

Additional guidelines for activities in the ASMA are found in the Appendices of this plan. Detailed operating procedures for some Zones and their Sectors have been written and are updated yearly; current versions may be available upon request from the USAP.

### ***10. References***

Standing Committee on Antarctic Logistics and Operations (SCALOP) and the Council of Managers of National Antarctic Programs (COMNAP). Antarctic Flight Information Manual: A Handbook of Antarctic Aeronautical Information. (See most recent update)

Mosley-Thompson, E., J.F. Paskievitch, A.J. Gow, and L.G. Thompson. 1990. Late 20<sup>th</sup> century increase in South Pole snow accumulation. *Journal of Geophysical Research* 104(D4):3877-3886.

## Appendix A:

### ***Additional Guidelines for Non-Governmental Organizations at the South Pole***

Guidelines for tourist activities have been established to improve coordination between the National Program(s) operating in the Area and non-governmental visitors to South Pole Station. Each austral summer, the South Pole Station receives a number of visitors associated with private expeditions and other Non-Governmental Organizations (NGOs). These visitors are most frequently associated with private companies that provide transportation, guides, and logistical support. The purpose of this Appendix is to inform NGO visitors about on-site resources, expectations, and hazards. In addition to these procedures, every person at the South Pole is expected to comply with the Antarctic Treaty and policies governing their respective National Program(s).

- For the purpose of this management plan, “Non-governmental organizations” includes all individuals or organizations that are not sponsored by a National Antarctic Program.
- The U.S. Antarctic Program (USAP) operates Amundsen-Scott South Pole Station. The USAP is not authorized to provide support for NGOs except in an emergency situation.
- All approaches to the Area should be made along a route approximately 204° east of grid north to avoid restricted sectors. Approaches from the north, east, or west would interfere with ongoing scientific activities in the Area.
- Overland approaches to the area should remain at least 10 meters to the south (grid) of the Very Low Frequency (VLF) antenna. If a group does walk under the antenna, care should be taken not to touch the masts or cables. Because of this antenna’s location across the historical approach path for NGO surface expeditions, future expeditions should be warned that anyone who approaches this antenna does so at his or her own risk. The location of the VLF antenna is noted in Map 3.
- Overland approaches should also be aware of ski-way visibility markers located various distances from the geographic South Pole in four directions around the station (Table 1). All markers are four feet high by eight feet wide, except the 1 mile markers which are eight feet by eight feet, and mounted four feet off the snow surface.

*Table 1. Visibility markers located around South Pole Station.*

<b>Direction (° E of grid N)</b>	<b>Marker 1 (miles)</b>	<b>Marker 2 (miles)</b>	<b>Marker 3 (miles)</b>	<b>Marker 4 (miles)</b>	<b>Marker 5 (miles)</b>	<b>Marker 6 (miles)</b>
113	0.5	1	1.5	2	-	-
204	0.5	1	1.5	2	3	4
270	0.75	1	2	3	-	-
353	0.5	1	1.5	2	-	-

- NGOs that intend to fly aircraft into the Area or land on the ski-way must obtain prior approval to do so from the National Program(s) that maintain the ski-way and associated air traffic control equipment. If prior approval is granted, NGO pilots should refer to and follow guidance in the AFIM and information provided by the National Program(s) operating in the Area. NGOs may not conduct a parachute operation from an aircraft and no pilot in command of an aircraft may allow a parachute operation to be conducted from that aircraft over or near the ski-way or other infrastructure in the Area.
- No access to email, telephones, or radios will be provided except as authorized by the appropriate National Program.
- 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 minimize disruption

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to station science, construction, and operational activities. Services and access to the station at other times are highly unlikely.

- When NGO visitors are required to spend the night in the Area, they must use their own provisions for food and camping.
- 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(s) operating in the area.
- The designated camping area has been chosen for the following reasons: it is located near the NGO parking area, it is close to medical or other emergency services (if needed), it does not usually interfere with vehicle traffic or USAP aircraft operations, and it is far removed from most hazardous areas and construction areas.
- To avoid disruption of official USAP activities, all South Pole Station buildings and operation and science areas are off limits to NGO personnel except when guided by an individual designated by the USAP or when within the aforementioned areas.
- In the event of an aircraft or medical emergency in the Area, NGOs shall notify COMMS immediately by any means possible. COMMS staff will notify the on-site National Science Foundation (NSF) Representative and other personnel as necessary.
- South Pole Communications personnel will record NGO arrivals and departures; this information may be made available to Antarctic Treaty Party members upon request.

