

**Management Plan
for Antarctic Specially Protected Area (ASPA) No. 130**

TRAMWAY RIDGE, MT. EREBUS, ROSS ISLAND

1. Description of values to be protected

The lower end of Tramway Ridge was originally designated in Recommendation XIII-8 (1985, SSSI No. 11) after a proposal by New Zealand on the grounds that the Area supports an unusual ecosystem of exceptional scientific value to botanists, phycologists and microbiologists. Mt. Erebus (3794 m) is one of only three known high altitude localities of fumarolic activity and associated vegetation in the Antarctic (Mt Erebus, Mt Melbourne and Mt Rittman).

Tramway Ridge is an ice-free area of gently sloping warm ground 1.5 km to the Northwest of the main crater of Mt. Erebus, located at an elevation of between 3350 m and 3400 m. The area has significant gas emission and its soil has the highest surface temperatures on Mt Erebus, making it of interest to volcanologists as well as biologists.

The single, as yet unidentified, moss species found in the Area is unusual in that it persists in the protonematal stage. An unusual variety of a common thermophilic cyanobacterium is especially noteworthy. The plant communities which have developed on the fumarolic soils within the Area differ significantly from those found elsewhere in Antarctica. The regional uniqueness of the communities is of substantial scientific interest and value. The very limited geographical extent of the ecosystem, its unusual biological features, its exceptional scientific values and the ease with which it could be disturbed through trampling or alien introductions, are such that the Area requires long-term special protection.

2. Aims and objectives

Management at Tramway Ridge aims to:

- avoid degradation of, or substantial risk to, the values of the Area;
- prevent unnecessary human disturbance to the Area;
- permit research on the unique physical environment and associated vegetation and microbial communities while ensuring they are protected from over-sampling;
- minimise the possibility of introduction of alien plants, animals and microbes to the Area;
- preserve a part of the Area, which is declared a Prohibited Zone, as a reference site for future studies;
- permit visits for management purposes in support of the objectives of the management plan.

3. Management activities

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

- i Durable wind direction indicators should be erected close to the designated helicopter landing site whenever it is anticipated there will be a number of landings near the Area in a given season. These should be replaced as needed and removed when no longer required.
- i Markers, which should be clearly visible from the air and pose no significant threat to the environment, should be placed to mark the helicopter landing pad.
- i A line of flags should be placed to mark the preferred snowmobile route (Map A) between the USAP Upper and Lower Erebus Huts, which should pass no closer than 200 m to the Area.
- i Signs illustrating the location, boundaries and clearly stating entry restrictions shall be placed on posts marking the boundaries of the Area.
- i Signs showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan should be kept available, in all of the research hut facilities located close to the summit of Mt. Erebus.
- i Markers, signs or structures erected within the Area for scientific or management purposes shall be maintained in good condition.
- i Visits shall be made as necessary to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- i National Antarctic Programmes operating in the region shall consult together with a view to ensuring these steps are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map A: Tramway Ridge, Mt. Erebus, location image map. Image is rectified by affine transformation and scale is approximate. Photography USGS/DOSLI (SN7842) 11 November 1993.

Map B: Tramway Ridge, Mt. Erebus, location contour map. Contours are derived from a digital elevation model generated using a 10 m grid for the orthophotograph in Map A. Precise area of warm ground is subject to variation seasonally and inter-annually.

Map C: Tramway Ridge, site image map. Orthophoto and protected area boundary coordinates are tied to the Camp Area Plane Datum 1981, a local framework, using the WGS72 spheroid. Precise GPS coordinates for the site will differ: these were unavailable at the time of mapping. Photography US Navy (SN6480) 9 February 1980.

Map D: Tramway Ridge, site contour map. Contours are derived from a digital elevation model generated using a 10 m grid for the orthophotograph in Map B: accuracy $\pm 2\text{m}$. Precise area of warm ground is subject to variation seasonally and inter-annually.

Figure 1: Perspective view of the Tramway Ridge area from an elevation of 6200 m, 5000 m out from the Area at a bearing of 215°SW, showing the protected area boundary, the location of the USAP Erebus huts, and the preferred helicopter landing site and snowmobile route. Image source: Map A.

