Management Plan for
Antarctic Specially Protected Area No. 147
ABLATION VALLEY AND GANYMEDE HEIGHTS, ALEXANDER ISLAND

1. Description of values to be protected

Ablation Point – Ganymede Heights (latitude 70°48' S, longitude 68°30' W, approximately 180 km^2 , Alexander Island, was originally designated in 1989 as Site of Special Scientific Interest (SSSI) No. 29 through Recommendation XV-6, after a proposal by the United Kingdom. Included was a largely ice-free region between latitudes 70°45' S and 70°55' S and from longitude 68°40' W to George VI Sound coastline. The Area comprised several valley systems separated by ridges and plateau of about 650-760 m high.

The original management plan (Recommendation XV-6) described the Area as "one of the largest ablation areas in West Antarctica…[with]…a complex geology, the main rock types being conglomerates, arkosic sandstones and shales with subordinate pebbly mudstones and sedimentary breccias. The base of the succession is formed of a spectacular mélange, including large blocks of lava and agglomerate. This outcrops on the valley floors and at the base of several cliffs. [The Area] possesses a wide range of geomorphological features including raised beaches, moraine systems and patterned ground. There are several permanently frozen freshwater lakes and many ice-free ponds supporting a diverse flora (including aquatic bryophytes) and fauna. The vegetation is generally sparse, with the unique moss and liverwort-dominated community type being restricted to 'oases' where water issues from otherwise dry barren hillsides. The terrestrial and freshwater ecosystems are vulnerable to human impact and therefore merit protection from uncontrolled human presence". In summary, the principal values of the Area were considered to be the geological, geomorphological, glaciological, limnological, and ecological features, and the associated outstanding scientific interest of one of the largest ice-free ablation area in West Antarctica.

The values noted in the original designation are reaffirmed and expanded in the present management plan. Further values evident from scientific descriptions of Ablation Valley – Ganymede Heights, are also considered important as reasons for special protection of the Area. These values are:

- The presence of exposures of the Fossil Bluff Formation, which is of prime geological importance because it is the only known area of unbroken exposure of rocks spanning the Jurassic – Cretaceous boundary in the Antarctic, which makes this a critical locality for understanding the change in floras and faunas at this temporal boundary;
- The presence of an exceptional and unique contiguous geomorphological record of glacier and ice-shelf fluctuations extending over several thousand years, together with an outstanding assemblage of other geomorphological features derived from glacial, periglacial, lacustrine, aeolian, alluvial and slope processes;
- Two perennially frozen freshwater lakes (Ablation and Moutonnée lakes) which have the unusual property of contact with the saline waters of George VI Sound;
- The presence of marine biota, including the fish *Trematomus bernacchii*, in Ablation Lake, where several seals have also been observed, despite the fact that it is almost 100 km from open sea;
- The Area has the greatest bryophyte diversity of any site at this latitude in Antarctica (at least 21 species); it also has a diverse lichen (>35 taxa), alga and cyanobacteria biota. Many of the bryophytes and lichens are at the southern limit of their know distributions. There are several species which are very rare in the Antarctic;

- Several mosses occur in lakes and ponds to depths of 9 m. Although these are all terrestrial species, they tolerate inundation for several months each year when their habitat floods. One species, *Campyliadelphus polygamus*, has adapted to an aquatic existence, and some permanently submerged colonies reach large dimensions, with shoots in excess of 30 cm length. These are the best examples of aquatic vegetation in the Antarctic Peninsula region;
- Several bryophyte species within the Area are fertile (producing sporophytes), and some of these are not known or very rare in this condition elsewhere in the Antarctic (e.g. the liverwort *Cephaloziella varians*, and mosses *Bryoerythrophyllum recurvirostrum*, *Distichium capillaceum*, *Schistidium* spp.);
- With the exception of one site on the northwestern coast, the Area has the most extensive stands of vegetation on Alexander Island. Many of these occur on seepage areas where the bryophyte and lichen communities cover up to 100 m^2 or more. In the sheltered seepage area assemblages of terricolous species develop communities not known elsewhere in Antarctica, while exposed rock ridges and stable boulder fields support a community of locally abundant lichens, usually dominated by *Usnea sphacelata*;
- Ablation Valley is comparatively rich in the number and abundance of microarthropod species for its locality this far south, with representation of the springtail *Friesia topo* which is thought to be endemic to Alexander Island. Ablation Valley is also the only site on Alexander Island where the predatory mite *Rhagidia gerlachei* has been described, making the food web more complex than other sites at this latitude.

The boundaries of the Area designated under Recommendation XV-6 have been changed, replacing the former rectangular-shaped boundary with one that is defined on the basis of prominent geographical features and the regional hydrological catchments.

2. Aims and objectives

Management at Ablation Valley – Ganymede Heights aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance and sampling in the Area;
- preserve the Area for its potential as a largely undisturbed reference site;
- allow scientific research in the Area consistent with the objectives of the management plan;
- minimise the possibility of introduction of alien plants, animals and microbes to the Area;
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

