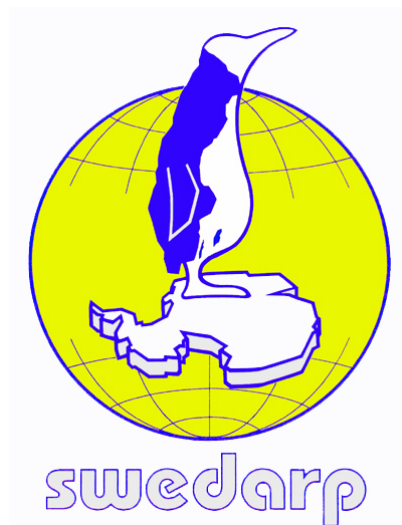


# Initial Environmental Evaluation Dronning Maud Land, DML 2009/10



## Swedish Antarctic Research Programme

Swedish Polar Research Secretariat  
P.O. Box 50003  
SE-104 05 Stockholm  
Sweden



## CONTENTS

<b>1. NON-TECHNICAL SUMMARY .....</b>	<b>3</b>
<b>2. INTRODUCTION .....</b>	<b>7</b>
2.1 BACKGROUND AND SCIENTIFIC PURPOSE .....	7
2.2 SCOPE OF THE INITIAL ENVIRONMENTAL EVALUATION.....	11
<b>3. DESCRIPTION OF THE EXPEDITION .....</b>	<b>12</b>
3.1 DRONNING MAUD LAND 2004/05 .....	12
3.2 ORGANISATION AND LEGAL FRAMEWORK.....	13
3.3 AREAS VISITED .....	14
3.4 SITE DESCRIPTION OF WASA AND SVEA .....	15
3.5 EDUCATION AND TRAINING.....	16
<b>4. ENVIRONMENTAL IMPACT ASSESSMENT .....</b>	<b>17</b>
4.1 IMPACTS IDENTIFICATION AND EVALUATION FROM LOGISTIC ACTIVITIES .....	17
4.1.1 <i>Station facilities</i> .....	17
4.1.2 <i>Ground transportation</i> .....	18
4.1.3 <i>Fuel management</i> .....	18
4.1.4 <i>Energy management</i> .....	20
4.1.5 <i>Chemical management</i> .....	20
4.1.6 <i>Waste and sewage management</i> .....	21
4.2 IMPACT IDENTIFICATION AND EVALUATION FROM SCIENTIFIC ACTIVITIES .....	22
4.2.1 <i>Bdelloid rotifers from Antarctica</i> .....	20
4.3 CUMULATIVE IMPACTS.....	23
4.4 ALTERNATIVE AREAS.....	25
4.5 THE ZERO ALTERNATIVE .....	25
4.6 MONITORING .....	25
4.7 GAPS OF INFORMATION .....	25
4.8 CONCLUSION.....	26
<b>APPENDIX I – NEH ENVIRONMENTAL GUIDELINES .....</b>	<b>27</b>

The IEE has been compiled by:

Cecilia Selberg  
Environmental officer  
SPRS  
P.O. Box 50003  
SE-104 05 Stockholm  
Sweden  
E-mail: [cecilia.selberg@polar.se](mailto:cecilia.selberg@polar.se)



## 1. NON-TECHNICAL SUMMARY

The initial environmental evaluation (IEE) indicates that environmental impacts from the planned activities most likely will be small. *Minor or transitory* environmental impact is expected from the logistic activities. All other environmental impacts are likely to be *less than minor or transitory*. Cumulative impacts are considered to be *at most minor or transitory*. From an environmental point of view, there is no reason not to carry out the DML 2009/10 expedition.

### Description of the activity

DML 2009/10, which will have 5 logistic members, will last from 27<sup>th</sup> of October 2009 – 3<sup>rd</sup> of February 2010. Two people within the MARA (the atmosphere physics) programme will also be staying during a part of the expedition and run their programme, they will arrive to Wasa by air the 30<sup>th</sup> of November and leave Antarctica the 3<sup>rd</sup> of February. Transport to and from as well as within Antarctica will be by aeroplane. The expedition will mostly be carried out in the area of Wasa research station but also a couple of days visit to Svea research station. This year's expedition has a logistic focus and concentrates on repairing, restoring and overhauling the vehicles from last year's expedition JASE 2007/08 and maintenance of the stations Wasa and Svea. The logistic members will also help out with sampling mosses, lichen and soil for a Swedish science project; Bdelloid rotifers from Antarctica. The expedition will use tracked vehicles and snowmobiles for transportation between Wasa and Svea. A summary of the identified activities that might effect their environment and the related environmental impact is presented below in table 1.

*Table 1. Summary of the activities identified as causing an impact on the environment.*

Activity/action	Less than minor or transitory impact	Minor or transitory impact	More than minor or transitory impact
<b>Logistics</b>			
Station facilities		X	
Maintenance of stations		X	
Ground transportation		X	
Fuel management		X	
Chemical management	X		
Waste and sewage		X	
Energy management	X		
<b>Science programme</b>		X	
<b>Cumulative impacts</b>		X	



### **Why is this expedition necessary?**

The Swedish Polar Research Secretariat is a government authority under the Ministry of Education and Science, and its task is to promote Swedish Polar research by organising and leading polar research expeditions, primarily as part of international efforts. The overall objective of the Swedish Antarctic Research Programme (SWEDARP) is to contribute to a better understanding of Antarctica's influence on the world's climate and environmental systems. A major task that covers almost all fields of science and engages the roughly 200 Swedish scientists involved in polar research. The research is not possible to conduct elsewhere than in the polar areas.

### **What impacts have been identified?**

Direct, indirect and cumulative impacts of the proposed activity have been considered. DML 2009/10 will have at most a minor or transitory impact on the environment as a consequence of:

***Emissions to air*** of exhaust fumes and particles from combustion engines. The associated impacts are increased concentrations of greenhouse gases and aerosols in the atmosphere, contributing to human induced climate change as well as altering the physical and chemical properties of the local environment. However, monitoring show that local impact is very low and emissions to air are expected to be transitory and dissipate as negligible concentrations.

***Grey-water from Wasa is discharged without treatment*** through a pipeline to an ice covered area in the vicinity of the station. The untreated grey water cause adverse effects to the receiving environment and impacts are considered to be minor or transitory. The water saving policy in force at Wasa limits the amount of grey water generated and decreases the environmental effects.

***Damage to vegetation cover*** might occur due to traffic in vicinity of the stations, or due to essential logistical transports on Nordenskjöld Basen. SWEDARP has a general restriction regarding pedestrian traffic in vegetated areas, and driving on bare ground is banned. Furthermore, no unique species have been registered in the area, and consequences are not considered to be significant. Monitoring indicates that no change can be attributed to human activities in lichens or mosses species abundance or composition.

***Accidental spills*** may be expected when handling fuel and hazardous chemicals resulting in contamination of the ground. Monitoring at Wasa shows that the main source of spills comes from fuel. Spills have so far been small and are very locally defined. Quantity of accidental spills is likely to be very limited and locally defined, associated impacts are therefore considered to be minor.

***Physical environment has been changed*** due to the presence of buildings, camps, depots and other facilities such as scientific monitoring equipment. Human presence in the area and the introduced changes in the natural envi-



ronment result in that the area is not longer considered as wilderness. The SWEDARP policy is that if stations are removed, the area is expected to return to its natural state. But as long as the station facilities exist, the impacts on the physical environment are considered to be minor or transitory.