# Appendix B

### ***Additional Guidelines for the Scientific Zone***

The Scientific Zone encompasses the Clean Air Sector, the Quiet Sector, the Downwind Sector, and the Dark Sector (Maps 1-4). The Clean Air Sector (CAS) ensures a pristine air- and snow-sampling environment for climate systems research. The Quiet Sector is an area where noise and equipment activities are limited for seismology and other vibration-sensitive pursuits. The Downwind Sector provides an area free from obstructions for balloon launches, aircraft operations, and other “downwind” activities. The Dark Sector provides an area free from light pollution and electromagnetic noise for astronomy and astrophysics research. Following are descriptions of the objectives of and special guidelines for activities in each sector of the Scientific Zone. For ease of description, the Sectors, with exception of the Clean Air Sector, originate at the Elevated Station. The Scientific Sectors and their guidelines apply to the area beyond the Operations Zone out to the edge of the ASMA.

#### **1. Clean Air Sector**

The Clean Air Sector (CAS) was established to preserve the unique conditions that are required for atmospheric research at the South Pole Station. The Earth’s atmosphere near the South Pole is remote from worldwide human influence, and a predominant northerly (grid) wind means the Atmospheric Research Observatory (ARO) is situated upwind of all other facilities more than ninety percent of the time. These natural conditions allow for nearly continuous measurement of important trace constituents of the atmosphere in a location remote from anthropogenic inputs. The air sampled at the South Pole is representative of the background atmosphere of the planet and is essentially the “cleanest air on Earth.”

#### **Geographic Boundaries of the Clean Air Sector**

The Clean Air Sector is a wedge-shaped area upwind (grid northeast) of the main station complex. Restricted areas on land and in the air have been designated to maintain the scientific value of the CAS.

The restricted area on the ground is defined by the following boundaries:

- On the ground, a line extending grid 340° from the SW corner of ARO building
- On the ground, a line extending grid 110° from the SW corner of ARO building
- On the ground, extending out to 150 km/80 nautical miles NE of the ARO building
- The De-Motorized Zone is an additional, semi-circular area extending 50 meters (m), or 150 feet (ft), downwind of the ARO building into which vehicle access is prohibited unless authorization is given by the National Program(s) operating in the area. All vehicles should approach ARO on the groomed trail and park at the “turnaround” where there is a sign stating “No Vehicles Beyond This Point.”
- No aircraft operations are allowed within 2 km of the snow surface in the Clean Air Sector.

The National Oceanic and Atmospheric Administration (NOAA) has conducted many hours of aircraft air pollutant measurements and data show that plumes can be traced for hundreds of miles in stable air. To protect measurements at the ARO and in the snow it was recommended that aircraft fly above 2 km to stay out of the boundary layer air and to limit deposition of particles and gas into the snow surface. The 150 km radius was selected as a reasonable buffer distance. However, Arctic studies suggest that twice that distance is justifiable.

#### **Additional guidelines for the Clean Air Sector**

- Where the Clean Air Sector overlaps the Dark Sector or the Quiet Sector, the procedures for all applicable sectors shall apply.
- The National Program(s) operating in the Area will document all pedestrian/surface vehicle excursions into the Clean Air Sector.