6. Description of the Area

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

The boundary of the designated Area is defined as a square of 200 m by 200.8 m which encompasses most of the warm ground area of lower Tramway Ridge (167°06'35"E, 77°31'05"S: Map B). The Area is divided into two parts of almost equal size, the northern half being a Prohibited Zone. The boundaries of the Area and the Prohibited Zone (marked by signposts at each corner) and prominent features are shown on Map B. Several boundary signposts have been offset owing to dangerous ground at the actual corner point.

The Area is in general on a gentle slope of about 5°, with much of the ice-free ground in the form of terraces which have a typical vertical height of about 0.5 m and steeper sides of up to 30° in slope. The steep sides of the terraces have the maximum development of crusts of vegetation, and it is from these sides that visible steam emissions occur. Visible vegetation covers about 16% of the Area. Low ice hummocks of up to about 1 m high are distributed over the Area where steam has frozen. Surface ground temperatures are up to about 75°C.

The steam-warmed lithosols in the Area provide an unusual habitat of limited extent. The acid reaction of the soils, the constant supply of moisture by condensation of steam and the regular supply of geothermal heat produce conditions which contrast markedly with most Antarctic soils. There is no evidence of the presence of microinvertebrate animals in the soils. The vegetation comprises protonematal moss and diverse microalgae, which has developed on the fumarolic soils and differs significantly from other Antarctic plant communities. The single moss species, *Campylopus pyriformis*, is unusual in that it has never been seen to produce leaves but persists in the protonematal stage. The vegetation occurs in zones related to surface temperature. Warmest ground, from about 35 to 60°C, is colonised by dark blue-green and reddish-brown mats of cyanobacteria, whereas cooler surfaces of about 10 to 30°C are dominated by green crusts of coccoid chlorophytes and moss protonema. Bare ground lacking a macroscopically visible vegetation occurs between 0 and 20°C.

The algal flora comprises six cyanobacteria and five chlorophytes. The presence of a thermophilic cyanobacterium is especially noteworthy as it is an unusual variety of the hot spring cyanobacterium *Mastigocladus laminosus*, which is common elsewhere in the world. Thermophilic bacteria have been isolated at 60°C. These include heterotrophic and a thiosulfate-utilising autotrophic species.

6(ii) Prohibited, restricted or managed zones within the Area

The northern half of the Area is designated a Prohibited Zone in order to preserve part of the Area as a reference site for future comparative studies, while the southern half of the Area (which is essentially similar in biology, features and character) is available for research programmes and sample collection. The south boundary of the Prohibited Zone is defined by a line that bisects the Area into two halves (Map B), and is marked at both ends by signposts. This boundary may be identified on the ground approximately as an extension westwards of the south ridge line of lower Tramway Ridge. The other three boundaries of the Prohibited Zone are defined by the boundaries of the Area. Access to the Prohibited Zone is strictly prohibited until such time it is agreed by management plan review that access should be allowed.

6(iii) Structures within and near the Area

Signposts mark the corner points of the boundaries. The USAP Lower and Upper Erebus Huts are located approximately 1 km to the Northeast (3400 m) and Southeast (3612.5 m) respectively.

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

The closest ASPAs are the historic huts at Cape Evans (ASPA No. 154) and Cape Royds (ASPA No. 156) approximately 20 km south west.

7. Permit conditions

Permits may be issued only by appropriate national authorities as designated under Article 7 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty. Conditions for issuing a Permit to enter the Area are that:

- it is issued only for scientific study of the ecosystem, or for a compelling scientific or management purpose that cannot be served elsewhere;
- access to the Prohibited Zone shall be prohibited;
- the actions permitted are not likely to jeopardise the natural ecological system or scientific values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- any Permit issued shall be valid for a stated period.

7(i) Access to and movement within the Area

Landing of helicopters within the Area is strictly prohibited. Helicopter overflight of the Area should be avoided, except for essential scientific or management purposes when helicopters shall in no instance fly lower than 50 m above the ground surface of the Area. Use of helicopter smoke bombs is strictly prohibited within 200 m of the Area. For short-duration visits which do not require camp establishment, access by helicopter should be to a designated landing site, located outside of the Area and 300 m to the Northwest (Map A and Figure 1). For visits which require camp establishment, helicopter access should be to the USAP Upper or Lower Erebus Huts, and

thence on foot or by land vehicle to the edge of the Area at Tramway Ridge. Landing of helicopters at other sites close to the Area is strongly discouraged. Only those persons specifically authorised by Permit are allowed to enter the Area. No special restrictions apply to the air or land routes used to move to and from the Area, although those traveling between the Upper and Lower Erebus Huts should keep to the preferred snowmobile route and, wherever practicable, stay at least 200 m from the protected area boundary.