### **What is likely to be the most significant impact of the activity?**

In the context of the Swedish Polar Research Secretariat's environmental management, all environmental impacts resulting from our activities in the Antarctic are considered to be significant, reflecting the susceptibility of the environment to human impacts. However, without human presence there will be no new knowledge of the Antarctica that can help to shed light on process that lies behind the global change in the environment.

### **What cumulative impacts could arise from this expedition?**

Since the season 1991/92 an environmental monitoring programme has been carried out in order to assess the impacts from human activities in the area. The results from the environmental monitoring programme have so far shown that the impacts from human activities have been minor. In the vicinity of the stations, treading might affect the lichen flora, while smaller fuel and wastewater spills and some lost waste may have an impact at certain well-defined spots. These impacts are inevitable and reoccurring with every expedition. The known cumulative environmental impacts are considered to be acceptable.

### **Are there gaps of information or other limitations in the IEE?**

Current understanding of many aspects of Antarctic biology and ecology is poor. The identification and classification of Antarctic species, especially invertebrates and microorganisms, is at a rudimentary stage. Information on the status and trends of Antarctic fauna and flora is fragmentary at best. On the other hand, many years of operation in the area has given SWEDARP a relative intimate understanding and knowledge of the area, which provides a base for the assessment.

### **What mitigations are used to reduce environmental impacts?**

SWEDARP act simultaneously as developer, planner, operator and manager, of polar research expeditions. This creates good opportunities to minimise the environmental impact of the expedition throughout the entire chain. Swedish Polar Research Secretariat has always have had a high environmental profile, and based on earlier expeditions, environmental management has been integrated in the regular work during expeditions.

Actions that will be taken to mitigate impacts from this expedition are described in the "*Field Course Handbook*" as well as the "*Nordic Environmental Handbook – Antarctic operations*" (NEH). See appendix 1 for SWEDARP's environmental code and mitigation measures. High-quality station practices and standardised routines make a good environmental performance possible.



### **What alternatives are there to the expedition that can give the same result but a reduced environmental impact?**

The largest contribution to environmental outputs and associated impacts are related to the physical presence in Antarctica. If researchers participated in other national expeditions, associated logistic and scientific impacts would basically be shunted to those programmes.

Also, technology and working conditions in Antarctica are limited due to the extreme conditions. Highest priority is given to safety and reliability. Thus, it is difficult to come up with a realistic alternative that might give the same result but with a reduced impact.



## 2. INTRODUCTION

### 2.1 Background and scientific purpose

Swedish polar research covers both the Arctic and the Antarctic and includes all fields of science with an emphasis on research related to climate and the environment. Participation in international science programs as well as international collaboration on logistics and other operational matters receive high priority.

For geographical reasons Sweden has always had a strong interest in the Arctic. During recent years several expeditions into the Arctic basin have been undertaken in addition to work on the Eurasian and North American Arctic. The Swedish Polar Research Secretariat was established in 1984. It is a governmental agency with the responsibility to organize polar research expeditions and to coordinate Swedish polar research.

Sweden became a consultative party to the Antarctic Treaty in 1988. The Antarctic program has its geographical focus on Dronning Maud Land where Sweden has two summer stations Wasa (in Vestfjella) and Svea (in the Heimefront Range).

Swedish scientists in collaboration with scientists from other countries active in the Antarctica:

- OSO - Oden Southern Ocean on marine research in collaboration with the USA
- AMANDA/Ice-cube - South Pole on astrophysics in collaboration with the USA
- Lashipa 8 - Large Scale Historical Exploitation of Polar Activities, to Signy Island, South Orkney on documentation the remains of an early 20<sup>th</sup> century whaling station in collaboration with the Netherlands.
- Expedition 4 2009/2010 in the Southern Ocean on Peat sampling on Macquaire Island to investigate atmospheric deposition of mineral matter during Holocene, in collaboration with Australia. The project will also be studying the influx of cosmic dust at the Antarctic continent around Davis station.

During the 2009/10 Antarctic season, for the Swedish Antarctic Research Programme (SWEDARP 2009/10) is engaged in the following programmes:

- DML 2009/10 - Logistic work in the area around Wasa and Svea
- Prevalence of antibiotic resistant enterobacteriace in different bird populations in Antarctica – Sampling of antibiotic resistant enterobacteriace from birds in the areas of South Shetland Islands and South Orkney Islands



- MARA 2009/10 - Movable Atmospheric Radar for Antarctica in the area around Wasa and Aboa station
- AMANDA/Ice-cube project - at the South Pole, particle physics
- OSO 2009/10 - Oden Southern Ocean - a marine research expedition in the area of the Ross Sea, the Amundsen Sea and the Bellingshausen sea
- DROMLAN - Air transport to/from Dronning Maud Land

### **DML 2009/10**

DML - Droning Maud Land which will have 5 members, will last from 27<sup>th</sup> November 2009 – 3<sup>rd</sup> February 2010. Transport to and from Wasa will be by aeroplane. The expedition will mostly be carried out in the area of Wasa station but also a couple of days visit to Svea station is planned. This year's expedition has a logistic focus and concentrates on repairing, restoring and overhauling the vehicles from last year's expedition JASE 2007/08 and maintenance of the stations Wasa and Svea. The expedition will use tracked vehicles and snowmobiles for transportation between Wasa and Svea.

### **Prevalence of antibiotic resistant enterobacteriace in different bird populations in Antarctica**

Bacteria display a unique ability to adapt to changes in their environment and to develop mechanisms to protect themselves against toxic compounds. Their ability to develop resistance mechanisms to antimicrobial agents has, from a human health perspective, assumed catastrophic proportions, rendering more and more infections that are difficult or impossible to treat. Most reports suggest that the main force behind emergence of drug resistance is the use, misuse, and abuse of antimicrobial agents during the past decades, but there is also evidence that epidemic spread of drug-resistant bacteria could be a contributing factor.

We must not only look at the use of antibiotics in human and veterinary medicine but must also look outside to see how bacterial resistance is transferred within the environmental reservoirs. At present our knowledge on the environmental effects of antibiotic usage is minute and we need to find means to explore this area. Birds are emerging as an important tool in this, serving as bio-indicators of how resistance is transferred between wild and domestic animals, and humans. Due to their diversity in migratory patterns and occupying different ecological niches, and their ease to pick up human/environmental bacteria, they act as mirrors of human activities.

To explore the role of the environment as a reservoir of resistance genes and if migrating birds are contributing to the spread of antibiotic resistance we try to focus on bird populations that migrates between areas with high and low levels of antibiotic resistance. To day Antarctica is one of the few places on earth with low human impact and thus very suitable for performing such studies.