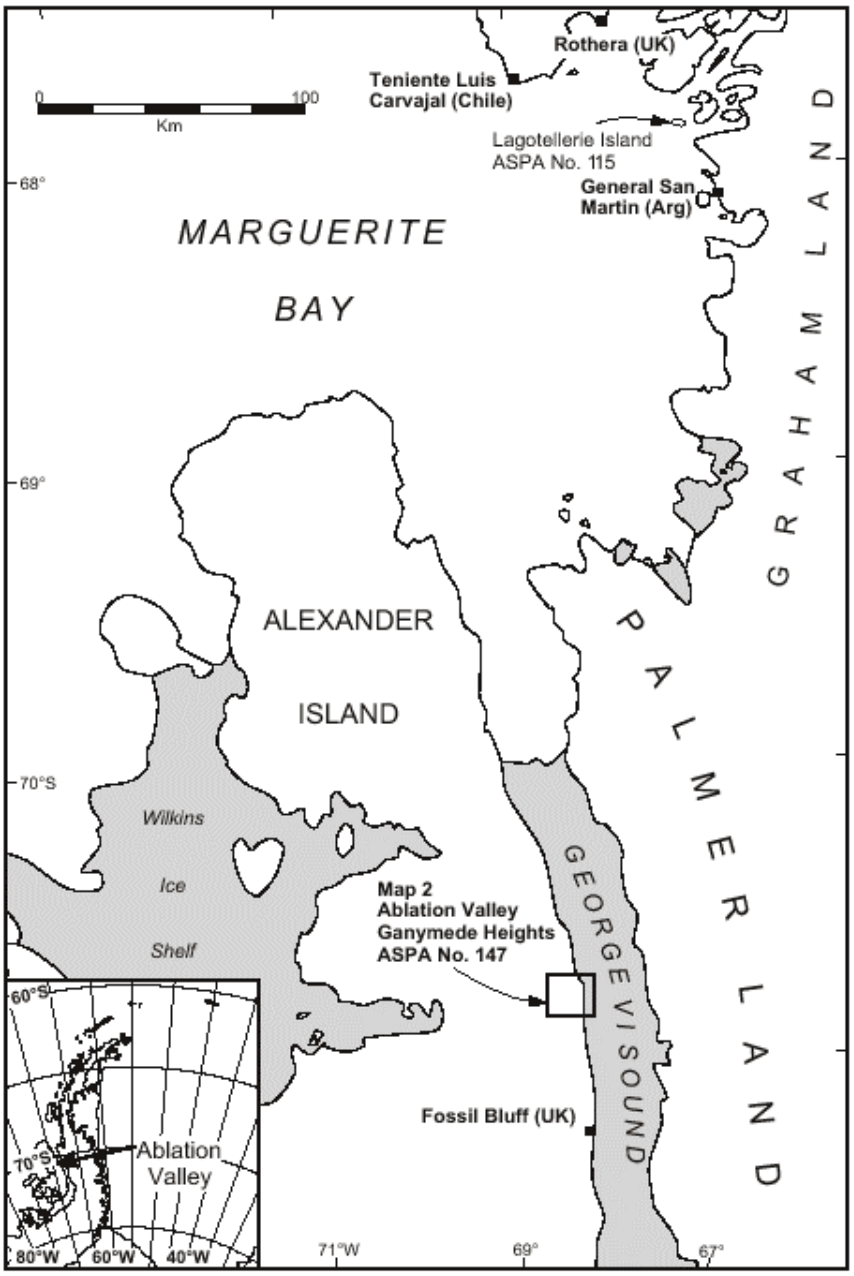
The following management activities shall be undertaken to protect the values of the Area:

- A map showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently at General San Martín (Argentina) and at Rothera (UK) scientific stations in Marguerite Bay, where copies of this Management Plan shall be made freely available.
- Abandoned equipment or materials shall be removed to the maximum extent practcable.
- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition.
- Visits shall be made as necessary (preferably at least once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.

4. Period of designation

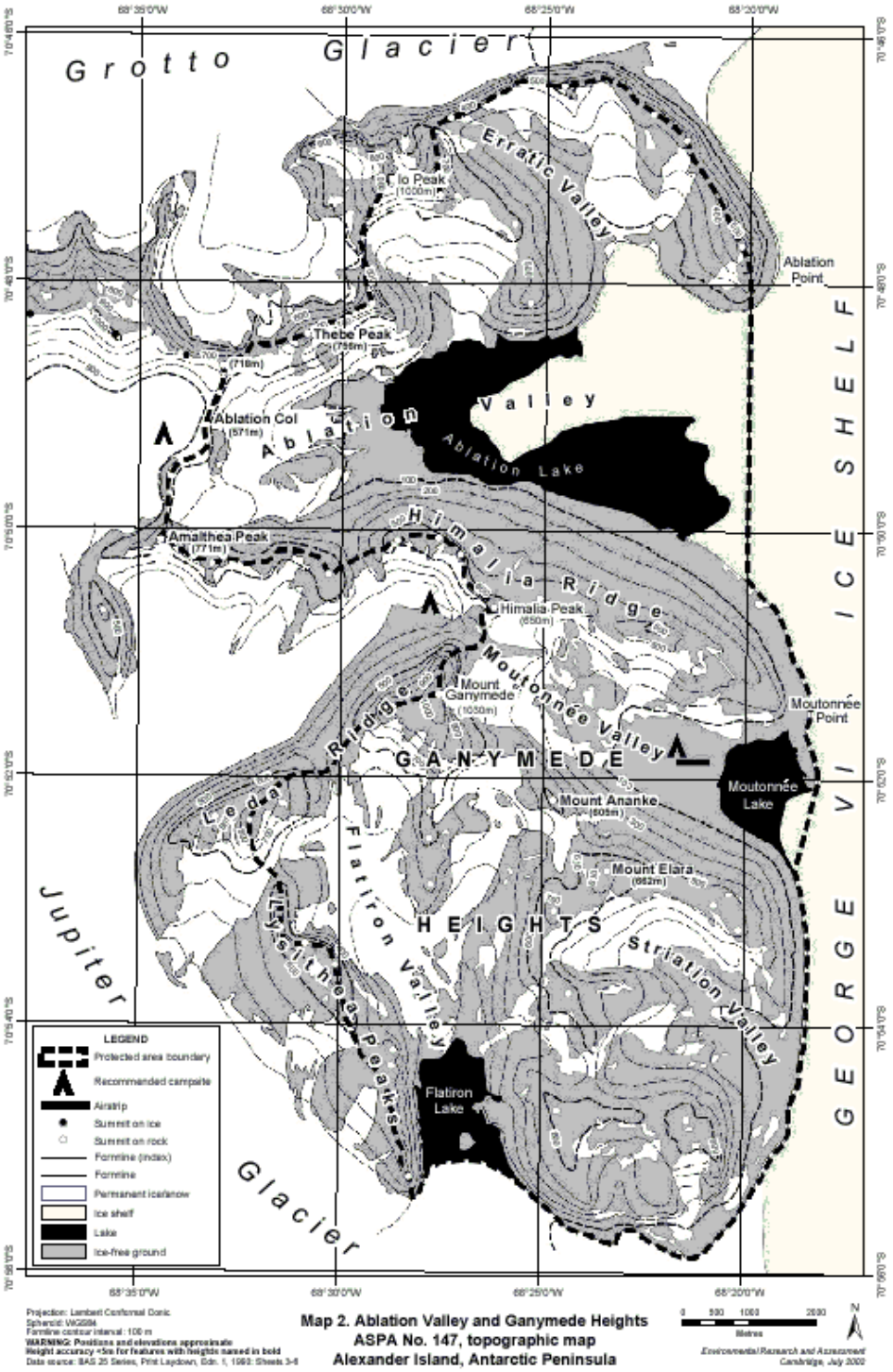
Designated for an indefinite period.

