

Draft Management Plan

1/11/88

Antarctic Protected Area

SIGNY ISLAND, SOUTH ORKNEY ISLANDS

prepared by

W N Bonner and R I Lewis Smith

British Antarctic Survey, Natural Environment Research Council,
Cambridge, UK

18 August 1988

Note: This draft management plan has been prepared in accordance with paragraphs 75-97 of the Report of the XIVth Antarctic Treaty Consultative Meeting. It is intended that the final draft should be submitted by the United Kingdom delegation to the Preparatory Meeting for the XVth Consultative Meeting to be held in Pais in 1989.

1. Description of Area

1.1 The Protected Area

The Area includes the whole of Signy Island, its offshore rocks and islets, including Moe Island (Specially Protected Area No. 13) and the inshore waters within 500 m of the shoreline and offshore islets, as shown on the accompanying map.

1.2 Physical Features

Signy Island, situated at approximately latitude 60°43'S and longitude 45°38'W (Figure 1) is^s the fourth largest of the South Orkney Islands. It is triangular in shape, about 8 km north to south and 5 km east to west, total area c. 20 km². Its interior rises to 279 m at Tioga Hill. About half the island, mostly in the central and southern parts, is covered with ice, notably the McLeod Glacier. Immediately to the south-west of Signy Island lies Moe Island.

The island is composed of metamorphosed sedimentary rocks, mainly quartz-mica-schists and amphibolites, with frequent marble as thin bands or as outcrops. The rocks have been extensively eroded by ice and weathered, and the ice-free landscape is mantled with glacial debris. Although there is no development of mature soils, there is limited development of loam-like soil beneath the larger stands of Antarctic hair grass, and extensive accumulation in some places of acid moss peat. Cryoturbation phenomena are conspicuous and permafrost exists below a depth of about 1 m in north-facing sites where there is deep soil.

Climate is greatly influenced by the surrounding sea. Fast ice usually surrounds the island for several months in winter and for several more months there is pack ice, but their duration is very variable. Mean annual

air temperature is -3.65°C but on calm sunny summer days ground temperatures can exceed 30°C for brief periods. The coldest month is July (mean -10.3°C); minimum temperatures occasionally fall below -30°C . February is warmest (0.87°C) and $10-15^{\circ}\text{C}$ can occur briefly. Prevailing winds are from south-west to north-west, with a mean velocity of 7.3 m s^{-1} . Precipitation, often as rain, occurs on about 250 days a year and mean daily sunshine is 1.55 h. The microclimate at ground level is considerably warmer than air temperatures might suggest. Winter snow provides thermal insulation, protecting biota from the lowest temperatures.

1.3 Biological Features

1.3.1 Terrestrial and freshwater biota

The wide range of ice-free habitats and soil types provide an environment for one of the richest and most diverse flora of any Antarctic locality. There are 2 flowering plants, and approximately 50 mosses, 14 liverworts, 45 macrolichens and 65 encrusting lichens, as well as macroalgae and fungi. The majority of the ice-free terrain supports typical Antarctic fellfield vegetation dominated by mosses (especially *Andreaea* spp.) and lichens (notably *Usnea* spp.). On marble and amphibolite soils there are assemblages of calcicole plants (*Schistidium*, *Tortula* spp.) which are not known elsewhere in the Antarctic. Stable wet slopes support moss carpets (*Calliergidium austro-stramineum*, *Calliergon sarmentosum*, *Drepanocladus uncinatus*) while on well-drained slopes moss turves (*Chorisodontium acphyllum*, *Polytrichum alpestre*) are established. Coastal cliffs and rocks subject to sea spray and nitrogen enrichment from sea-bird colonies support colourful stands of lichens dominated by species of *Caloplaca* and *Xanthoria*. Around penguin colonies and areas frequented by elephant and fur seals the green foliose alga *Prasiola crispa* forms

extensive sheets. The two flowering plants, Antarctic hair grass, Deschampsia antarctica, and Antarctic pearlwort, Colobanthus quitensis, are restricted to moist, north-facing sheltered slopes near the shore.

The invertebrate land fauna consists of about 50 protozoans, 13 rotifers, 15 tardigrade, 36 nematodes and 18 microarthropods. Of the latter, 4 species of springtail are only the insects, while the remainder are mites. The springtail Cryptopygus antarcticus is common and conspicuous, often in large aggregations. The oribatid mite Alaskozetes antarcticus is often locally abundant, particularly in association with Prasiola.

There are 17 lakes and numerous pools and melt streams. The lakes are frozen for 8 to 12 months of the year and are of very different nutrient status, ranging from extreme oligotrophic to highly enriched waters. The deeper water vegetation is mostly aquatic mosses, notably Drepanocladus cf. aduncus and Calliergon sarmentosum, and algal mats dominated by Tolypothrix sp. and Plectonema sp. The deep water communities vary from lake to lake but shallow water communities are consistently dominated by the cyanobacterium Phormidium sp. and diatoms. The largest invertebrate is the fairy shrimp Branchinecta gainii. Copepods, Pseudoboeckella poppei and Parabroteus sarsi, are common. The aquatic mite, Neohydesia signyi, is endemic to a few brackish pools at Paal Harbour.

Following 27 years of intensive biological research, much detailed information is available on the diversity and distribution of terrestrial and freshwater biota and of ecosystem dynamics at Signy Island with over 200 scientific papers published during that period.