### MARA 2009/10

MARA - Moveable Atmospheric Radar for Antarctica. Professor Sheila Kirkwood from the Atmospheric Physics group at Swedish Institute of Space Physics (IRF) set up MARA at Nordenskiöldbasen during SWEDARP 2006/07. The science addressed with the radar includes

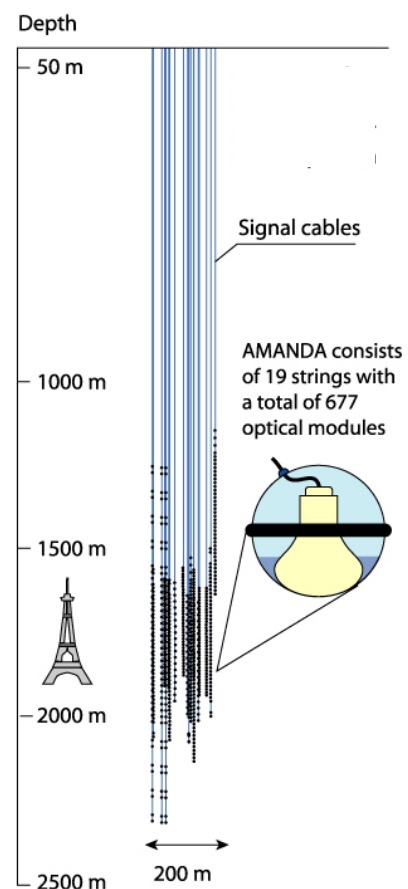
- Understanding processes related to aerosol-particles and waves in the polar middle atmosphere by testing theories based on measurements in the Arctic against observations in the distinctly different conditions over Antarctica.
- Understanding the origin and development of tropospheric aerosol particles in the 'clean' air of the Antarctic in comparison with the polluted air of the Arctic. The radar will contribute to accurate back-trajectory calculations for aerosol particles arriving at the measuring site, which are studied by scientists from the Finnish meteorological Institute.
- Improving understanding of the meteorological disturbances which determine weather conditions at Nordenskiöldbasen and neighbouring Antarctic stations.

More information on the project is available at:

[http://www.irf.se/program/afp/?dbfile=MARA\\_AFP\\_IRF2&dbsec=IPY](http://www.irf.se/program/afp/?dbfile=MARA_AFP_IRF2&dbsec=IPY)

**AMANDA** (Antarctic Muon And Neutrino Detection Array) and Ice Cube project is joint project between US, UK, Sweden, Germany, Belgium and Venezuela, that investigates the particle nature of dark matter in space. This is done by a series of neutrino detectors deployed to long strings in the ice sheet at the South Pole at depths between 1.5 and 2.4 km see figure 1. The detectors are put into holes with a diameter of about 50 cm, which are drilled using hot water. The muon travel faster than light in the ice producing a shock wave of light. This light is detected, and the trace of the neutrinos can be reconstructed with an accuracy of a couple of degrees. Thus the direction of the incoming neutrino and hence the location of the neutrino source can be pinpointed. Currently 19 strings with a total of almost 700 light detectors have been lowered in the ice.

Right now the construction of IceCube is being planned. IceCube will have a volume of a cubic kilometre, and about 4800 detectors. The first IceCube strings will be deployed in January 2005.



**Figure 1.** Overview of AMANDA with the Eiffel tower for comparison.

### OSO 2009/10

OSO - Oden Southern Ocean 2009/10 is a marine research expedition in the Southern Ocean during the austral summer of 2009/10 (February-March 2010). The cruise, with the Swedish icebreaker Oden as a platform, is jointly planned and carried out by the National Science Foundation Office of Polar Programs (NSF/OPP) and the Swedish Polar Research Secretariat (SPRS). The primary cruise track will go from McMurdo Sound, Antarctica across the Drake Passage towards South America. At the Marginal Ice Zone the ship will follow the ice edge through Ross Sea polynya and Amundsen Sea, and then Bellingshausen Sea to Punta Arenas, Chile.

The primary mission of the Oden is to lead the annual break-in of the McMurdo Ship Channel in the Ross Sea. In addition to the transit from the McMurdo Sound Ice Edge, Ross Sea towards Punta Arenas in Chile the NSF/OPP and SPRS will be providing dedicated science days for transects or stations. The total number of participants will be around 30 and the total number of crew will be 23. The scientific objective of the cruise will be to collect a range of data in sectors of the Antarctic seas that are rarely visited and data-poor.

**DROMLAN** (Dronning Maud Land Air Network) is the logistic hub that provides air transportation to/from and within Dronning Maud Land to any member country of the Committee of Managers of National Antarctic Programs (COMNAP) in science related activities, see figure 2.



**Figure 2.** Map showing Dronning Maud Land Air Network operating area and the location of the Swedish research stations Wasa and Svea.



## 2.2 Scope of the initial environmental evaluation

The scope of this initial environmental evaluation is the logistic work carried out within DML 2009/10.

A preliminary assessment of environmental impacts of MARA is done by SPRS with the conclusion that the environmental impacts are likely to be less than minor or transitory.

A preliminary assessment of environmental impact of Prevalence of antibiotic resistant enterobacteriace in different bird populations in Antarctica is done by SPRS with the conclusion that the environmental impact are likely to be less than minor or transitory, since there only will be swabbing of faecal droppings from birds and seals on the ground.

The Initial Environmental Evaluation of OSO 2009/10 is the responsibility of Sweden, SPRS but will not comprise part of this initial environmental evaluation.

The environmental evaluation process of the Lashipa 8 project is the responsibility of the Netherlands and will not comprise part of this initial environmental evaluation.

The environmental evaluation process of the Expedition 4 2009/2010 project is the responsibility of Australia and will not comprise part of this initial environmental evaluation.

The environmental evaluation process of the AMANDA project is the responsibility of the United States, and will not comprise part of this initial environmental evaluation.

Transport to and from Antarctica and within Dronning Maud Land will be arranged within the co-operation of DROMLAN. Organiser of and responsible operator for the planned flights performed by ALCI is the Russian and South African company INTAARI. The environmental evaluation process of the aircraft transportations is the responsibility of INTAARI, and will not comprise part of this initial environmental evaluation.

### 3. DESCRIPTION OF THE EXPEDITION

#### 3.1 Dronning Maud Land 2009/10

The expedition, which will have five logistic members, will last from 27<sup>th</sup> of October 2009 – 3<sup>rd</sup> of February 2010. Two people within the MARA (the atmosphere physics) programme will also be staying during a part of the expedition and run their programme, they will arrive to Wasa by air the 30<sup>th</sup> of November and leave Antarctica the 3<sup>rd</sup> of February.

The expedition has its focus on maintenance, inventory and minor improvements on the stations Svea and Wasa with surroundings as upgrading the VHS repeater at the nearby nunatak Plogen, overhauling the vehicles from last years traverse JASE 2007/08 and supporting the scientific group MARA. There will also be a joint airdrop with fuel and spare parts to the finish station Aboa and Wasa. Preparing a landing strip and collect the fuel and goods for transport to the station is also a major task.

The expedition will mainly be carried out in the area of Wasa station but does also include a visit to Svea station, figure 3.



*Figure 3. Pictures of the Swedish research stations Wasa (left) and Svea (right).*

The first team of 4 people will fly on the 3<sup>rd</sup> of November from Cape Town to the Novolazarevskaya runway (Novo). The team will wait on the airbase until a feeder flight can take them to Wasa. The logistic team starts up Wasa on arrival.

The second team of 2 scientists and 1 logistician flies from Cape Town to Novo on the 26<sup>th</sup> of November. During the stay a logistic team of 5 persons will also go to Svea, using tracked vehicles (Hägglund TL4/TL6) to perform maintenance of the station.

The logistic group returns to Wasa after approximately six days. The logistic team closes Wasa and flies out from the station around the 1<sup>st</sup> of February. All members of the expedition will leave Antarctica on the 3<sup>rd</sup> of February.



### 3.2 Organisation and legal framework

The expedition leader for DML 2009/10 is employed by the Swedish Polar Research Secretariat. The expedition leader has the overall responsibility to coordinate the expedition, ensuring that the expedition and related activities are in compliance with the *Antarctic Treaty System*. The legal framework is presented in the “*Nordic Environmental Handbook – Antarctic operations*” (NEH). All expedition- and project leaders must be familiar with the contents of NEH, and all expeditioners must be aware of existing station routines and guidelines presented in the “*Field course handbook*” and NEH.