5. Maps and photographs



Map 1. Ablation Valley - Ganymede Heights, ASPA No. 147, location map

Map 1: Ablation Valley – Ganymede Heights ASPA No. 147 location map. Inset: Location of Ablation Valley on the Antarctic Peninsula



Map 2: Ablation Valley – Ganymede Heights ASPA No. 147 topographic sketch map.

6. Description of the Area

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

GENERAL DESCRIPTION

Ablation Valley – Ganymede Heights (between latitudes 70°45' S and 70°55' S and longitudes 68°21' and 68°40' W, approximately 180 km^2, is situated on the east side of Alexander Island, the largest island off the western coast of Palmer Land, Antarctic Peninsula (Map 1). The Area has a central west–east extent of about 10 km and a north–south extent of about 18 km, flanked to the west by the upper part of Jupiter Glacier, to the east by the permanent ice shelf in George VI Sound, to the north by Grotto Glacier and to the south by the lower reaches of Jupiter Glacier. Ablation Valley – Ganymede Heights contains the largest contiguous ice-free area in the Antarctic Peninsula sector of Antarctica, with the smaller permanent ice fields and valley glaciers within the massif representing only about 17% of the Area. The topography of the region is mountainous, comprising steep-sided valleys separated by gently undulating plateau-like ridge crests lying generally between 650-750 m, rising to a maximum altitude of 1070 m (Clapperton and Sugden 1983). The region has been heavily glaciated, although the relatively flat-lying attitude of the sedimentary rocks and rapid weathering have contributed to a generally rounded form of topography, coupled with sheer cliff 'steps' of thickly-bedded sandstones and conglomerates (Taylor et al 1979).

The Area includes four principal ice-free valleys (Ablation, Moutonnée, Flatiron and Striation), the first three of which contain large ice-covered freshwater lakes (Heywood 1977, Convey and Smith 1997). The largest of these is the proglacial Ablation Lake (approximately 7 km^2), which has been impounded by shelf ice penetrating up-valley under pressure from the westward movement of the 100-500 m thick George VI Ice Shelf, the surface of which lies 30 m above sea level (Heywood 1977, Clapperton and Sugden 1982). Biologically, the terrestrial ecosystem is intermediate between the relatively mild maritime Antarctic farther north and the colder, drier continental Antarctic to the south. As a "dry valley" area it is extremely rich in biota and serves as a valuable contrast to the more extreme and biologically impoverished ablation areas on the Antarctic continent (Smith 1988). For a detailed description of the geology and biology of the Area see Annex 1.

BOUNDARIES

The designated Area comprises the entire Ablation Valley – Ganymede Heights massif, bounded in the west by the principal ridge dividing Jupiter Glacier from the main Ablation – Moutonnée – Flatiron valleys (Map 2). In the east, the boundary is defined by the western margin of George VI Ice Shelf. The northern boundary of the Area is defined as the principal ridge dividing Grotto Glacier from Erratic Valley and other tributary valleys feeding into Ablation Valley, immediately to the south. In the northwest of the Area, the boundary extends across the mostly-glaciated col separating upper Jupiter Glacier from Ablation Valley. The southern boundary of the Area, from east of the principal ridge on the west side of Flatiron Valley to where Jupiter Glacier joins George VI Ice Shelf, is defined as the northern lateral margin of Jupiter Glacier.

As the margin between Ablation Lake and George VI Ice Shelf is in places indistinct, the eastern boundary of the Area at Ablation Valley is defined as a straight line extending due south from the eastern extremity of Ablation Point to where the ice shelf abuts land, and from where the eastern boundary follows the land / ice shelf margin. The physiography is similar further south at Moutonnée Lake, and the eastern boundary in this locality is defined as a straight line extending from the eastern extremity of the point on the northern side of (and partially enclosing) Moutonnée Lake to the locality of a prominent meltwater pool where the ice shelf abuts land, and from where the boundary follows the land / ice shelf margin south to where Jupiter Glacier and George VI Ice Shelf adjoin. The Area thus includes the entirety of Ablation and Moutonnée lakes and those parts of the ice shelf behind which they are impounded.

6(ii) Restricted and managed zones within the Area

None.

6(iii) Structures within and near the Area

There are no structures known to be present in the Area. A number of cairns have been installed as survey markers in throughout the Area (Perkins 1995, Harris 2001). Nine plastic bright red reflector markers (30 cm high, held down by rocks) have been placed to mark the airstrip in Moutonnée Valley. The nearest structure to the Area appears to be an abandoned caboose at Spartan Cwm, approximately 20 km south of the Area, although in 2001 the structure was reported to be buried by snow. A summer-only scientific camp facility exists at Fossil Bluff (UK), approximately 60 km to the south on the eastern coast of Alexander Island. The nearest permanently occupied scientific research stations are in Marguerite Bay (General San Martín (Argentina) and Rothera Research Station (UK)), approximately 350 km to the north (Map 1).