1.3.2 Birds and seals

Sixteen species of birds breed at Signy Island, forming one of the most diverse assemblages of species so far recorded in the maritime Antarctic and including all species known to breed in this region, except the Antarctic fulmar, *Fulmarus glacialisoides*. There are large populations of Adelie and chinstrap penguins, *Pygoscelis adeliae* and *P. antarctica*. It is also an important breeding site for gentoo penguins (*P. papua*), giant petrels (*Macronectes giganteus*), cape petrels (*Daption capense*), snow petrels (*Pagodroma nivea*), Wilson's storm petrels (*Oceanites oceanicus*), dove prions (*Pachyptila desolata*) and blue eyed cormorants (*Phalacrocorax atriceps*).

The most abundant pinniped is the Weddell seal, *Leptonychotes weddellii*, of which some 100-130 pups are born each year on sea-ice or snow. Elephant seals, *Mirounga leonina*, breed on Signy Island although in much smaller numbers, usually fewer than 10 pups being produced. Crabeater, *Lobodon carcinophagus*, and leopard, *Hydrurga leptonyx*, seals are often seen on ice floes around the island. Antarctic fur seals, *Arctocephalus gazella*, have become increasingly frequent summer visitors to Signy Island since 1948 when the first specimen was recorded. In February 1988 16553 were present on the island. Nearly all the seals are juvenile males and very few births have been recorded (maximum 6 in 1988).

1.3.3 Inshore marine biota

Signy Island is a typical maritime Antarctic habitat. The water temperature varies from only +1°C in summer to -1.8°C and fast ice is present on average for 140 days each year (extreme values are 59 and 230 days). The marine environment is intensely seasonal with the phytoplankton bloom averaging only 100 days, and virtually no phytoplankton detectable in winter. The intertidal areas are almost devoid of life because of the scouring effect of winter fast ice or brash ice which can occur at any time. Seaweeds include ephemeral species of the green *Ulothrix* and red *Porphyra*. The limpet *Nacella concinna* dominates the littoral fauna. Shallow sub-tidal waters also suffer from this scouring action, but there are small clumps of seaweeds (green *Enteromorpha* and *Ulothrix* and calcareous pink *Lithothamnion*). Limpets, crustaceans and occasional small fish are the most abundant fauna. In deeper waters, however, there is a rich flora and fauna which includes extensive stands of macroalgae (*Desmarestia* and *Himantothallus* spp.), numerous invertebrates such as crustaceans (*Antarcturus*, *Glyptonotus*, *Serolis* spp.), molluscs (*Lissarca*, *Laternula*, *Yoldia* spp.) and echinoderms (*Odonaster*, *Sterechinus* spp.), and fish (*Chaenocephalus aceratus*, *Notothenia neglecta*, *Trematomus newnesi*). In general growth rates are slow and population turnover times long, so that recovery from disturbance is likely to take a long time.

2. Reasons for designation

Signy Island is the least glacierised and most extensively vegetated of the South Orkney Islands. The contrasting rock types and associated ice-free

soils provide a wide variety of substrata whilst seventeen lakes display a possibly unique range of freshwater habitats. The island is especially valuable for biological research, some studies (notably birds and seals) having been carried out continuously since 1948. Many field sites have been set up and long-term experiments established. The particular value of the terrestrial, freshwater and marine studies at Signy, in terms of not only Antarctic biology but also biology in general, is that routine environmental studies have been combined with detailed biological programmes, with both running simultaneously throughout the year, and that this integrated approach has been in operation for at least two decades. The biological bibliography on Signy Island now numbers around 300 publications. This corpus of knowledge represents an important scientific investment as well as providing a basis for future research which it would be difficult to match elsewhere in the maritime Antarctic.

Antarctic vegetation and soils are physically fragile and unable to withstand trampling. Oligotrophic lakes and inshore marine sites are vulnerable to pollution. Nesting birds may desert if disturbed. Hence it is desirable to limit human activity over parts of Signy Island in order to preserve its environmental values and potential to support scientific research.

The objectives of this Management Plan are

2.1: to afford maximum protection to the environment and its biota throughout the Area and to minimise human impact in sites of intensive research;

2.2: to restrict human impact on Signy Island to a scale which will limit any significant lasting changes to levels which will not jeopardise existing or planned research there;

2.3: to protect the scenic values of Signy Island, including artefacts associated with the whaling industry and graves on the island.

3. History of previous human impacts

3.1 Discovery and Early History

The South Orkney Islands, discovered in 1821, were of little interest to sealers, as few fur seals were to be found there. From 1912-13 three whaling companies operated around Signy Island and in 1920-21 a small shore station was built at Factory Cove. Few traces of this (which is the site of the present research station) remain but the ruins of seven small dams at various places on the island, a water pump (at Pumphouse Lake), a quantity of barrel staves and hoops near a group of five graves at Drying Point are associated with this period. Whaling activities at Signy were abandoned after the 1929-30 season, except for one expedition in 1936.

3.2 The Research Station

In March 1947 the first of a series of buildings to support scientific research was erected at Factory Cove by the Falkland Islands Dependencies Survey (FIDS, now British Antarctic Survey). This was replaced in 1955 by a larger wooden hut and a two-storey glass-fibre reinforced plastic hut was added in 1964. These, together with another large steel-clad building put up

in 1981 and various smaller buildings, form the basis of the present station. Additionally, there are three field huts which provide basic accommodation for two- or three-person parties.

