



SVALBARDS  
MILJØVERN FOND

**Limits of acceptable change caused by local activities in Ny-Ålesund  
Report from a pre-project, containing a proposal for a main project**



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## Preface

Ny-Ålesund has been established as a research town on the assumption that this is an ideal area to study an environment shaped only by natural forces. Consequently the need to keep the environmental impacts resulting from local human activities at a low level has been emphasized in many policy statements from the Norwegian government and the actors in Ny-Ålesund.

Following up on such policy objectives and recommendations from earlier Environmental Impact Assessments (EIAs) prepared for Ny-Ålesund, Kings Bay initiated a project to operationalize the environmental limits of the operations. During the work, it was clear that it would not be possible to do this without better information about environmental conditions in Ny-Ålesund. New fieldwork would be required to collect data and conduct detailed assessment as to which degree observed changes can be attributed to local activities. The steering group therefore decided to prepare a pre-project, planning a main project that will allow for better definitions of environmental limits. It decided to focus on three areas that according to the EIAs are likely to be most negatively affected by station activities: air quality, vegetation and birds.

This report consists of a general part containing an update on the EIAs from Ny-Ålesund with recommendations on the general environmental work, and a framework for a main project. Detailed project descriptions of sub-projects on air quality, vegetation and birds are found in annexes.

The project has been administered by a steering group comprising of Ole Øiseth (Kings Bay), Wenche Aas (Norwegian Institute for Air Research - NILU), Kim Holmén, (Norwegian Polar Institute - NPI) and Pål Prestrud (CICERO/Board of Kings Bay - until autumn 2013)

Gunnar Sander from NPI has been the project manager and has written the general part of the report. Elisabeth Bjerke Råstad and Sebastien Barrault from Kings Bay contributed with information on the implementation of measures recommended in the preceding EIAs and statistics on station activities. The three sub-projects have been developed by:

- Air quality: Wenche Aas (NILU), Kim Holmén and Gunnar Sander (NPI), Roland Neuber (Alfred Wegener Institute), Johan Ström (Stockholm University) and Roberto Udisti (CNR/University of Firenze)
- Vegetation: Gunnar Sander and Fiona Banks (NPI), Dagmar Hagen (Norwegian Institute for Nature Research - NINA), Maarten Loonen (University of Groeningen) and Bernt Johansen (Northern Research Institute - NORUT)
- Birds: Sebastien Descamps and Geir Wing Gabrielsen (NPI), Børge Moe and Sveinn-Are Hanssen (NINA), Olivier Chastel (University of La Rochelle-France) and Maarten J.J.E. Loonen (University of Groeningen)

The Svalbard Environmental Fund has provided 100 000 NOK to support the development of this pre-project. Kings Bay has allocated 500 000 NOK to initiate work on the main project, which will be spent on the sub-project on vegetation. Kings Bay and the partners involved will need to continue to focus on funding opportunities in order to implement the main project as proposed in full.

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## Summary

The mandate for this project has been to update information from and revise the implementation of the Environmental Impact Assessments (EIAs) for Ny-Ålesund, and to plan for how to define the environmental limits that should guide the operation of the research station.

### **The broader environmental work in Ny-Ålesund**

A major conclusion from the most recent EIA in 2006 was that there is a need for a more systematic approach to the environmental work in Ny-Ålesund. It recommended that an Environmental Plan should be elaborated every fifth year, with specific objectives, monitoring against these objectives and periodic assessments of performance that should guide the development of an Environmental Action Programme. This framework is still not in place and should be established. It is suggested that this situation may be due to unclarity regarding responsibilities for the environmental work and insufficient dedicated resources.

Activities at the station have increased over the last years, potentially leading to increased pressures on the local environment. Kings Bay has implemented several measures to reduce negative impacts, like extensive waste management and good information to visitors. New initiatives recent years include successful reduction of energy consumption, measurements of local air emissions, registration of research projects and start of a GIS-system for the activities. Coordination of research projects and local initiatives to reduce their impacts seems modest. Procedures for acceptance and management of research projects should be evaluated as a basis for proposing improvements.