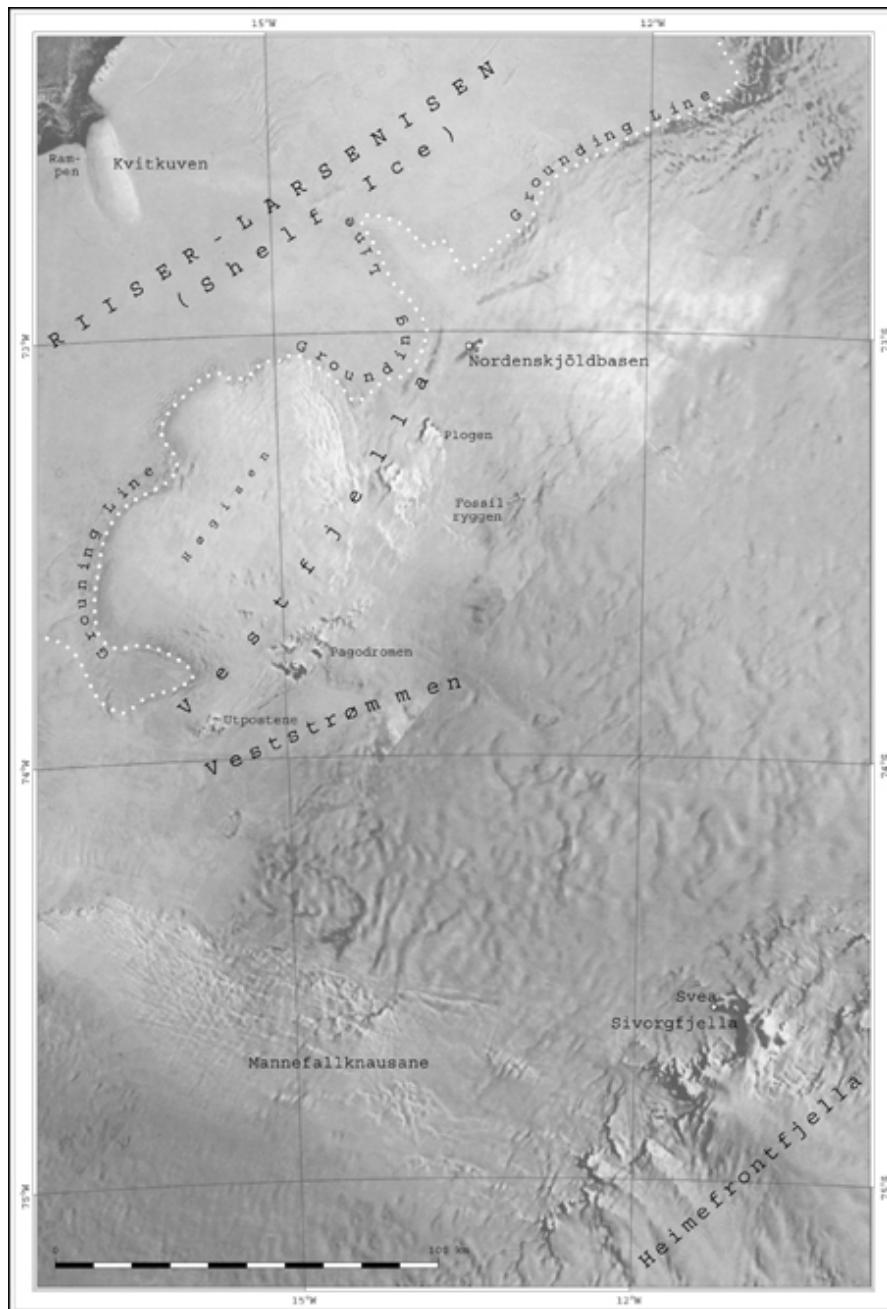
### 3.3 Areas visited

DML 2009/10 will mainly visit the following areas;

**Wasa:** At the nunatakk Nordenskjöld Basen (73°03'S, 13°25'W)

**Svea:** At the nunatakk in Heimefrontfjella (74°34'S, 11°13'W)

In addition to the above-mentioned areas, the ice-covered areas lying between Wasa and Svea will be visited during transit between the stations, figure 4.



*Figure 4. Map showing surrounding areas of Vestfjella and Heimefrontfjella.*

### 3.4 Site description of Wasa and Svea

The Swedish summer station Wasa is located approximately 120 km from the ice edge. The main building is approx 130 m<sup>2</sup>. It's made of wood and it rests on 1.5-m high poles in order to avoid the accumulation of blowing snow. Close to the station house is the generator house. The building contains generators, the water supply system, and a workshop. As winter storage for the tracked vehicles, four 40-foot containers are used and another four 20-foot containers are used for storage of food, chemicals and scientific and logistic equipment.

The macro fauna at Basen is limited to birds. Four species have been observed, see figure 5; the snow petrel *Pagodroma nivea*, south polar skua *Catharacta maccormicki*, wilson's storm-petrel *Oceanites oceanicus* and Antarctic petrel *Thalassoica antarctica*. There is a snow petrel nesting area located on the precipice on the western part of Basen, about one kilometre from the station area. The number of breeding snow petrel was estimated to 100 pairs in 1991/92. No nesting birds have been observed on Fossilryggen.



**Figure 5.** Birds that have been observed at Wasa and Svea

The flora in the Vestfjella consists of 23 lichen species, seven lichenicolous fungi and three mosses. In order to monitor human impact of activities in Vestfjella and Heimefrontfjella permanent plots were established in 1991/92 to study changes in lichens and mosses. Repeated monitoring in 2001/02 found an increase in both mean species number and abundance per sample plot. No relation between supposed change and human activities has been found.

Microfauna have been investigated and are mostly found to inhabit soil material, mosses and lichen. Four species of nematods, sixteen species of rotifers and seven species of tardigrades have been extracted from the samples. Specimens of the genus *Plectus* are the most common nematodes. One of the nematodes, *Panagrolaimus magnivulvatus* was described as a new species.

Svea station was built 1987/88 and was the first Swedish research station in Antarctica (since Maudheim 1949 and Snow Hill station 1901). Svea is located at the Heimefrontfjella about 300 km from the coast. Svea consists of two fiberglass huts put together. There are approximately 200-500 breeding pairs of snow petrel in the vicinity of Svea. In addition, there are south polar skuas in the area, probably nesting in the surroundings, but no breeding pair has been observed.

### 3.5 Education and training

All expedition participants has a previous year taken part in a one-week induction training at the Swedish research station Tarfala, under Antarctic-like conditions (see figure 6) including basic environmental education based upon the contents of the NEH the "*Field Course Handbook*". Environmental guidelines are found in Appendix 1. A summarized version of the guidelines is found in the "*Pocket Book*".

Participants undergo training on various aspects of environmental management and contingency plans while in Cape Town and at the research stations in Dronning Maud Land. In addition, at the beginning of the season the expedition leader organizes instruction at the station on environmental management e.g. waste handling and fuel management.



*Figure 6. Expeditioners practicing glacier safety and rope technique in Tarfala.*



## 4. ENVIRONMENTAL IMPACT ASSESSMENT

Within SWEDARP, Sweden is responsible for the environmental impact for the terrestrial research expedition DML 2009/10. The procedure follows to a large extent COMNAP's "*Guidelines for Environmental Impact Assessment in Antarctica*". The impact identification and evaluation process is not presented in this document, but can be obtained upon request from the environmental officer at the Swedish Polar Research Secretariat.