4. Details of present and planned activities

4.1 Logistic Activities

4.1.1 The station area

The Signy station complex is situated on the south side of Factory Cove. It is compact by most Antarctic stations standards, all buildings and fuel storage (but excluding the emergency store, fuel pump-house and main communications aerial array) being contained within a rectangular area of about 9800 m² (i.e. less than 1 ha). However, the area of station activity is more extensive. For example, there is considerable impact in the area between the north end of the buildings complex and the fuel tank and beyond the pump-house by the shore. Before and after the transfer of fuel from a ship in Factory Cove, up to 200 m of flexible pipeline is laid out on the ground close to the pump-house. Much of this area is severely disturbed, although the recent activity of fur seals within the same area has had a greater impact. Between the accommodation building and the pump-house is the walled bonfire site, where combustible waste is burned. A flat raised beach area towards Berntsen Point was the site of the original FIDS station and, although totally removed, there are still signs of disturbance in the form of ash, coal, concrete etc. The emergency store and anemometer tower are situated on Bernsten Point. There is a path from the station to "Gash Cove", 200 m to the north-east where non-hazardous, non-combustible waste is discarded into the sea. Beyond this restricted area of activity human impact decreases

rapidly. Although the total area influenced directly by station activities is approximately 5.25 ha, at least half of this is virtually unaffected (as witnessed by the presence of five species of breeding birds).

Offshore, the main logistic impact on the marine environment is in Factory Cove within a line joining Mooring Point, Billie Rocks, Small Rock, Bare Rock, Outer Island and Bernsten Point; local boating and diving activities create minimal perturbation. Once, or occasionally twice, a year ships anchor in this area to discharge fuel to the pump house on the shore, but generally cargo and personnel discharge is from an anchorage beyond this area (normally c. 1 km north-east of Berntsen Point).

The layout of the main station buildings is shown in Figures 2 and 3. Tonsberg House (28.5 m) x 9.0 m) provides laboratory and work spaces and technical services for the station. There is a marine laboratory, a communications room, a surgery and a carpenter's workshop. Other rooms serve as stores. The northern end of Tonsberg House communicates with the plastic building (24.0 m x 7.75 m). The ground floor of this is used for science and administration. It contains an analytical laboratory, a library, a balance room, a dark room, the Station Commander's office and five general laboratories. The upper floor is for domestic purposes. There are eight bunkrooms, a lounge, dining room, kitchen and washroom. Sorlle House is a two-storey metal-clad building (27.5 m x 8.0 m). The lower floor houses the food store, cool room, deep-freeze chamber, a snow vehicle garage, constant-temperature room, and the diving facility. On the upper floor there is a scientific equipment store, a clothing and hardware

store, a travel store, compression room and a bunkroom. Adjacent to Sorlle House is a boatshed, 9.5 m x 7.5 m. The generator house (12.0 m x 10 m) contains the generators and water storage tanks, a mechanic's workshop and store. There is a wood store shed (6.0 m x 4.6 m) and two smaller stores (2.35 m x 1.5 m and 1.45 m x 0.9 m). A butyl-lined open tank, 7.8 m in diameter, collects water from an old whaler's dam. A bulk oil storage tank, 9.15 m in diameter with a capacity of 400 tonnes, is used to store diesel fuel. Emergency fuel is stored in 200 litre drums. A wooden hut (4.1 m x 2.55 m) near the tip of Berntsen Point is used as an emergency store.

It is proposed to rebuild the station over a period of 3 years commencing in 1990-91. The new base complex (to accommodate up to 40 personnel) will be situated immediately to the north of the present station, and most of the old buildings will be removed. The area of logistic impact will be contained within the present area.

4.1.2 Field huts

There are three recreational field huts with suitable overnight facilities for 2-3 people. Foca field hut (4.3 m x 2.4 m) is situated at about 20 m a.s.l. in Foca Cove. Gourlay field hut (2.8 m x 2.13 m) is on the north side of Rock Haven on Gourlay Peninsula. Cummings field hut (c. 3.5 m x 2.5 m) is sited just above the beach at Cummings Cove in the southwest corner of the island. Elsewhere, there are several huts which serve biological research programmes, but do not have overnight facilities. These are situated on Factory Bluffs, Moraine Valley, Jane Col, east side of Heywood Lake, between Heywood Lake and Sombre Lake, north-west of Gourlay Peninsula, and two very small huts on the mainland opposite Shagnasty Island and at North Point. The impact of these buildings is minimal and does not extend

more than 1-2 m from the huts. The locations of the huts are shown in Figure 1.

4.1.3 Relief operations

The station is self-contained and operates throughout the year. Resupply is by annual visits from the two BAS ships. During the main relief RRS John Biscoe anchors in Factory Cove, fuel lines are connected and the station resupplied with diesel. Simultaneously, approximately 100 cubic metres (c. 30 tonnes) of cargo is discharged. All cargo is transported ashore in "scows" (open barges) and, with no mechanical lifting devices at the station, every item is manhandled ashore. At the mid-season call by RRS Bransfield a further 25 tonnes is usually discharged. Relief operations commonly take two days, though poor weather invariably causes delays. Outgoing cargo, including waste, is loaded on the last call prior to winter.

Personnel exchanges are undertaken each year. During the summer season (mid-November to early April) a station commander, seven general support staff, scientific personnel and diver support occupy the station. Accommodation is available for 27 persons, though the wintering complement rarely exceeds 16.

Besides early, mid and late summer calls by BAS ships, HMS Endurance, foreign research ships and tourist vessels make occasional visits. Tourists are not permitted to land on Signy, but station personnel give guided tours of the scenic and biologically rich area at Shingle Cove on Coronation Island, c. 5 km to the north.