It is hard to evaluate the effectiveness of the measures implemented due to a lack of monitoring of the most likely environmental impacts from the station activities. The lack of systematic information on how the situation has changed since 1998 also makes it difficult to assess status and trends. It should be noted however, that disturbance of air measurements primarily caused by emissions from the power plant and visiting ships is still a problem.

### **Project proposal: Limits of acceptable change in Ny-Ålesund**

The first EIA from 1998 proposed to set a precautionary upper limit on the total activity or number of people at the research station. However, there is no simple linkage between any number of people at the research station and the resulting environmental impacts; impacts depend on type of activity, its timing and location and the mitigating measures introduced. Specific analyses of how environmental qualities are affected by discrete station activities are therefore needed. This may reveal factual cause-effect relationships, but will not determine what is acceptable or not; for this purpose, there is a need for normative judgements and decisions as well. Such deliberations have led to the use of "limits of acceptable change" in the title of the proposed main project. This refers to a management system that uses adaptive management led by objectives and is a parallel to the approach proposed for the Environmental Plan in the last EIA.

A main project that will lay the foundation for a future knowledge-based environmental management of the activities in Ny-Ålesund is described. The proposed project consists of a coordinating module and three sub-projects addressing air quality, vegetation and birds respectively. These qualities are likely to be most negatively affected by station activities according to the first EIA. Each sub-project will:

- Elucidate how the local human activities in Ny-Ålesund affect environmental and scientific interests or qualities related to air quality, vegetation and birds respectively
- Analyze how to measure impacts from local activities and suggest a set of indicators for a monitoring program to follow development over time.
- Discuss alternative objectives for what are acceptable conditions, preferably with related target values for the state of the indicators, and conclude with a recommendation
- Suggest measures to reach the desired objectives and target values.
- Where relevant, suggest research needs for better understanding of local impacts

The estimated costs for implementing the project in full is 6,45 million NoK over three years, of which 0,5 mill already have been allocated by Kings Bay. Whereas costs for the air quality project shall cover analysis of and further work based on measurement data from field campaigns in 2008-2010, there is a need for new fieldwork on vegetation and birds.

It will be advantageous to run the three sub projects in parallel in order to coordinate approaches and to use the results as key input to an Environmental Plan for Ny-Ålesund. Such a plan however must also cover a broader set of issues that are not discussed here.

## Table of Contents

1	Background.....	6
1.1	The policy background: Environmental ambitions for Ny-Ålesund.....	6
1.2	Environmental Impact Assessments in Ny-Ålesund .....	7
	EIA 1998.....	7
	EIA 2006.....	8
2	Scope of this project.....	9
3	General work on the environment in Ny-Ålesund .....	9
3.1	Update on activities.....	9
3.2	Accomplishment of the Environmental Action Programme .....	13
3.3	Comments on achievements and status .....	15
3.4	Recommendations for environmental management.....	17
4	Proposed project: Limits of acceptable change in Ny-Ålesund.....	18
4.1	From precautionary to knowledge based, adaptive management .....	18
4.2	Objective and tasks .....	19
4.3	Organisation .....	20
4.4	Costs .....	20
5	Literature.....	22

# 1 Background

## 1.1 The policy background: Environmental ambitions for Ny-Ålesund

Construction and operation of the infrastructure in Ny-Ålesund as well as the research itself will inevitably affect the environment. Legislation and policies for Svalbard provide an important incentive to reduce such impacts; the overarching ambition is to preserve a virtually untouched environment, and all actors on the islands, including the research community, are required to act accordingly.<sup>1</sup> In Ny-Ålesund, an additional incentive is the need for the scientists to observe natural processes and answer primary research questions without disturbance from the research activities themselves, or other local human activities. Local influences on their measurements will complicate the interpretation of observed changes and their causes, and may in worst case lead to flawed results. A near pristine environment is thus a unique scientific quality and prerequisite for the environmental research that Ny-Ålesund is dedicated to. If local activities are not managed well, it may have consequences for the type and quality of research that can be conducted at the station.