- Aircraft flying above the Clean Air Sector (above 2 km or 6,000 ft) should notify the National Program(s) operating in the Area.
- Access to the roof of the ARO building is restricted. Please contact the USAP if access is required for your project. Users of the roof area must note all roof excursions in the Clean Air Sector Log. Structures, objects, etc. are not allowed on the roof of the ARO building in a location that would interfere with air sampling intakes or at a height exceeding 1.3 m (4 ft) above the roof surface, due to interference with the current solar and terrestrial radiation instruments. Do not obstruct the roof hatches with equipment or materials.
- Access to the orange and white meteorological tower and to the snow surface near the tower is restricted. Objects and activity on the tower and on the snow surface in its vicinity (particularly within a distance of approximately three times the tower's height) can interfere with measurements conducted from the tower. Please contact the USAP if access is required.
- Activities, structures, and instrumentation located within the Clean Air Sector should not interfere with projects already established, except as specifically authorized by the appropriate National Authority.
- Structures should not be placed in a manner that they could cause drifting upwind of, under, or near the ARO building.
- All instrumentation within ARO and the Clean Air Sector must meet the criteria set for current instrumentation as determined by the appropriate National Authority.
- Due to the electromagnetic (EM) sensitivity of solar and thermal atmospheric radiation measurements being conducted at and nearby ARO, the use of EM transmitters near ARO is prohibited except for infrequent but necessary use of handheld radios.
- Any individual or organization wishing to establish an experiment within ARO and/or the Clean Air Sector must coordinate with the National Program(s) operating in the area.
- Transit within the Clean Air Sector is prohibited with few exceptions, outlined below:
  - In the event of an emergency, access will be unlimited.
  - Established experiments sometimes require access to the ARO roof and entrance into the Clean Air Sector (to clean/replace albedo instruments, take air/snow samples, etc.).
  - Occasional cleaning and maintenance to the ski-way visibility markers located along 353° east of grid north (Table 1).
  - Ski-way Maintenance: the ski-way requires frequent maintenance using heavy equipment.
  - National Program aircraft are permitted to enter the No-Fly Zone as necessary for both official activities and essential purposes, including but not limited to USAP-directed missions, FAA checks, aerial photographs, emergency flight paths, approaches, etc. In all cases, pilots are asked to minimize potential contamination of the Clean Air Sector when flying within or above the No-Fly Zone.
  - The Mass Accumulation Network consists of established spokes of snow stakes radiating several km from the South Pole in all directions; snow depth is measured here annually.
  - Snow/trail Maintenance: occasional excavation of the Met Tower and ARO will be required. Maintenance of the trail to ARO occurs during the austral summer. This typically requires several passes using heavy equipment and chain drags to remove snowdrifts.

### **Restricted Chemical Use**

Below is a partial list of specific chemical substances, the atmospheric concentrations of which are currently being measured at the Clean Air facilities. Most of these substances are being measured to a precision of parts per trillion, and the measurements are particularly susceptible to contamination from local sources.

The use of chemicals listed below, or of products and equipment that contain or emit them, is prohibited at ARO and in the CAS (this includes the area beneath the building, the roof of the building, and near the orange and white NOAA meteorological tower). Please contact the National Program(s) operating in the area for help in finding alternatives to their use.

*Chlorofluorocarbons (CFCs)*

## II. Measures

Used as refrigerants, solvents, foam blowing agents, aerosol propellants, and heat exchange medium (no longer manufactured in the U.S.)

$\text{CCl}_3\text{F}$	trichlorofluoromethane	CFC-11
$\text{CCl}_2\text{F}_2$	dichlorodifluoromethane	CFC-12
$\text{CCl}_2\text{FCClF}_2$	trichlorotrifluoroethane	CFC-113

### *Hydrochlorofluorocarbons (HCFCs)*

Used as refrigerants, solvents, foam blowing agents, aerosol propellants, and heat exchange medium (HCFCs are found in the “blueboard” at South Pole)

$\text{CHCl}_2\text{F}$	dichlorofluoromethane	HCFC-21
$\text{CHClF}_2$	chlorodifluoromethane	HCFC-22
$\text{CF}_3\text{CHClF}$	chlorotetrafluoroethane	HCFC-124
$\text{CCl}_2\text{FCH}_3$	dichlorofluoroethane	HCFC-141b
$\text{CClF}_2\text{CH}_3$	chlorodifluoroethane	HCFC-142b

### *Hydrofluorocarbons (HFCs)*

Used as refrigerants, foam blowing agents, and aerosol propellants

$\text{CF}_3\text{CH}_2\text{F}$	tetrafluoroethane	HFC-134a
$\text{CH}_3\text{CHF}_2$	difluoroethane	HFC-152a

### *Halons*

Used in fire suppression and extinguishing systems (no longer manufactured in the U.S.)

$\text{CBrClF}_2$	bromochlorodifluoromethane	halon-1211
$\text{CBrF}_3$	bromotrifluoromethane	halon-1301

### *Chlorocarbons*

Used as solvents, cleaning agents, degreasing agents, and in other less common applications

$\text{CH}_3\text{Cl}$	chloromethane, methyl chloride
$\text{CH}_2\text{Cl}_2$	dichloromethane, methylene chloride
$\text{CHCl}_3$	trichloromethane, chloroform
$\text{CCl}_4$	tetrachloromethane, carbon tetrachloride
$\text{CH}_3\text{CCl}_3$	trichloroethane, methyl chloroform
$\text{C}_2\text{Cl}_4$	tetrachloroethene, perchloroethene