4.2 Scientific Activities

4.2.1 Terrestrial and freshwater biology

In an Antarctic context Signy Island possesses a great diversity of terrestrial and freshwater biota and wide range of habitats. Consequently, it has provided exceptional opportunities for detailed long-term integrated studies of Antarctic ecological and physiological processes in relation to environmental factors. The research also serves to provide an understanding of the early stages of development and functioning of terrestrial and freshwater systems in a global context.

Terrestrial and freshwater biological research has been carried out year-round on Signy Island since 1961, although some collections of plants and animals were made before then. During the 1960s many of the research projects were directed towards ecological surveys and obtaining a better understanding of the composition of the biota. Between 1967 and 1970 Signy Island was chosen as one of three Southern Hemisphere sites for the International Biological Programme Tundra Biome Investigations. Various studies of plant productivity, life cycles and decomposition in relation to microclimate were undertaken. This led in 1969 to the selection of two intensive study sites representative of two of the predominant plant communities occurring on the island and throughout the maritime Antarctic (a relatively dry moss turf and a wet moss carpet). These Signy Island Reference Sites (SIRS) were north-west of Goulay Peninsula and most of the terrestrial research was concentrated there in an interdisciplinary programme until 1981. Various projects examined aspects of the vegetation and primary production, the invertebrate fauna and their population dynamics and physiology, decomposition and nutrient cycling processes, and microclimate. These studies complemented each other and many of the data were used to develop energy budget model for each

system.

In 1980 a new long-term programme in terrestrial biology commenced on Signy Island concerned with the Antarctic fellfield ecosystem (the Fellfield Ecology Research Programme - FERP). The research is aimed at the processes of colonization, community development and organism survival in relation to environmental variables, notably water, temperature, nutrient availability and substrate quality. Of seven demarcated fellfield sites selected, three primary sites were chosen for the main studies (at Factory Bluffs, Moraine Valley and Jane Col). This programme will continue until 1990 when a new long-term programme will be implemented, building on experience gained during the past three decades. Research will concentrate on the dynamics of terrestrial and freshwater ecosystems and will involve an integrated approach to ecological, biological and physical processes on land and in freshwater. It will comprise two major projects: survival strategies, and ecosystems and conservation.

Elsewhere on the island the recession of the ice fields is being monitored and re-exposed vegetation radiocarbon-dated to provide information on when the major periods of ice advance occurred, signifying a deterioration of the region's climate. Lichen growth and colonization have been monitored since 1973 and the rate of degradation or recovery of vegetation caused by fur seal activity in control and fenced plots are also being studied in various parts of the island.

Freshwater research is undertaken in all 17 of the island's lakes, as well as in some smaller pools and streams, although intensive studies are restricted to a few selected lakes. Investigations are

concentrated in the oligotrophic Sombre Lake and in the eutrophic Heywood Lake. Detailed studies are also carried out from time to time in Amos, Moss and Changing Lakes. Other lakes are used as reference sites and for purposes of comparison. The long-term programme is concerned with plant production ecology, geomicrobiology cycling, redox chemistry and microclimate.

4.2.2 Marine biology

Biological studies of the near-shore marine ecosystem have been carried out continuously since the early 1960s, and have made a major contribution to understanding the Southern Ocean marine ecosystem in general. These studies have been carried out year-round, using SCUBA techniques in both winter and summer. Most work has been carried out within a few kilometres of the research station, particularly in Borge Bay, using a variety of small boats in summer and snowmobiles in winter (when access is gained through holes cut into the fast-ice with chain saws).

In the early years, two parallel approaches were used. These were, firstly, a long-term study of the environmental parameters in the near-shore ecosystem (temperature, salinity, chlorophyll biomass and macronutrient concentration) and, secondly, a series of detailed autecological studies of selected species of macro-invertebrates. The environmental study ran for 15 years and has provided the only such long-term data set for anywhere in Antarctica. It has been important in establishing both the intensely seasonal nature of the environment and demonstrating significant year-to-year variability in factors such as the size of the phytoplankton bloom. A further programme will commence in 1988/89 with the specific aim of relating this variability to factors such as fast-ice cover and local wind conditions. At the

same time a long-term study of vertical flux to the sediment (pelagic-benthic coupling) will be initiated.

The detailed ecological studies are continuing, and a comprehensive investigation of the dominant infaunal bivalve Yoldia will start in 1988/89. At the same time emphasis is now switching from studies of individual species to processes. In particular, future studies will address patterns of energy flow within the marine community, particularly in relation to the stable low temperature and the seasonal nature of production.

4.2.3 Bird and seal biology

Signy Island was a major site for pioneering studies of sea birds, commencing in the early 1950s. Numerous short-term studies have been made of most of the island's breeding species. Since 1976 the main work has involved detailed long-term monitoring and routine mark-recapture studies. Two major recent studies have been on the comparative biology and ecology of Adelie and chinstrap penguins and the reproductive biology of blue-eyed cormorants. Since 1980 the breeding success of the two penguin species has been monitored in permanent plots within large colonies at Gourlay Peninsula and North Point. This project is part of a wider network throughout the southern ocean designed to try to obtain information on population fluctuations and breeding success of key

indicator species which may form base-line data against which to evaluate changes which might reflect commercial exploitation of prey stocks.