### 4.1 Impacts identification and evaluation from logistic activities

The logistic issues for DML 2009/10 cover ground transport, accommodation, storage of fuel and hazardous substances, maintenance of the stations and equipments, supply of power and water etc. The basic information below is collected from personnel at the Logistics Centre at the Swedish Polar Research Secretariat.

#### 4.1.1 Station facilities

Operation of the research stations Wasa and Svea is considered essential in order to have a base for Swedish research activities in Antarctica. Wasa station is the logistical hub for SWEDARP's expeditions to Dronning Maud Land. Main functions include accommodation, supply storage and maintenance of equipment. Wasa station is also essential for safety purposes where the medical equipment and facilities are located.

Both Wasa and Svea will be manned during this year's expedition. Requirements that have to be covered by the stations during DML 2009/10 are equivalent to 273 person days at Wasa, 25 person days at Svea and 20 person days in the field for the logistics people. The two MARA scientists will stay at Wasa for 66 person days.

The procedures of the stations operations has to be followed in order to minimise environmental impacts as well as for occupational health and safety reasons. The routines are described in the NEH, see also the summary environmental guidelines in Appendix 1.

Water supply of Wasa station is based on transporting melt-water from a nearby blue-ice area located approximately 1,5 km away from the station buildings.



#### 4.1.2 Ground transportation

Snowmobiles (Yamaha Viking I and II) running on unleaded petrol and tracked vehicles (Hägglund TL4/TL6) running on Jet A-1 will be used. Vehicular transport will produce exhaust fumes that contributes to air pollution. Air in the local area around combustion engines will be exposed to exhaust emission.

Monitoring of pollutants in snow and ice show that hitherto human impact from exhaust fumes has been low and very local. Based on the findings from analyse of snow and ice, exhaust emissions from combustion of fuel during DML 2009/10 are not expected to adversely impact the environment or human health. Emissions to air are expected to be transitory and dissipate as negligible concentrations around the stations and along traverse routes.

However, the release of greenhouse gases and aerosols to the atmosphere from usage of fossil fuels is one of the main environmental impacts resulting from the Swedish Polar Research Secretariat activities. In this context, releases of air emissions from combusting engines are considered to have a minor impact on the environment.

Vehicular transport will produce noise as well as tracks that might persist for some years in snow and on bare ground. Tracks impact snow/ice surface temporarily, although due to the low level of activity and the type of disturbance, environmental impact from vehicle tracks are considered insignificant. Driving on bare ground is banned, with the possible exception of vital logistical transports at the Wasa station "court yard".

Walking on foot is the most common transportation at Nordenskjöld Basen. There are two areas sensitive to disturbance, both located on the precipice on the western part of Basen. One is a permanently protected area with rich growth of lichens and mosses. Expeditioners must have the expedition leader's permission to visit this area. The other is the bird nesting area. Since birds do not nest on exactly the same spots every year, all participants must be extra careful at the beginning of the expedition before the nesting areas are located. For each expedition, the expedition leader will inform in which areas vehicle driving and in which all visits are prohibited due to nesting birds.

The areas on Basen not sensitive to disturbance may be visited on foot. Although these areas may be visited they are susceptible to wear, hence normal caution should be shown here. Outside of the station area, you are not allowed to walk on lichens and mosses. The only exceptions are the marked squares around Wasa and Svea, which act as monitoring areas of extra wear due to human presence.

#### 4.1.3 Fuel management

During operations every effort is made to prevent accidental oil spills through careful attention to fuel management and transfer operations, and by maintain-



ing storage facilities to a high standard. Emphasis on prevention of any spills or leaks is given in all operations. The Oil Spill Contingency Plan describes procedures to be used in the event of oil spills. Any spill that might occur is considered as serious and every effort will be done in order to minimise the environmental impact as far as possible.

Refuelling of vehicles will be performed according to the guidelines in the NEH. Some emission to ground from small fuel-spills might be expected. An investigation was made in 2001/02 regarding contamination of heavy metals and petroleum hydrocarbons in soil and grey water. Samples were analysed for presence of fuel components such as aliphatic hydrocarbons, aromatic hydrocarbons, specifically BTEX (benzene, toluene, ethylbenzene and xylene) and 16 PAH (polycyclic aromatic hydrocarbons), as well as heavy metals, organic carbon and nutrients. Results showed that the levels of soil contamination are comparable to other Antarctic research stations. The spills were in a few relatively small and rather well defined areas. Antarctic investigations show that fuel spills are persistent over time. Hence, impacts from fuel spillage are considered as significant even though they are very locally defined and small.

An overall conclusion based on the investigation of soil contamination is that the storage and handling of fuel is the predominant cause of contamination of soil and that any further preventive actions should be focused on this area. Fuel drums (Jet A1 and petrol) are stored outdoors on wooden-floored platform and on tracked vehicle sledges at Wasa station.

At Svea station fuel drums are stored in the vicinity of the station. During fieldwork, fuel will be brought on sledges. LPG (Liquefied petroleum gas) is stored at Wasa in 1 x 190 kg bottle of steel close to the generator building. At Svea, LPG is stored in 2 x 11 kg bottles.

Estimated fuel consumption for the expedition is presented in table 2. Resulting CO<sub>2</sub>-emission is estimated<sup>1</sup> to about 6.3 tonnes. These numbers are based on combustion under perfect conditions. In Antarctica combustion is not total, hence resulting CO<sub>2</sub>-emission will actually be less.

**Table 2.** *Estimated fuel consumption for ground transportation during DML 2009/10*

Type of fuel and usage	Estimated fuel consumption	Maximum estimated CO <sub>2</sub> emissions
<b>Jet A1</b>		
Tracked vehicles	10 drums á 200 l (2 000 l)	4720 kg
<b>Petrol (unleaded)</b>		
Snow mobiles	2 drums á 200 l (400 l)	944 kg
<b>LPG</b>		
Wasa and Svea	4 bottle á 48 kg (190 kg)	568 kg

<sup>1</sup> One liter Jet Gasoline equals to 2,36 kg of CO<sub>2</sub> and one kg LPG equals to 2,99 kg of CO<sub>2</sub> (Source: EPA, Sweden)



#### 4.1.4 Energy management

When Wasa station was constructed it was part of a building research programme in cold climates. The station is therefore designed to be highly energy efficient. A heat exchange system circulates heat from one part of the building to another.

Overall energy requirements for Wasa station are heated volume: 288 m<sup>3</sup> and heated floor space: 120 m<sup>2</sup>. The heaters, stove, refrigerators, hot water and sauna are run by LPG Gas. Solar panels have been installed, computers and minor electrical units are run by solar energy. In total there are 48 solar panels with an area of 20.6 m<sup>2</sup>. Each panel has an output of 55W (12V), the total output varies between 1.76 kW (12V) during day and 0.88 kW (12V) during night. Ni/Cd-batteries are charged from the solar panels and stored underneath the main building. The solar panels and battery pack cover approximately 95% of the energy usage from the electrical equipment.

There are also two diesel generators but they have not been regularly used since 1996, following the renovation of the energy system. The diesel generators are needed only in bad weather conditions. During the season 2001/02 only 130 kg LPG per month was used to provide energy for the whole station compared to 2095 litres of diesel per month used in the 1991/92 season.