Access into the Area shall be on foot and land vehicles are prohibited. Visitors should avoid walking on visible vegetation and, as far as practicable, areas of warm ground. Visitors should be aware that walking in the Area can compact soil, alter temperature gradients (which may change rates of steam release), and break thin ice crusts which may form over warm ground, with resulting damage to soil and biota below. The presence of snow or ice surfaces is not a guaranteed indication of a suitable pathway: therefore every reasonable effort should be made to minimise the effects of walking activity. Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities.

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

- Scientific research which will not jeopardise the ecosystem of the Area
- Essential management activities, including monitoring
- Entry to the Prohibited Zone is prohibited.

7(iii) Installation, modification or removal of structures

No structures, except boundary markers and signs, are to be erected within the Area except as specified in a Permit. All scientific equipment installed in the Area must 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 the responsibility of the authority which granted the original Permit.

7(iv) Location of field camps

Camping required for work in the Area should be near the existing USAP Upper or Lower Erebus Hut sites, and is discouraged anywhere within 500 m of the boundaries of the Area (Map A).

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

To avoid compromising the microbial ecosystem for which this site is protected no living animals, plant material or microorganisms shall be deliberately introduced into the Area and precautions 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.

Fuels are not to be brought into the Area. Food shall not be consumed within the Area. Equipment and other materials are not to be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted. All such 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.

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

Taking of or harmful interference with native flora or fauna is prohibited, except in accordance with a Permit. Where taking of animals or harmful interference is involved this should be in accordance with the SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica, 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. Material of human origin, not brought into the Area by the Permit Holder, but which is likely to compromise the values of the Area may be removed from any part of the Area, including the Prohibited Zone.

7(viii) Disposal of waste

All wastes, including all human wastes, must be removed from the Area. Excretion of human wastes is prohibited within 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. The Permit, or an authorised copy, must be carried within the Antarctic Specially Protected Area.
2. Permits may be granted to enter the Area to carry out biological or physical monitoring and site inspection activities, which may involve the collection of small samples for analysis or audit, to erect or maintain signposts, or protective measures.
3. To help maintain the scientific value derived from the unique communities found at Tramway Ridge visitors shall take special precautions against introductions, especially when visiting several thermal regions in a season. Of particular concern are microbial or vegetation introductions sourced from:
 - thermal areas, both Antarctic and non-Antarctic;
 - soils at any other Antarctic sites, including those near stations;
 - soils from regions outside Antarctica.

To this end, visitors shall take the following measures to minimise the risk of introductions:

- (a) Any sampling equipment or markers brought into the Area shall be sterilised and maintained in a sterile condition before being used within the Area. To the maximum extent practicable,

footwear and other equipment used or brought into the Area (including backpacks or carry-bags) shall be thoroughly cleaned or sterilised and maintained in this condition before entering the Area;

- (b) Sterilisation should be by an acceptable method, such as by UV light, autoclave or by washing exposed surfaces in 70% ethanol solution in water.
- (c) Sterile protective overclothing shall be worn. The overclothing shall be suitable for working at temperatures of -20°C or below and comprise at a minimum sterile overalls to cover arms, legs and body and sterile gloves suitable for placing over the top of cold-weather gloves.