Pioneer research on elephant and Weddell seals was conducted at Signy Island between 1949 and 1953. Subsequently, the seal research programme has concentrated on Weddell seals, although an annual late-February census of all seals around the island has been conducted since 1977. The Weddell seal programme is designed to provide information on aspects of the population dynamics of this species. Each year as many as possible of females breeding at Signy are tagged or have their existing tag numbers recorded. All their pups are sexed and tagged. About one-third of the breeding population now comprises known-age animals and for many of these records of their life-time reproductive performance are being built up.

4.2.4 Other research

From the establishment of the station at Signy Island until 1969 synoptic weather observations were recorded every three hours by professional meteorologists. Because of the much longer run of data available from the Argentine Meteorological Station at Laurie Island, the eight daily observations at Signy were reduced to two and were undertaken by a biologist. From time to time non-biological research projects have been carried out. These have included geology, pedology, glaciology, survey mapping and inshore and offshore hydrographical survey.

4.3 Research Sites

Most field research has an inevitable destructive element, both as regards access to a study site and in the sampling regime employed within it. The nature of the process-oriented terrestrial and freshwater research at Signy Island has necessitated concentrating activities at a few selected sites. Since 1969 this has resulted in the delimitation of boundaries with marker poles to indicate the limits of the sites and warn unauthorised personnel to avoid the area. When work ceases at a site all markers and other artefacts associated with the study are removed. The catchment areas of lakes have been marked if they are included in the research programme. Elsewhere the devastating activity of fur seals has been monitored and enclosure fences have been erected to protect small plots of vegetation. Bird studies mostly involve wide scale censuses but small marked sub-colonies in penguin and petrel colonies are being monitored. There are no marine sites marked and most inshore research is carried out throughout the Factory Cove-Small Rock-Bare Rock area. Other regular diving sites include the area around Powell Rock 500 m north-east of Balin Point. The locations of the current research sites are given in Fig. 4 and Tables 1 and 2.

Terrestrial research sites vary in size from a few square metres to about 2.5 ha but each is clearly delimited by prominent posts and individual research plots within a site are marked with short stakes bearing code numbers designating respective projects and the name of the principal investigator. Only scientists are permitted to enter the sites, unless authorization has been granted to other personnel. Movement within sites is restricted and concentrated along pathways to minimise trampling disturbance. Sampling is a facet of experimental research and the controlled removal of plant or soil samples has minimal effect on the environment. Coring of deep moss peat may have a permanent effect since the resulting holes can remain for decades. Every precaution is taken to minimise perturbation.

All lakes are regarded as research sites and are used only for research purposes. No manipulation experiments (e.g. enrichment) of lake systems have been undertaken and sampling is designed to minimise damage to lake communities and benthic sediments. Summer sampling involves the use of a rubber dingy. Winter sampling requires holes to be cut in the 1 m+ thick ice using a petrol-driven ice auger (to drill 23 cm diameter holes) or chainsaw with a 1.75 m ice blade (to cut holes for SCUBA divers). From 15-30 dives a year are made in the main study lakes. Ice holes are kept open by making regular visits to chip away new ice, thereby minimising the use of the auger or chainsaw. Great care is taken to prevent ingress of petrol or oil into the holes or on to surrounding snow or ice. Because of the fragility of the lake sediment communities, damage by divers is minimised by installing duraluminium frames at the main sampling site on which the diver can lie supported roughly 60 cm above the sediments and sampling around the frame. All sampling is restricted to defined areas of the lakes so that major stands of benthic plants remain unaffected.

In the inshore marine zone some research programmes require small short-term plots to be regularly sampled, occasionally to the extent of removing most of certain species. These areas are, however, quickly recolonised. Otherwise, sampling is undertaken over large unmarked areas. Most sampling is carried out by SCUBA divers operating from small boats in summer or through ice holes cut by a petrol-driven chainsaw in winter.

5. Management measures

The measures set out below represent the major elements of regulations which are currently in force for BAS personnel. For the purposes of achieving the objectives set out in Section 2 above it is requested that all persons should have regard to these measures.

5.1 Throughout the Area the provisions of the Antarctic Treaty, including the Agreed Measures for the Conservation of Antarctic Fauna and Flora and any Recommendations made at Consultative Meetings, shall prevail. No litter shall be discarded anywhere in the Area and wastes shall be disposed of as provided for by BAS regulations currently in force. These regulations are based on the relevant Antarctic Treaty Recommendations and take account of the special needs imposed by present and future research programmes. The total number of people spending more than 24 hours continuously in the Area shall at no time exceed 40, except in emergencies.

5.2 The Area is divided into the zones shown in Figure 1. Zones (except the General Access Zone) are identified on the ground by prominent markers. Permanent buildings and station installations (excluding field huts and temporary shelters) shall be confined to the Logistics Zone. Within the General Access Zone necessary activities are permitted, subject to the Agreed Measures and local rules currently in force; this Zone includes marked ecologically sensitive areas. Within the Scientific Zones activities shall be restricted to those which will not disturb the research sites or research programmes there. No waste, including human wastes, shall be deposited in the Scientific Zone. Within the SPA Zone (Moe Island) the special measures of Article VII of the Agreed Measures shall apply.

5.3 Outside the Logistics Zone and where practicable, persons crossing snow- or ice-free ground shall keep to marked tracks and avoid areas of dense vegetation or soft ground, particularly if exhibiting periglacial features.

Vehicular traffic (over-snow vehicles only) shall be restricted to designated routes and operate only during winter.

5.4 Unauthorised persons shall avoid colonies of nesting birds.

5.5 Unauthorised persons shall not enter or disturb marked research sites or any lakes.

5.6 All waste from field activities shall be returned to the Logistics Zone for disposal.

5.7 In evaluating the environmental impact of proposed scientific or logistic activities, regard shall be paid to the status of the Area as an Antarctic Protected Area.