6(iv) Location of other protected areas within close proximity of the Area

There are no other protected areas within 300 km of the Area. The nearest protected area to Ablation Valley – Ganymede Heights is Lagotellerie Island, ASPA No. 115, approximately 350 km north in Marguerite Bay (Map 1).

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by an appropriate national authority. Conditions for issuing a Permit to enter the Area are that:

- it is issued only for compelling scientific reasons that cannot be served elsewhere, or for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardise the natural or scientific values of the Area;
- any proposed sampling will not take, displace, remove or damage such quantities of rock, soil, water, or native flora or fauna so that their distribution or abundance at Ablation Valley – Ganymede Heights is significantly affected;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or an authorised copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period;
- the appropriate authority should be notified of any activities/measures undertaken that were not included in the authorised Permit.

7(i) Access to and movement within the Area

- Access to the Area shall be by aircraft, vehicle or on foot.
- Movement over land within the Area shall be on foot.
- Movement by vehicle within the Area shall be restricted to snow or ice surfaces.

- Movement by aircraft within the Area is subject to the restrictions described below.

There are no special restrictions on the points of access to the Area, nor on the overland or air routes used to move to and from the Area. However, access from George VI Ice Shelf may be difficult because of pressure ice, and some routes into the Area from the glaciers to the west are steep, crevassed and arduous.

- Landing of fixed-wing aircraft within the Area is restricted to the ice-covered lakes or to a single terrestrial site immediately west of Moutonnée Lake, provided landings are feasible.

Pressure deformation of the ice surface of lakes, meltwater and thinning ice-cover may make landing on lake ice impractical later in the summer. Landings at Ablation Lake and the terrestrial site were carried out in November 2000. The terrestrial landing site near Moutonnée Lake (Map 2) is oriented E–W and consists of approximately 350 m of gently sloping coarse gravel on a bench raised approximately 2 m above the surrounding valley. The gravel bench was mostly frozen in November 2000, and generally dry and well drained in February 2001 (some 50 m was moist and soft at the western end of the strip at that time). Red reflective markers at both ends mark the landing site and mid-way on the side, with some red-painted stones also marking the western (upper) end in the form of an arrow. Tyre-impressions are evident in the gravel. Should helicopter access prove feasible, specific landing sites have not been designated but landings are prohibited from within 200 m of lake shores, or within 100 m of any vegetated or moist ground, or in stream beds. Access is also possible by aircraft to upper Jupiter Glacier (550 m), immediately west of Ablation Valley and outside of the Area, from where access may be made into the Area overland on foot.

- Pilots, air crew, or other people on aircraft, are prohibited from moving on foot beyond the immediate vicinity of their landing site unless specifically authorised by Permit.
- Any visitors should move carefully so as to minimise disturbance to soil and vegetated surfaces. Avoid walking in stream or dry lake beds, or on moist ground, if practical, to avoid disturbance to the hydrology and / or damage to sensitive plant communities. Care should be taken even when moisture is not obviously present, as inconspicuous plants may still colonise the ground. Visitors should by preference and where practical walk on rocky or ice-covered terrain, and avoid sensitive geomorphological features such as dunes. Pedestrian traffic should be kept to the minimum consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise trampling effects.
- Diving in lakes within the Area is normally prohibited unless it is necessary for compelling scientific purposes. If diving is undertaken, great care should be taken to avoid disturbance of the water column and of sensitive sediments and biological communities. The sensitivity of the water column, sediments and biological communities to disruption by diving activities shall be taken into account before Permits are granted for these purposes.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

- Scientific research that will not jeopardise the ecosystem or scientific values of the Area, and which cannot be served elsewhere;
- Essential management activities, including monitoring.

7(iii) Installation, modification or removal of structures

Structures shall not be erected within the Area except as specified in a Permit and permanent structures or installations, other than the airstrip markers, are prohibited. All scientific equipment installed in the Area shall be approved by Permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit.

7(iv) Location of field camps

When necessary for purposes specified in the Permit, temporary camping is allowed within the Area. One camp site has been designated within the Area: it is located on the north-western (upper) end of the airstrip in Moutonnée Valley (latitude 70°51'48" S, longitude 68°21'39" W) (Map 2). The site is not marked, although tents should be erected as close as practicable to the marker on the north-western end of the airstrip. This site should be used by preference when working in this vicinity. Other specific camp site locations have not, as yet, been designated, although camping is prohibited on sites where significant vegetation is present. Camps should be located as far as practicable (preferably at least 200 m) from lakeshores, and avoid dry lake or stream beds (which may host an inconspicuous biota). By preference and where practical, camps should be located on snow or ice surfaces. Previously existing campsites should be re-used where possible, except where the above guidelines suggest these were inappropriately located.

7(v) Restrictions on materials and organisms which can be brought into the Area

No living animals, plant material or microorganisms shall be deliberately introduced into the Area and the precautions listed in 7(ix) below shall be taken against accidental introductions. No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted. Fuel is not to be stored in the Area, unless authorised by Permit for specific scientific or management purposes. All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimised. If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*. The appropriate authority should be notified of any materials released and not removed that were not included in the authorised Permit.

7(vi) Taking or harmful interference with native flora or fauna

Killing of any seal within the Area is prohibited. Any other taking or harmful interference with native flora or fauna is prohibited, except by Permit issued in accordance with Annex II to the Protocol on Environmental Protection to the Antarctic Treaty. Where taking or harmful interference with animals is involved, the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica* should be used as a minimum standard.