### *Bromocarbons*

$\text{CH}_3\text{Br}$	bromomethane, methyl bromide
$\text{CH}_2\text{Br}_2$	dibromomethane, methylene bromide
$\text{CHBr}_3$	tribromomethane, bromoform

### *Iodocarbons*

$\text{CH}_3\text{I}$	iodomethane, methyl iodide
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### *Others*

$\text{N}_2\text{O}$	nitrous oxide (commonly used as an oxidizer)
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SF <sub>6</sub>	sulfur hexafluoride (commonly used in electric transformers)
COS	carbonyl sulfide
C <sub>6</sub> H <sub>6</sub>	benzene

## 2. Quiet Sector

The “Quiet Sector” is an area where noise and equipment activities are limited for seismology and other vibration-sensitive pursuits. Measurement of the Earth’s vibrations is the observational goal of the science of seismology. Seismographic facilities have been operated continuously at the South Pole since the International Geophysical Year in 1957. To provide a remote laboratory for experiments requiring quiet settings, the USAP has established SPRESSO—the South Pole Remote Earth Science and Seismological Observatory—located 8 km grid SE of the South Pole Station.

### Geographic Boundaries of the Quiet Sector

The Quiet Sector is surrounded (clockwise, from grid North) by the Operations Sector, the Clean Air Sector, and the Downwind Sector (Map 2). The Quiet Sector extends out to 20 km from the Elevated Station. The Quiet Sector also includes the Quiet Circle, with a radius of 7.25 km from the SW corner of the SPRESSO facility (Map 2). The Treaty parties may consider changes to this Sector in the future, if there is scientific or operational need.

### Additional Guidelines for the Quiet Sector

The Quiet Sector is reserved for scientific experiments that require quiet conditions or can operate under stringent quiet conditions. Sections of the Quiet Circle overlap the Clean Air Sector, Operations Sector, and the Downwind Sector; activities in this Circle should abide by the guidelines established here for the Quiet Sector as far as practicable. The Operational Communications Area overlaps the Operations Zone and Quiet Circle. Communications equipment has been installed in this area, and additional communications equipment may be added in the future if it would not have a substantial impact on the ongoing science in the Quiet Sector.

- The Quiet-sector has the lowest measured values of seismic noise anywhere on the Earth at periods less than 1 sec. Activities, structures, and instrumentation located within the Quiet Sector should not produce seismic vibrations at levels greater than the United States Geological Survey (USGS) low noise model (LNM) at periods greater than 1 sec. At periods less than 1 second, levels should not be greater than 12 dB below the LNM (Figure B.1).

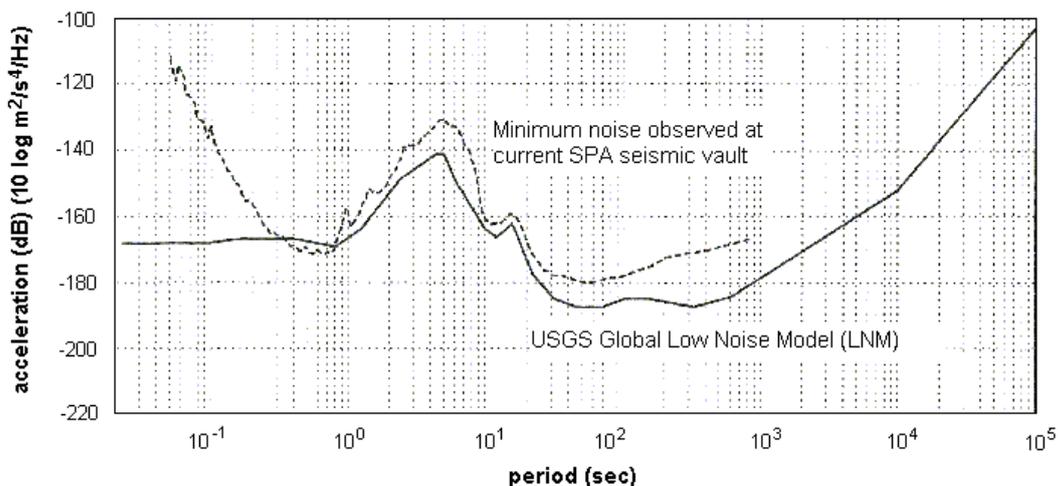


Figure B.1. Noise thresholds for the Quiet Sector. The lowest noise levels achievable at the SPA seismic vault (in 2000) and the USGS LNM based upon quietest noise conditions globally. The seismic band of interest is from 80 Hz to tidal frequencies (<0.001 MHz).