5.8 Artefacts associated with the early history of the Area shall not be disturbed, except in the course of proper archaeological research or conservation. Graves shall not be disturbed, except to tend them.

5.9 The collection of biological or geological specimens within the Area, except in the course of scientific research shall be subject to prior authorization.

5.10 Where practicable, and where good seamanship allows, vessels shall not anchor within the Area, except in the designated Anchoring Zone (see Fig. 1).

5.11 Vessels shall not discharge ballast or other wastes within the Area, or within 5 km of it.

5.12 The person who for the time being is responsible for the local operation of Signy research station within the Area, shall have authority to apply and interpret these rules locally and shall take scientific advice when appropriate. He shall be informed of the numbers and proposed activities of persons planning to visit the Area. His advice shall be heeded with regard to precautions to be taken to avoid damage to the environment and biota of the Area and to protect the research programmes conducted there.

5.13 All markers and other features associated with a research site shall be removed when that site is no longer required for research purposes.

6. Review of the Management Plan

This Management Plan shall be reviewed within five years of its coming into force and thereafter at intervals of not more than five years. Adequate records shall be kept to monitor changes in the physical and biological environment that can reasonably be attributed to human impacts.

7. Availability of the Management Plan

Copies of the Management Plan are available from SCAR and from British Antarctic Survey.

Table 1 Major research sites on Signy Island

Site/Locality	Approx. area (ha)
<u>Terrestrial sites</u>	
Factory Bluffs ¹	0.41
Moraine Valley ¹	2.40
Jane Col ¹	0.90
Mooring Point ²	0.66
Marble Knolls ²	0.55
North-east Moraine Valley ²	0.50
"Paal Col" between Factory Bluffs and Moraine Valley ²	0.24
<u>Freshwater sites</u>	
Heywood Lake ¹	4.50
Sombre Lake ¹	2.66
Pumphouse Lake ¹	1.22
Moss Lake ¹	1.54
Amos Lake ¹	0.56
Twisted Lake ²	3.10
Gneiss Lake ²	0.21
"Khyber Lakes" south of Moraine Valley adjacent to McLeod Glacier ²	0.21, 0.07
<u>Bird sites (colonies)</u>	
Gourlay Peninsula ¹ (Adelie, chinstrap penguins)	
Shagnasty Island ¹ (blue eyed cormorants)	
North Point ¹ (blue eyed cormorants)	
Factory Bluffs ¹ (snow, cape petrels)	