7(vii) Collection or removal of anything not brought into the Area by the Permit holder

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorised, may be removed unless

the impact of removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes, except human and domestic liquid wastes, shall be removed from the Area. Human and domestic liquid wastes may be disposed of within the Area down ice cracks along the margin of George VI Ice Shelf or Jupiter Glacier, or by burying in moraine along the ice margin in these localities as close as practical to the ice. Disposal of human and domestic liquid wastes in this manner shall be more than 200 m from, and avoiding the catchments of, the main lakes in Ablation, Moutonnée or Flatiron valleys, or shall otherwise be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

1. Permits may be granted to enter the Area to carry out monitoring and site inspection activities, which may involve the small-scale collection of samples for analysis or review, or for protective measures.
2. Any specific long-term monitoring sites shall be appropriately marked.
3. To help maintain the ecological and scientific values derived from the relatively low level of recent human impact at Ablation Valley – Ganymede Heights, visitors shall take special precautions against introductions. Of concern are microbial, invertebrate or plant introductions derived from soils at other Antarctic sites, including stations, or from regions outside Antarctica. Visitors shall ensure that sampling equipment or markers brought into the Area are thoroughly cleaned or sterilised. To the maximum extent practicable, footwear and other equipment to be used in the Area shall be thoroughly cleaned beforehand.

7(x) Requirements for reports

Parties should ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form suggested by SCAR. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organising the scientific use of the Area.

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6(i) Additional information on the natural features of the Area.

CLIMATE

No extended meteorological records are available for the Ablation Valley – Ganymede Heights area, but the climate has been described as dominated by the dual influences of easterly-moving cyclonic depressions of the Southern Ocean, against the more continental, north to northwesterly, flow of cold anticyclonic air from the West Antarctic Ice Sheet (Clapperton and Sugden 1983). The former bring relatively mild weather, strong northerly winds and a heavy cloud cover to the region, whereas the latter induces clear, cold and stable conditions with temperatures below 0º C, and relatively light winds from the south. Based on data recorded nearby (25 km) in the early 1970s, the mean summer temperature was estimated as just below freezing point, with mean annual temperature estimated at about -9º C (Heywood 1977); precipitation was estimated at <200 mm of water equivalent per year, with little snow falling in summer. A thin snow cover is common after winter, but the region is generally snow-free by the end of the summer, apart from isolated snow patches that may persist in places.

GEOLOGY

The geology of Ablation Valley – Ganymede Heights is complex, but is dominated by well-stratified sedimentary rocks. The most prominent structural feature of the massif is a large asymmetrical anticline with a northwest–southeast orientation, extending from Grotto Glacier to Jupiter Glacier (Bell 1975, Crame and Howlett 1988). Thrust faults in the central part of the massif suggest vertical displacements of strata of up to 800 m (Crame and Howlett 1988).

The main lithologies are conglomerates, arkosic sandstones and fossiliferous shales, with subordinate pebbly mudstones and sedimentary breccias (Elliot 1974, Taylor *et al* 1979, Thomson 1979). A range of fossils have been found in the strata, which are of Upper Jurassic–Lower Cretaceous age, including bivalves, brachiopods, belemnites, ammonites, shark teeth and plants (Taylor *et al* 1979, Thomson 1979, Crame and Howlett 1988, Howlett 1989). Several interstratified lavas have been observed in the lowest exposures at Ablation Point (Bell 1975). The base of the succession is formed of a spectacular mélange, including large blocks of lava and agglomerate which crop out on the valley floors and at the base of several cliffs (see Bell 1975; Taylor *et al* 1979). The presence of exposures of the Fossil Bluff Formation is of prime geological importance because it is the only known area of unbroken exposure of rocks spanning the Jurassic – Cretaceous boundary in the Antarctic, which makes this a critical locality for understanding the change in floras and faunas at this temporal boundary.

GEOMORPHOLOGY AND SOILS

The entire area was at one time over-run by glacier ice from the interior of Alexander Island. Thus, landforms of both glacial erosion and deposition are widespread throughout the Area, providing evidence of a former general eastward flow of ice into George VI Sound (Clapperton and Sugden 1983). Misfit glaciers, striated bedrock, and erratics indicate considerable deglaciation since the Pleistocene glacial maximum (Taylor *et al* 1979). Numerous terminal moraines fronting present remnant glaciers, several unexpectedly talus-free sites, and polished and striated roches moutonnées indicate that glacial retreat may have been rapid (Taylor *et al* 1979). There is evidence that George VI Ice Shelf did not exist around 6500 yr B.P., which suggests that the Ablation Valley – Ganymede Heights massif is

likely to have been largely free of permanent ice around that time, although there have been a number of subsequent glacier fluctuations in the region (Clapperton and Sugden 1982).

The landforms have been modified by periglacial, gravitational and fluvial processes. Bedrock on the upper plateau surfaces (where it has been largely scraped free of a till overburden) has been shattered by frost action into platy or blocky fragments (Clapperton and Sugden 1983). On valley slopes gelifluction lobes and stone stripes and circles are common, while on valley floors stone circles and polygonal patterned ground are frequently found in glacial till and in fluvioglacial sediments subjected to frost action. Valley walls are also dominated by landforms derived from frost action, rock/ice-fall activity, and seasonal meltwater flows, which have led to ubiquitous talus slopes and, commonly, boulder fans below incised gullies. Mass wasting of fissile sedimentary rocks has also led to the development of steep (about 50º) horizontally rectilinear bedrock slopes thinly veneered with debris. Occasional aeolian landforms have been observed, with dunes of up to 1 m in height and 8 m in length as, for example, in Erratic Valley (Clapperton and Sugden 1983). 'Raised beaches' mentioned in the original management plan are not described in other literature (Clapperton and Sugden 1983): it is likely the reference is either to elevated moraines derived from a formerly more extensive George VI Ice Shelf, or perhaps to raised alluvial or lacustrine beaches. Thin layers of peat of up to 10-15 cm in depth are occasionally associated with vegetated areas, and these are the most substantial developments of soil within the Area.