**The Norwegian government** has designated Ny-Ålesund as a green research facility with high environmental ambitions in at least four white papers since the beginning of the 1990's.<sup>2</sup> In the most recent one from the Ministry of Trade and Industry, the owner of Kings Bay, it is stated that: «The goal of state ownership in Kings Bay AS is to ensure that Ny-Ålesund can be developed as a centre for international Arctic research within the natural sciences in Svalbard. Ny-Ålesund shall be a green research station, which requires that Kings Bay implements measures that can reduce the environmental impact from the activities in the Ny-Ålesund area to a minimum. Further growth in research must take place within responsible environmental limits.”<sup>3</sup>

**Kings Bay** has developed objectives and strategies regarding reduction of the station's environmental footprint in their four-year strategic plans. In the most recent one for 2012-15, the objectives establish that Kings Bay should have an environmental profile and work towards developing Ny-Ålesund as a green society. It also establishes that the Kongsfiord-area should be managed as a natural and cultural environment with minimal local disturbances and pollution (p. 13). One of the strategies is “to develop Ny-Ålesund within responsible environmental frames”. Several measures are listed for the programme period, including this project, annual reporting of the status of Ny-Ålesund as a green station, improved energy efficiency and reduction of emissions from the power station (depending on financing).

The **Ny-Ålesund Science Managers Committee (NySMAC)** in its founding articles from 1994 defined among its objectives “to minimize and mitigate environmental impacts of scientific activity conducted from Ny-Ålesund” and to “avoid negative impacts on research programmes from other activities (including other scientific activities) in Ny-Ålesund”. In order to achieve this, NySMAC shall

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<sup>1</sup> See “Act Relating to the Protection of the Environment in Svalbard”, available at <http://www.regjeringen.no/en/doc/Laws/Acts/Svalbard-Environmental-Protection-Act.html?id=173945a> and Justisdepartementet/Ministry of Justice 1999 and 2009.

<sup>2</sup> Miljøverndepartementet (Ministry of the Environment) 1992, Justisdepartementet (Ministry of Justice) 1999 and 2009, Nærings- og Handelsdepartementet (Ministry of Trade and Industry) 2010.

<sup>3</sup> Nærings- og handelsdepartementet (Ministry of Trade and Industry) 2010, section 6.4.8

“assess new scientific projects and other activities which may have significant impacts on existing projects or the environment”.<sup>4</sup>

A mission statement from 1997 addresses i.a. the environmental aspects of the operations by declaring that “the mission of Ny-Ålesund, Svalbard, is to: (...)

- give priority to scientific research and monitoring that is dependent on the near pristine environment or unique qualities of the Ny-Ålesund area, in particular research related to long range pollution, climate change and polar ecology;
- preserve the near pristine environment of the Brøgger Peninsula and the Kongsfjorden area, as well as the cultural heritage of Ny-Ålesund;
- keep local human environmental impacts at the lowest possible level so as not to jeopardize scientific research and monitoring;
- give scientific research and monitoring priority over other local human activities, such as tourism and commercial fishing;
- be a prime example of the sustainable operation and development of a research station in the polar regions.

## 1.2 Environmental Impact Assessments in Ny-Ålesund

The above-mentioned policy has been the backdrop for two Environmental Impact Assessments (EIAs) of the activities in Ny-Ålesund.

### EIA 1998

The first EIA (Shears et al 1998) was initiated by NySMAC in 1996 and prepared jointly by British Antarctic Survey (BAS) and Norwegian Polar Institute (NPI), collaborating with several other institutions. The project had a budget and in-kind resources that enabled it to undertake ten specially commissioned technical studies. Among the topics were birds, effects of traffic, local air pollution, terrain vulnerability and sensitivity. Impacts on the environment and on scientific activities were assessed and ranked according to significance.