7(x) Requirements for reports

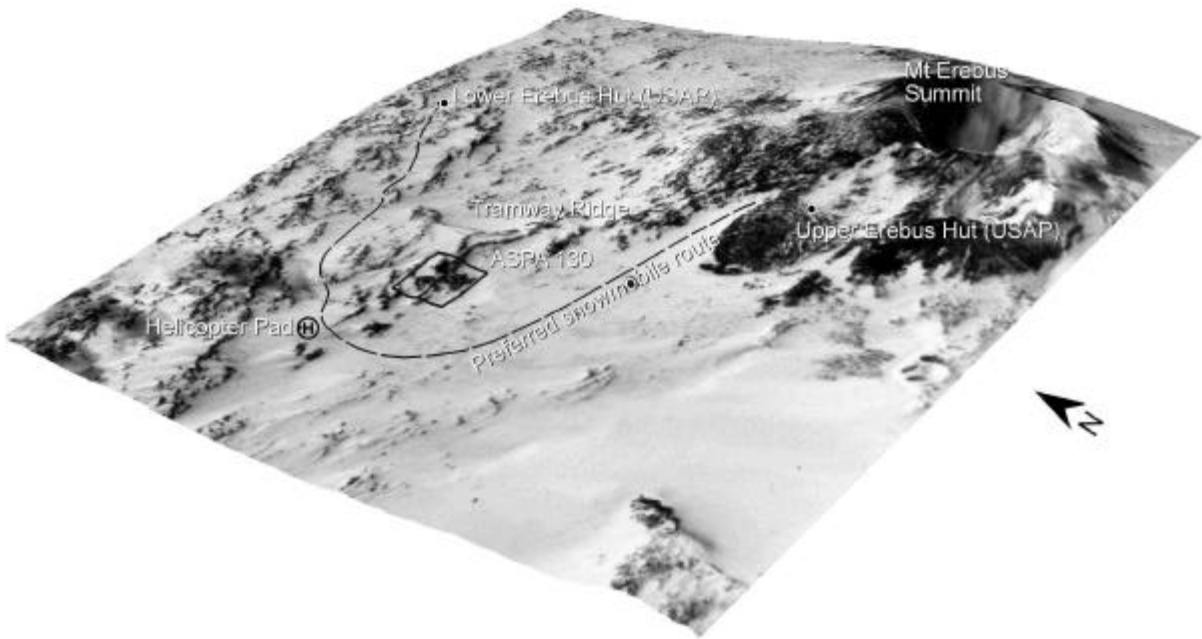
Parties shall ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report Form suggested by SCAR. Parties shall maintain a record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

8. Bibliography