Students of The Royal Institute of Technology in Stockholm (KTH) and Uppsala University have carried out a feasibility study on alternative energy sources and a study on wind turbines at the station for future upgrading of the power supply. Power and heat generation is considered to have less than minor or transitory impacts on the environment.

#### 4.1.5 Chemical management

In total 55 different chemicals are stored at the premises of the station. This number covers all the lubricants and anti-freezers used for logistic equipments, 9 different types of motor oil, 4 types of transmission oils, 7 types of 2-stroke oils, 4 types of automatic transmission oils, 4 anti-freezers etc. Absorption material is always available at the stations, for taking care of possible leaks of environmentally hazardous liquids.

Storage and monitoring arrangements of hazardous chemicals are advanced at the Wasa station. Acid and lye for the batteries are stored in plastic, 25-liter containers, separated from each other. Lubricants, fluids etc. are stored in a container for this purpose. A database for monitoring the use of chemicals is currently under design and the general policy applied at the station is to systematically substitute hazardous substances with less hazardous ones.

Due to relatively small expeditions during a limited time period, the number and quantity of chemicals handled is very limited. Environmental impacts from chemical usage and management are not considered to be significant.



#### 4.1.6 Waste and sewage management

The "*Antarctic Waste Management Handbook*", which is an inherent part of the NEH, provides guidelines for waste management plans of Nordic expeditions in Antarctica and is thus also used as a basis planning individual expeditions and operations organised by SWEDARP.

The key element of the waste management policy at Wasa station is to minimize generation of waste. The chain of order for the material brought to Wasa is; reduce, reuse, recycle and return. Expedition members receive instruction in waste management during their induction training. Waste, sewage and spilled fuel and oil are to be separated and collected in empty fuel drums. Waste from Svea and the field will be brought back to Wasa. The waste will be safely stored and retrograded at a later time.

To minimize environmental impact on the receiving waters, dry toilet systems are used where the freeze-dried residue is transported back to South Africa by ship. Sewage from Svea or field trips will be collected and transported to Wasa.

Minor releases of other materials to the environment are expected to happen occasionally. Some littering may be expected due to extreme weather conditions. These kind of accidental releases, as well as the unrecoverable loss of equipment, or the dispersal and loss of materials and wastes due to high winds are not planned, their frequency, magnitude, and composition can therefore not be projected in advance. Yearly efforts are being made to pick up debris lying around the station.

Materials and paint e.g. used as site markers in the scientific programmes, or other material that cannot be practically retrieved may result in an impact on the ground surface. Such markers will result in a minor, temporary alteration of the environment and their impact is expected to be negligible.

A wastewater treatment system was installed at Wasa in 1991/92 but decommissioned in 1996, as it did not function properly. Hence, the grey water generated at Wasa is not treated by any means but discharged through a pipeline to an ice covered area in the vicinity of the station from where it ultimately drains to the sea. Grey water contains remains of soap, detergents from laundry and washing, as well as organic matter (food particles). At Svea, untreated grey-water is discharged onto a glacier close to the station. Untreated grey water might cause adverse effects to the receiving environment and is considered to have a minor or transitory impact upon receiving environment. The water saving policy in force at Wasa limits the amount of grey water generated and may decrease possible adverse environmental effects.

An inspection Team from Finland visited Wasa in February 2004. They noted that the station could pay more attention to the treatment of the wastewater from an environmental point of view.



## 4.2 Impact identification and evaluation from scientific activities

This part of the environmental evaluation deals with the scientific programmes for DML 2009/10. The evaluation does not include transportation, etc., that rightly belongs to logistics. The assessment is based on information obtained from the project leader. The evaluation indicates that at most *minor or transitory impact* will result from planned scientific activities. Therefore, from an environmental point of view, there are no reasons not to perform the scientific projects.

The zero alternatives imply that no scientific activities will be carried out. It is considered to entail no additional consequences for the environment, as opposed to a situation when the areas are visited.

### 4.2.1 Bdelloid rotifers from Antarctica

**Project leader:** Diego Fontaneto, Department of Invertebrate Zoology, The Swedish Museum of Natural History

**Project title:** Bdelloid rotifers from Antarctica

#### **Project description**

Bdelloid rotifers are considered cosmopolitan animals. They are microscopic animals living in water, but they are able to disperse easily with the wind in a desiccated stage, and recover quickly to life when reach water again. Thus, it is possible to find the same species everywhere, in our own backgarden and in a remote place at the far distant side of the world. But there is one exception: Antarctica. That is the only place where endemic bdelloids are known. Some species have been found there, and only there. Species living in the high arctic are found also at high altitudes for example in the Alps, Hymalaia and Andes, but many Antarctic species seem to live only there. If this is the case, why are there other species which live both in Antarctica and also in the rest of the world? Are they really the same species, or it is simply that traditional taxonomy is not able to tell them apart? I will test this idea using statistical methods for species identification from molecular genetic markers from individuals of the same putative species collected in Antarctica and in other geographic areas. The results of the analysis will either provide further support for the uniqueness of Antarctic bdelloids, or suggest that some bdelloids are able to move to and from Antarctica. Then the following question will be why not all of them can do that...



### Sampling procedure

The procedure to collect samples to obtain bdelloid rotifers is rather easy:

- 1 Cut about 5-10 square cm of moss or of lichen from the substrate
- 2 Let them dry overnight on paper, if they are not already dry
- 3 Put each sample in a paper envelope, close it and write info on place, date, coordinate, substrate, and any other information regarding the sample
- 4 Store the paper envelopes in paper bags in a dry and cold place to avoid fungi to grow.

The animals we are looking for, bdelloid rotifers, live in water but survive long periods of desiccation, so it is easy to recover them in the lab by simply adding some water to the desiccated sample. In the same way, small samples of soil can be collected and stored in the paper envelopes. These samples will be less easy to deal with, as densities of rotifers in soil are generally low, but maybe they will provide interesting results. As this is only a preliminary project, up to 30 samples of mosses, 30 samples of lichens, and 15 samples of soil will do fine. Samples could be collected in three different sampling sites (10 mosses, 10 lichens and 5 soil samples each).

### Geographical areas

In the vicinity of Wasa and Svea stations.

### Environmental impact

Sampling of mosses, lichens and soil will be made with great care and only a small amount of each sample will be collected at each site. The sampling is considered to have *minor or transitory impact*.

## 4.3 Cumulative impacts

The area around Heimefrontfjella and Vestfjella is a pristine and untouched area, with the exception of the impact created by the Swedish and Finnish station facilities (Wasa, Aboa and Svea). Activities in the areas during the 1960s and 1970s consisted mainly of sporadic visits to the Heimefrontfjella area by glaciologists and geologists, mainly from England and Germany. Some records from this period have been collected. During the 1980s sporadic visits continued, such as the Norwegian expedition to Heimefrontfjella and Vestfjella in 1984/85.

During the 1987/88 season Svea station was established and in 1988/89 Wasa station was set up. During this expedition fairly extensive building work was performed, which among other things led to relatively numerous helicopter flights. Thereafter these areas have been visited by SWEDARP expeditions during 1989 to 2008. Most of the expeditions' activities have been carried out on snow- and ice-covered ground. The cumulative effect of these almost yearly visits has been slight, producing at most minor or transitory impacts on the environment.



Since the season 1991/92 an environmental monitoring programme has been carried out in order to assess the impacts from human activities in the area. The results from the environmental monitoring programme have so far shown that the impact from human activities is considered to be minor or transitory. In the vicinity of the stations, treading has affected the lichen flora, while smaller fuel and wastewater spills and some lost waste may have had an impact at certain well-defined spots. These inevitable impacts are reoccurring with every expedition. The cumulative impacts at Wasa are considered acceptable.