FRESHWATER ECOLOGY

Ablation Valley – Ganymede Heights is an exceptional limnological site that contains a number of lakes, ponds and streams and a generally rich benthic flora. From late December until February running water develops from three main sources: precipitation, glaciers and from melting on George VI Ice Shelf, with run-off generally converging toward the coast (Clapperton and Sugden 1983). Most of the streams, which are up to several kilometres in length, drain glaciers or permanent snowfields. The principal streams drain into Ablation Lake and Moutonnée Lake, both dammed by the ice shelf. Surveys in the early 1970s recorded these lakes as frozen to 2.0–4.5 m depth year-round, with maximum water depths of around 117 m and 50 m respectively (Heywood 1977). A stable upper layer of fresh water, down to approximately 60 m and 30 m respectively, overlies increasingly saline waters influenced by interconnection with the ocean beneath the ice shelf and which subjects the lakes to tidal influence (Heywood 1977). Surface meltwater pools – which in summer form particularly in hollows between lake-ice pressure ridges – flood to higher levels daily and encroach up alluvial fans in the lower valleys (Clapperton and Sugden 1983). Some recent observations suggested a decrease in the permanent ice cover of the lakes, for example with about 25% of Moutonnée Lake being free of ice cover in the 1994–95 and 1997–98 summers (Convey and Smith 1997, Convey pers comm 1999). However, all three of the main lakes in the Area showed almost complete ice cover in early February 2001 (Harris 2001).

Numerous ephemeral, commonly elongated, pools and ponds form laterally along the land / ice shelf margin, varying in length from 10 to 1500 m and up to 200 m wide, with depths ranging from 1 to 6 m (Heywood 1977, Clapperton and Sugden 1983). These pools / ponds often rise in level over the melt period, yet on occasion may drain suddenly via sub-ice fissures opening into the ice shelf, leaving former lake shorelines evident in surrounding moraines. The pools / ponds vary widely in their turbidity depending on the presence of suspended glacial sediment. The pools are typically ice-free in summer, while the larger ponds often retain a partial ice cover, and all but the deeper ponds probably freeze solid in winter (Heywood 1977).

Numerous ponds of up to 1 ha and 15 m in depth are present within the valleys, some with moss growth covering extensive areas down to 9 m in depth (Light and Heywood 1975). The dominant species described were *Campylidelphus polygamus* (=*Campylium polygamum*) and *Dicranella*, stems of which reached 30 cm in length. *Bryum pseudotriquetrum* (and

possibly a second *Bryum* species), *Distichium capillaceum*, and an unidentified species of *Dicranella* all grew on the benthic substratum at or below 1 m in depth (Smith 1988). Moss cover was 40-80% in the 0.5-5.0 m depth zone (Light and Heywood 1975). Much of the remaining area was covered by dense cyanobacterial felts (11 taxa) up to 10 cm thick, dominated by species of *Calothrix*, *Nostoc* and *Phormidium* together with 36 taxa of associated microalgae (Smith 1988). The extensive growths of moss suggest that these ponds are probably relatively permanent, although their levels may fluctuate from year to year. The water temperature reaches 7ºC in the deeper ponds and 15ºC in the shallower pools in summer, offering a relatively favourable and stable environment for bryophytes. The shallower pools, in which several mosses have been found, may normally be occupied by terrestrial vegetation and flooded for short periods during summer (Smith 1988).

Algae are abundant in slow-moving streams and ephemeral melt runnels, although they do not colonise the unstable beds of fast-flowing streams. For example, large wet areas of level ground in Moutonnée Valley have particularly rich floras, in places forming over 90% cover, with five species of desmid (which are rare in Antarctica) and the filamentous green *Zygnema* being abundant, and *Nostoc* sp. and *Phormidium* spp. colonising drier, less stable and silted areas (Heywood 1977).

Protozoa, Rotifera, Tardigrada and Nematoda form a benthic fauna in the pools, ponds and streams, and probably occur in the lakes although none has thus far been caught (Heywood 1977). Densities are generally highest in the slow-moving streams. The copepod *Boeckella poppei* was abundant in lakes, ponds and pools, but absent from streams. The marine fish *Trematomus bernacchii* was captured in traps laid in Ablation Lake at a depth of 70 m, within the saline water layer (Heywood and Light 1975, Heywood 1977). A seal (species unidentified, but probably crabeater (*Lobodon carcinophagus*) or Weddell (*Leptonychotes weddellii*)) was reported at the edge of Ablation Lake in mid-December 1996 (Rossaak 1997), and isolated sightings of solitary seals have also been reported in earlier seasons. The fish and seals may be part of a marine ecosystem present beneath the adjacent ice shelf that is capable of travel to the open sea, or may represent isolated vestigial populations confined to the Ablation Point region following the relatively recent re-formation of George VI Ice Shelf (Clapperton and Sugden 1982). If the latter, then the populations may have special genetic significance because of their extended isolation. However, the seals may be capable of travel to the sea overland on George VI Ice Shelf. Further research is required to explain these observations.

VEGETATION

Much of the Ablation Valley – Ganymede Heights area is arid, and overall vegetation abundance is low with a discontinuous distribution. However, complex plant communities exist in seepage areas and along stream margins, which are of particular interest because:

a) they occur in an otherwise almost barren landscape;

b) the mixed bryophyte and lichen communities are the best-developed and most diverse of any south of 70ºS (Smith 1988);

c) some bryophyte taxa are profusely fertile and fruiting at their southern limit – an unusual phenomenon in most Antarctic bryophytes, especially so far south;

d) the region represents the southernmost known locality for many taxa; and

e) although some of these communities also occur at other sites on southeastern Alexander Island, the Area contains the best and most extensive examples known at this latitude.

The diversity of mosses is particularly high for this latitude, with at least 21 species recorded within the Area, which represents 73% of those known to occur on Alexander Island, and half of all those occurring on the Antarctic Peninsula (Smith 1997). The lichen

flora is also diverse with more than 35 taxa known. Of the macrolichen flora, 12 of the 15 species known to occur on Alexander Island are represented within the Area, which is about one third of the 35 species described on the Antarctic Peninsula as a whole (Smith 1997). Moutonnée and Striation valleys, and the SE coastal area, contain the most extensive stands of both terrestrial and freshwater vegetation (Smith 1998, Harris 2001).