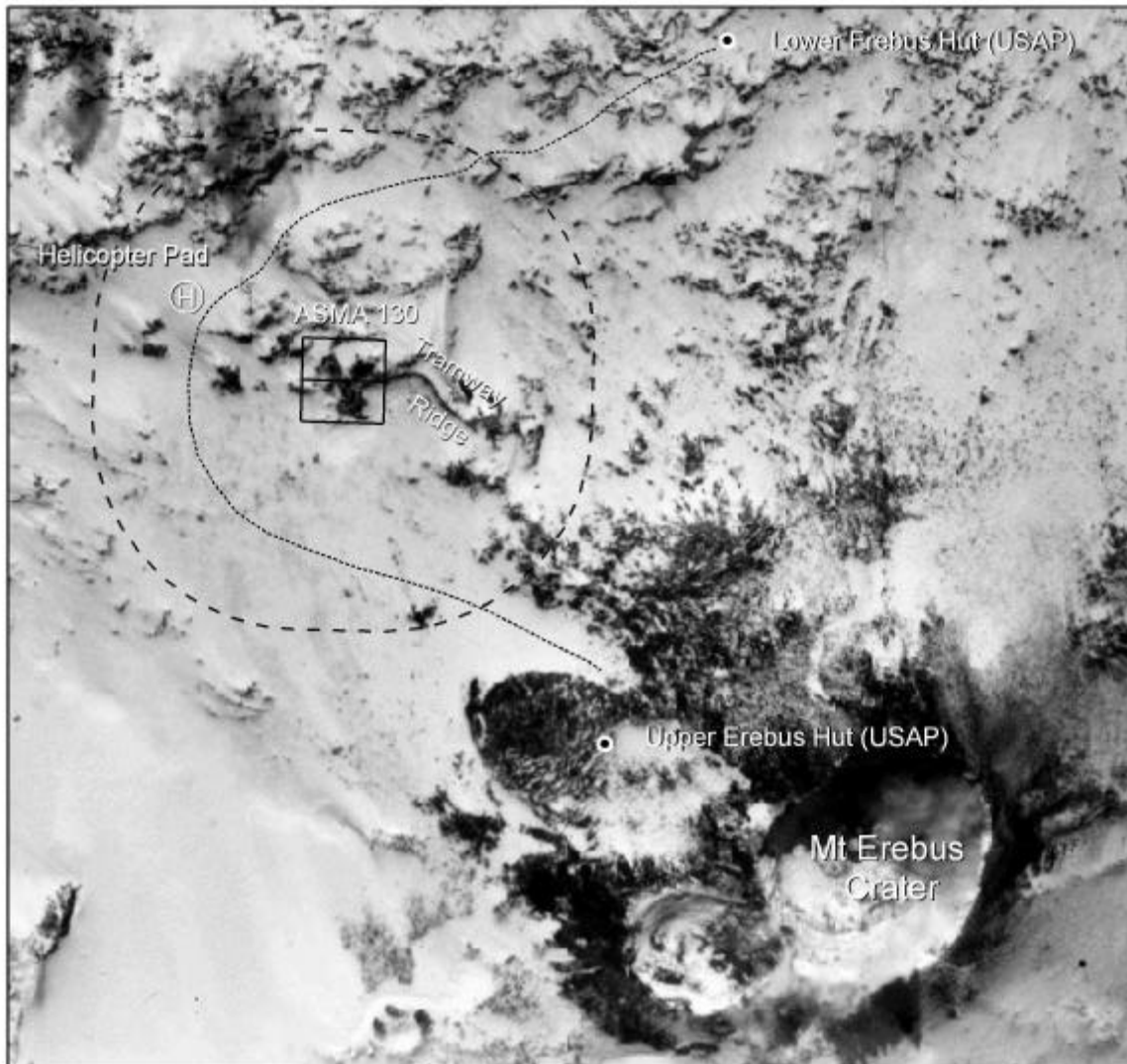
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Lesser MP, Barry TM, Banaszak AT. 2002. Effects of UV radiation on a chlorophyte alga (*Scenedesmus* sp.) isolated from the fumarole fields of Mt. Erebus, Antarctica. *Journal of Phycology* 38: 473-481.