The installation of the Finnish automatic weather station during DML 2003/04 resulted in tracks from the tracked vehicle was made on the ground. The tracks has destroyed the top active layer in the ground moraine on Basen, a structure having being shaped by permafrost over thousands of year. It is very unique with soil on nunatakks, since most of the Antarctic nunatakks are made of rock outcrop. With two nearby stations, it is needed to take further mitigations to protect the ground area in the future.

Due to increased activities, more facilities have been added to Wasa and Svea since their construction and the station footprint area has continuously increased. Wilderness and aesthetic values are affected when new elements are introduced into the surrounding environment. Human presence in the area and the introduced changes in the natural environment result in that the area is not longer considered as wilderness. Often a larger zone (5 km) surrounding an impacted area is no longer defined wilderness. However, since this is an area that is already affected by ongoing activity, the cumulative impact is expected to be quite limited.

The physical environment has been changed due to the presence of buildings, camps, depots and other facilities such as scientific monitoring equipment. Human presence in the area and the introduced changes in the natural environment result in that the area is not longer considered as wilderness. Often a larger zone (5 km) surrounding an impacted area is no longer defined wilderness. Also, changes to physical environment by including human elements into natural landscape may change the emotional experience for visitors. However, as in the case of SWEDARP visitors in the area so far have only been associated with research expeditions, and thus, will normally expect the presence of human elements in the landscape. The ambition for SWEDARP is that if the stations are removed, the area is expected to return to its natural state, but as long as the station facilities exists, the impacts are considered to be minor or transitory.

As a conclusion, cumulative effects from yearly visits to Dronning Maud Land from Swedish expeditions are considered to be at most minor or transitory. However, a strategic environmental assessment for the whole Dronning Maud Land would be valuable for future assessments.



#### 4.4 **Alternative areas**

There are no relevant alternatives to the chosen areas.

#### 4.5 **The zero alternative**

The zero alternatives imply that no activities will be carried out. It is considered to entail no additional consequences for the environment, as opposed to a situation when the areas are visited. This situation, however, will deprive scientist of an important logistical framework, which is necessary in order for them to carry out their research.

#### 4.6 **Monitoring**

In the season 1991/92 an environmental monitoring programme was established in accordance with Protocol on Environmental Protection of the Antarctic Treaty. The programme is an environmental management tool with the objective to minimize human impacts from Swedish activities in the Antarctic Treaty area including a system to:

- Establish the present status of key values and resources
- Verify effectiveness of predicting impacts through the EIA process
- Detect unforeseen effects

Key environmental values identified for the stations surroundings are:

- Flora
- Fauna
- Freshwater environment
- Soil
- Snow and Ice
- Air
- Wilderness
- Aesthetic values

The main focus for the monitoring programme is pollution levels in snow/ice and soil, lichen and micro fauna studies and station footprint area. The main environmental impacts detected so far have been fuel spills, grey-water discharge and station footprint area.

#### 4.7 **Gaps of information and other uncertainties**

Current understanding of many aspects of Antarctic biology and ecology is poor. The identification and classification of Antarctic species, especially invertebrates and microorganisms, is at a rudimentary stage. Ecological processes that govern life in Antarctic soils, in the Southern Ocean, and at the ice edge are only beginning to be understood. Information on the status and trends of Antarctic fauna and flora is fragmentary at best. More research and monitoring are required to track trends in basic environmental parameters in the Antarctic. Access to and logistics in remote Antarctic areas are a major challenge to researchers. New techniques, including remote sensing, and further studies will shed light on these critical areas.



Knowledge of the synergies and interlinkages present in the natural environment will never be sufficient to accurately predict the exact impacts of a project. Simplified assumptions are structural errors that occur through the use of models that simplify environmental systems by eliminating variables that are viewed as less important. By simplifying a problem, the likelihood of making an accurate prediction increases, but also makes it less precise. Given the complex synergies and interlinkages inherent to the natural world, it is impossible not to simplify the assumptions made in an initial environmental evaluation.

The limits of current knowledge and methodology of evaluation process must be recognized before potentially harmful development is undertaken. This circumstance contributes to uncertainties regarding the assessment. We must tread carefully where the consequences of our actions cannot be foreseen. On the other hand, many years of operation in the area has given SWEDARP a relative intimate understanding and knowledge of the area, which provides a base for the assessment.

#### **4.8 Conclusion**

The initial environmental evaluation indicates that unavoidable environmental impacts from DML 2009/10 associated with scientific activities are considered to be less than minor or transitory. At most minor or transitory impact will result from the logistic activities or from cumulative impacts.

Thus, from an environmental point of view there are no reasons not to perform DML 2009/10, assuming that the expedition is conducted within the framework described in this IEE.



## APPENDIX I – NEH ENVIRONMENTAL GUIDELINES

### - Environmental Code of Conduct

#### **Vegetation** (Annex II of the Protocol refers)

*Vegetation is scarce and sensitive. Do not collect or interfere without a permit.*

- Avoid trampling
- Do not collect plants or harmfully interfere without a permit
- Be aware of the risk of introducing non-native species

#### **Birds and mammals** (Annex II of the Protocol refers)

*Birds and mammals are more stressed than they appear. Taking or interference is not allowed without a permit.*

- Keep your distance (do not approach) and be quiet and calm in presence of seabirds and seals.
- Do not use motorized vehicles closer than 200 meters from bird colonies (and be aware that pilots have been advised to keep helicopters/aircraft at a distance of at least 2000 meters from bird colonies)
- Do not handle animals without a permit
- Be aware of the risk of introducing diseases to Antarctic wildlife

#### **Site Management** (Annex III and V of the Protocol refers)

*A site should always be left in its natural condition.*

- Always bring with you all garbage and other material when you leave a site
- Do not collect fossils and rocks, or in other manners deface the surface, unless for authorized research purposes
- Do not damage or remove historic remains

#### **Waste and Pollutants** (Annex III and IV of the Protocol refers)

*No waste is to be left in Antarctica and pollutants are not to be released into the environment*

- Minimize waste before you leave for Antarctica by removing unnecessary packaging material
- Separate metal and glass from the waste stream, and dispose of all waste in appropriate designated containers.
- Avoid fuel spills by utilizing absorbents when handling fuel.
- Clean up all fuel spills

#### **Protected Areas** (Annex V of the Protocol refers)

*Some sites have been designated as Protected Areas. Do not enter without a permit.*

- Protected Areas are protected for a purpose, e.g. for physical/ biological occurrences, scientific value, etc. You should respect this designation.
- Do not enter a protected area without a permit.
- If you have a permit, be sure to adhere to the permit conditions and be sure to bring the permit with you in the field



## **- Flora, Fauna and the Natural Environment**

*Human activity can have a large impact on the vulnerable natural environment in Antarctica. Show respect, and do your utmost to ensure that your presence does not harm the environment unnecessarily*

### **Plants**

- Plants in Antarctica are rare, fragile and grow slowly. Therefore you should avoid areas where mosses and lichens grow. Use established paths and trails where these exist.
- Establish camps in non-sensitive areas
- It is prohibited to collect plants without a special permit.
- It is prohibited to bring plants to Antarctica except in accordance with a permit.