Smith (1988, 1997) reported the bryophyte vegetation is generally found in patches of about 10 to 50 m^2, with some stands up to 625 m^2, occurring from around 5 m to 40 m altitude on the north- and east-facing gentle slopes of the main valleys. More recently, Harris (2001) recorded large stands of near-continuous bryophyte vegetation of up to approximately 8000 m^2 on gentle SE-facing slopes on the south-eastern coast of the Area, at an elevation of approximately 10 m, close to where the Jupiter Glacier joins George VI Ice Shelf. A continuous stand of approximately 1600 m^2 was recorded on moist slopes in lower Striation Valley. Several large patches of continuous moss (of up to 1000 m^2) were observed on SW/NW-facing eastern slopes of Flatiron Valley, at elevations of 300-400 m. Small discontinuous patches of moss were recorded in this vicinity up to an elevation of 540 m. Mosses were observed on peaks above Ablation Valley at elevations of up to approximately 700 m. Samples are being analysed to identify species.

The dominant bryophyte in the wettest areas is frequently the liverwort *Cephaloziella varians* (= *C. exiliflora*), which forms a blackish mat of densely interwoven shoots. Although the most southerly record of *C. varians* has been reported at 77ºS from Botany Bay (SSSI No. 37) in Victoria Land, the extensive mats it forms in the Ablation Valley – Ganymede Heights massif represent the most substantial stands of this species this far south. Cyanobacteria, notably *Nostoc sp.,* are usually associated either on the surface of the liverwort or soil, or with moss shoots. Beyond the wettest areas, undulating carpets of pleurocarpous mosses dominated by *Campyliadelphus polygamus* forms the greenest stands of vegetation, with associated *Hypnum revolutum.* These carpets overlie up to 10-15 cm of peat composed of largely undecomposed moribund moss shoots. Intermixed with these mosses, but often predominating on the drier margins, *Bryum pseudotriquetrum* grows as isolated cushions that may coalesce to develop a convoluted turf. In these drier, peripheral areas, several other turf-forming bryophytes are often associated with *Bryum.* Besides the more hydric species already cited, these include the calcicolous taxa *Bryoerythrophyllum recurvirostrum, Didymodon gelidus, Distichium capillaceum, Encalypta rhaptocarpa* (=*E. patagonica*)*, E. procera, Pohlia cruda, Schistidium antarcticum*, *S. fragilis, Syntrichia princeps* (=*Tortula princeps*), *Tortella alpicola,* and several unidentified species of *Bryum* and *Schistidium*.

A significant characteristic of the vegetation in the Ablation Valley – Ganymede Heights massif is the unusual occurrence of a number of fertile bryophytes. Antarctic bryophytes seldom produce sporophytes, yet *Bryum pseudotriquetrum*, *Distichium capillaceum*, *Encalypta rhaptocarpa*, *E. procera* and *Schistidium* spp. have all been recorded in the Area as frequently fertile. Most unusually, small quantities of the moss *Bryoerythrophyllum recurvirostre* and the liverwort *Cephaloziella varians* have been observed fruiting in Ablation Valley, which was the first time this had been recorded anywhere in Antarctica (Smith pers comm., cited in Convey 1995; Smith 1997); in addition, *D. capillaceum* has never before been recorded with sporophytes throughout the maritime Antarctic (Smith 1988). *E. procera* has only been reported as fertile in one other Antarctic location (on Signy Island, South Orkney Islands: Smith 1988).

Beyond the permanent seepage areas, bryophyte vegetation is extremely sparse and restricted to habitats where there is free water for at least a few weeks during the summer. Such sites occur sporadically on the valley floors, stone stripes on slopes, and also in crevices in north-facing rock faces. Most of the species occurring in the bryophyte patches have also been observed in these habitats, including lichens, most frequently in the shelter of, or even in crevices beneath, larger stones – especially at the margins of patterned ground features. At elevations of over 100 m aridity increases, and at higher altitudes only *Schistidium antarctici*

(at 500 m in MoutonnéeValley) and *Tortella fragilis* (near the summit of the highest peak south-west of Ablation Valley (775 m) have been recorded.

In these drier habitats lichens tend to become more frequent, especially where the substratum is stable. Lichens are widespread and locally abundant on the more stable screes, ridges, and plateaux above the valleys, the most predominant species being *Usnea sphacelata (=U. sulphurea*), giving rock surfaces a black hue. This species is often associated with *Pseudephebe minuscula*, several crustose lichen species and, rarely, *Umbilicaria decussata* reaching the highest part of the massif; all but the latter species are also common in Moutonnée Valley. Epiphytic and terricolous lichens, predominantly the white encrusting species *Leproloma cacominum*, are often frequent where the marginal bryophyte surface is driest. Other genera such as *Cladonia galindezii, C. pocillum* and several crustose lichens are also sometimes present. Various lichens colonise the dry soil and pebbles in these localities, occasionally spreading onto cushions of moss. These include *Candelariella vitellina*, *Physcia caesia, Physconia muscigena*, occasional *Rhizoplaca melanophthalma, Usnea antarctica, Xanthoria elegans*, and several unidentified crustose taxa (especially species of *Buellia* and *Lecidea*). An abundance of *Physcia* and *Xanthoria* in isolated places suggests nitrogen enrichment deriving from south polar skuas (*Catharacta maccormicki*). A few ornithocoprophilous lichens occur on occasional boulders used as bird perches.