## II. Measures

- Structures that potentially may be buffeted by the wind, producing extraneous detectable vibrations should be located below the snow surface.
- All instrumentation located in SPRESSO must meet the quiet criterion established by the National Program(s) operating in the area for seismological instrumentation.
- All instrumentation located in SPRESSO shall be remotely operable from the South Pole, particularly during the austral winter.
- Any individual or organization wishing to establish an experiment within the Quiet Sector must coordinate with the National Program(s) operating in the Area.
- Transit of motorized vehicles within or across the Quiet Zone circle within the Quiet Sector for purposes other than logistical support of SPRESSO is prohibited with few exceptions, outlined below:
  - In the event of an emergency, access will be unlimited.
  - Trail Maintenance: if a hard-packed route to SPRESSO is required, the trail may be maintained through the austral summer. This typically requires several passes using heavy equipment and chain drags to knock down drifts caused by windstorms.
  - Snow Mine: the South Pole Station snow mine is located just within the NW edge of the Quiet Sector. Snow is no longer harvested for drinking water; however, the snow mine may be maintained as a backup source of clean snow.
  - The USAP Meteorological Team requires monthly access to a snow stake field, which is located within the Quiet Circle. Snow machines and/or tracked vehicles are typically used to traverse to the field, and measurements of the stakes usually take 4-5 hours.
  - Mass Accumulation Network: In addition to the meteorological snow stake field, established spokes of snow stakes to measure snow accumulation radiate several km from the South Pole in all directions. Snow depth is measured here annually.
  - Antenna Field: several communications antennas are located within the Quiet Sector. These antennas require frequent maintenance and inspection, often accomplished on foot, but sometimes requiring vehicle support.
  - Authorized USAP personnel may occasionally traverse the line extending 110° from ARO (the boundary between the Clean Air Sector and the Quiet Sector), passing through the Quiet Circle.
  - National Program(s) operating in the Area may enter the Quiet Sector to remove scientific equipment that is no longer in use, if it will not interfere with other scientific research.
- The National Program(s) operating in the area shall document all excursions into the Quiet Sector.

### **3. Downwind Sector**

The Downwind Sector was established to provide an area free from obstructions for balloon launches, aircraft operations, and other activities. Both scientific activities and operations activities are permitted in the Downwind Sector.

#### **Geographic Boundaries of the Downwind Sector**

Bounded by Dark Sector, Operations Sector, and Quiet Sector, the Downwind Sector extends 20 km from the Elevated Station.

#### **Additional Guidelines for the Downwind Sector**

- Activities in the Downwind Sector should not require any maintenance (e.g., snow removal) and should not otherwise obstruct scientific balloon launches or aircraft operations.

### **4. Dark Sector**

The Dark Sector was established to preserve the conditions of low light pollution and low electro-magnetic interference at South Pole Station that allow for important research in astrophysical, astronomical, and aeronautical observations.

### **Geographic Boundaries of the Dark Sector**

The Dark Sector is surrounded by the Downwind Sector, Ski-way, Hazardous Zone, and Clean Air Sector (along 340° grid line from ARO), and extends 20 km from the Elevated Station.

### **Additional guidelines for activities in the Dark Sector**

- Science activities in the Dark Sector are restricted to experiments that do not emit light or electromagnetic interference (EMI) above approved levels.
- Telescopes and other scientific instruments that are light and EMI sensitive should be contained in the Dark Sector.
- The geographic location of the South Pole Very Low Frequency (VLF) antenna will vary slightly from year to year as the polar cap slides across the continent (grid NW @ 10 m/year). In November 2003 the antenna was located at the following GPS coordinates:

Latitude		Longitude
North End	89° 57.3813' S	150° 45.1500' W
South End	89° 57.7733' S	121° 11.3000' W

- The VLF 7-km beacon antenna is supported by upright aluminum masts held in place with guy wires. The masts are spaced 61 m apart and have “Danger High Voltage” signs on each side. The antenna cable is strung atop clamp-top insulators mounted on each of the antenna masts. The maximum “droop” between masts is approximately 0.6 m. It is recommended that no one touch any component of the line or masts, and do not pass under, but circle around the entire antenna line.