¹ Primary research site

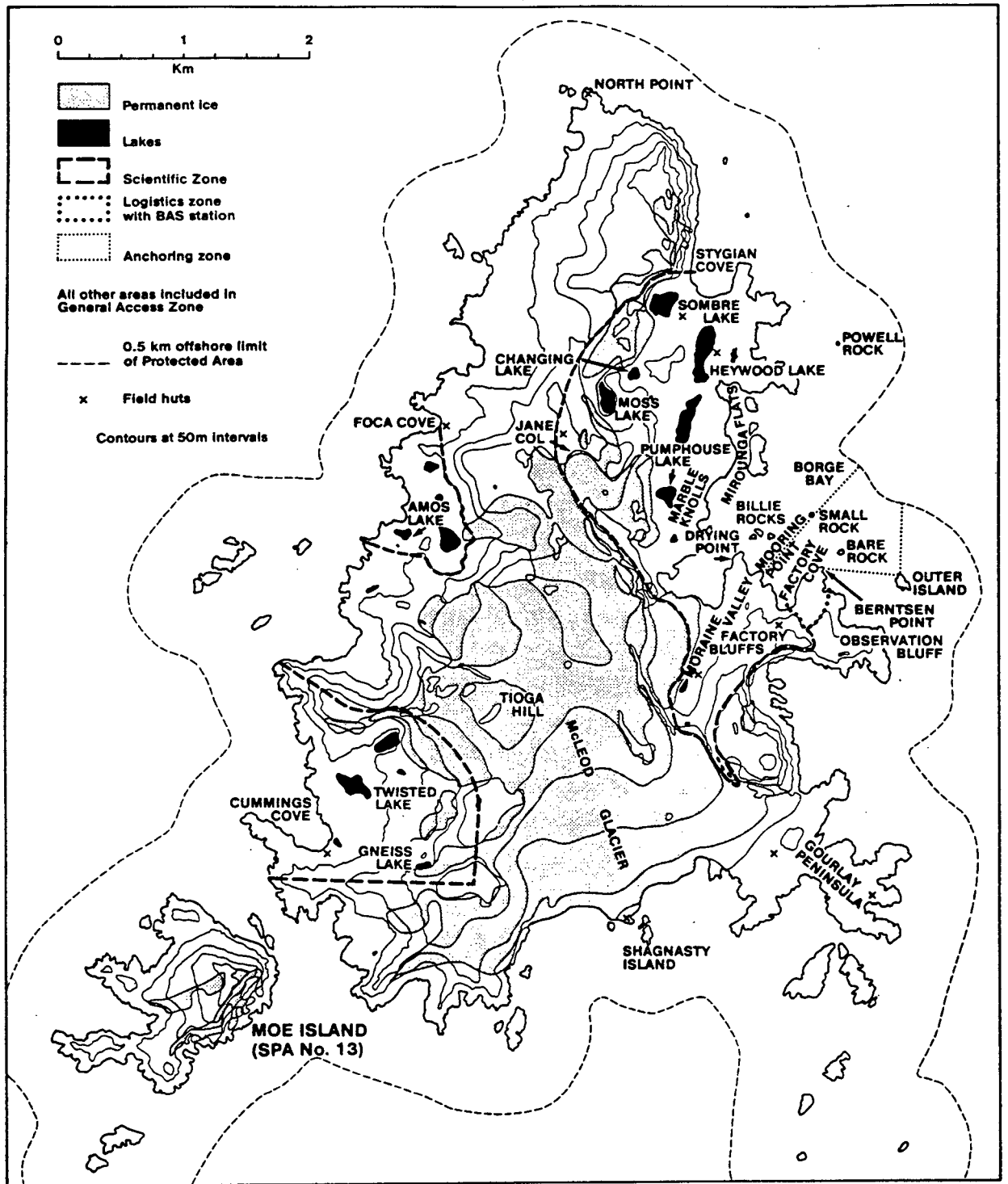
² Secondary research site

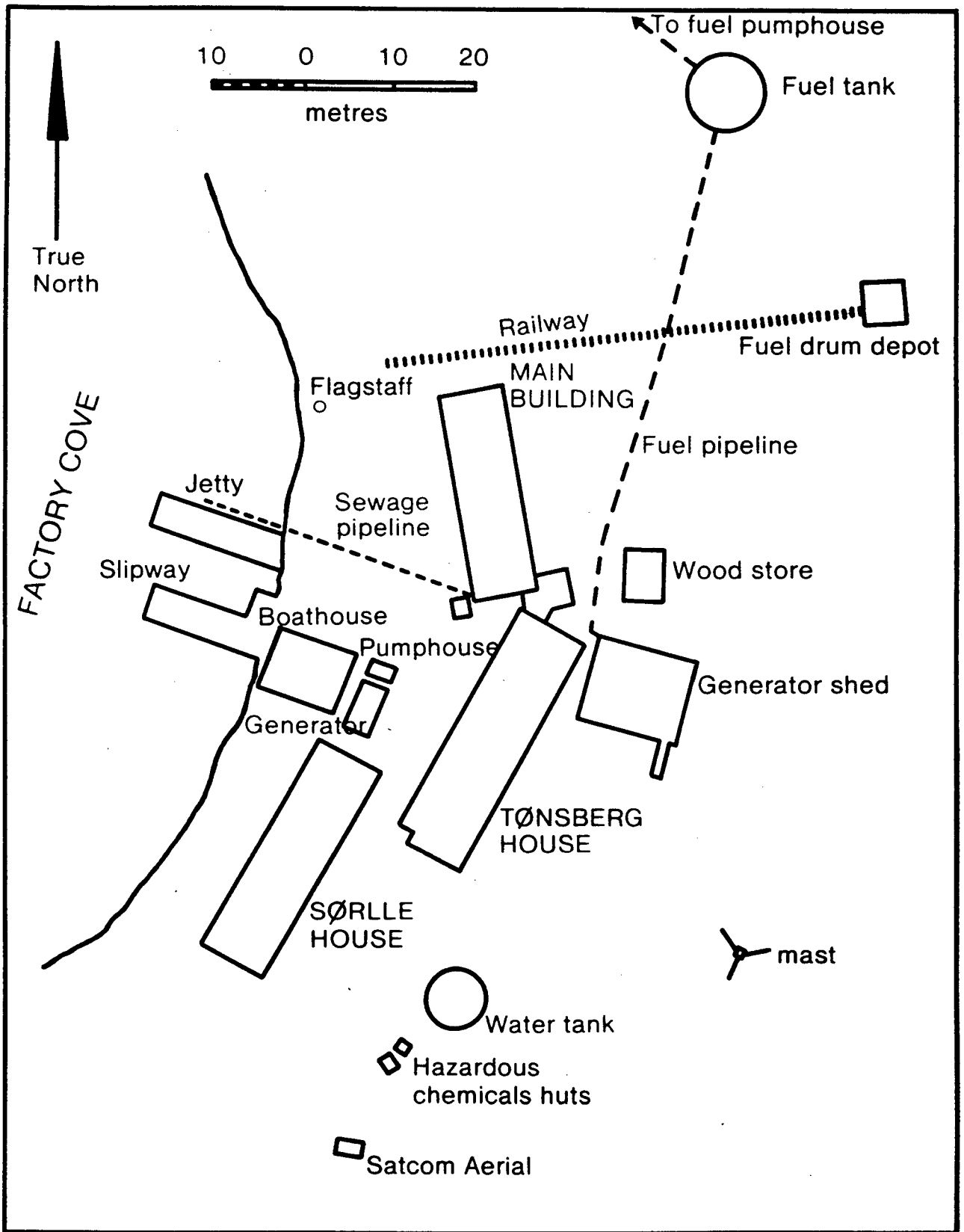
Table 2 Long-term monitoring sites on Signy Island