Many of the bryophytes and lichens are at the southern limit of their know distributions and several species are very rare in the Antarctic. Rare moss species within the Area include *Bryoerythrophyllum recurvirostrum*, *Campylium polygamum*, *Encalypta rhaptocarpa*, *Tortella alpicola*, and *Tortella fragilis*. Several *Bryum* species, *Encalypta* rhaptocarpa, Schistidium *occultum* and *Schistidium chrysoneurum* are all at the southern limit recorded for these species. Of the lichen flora, Ablation Valley is the only known site where *Eiglera flavida* has been observed in the S. Hemisphere, and *Mycobilimbia lobulata* and *Stereocaulon antarcticum* are also rare. Lichen species with furthest-south records are *Cladonia galindezii*, *Cladonia pocillum*, *Ochrolechia frigida*, *Phaeorrhiza nimbosa*, *Physconia muscigena*, and *Stereocaulon antarcticum*.

INVERTEBRATES, FUNGI, BACTERIA

The microinvertebrate fauna thus far described is based on ten samples from Ablation Valley, and comprises seven confirmed taxa (Convey and Smith 1997): two Collembola (*Cryptopygus badasa*, *Friesea topo*); one cryptostigmatid mite (*Magellozetes antarcticus*); and four prostigmatid mites (*Eupodes parvus, Nanorchestes nivalis* (*= N. gressitti*)*, Rhagidia gerlachei* and *Stereotydeus villosus*). A number of specimens collected were earlier reported as *Friesea grisea*, a widespread maritime Antarctic species. However, specimens of *Friesia* collected subsequently from Alexander Island (i.e. from 1994 onwards) have been described as a distinct new species, *F. topo* (Greenslade 1995), which is itself currently thought to be endemic to Alexander Island. The earlier specimens from Ablation Valley have been re-examined, with all those that remain identifiable being reassigned as *F. topo*.

While the same number of species has been described at one other site on Alexander Island, the samples from Ablation Valley exhibited a mean total microarthropod population density about seven times greater than other sites in the region. Diversity at Ablation Valley was also greater than at several other documented sites on Alexander Island. Both diversity and abundance are considerably less than has been described at sites in Marguerite Bay and further north (Star_ and Block 1998, Convey et al 1996, Convey and Smith 1997, Smith 1996). The most populous species recorded in Ablation Valley was *Cryptopygus badasa* (96.6% of all arthropods extracted), which was particularly common in moss habitats. *Friesea topo* was found on stones at low population densities and was virtually absent from the moss habitat, showing these species to have distinct habitat preferences. Ablation Valley is the only site on Alexander Island where the predatory mite *R. gerlachei* has been described. Very little research has been conducted on fungi in the Area, and the only publication

available reported an unidentified nematode-trapping fungus present in a pond in Ablation Valley (Maslen 1982). While further sampling is required to describe the terrestrial microfauna more fully, available data support the biological importance of the Area.

BREEDING BIRDS

The avifauna of Ablation Valley – Ganymede Heights has not been described in detail. A few pairs of south polar skuas (*Catharacta maccormicki*) have been reported as nesting close to some of the moist vegetated sites (Smith 1988). Snow petrels have been noted as "probably breeding" in the vicinity of Ablation Point (Croxall *et al* 1995, referring to Fuchs and Adie 1949). No other bird species has been recorded in the Ablation Valley – Ganymede Heights massif.

HUMAN ACTIVITIES / IMPACTS

Human activity at Ablation Valley – Ganymede Heights has been exclusively related to science. The first visit to the Ablation Valley area was by members of the British Graham Land Expedition in 1936, who collected about 100 fossil specimens from near Ablation Point (Howlett 1988). The next visits were about a decade later, when basic geological descriptions and further fossil collections were undertaken. More intensive palaeontological investigations were made by British geologists in the 1960s through to the 1980s, with detailed studies of the geomorphology (Clapperton and Sugden 1983). Limnological investigations were undertaken in the 1970s, with a number of expeditions examining the terrestrial biology being initiated in the 1980s and 1990s. All known expeditions into the Area have been by British scientists. The impacts of these activities have not been fully described, but are believed to be minor and limited to footprints, aircraft tracks at the Moutonnée Valley terrestrial airstrip (see Section 7.1), removal of small quantities of geological and biological samples, markers, abandoned items such as supplies and scientific equipment, and the remains of human wastes.

In February 2001 an abandoned depot remained on the moraine bench adjacent to George VI Ice Shelf, approximately 500 m north of Moutonnée Lake. The depot consists of a number of fuel and oil containers, an old food box, poles, disintegrating cardboard and string. Various expeditions in the 1970s-80s placed empty fuel drums as route markers through pressure ice from George VI Sound into Ablation Valley, and a large onshore rock is painted yellow SE of Ablation Lake (McAra 1984, Hodgson 2001). Nearby is a large cross made from red painted rocks and cairns, with a wooden marker board in the centre.

Evidence of campsites close to the shore of Ablation Lake remained in 2000-01 (Harris 2001, Hodgson 2001). One site is on the SW shore near a rich area of vegetation, and another is approximately four kilometres east on the SE shore. At both sites circles of stones mark old tent sites, and circular structures have been built with low (0.8 m) stone walls. At the former site a number pieces of wood (including old markers), an old food box, string and human wastes were observed (Harris 2001, Hodgson 2001). Several red-painted rocks were found around the southern and western shores of Ablation Lake in February 2001, and paint fragments were sometimes observed in sediments. In 2000-01 some of the abandoned materials in Ablation Valley were removed: three fuel drums on lake ice, the old food box and some wood and string on the SW shore, and numerous fragments from broken perspex acryllic cloches on the SW shore (nine were deployed in January 1993 – Wynn-Williams 1993, Rossaak 1997 – all were destroyed by wind) (Harris 2001, Hodgson 2001). The painted rocks and other materials remain.

Snowmobiles have been used on lake and glacier ice, and modified snowmobiles with front wheels were used over gravel terrain in a limited vicinity of the SW shore of Ablation Lake in 1983–84 (McAra 1984). Some evidence of erosional paths forming on steep scree slopes,

presumably a result of field work, was recorded in Moutonnée Valley (Howlett 1988). Cairns have been built on a number of mountain summits and to mark a number of survey sites throughout the Area.