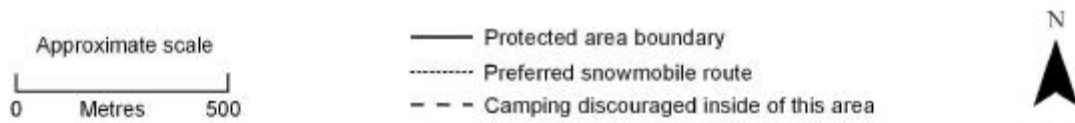
Figure 1 - Tramway Ridge, Mt. Erebus Antarctic Specially Protected Area 130: Perspective view



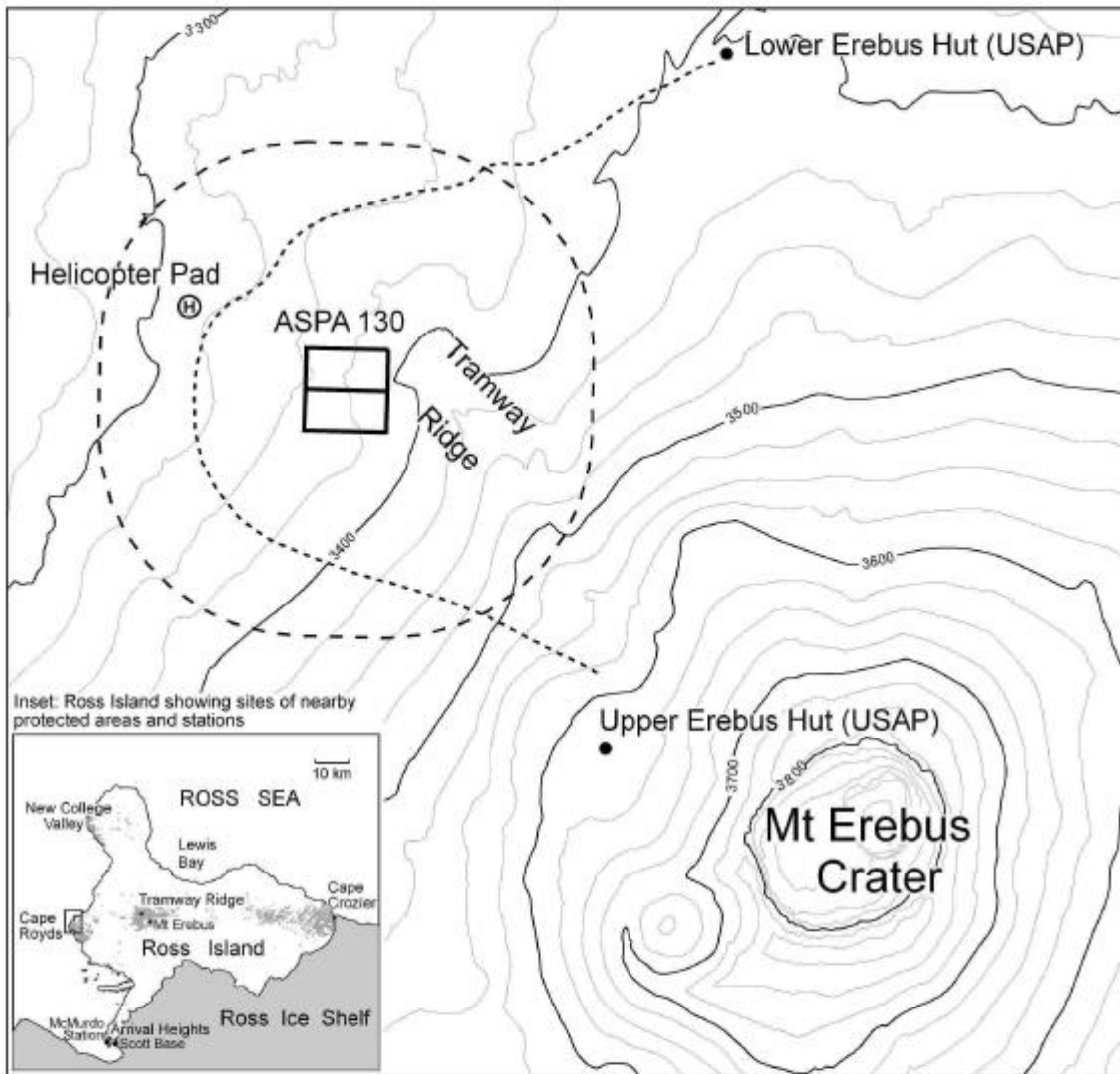
Map A - Tramway Ridge, Mt Erebus:
Antarctic Specially Managed Area 130
location image-map



Photography, 11 November 1993: rectified using affine transformation.



Map B Tramway Ridge, Mt. Erebus :
 Antarctic Specially Managed Area 130
 location contour map.