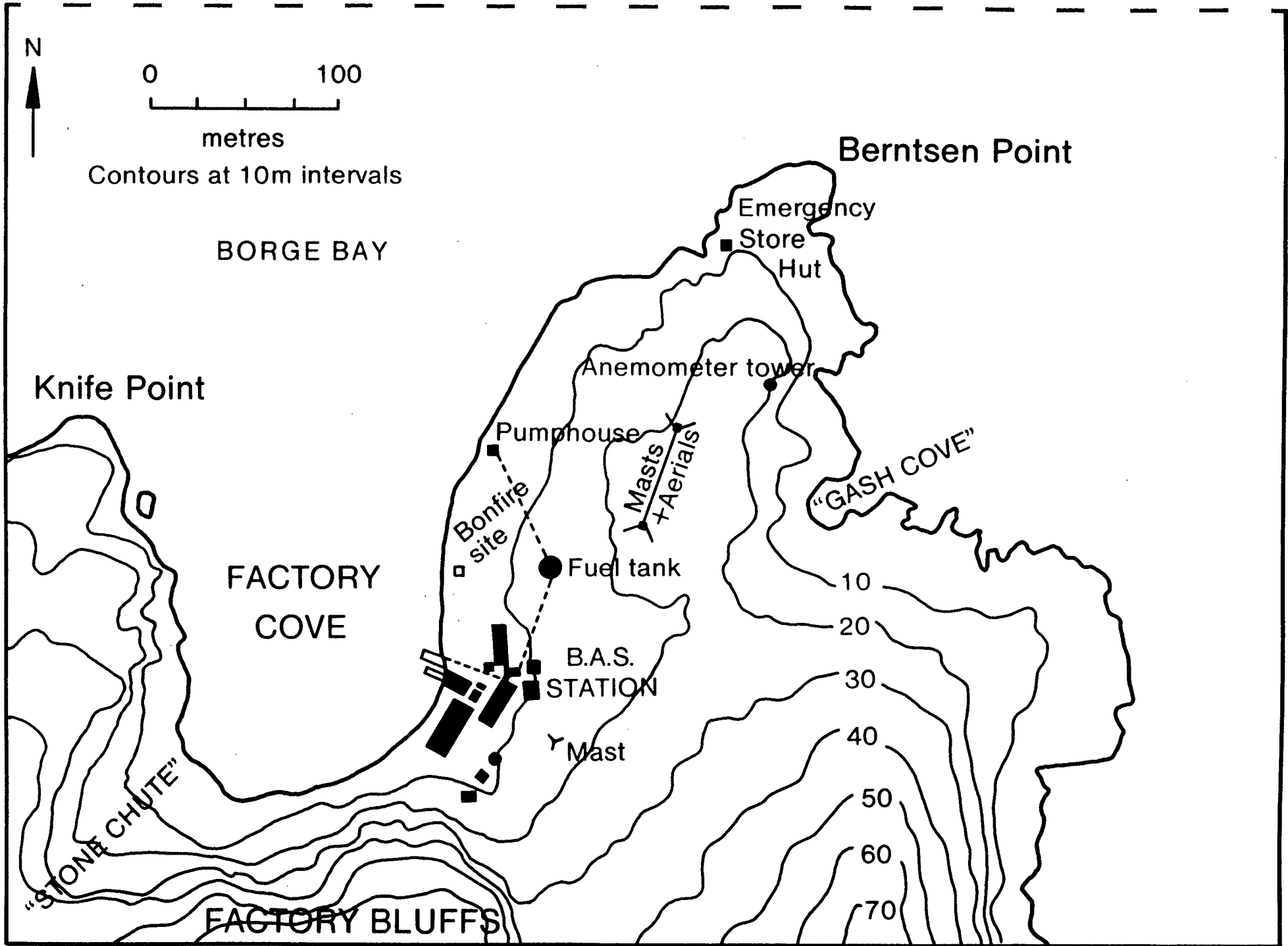
Site/Locality	Comments
<u>Terrestrial sites</u>	
Fur seal impact exclosures: Mirounga Flats (50 m ²) Stygian Cove (25 m ²)	Each site contains permanent quadrats being monitored for recovery of vegetation.
Unprotected Marble Knolls (25 m ²) Between Mirounga Flats and Marble Knolls (25 m ²) North-west of Gourlay Peninsula (2) (25 m ²)	control quadrats outside the fences are monitored for degradation of vegetation.
Head of Moraine Valley (c. 0.25 ha)	Monitoring of colonisation by biota on small moraine and in pool at edge of receding ice field.
East side of McLeod Glacier (25 m ²)	Monitoring recolonisation on re-exposed moribund moss bank after recession of ice field.
Lichen growth study (1-4 m ²)	Monitoring growth of individual thalli since 1973 at numerous sites on rock surfaces around island.
Introduced invertebrate study naturalised Factory Bluffs (c. 25 m ²)	Monitoring spread of two soil invertebrate species.
Foca Cove botanical reserve (c. 2.5 ha)	An ecologically sensitive area on a steep unstable slope protected for its exceptional diversity of flora and soil types.
<u>Freshwater sites</u>	
All lakes	Water chemistry and biota are monitored tri-annually.
<u>Bird sites</u>	
Selected colonies of penguins at most major breeding sites around island.	Annual monitoring of breeding success.
Snow and cape petrel colonies in gully on north side of Observation Bluff.	Annual monitoring of breeding success.

FIGURE CAPTIONS

- Figure 1 Signy Island showing features named in the text and the different zones of the Protected Area.
- Figure 2 Plan of buildings and related features associated with the British Antarctic Survey research station on Signy Island.
- Figure 3 Distribution of buildings and related features associated with the British Antarctic Survey research station on Signy Island.







metres

Contours at 10m intervals

Berntsen Point

BORGE BAY

Emergency
Store
Hut

Knife Point

Anemometer tower

Pumphouse

"GASH COVE"

Bonfire
site

Masts
+Aerials

Fuel tank

FACTORY
COVE

10

20

30

40

50

60

70

B.A.S.
STATION

Mast

"STONE CHUTE"

FACTORY BLUFFS