### **Animals**

- Keep distance to animals, and be quiet and calm in their presence. Be especially alert in periods when animals breed. Do not walk through bird and seal colonies unless you are conducting approved research in the area. Avoid use of motorised vehicles closer than 200 meters from any animal.
- Do not feed, touch or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour.
- It is prohibited to collect animals without a special permit
- It is prohibited to bring animals to Antarctica

### **Natural environment**

- Do not paint on rocks or boulders, or in any other manner deface these.
- Avoid collecting or taking away geological specimens as a souvenir, including rocks, bones, fossils.
- When leaving a site it should be left in a natural state. Go thoroughly through the area before you leave, and remove waste and other left behind effects.

### **Protected areas**

- Always check whether there are Antarctic Specially Protected Areas (ASPAs), Antarctic Specially Managed Areas (ASMA), or registered historic sites and monuments in the vicinity.
- Special permits are required for entering or engage in activity in ASPAs. The permit must be with you in the field.
- ASMA and ASPA have management plans. It is your responsibility to familiarise yourself with and adhere to existing requirements and rules for these management plans.
- Cultural remains shall not be damaged, destroyed or removed.



## - Waste Management

### Waste Minimization

- Minimize purchase of products with plastic, glass or other bulky packaging material.
- Buy durable products instead of disposable products.
- Get rid of unnecessary packaging material (especially plastic) before leaving
- Substitute shredded paper, polystyrene chips, beads and other similar loose packaging material with bubble wrap, cardboard or paper.
- Buy products that easily can be re-used for other purposes.
- Use packaging material that can be re-used.
- Re-use products/material whenever this is practicable.

### Environmentally harmful products

- Polychlorinated biphenyls (PCB), non-sterile soil, polystyrene chips/beads and similar forms of packaging material, pesticides are not allowed.
- The use of polyvinylchloride (PVC) products is highly discouraged.
- The introduction of non-native species of animals and plants (including seeds, viruses, bacteria, parasites, fungi and yeast) requires a special permit.
- Hazardous chemicals and products should be treated with special attention so that no emission and dispersal occur.

### Waste Removal

- No waste is to be disposed of in Antarctica unless special permission has been granted.
- No open burning of waste is allowed.

### Separation of waste

Waste is to be separated into the following categories:

BLUE	Metal waste
GREEN	Glass waste
ORANGE	Mixed combustible solid wastes
BLACK	Sewage and food waste

### Sewage

- Discharge of sewage is prohibited under all circumstances unless the project has been granted exemption.
- Under no circumstances must sewage or domestic liquid waste be disposed of in vegetated areas or in areas with discharge to fresh water.

### Hazardous waste

- Different categories of hazardous wastes should never be mixed together in the same drum or crate
- Oil-contaminated soil/water/fabric is to be stored in separate containers
- Solids to be combusted
- No burning is allowed
- Radioactive waste
- For both liquid and solid radioactive waste it is essential that the correct information is provided in the labelling of the containers.



## **- Fuel Management**

*Fuel spills in Antarctica can cause long-lasting environmental damage. Any person handling fuel therefore has a certain responsibility to ensure that spills do not occur. All expedition members shall be aware of the guidelines outlined below and act accordingly.*

### **Fuel Storage**

- Fuel must not be stored in the vicinity of environmentally sensitive areas, i.e. vegetated areas, fresh water, bird colonies, etc.
- Store all containers, drums, etc. in such a way that any drips, leaks and spills are minimized and will not enter into the environment. An accumulation of such minor releases can easily add up to unnecessary contamination.
- Fuel shall only be stored in containers specifically designed for the products being stored, and suitable for the prevailing climatic conditions.
- Containers must not leak, and must be sealed with a proper fitting lid or cap.
- Keep lids, valves, etc. tightly closed except during transfer of fuel.

### **Transport of fuel**

- During transport all drums must be transported upright and properly secured with adjustable straps to the vehicle to prevent shifting or swaying in any manner.
- Containers of 20 litres or less should be stored in leak proof storage box during transport. This will keep the containers from bouncing out of the vehicle and will contain any spillage that may occur from small leaks.
- Maintain appropriate spill handling equipment with the transport vehicle. If leaks and spills are noticed, these should be stopped and contained immediately. Fuel from leaky or damaged containers should be transferred to un-damaged containers or to a safety drum.

### **Handling & Transfer of fuel**

- Re-fuelling should as far as possible occur sheltered from the wind.
- During fuel transfer absorbent material should always be available. Fuel spills and leaks shall be removed with the aid of absorbents and disposed of in an approved manner.
- During fuel transfer operations absorbent mats should as far as practicable be used to avoid accidental spills to the ground.
- All spills and leaks must immediately be contained, cleaned and disposed of in an approved manner according to procedures described in the Oil Spill Contingency Plan (OSCP).
- Ensure that all spills are to be reported according to the procedures described in OSCP. Spills larger than 200 litres are to be reported to expedition leader immediately.
- All sources of ignition must be eliminated or removed while refuelling.

### **Maintenance & Inspection**

- Fuel containers should be visually checked for leaks and spills by any person having errands in the fuel storage area.
- All fuel storage drums are to be thoroughly inspected on a regularly basis, and as soon as possible following adverse weather. The storage drums and storage area should be checked for leaks, spills, and deformed drums, etc.



## **- Fuel Spill Response**

*The physical conditions in Antarctica retard the decomposition of the fuel products, and clean-up efforts are made difficult by the conditions as well. The best strategy is to prevent spills from happening in the first place. If a spill occurs, persons involved shall act according to the guidelines below.*

### **Initial assessment**

The observer of the spill must carry out an initial assessment of the situation. He/she must check the:

- 1) Probable quantity of fuel spilled
- 2) Type of fuel
- 3) Location of the spill
- 4) Probable source and cause
- 5) Risk of fire or harm to human health

### **Initial notification**

If spill is assessed to be larger than 200 litres the observer of the spill must notify expedition leader and communicate the information obtained in the initial assessment.

### **Response team**

If spill is assessed to be less than 200 litres, observer initiates further response alone or with present personnel. Observer should request additional personnel if deemed necessary. If spill is assessed to be larger than 200 litres, the Expedition Leader must decide on the most appropriate response strategy and ensure the presence of adequate personnel to take care of the spill. It is the duty of the selected personnel to protect:

- A) *Health and safety*
- B) *Station facilities*
- C) *Threatened resources*

### **General clean-up procedures**

Although each oil spill is different, general common procedures are outlined below:

- Ensure oil spill equipment is in a known and accessible location.
- If a spill occurs, stop or minimise any further spillage. Ensure safety of all personnel. Check for fire and explosion risk. Ensure safety equipment is worn.
- For all spills, deploy absorbents to contain fuel if possible. It may be possible to hold fuel in depressions by using absorbent materials, or by building small dams.
- If possible use pump to remove fuel from ground straight into 200-litre drums. Ensure that sufficient good quality empty drums are available near the spill site.
- Put absorbent pads on any remaining fuel or oil outside which cannot be pumped or manually removed. Oil soaked absorbents must be picked up and put into plastic bags and/or empty 200-litre drums.
- Contaminated snow can be stored in 200-litre drums that have had their tops removed. Allow the snow to melt and decant off fuel.
- Any waste drums containing a mixture of fuel and snow or water are likely to freeze. To prevent drums from splitting, use only those in good conditions. Do not fill completely.



- Drums of recovered fuel/water, oil soaked absorbents and contaminated clothing must be sent for disposal outside Antarctica. Follow the disposal instructions given in the Nordic Waste Management Handbook