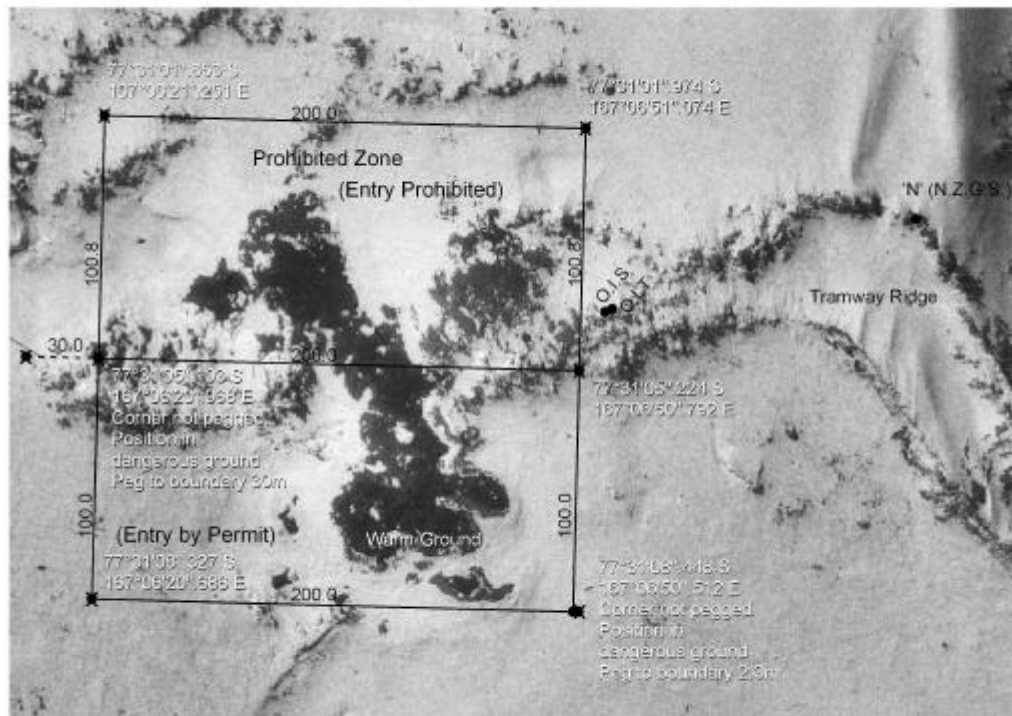


Contour interval: 25m
 0 metres 500
 (Approximate scale)

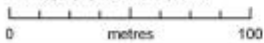
- Protected area boundary
- - - - Preferred snowmobile route
- - - - Camping discouraged inside of this area



Map C - Tramway Ridge, Mt Erebus: Antarctic Specially Protected Area 130 site image map



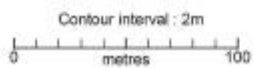
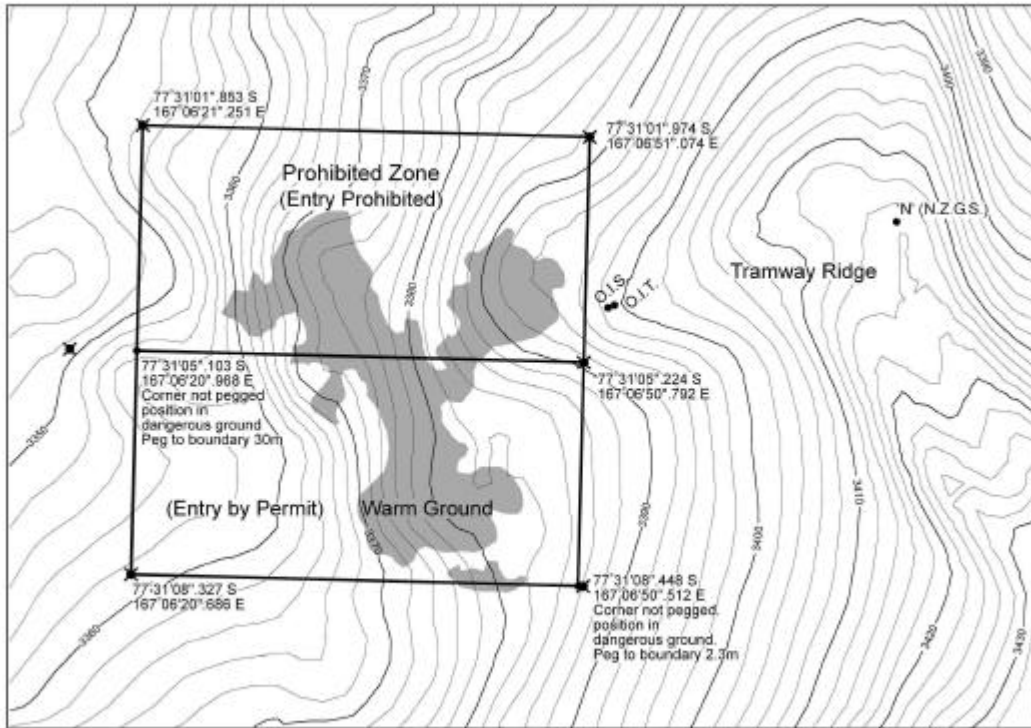
Photography, 9 February 1980



- Protected area boundary
- Survey marks
- X Boundary signpost

Orthophoto positional accuracy: +/- 2m
 Protected Area boundary origin of coordinates:
 Station EB, Camp Area Plane Datum 1981, WGS72
 DOSLI survey: 37/142

Map D - Tramway Ridge, Mt. Erebus : Antarctic Specially Managed Area 130 site contour map



- Protected area boundary
- Survey marks
- ✕ Boundary signpost

Planimetric positional accuracy : +/- 2m
Protected Area boundary origin of coordinates : Station EB, Camp Area Plane Datum 1981, WGS72.
DOSLI survey, 37/142
Area of warm ground subject to change.