- Environmental impacts that were assessed to have
  - *very high significance*: damage and destruction of habitat (e.g. tundra) from station activities and cumulative effects of the increased human “footprint” at the station;
  - *high significance*: impacts on benthic soft sediments due to shrimp trawling, potential contamination from major fuel spills and leaks at the station or from vessels, and chronic contamination of the marine environment from leaching dump sites;
  - *medium significance*: damage to local bird protection areas, disturbance (e.g. noise) of breeding birds and pollution of the sea from sewage.
- Conflicts with scientific activities that were assessed to have
  - *very high significance*: loss of atmospheric monitoring data because of local air pollution from station operations and vessels;

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<sup>4</sup> See Appendix 1 in Ny-Ålesund charter (NySMAC 2013).

- *high significance*: partial loss of Kongsfjorden for research due to shrimp trawling and potential electromagnetic interference with scientific instruments produced by active sources like radios, radars etc;
- *medium significance*: cumulative conflicts and partial loss of Brøggerhalvøya as a botanical and ornithological research area due to overgrazing by reindeer.

The study finally proposed a 12-point Environmental Action Programme including a list of measures associated with each point. A recommendation highly relevant for this study was to "set a precautionary upper limit on the station activities". The report also recommended a long-term monitoring programme with concrete designation of key ecosystem indicators and indicators for activities.

### EIA 2006

The second EIA (Sander et al 2006) was prepared by NPI in collaboration with Kings Bay and BAS. The project had no funding and mostly was a desktop study supplemented by field inspections. There was practically no new information made available on the state of the local environment that could reveal eventual changes since the first EIA, despite its recommendation on monitoring. It proposed to conduct studies in 2006 and 2007 on degradation of the tundra and the effects of local air emissions on the air measurements.

The assessment team updated what was known about changes in the activities and measures that had been introduced, for example banning of trawling in Kongsfjorden, securing of fuel tanks and cleaning up old spills. That made it possible to single out issues that probably had been solved or reduced as a rough update of the former impact assessment. One observation was that whereas many measures had been directed at reducing negative impacts from the infrastructure, little attention had been paid to the research activities.

A major conclusion was that there is a need to work more systematically with environmental issues in Ny-Ålesund. Based on EIA 1998, it was proposed to elaborate an Environmental Plan in 2009 that should be rotated every fifth year, with the following core elements:

- *Targets* for the environmental performance of the station which are specific for certain desired results/qualities or activities, making the more general objectives (ref section 1.1) operational.
- *Monitoring programme*: Initiate monitoring of pressures on (activities) and state of the environment and make the results available for the community in Ny-Ålesund. Data should be used to evaluate environmental performance against objectives and targets
- *Environmental Action Programme*: New measures or initiatives should be designated based on the assessment of performance and eventually other studies, like cost-benefit of alternative measures.

Other recommendations were to establish a project directory for the research activities, a GIS associated to it for documenting research activities and changes to infrastructure, better coordination and management of eventual conflicts, and a revised Environmental Action Programme (see section 3.2.)

Regarding the recommendation from EIA 1998 to set a precautionary upper limit on the total activity, it was recommended to "fulfil the discussions".

## 2 Scope of this project

The steering group originally set the mandate for the current project to:

- Update the information on activities that are described in the EIA: Include data on activities that were not previously available. Collate data on the state of the environment that were mostly not available in EIA 2006. Revise the implementation of the recommended measures from previous reports.
- Assess what are acceptable limits for change in the natural environment with a special emphasis on factors that are important to research and monitoring.
- Propose concrete measures to avoid that the limits are exceeded.

The collection of data on the environment proposed in the first bullet point is hard to accomplish. There is still no comprehensive monitoring programme covering local environmental impacts in Ny-Ålesund. Current plans within NySMAC for establishing a long-term, question-driven monitoring programme for the station will need to identify the influences from local activities and consider them when planning for the primary purpose of the monitoring. The work on air quality, vegetation and birds, as proposed here, will start the process. A workshop for discussing the monitoring is planned to be held in the autumn of 2014.

This report therefore focuses on the second bullet point, assessment of acceptable environmental limits. Due to the lack of data on the environment, there is a need to do more fieldwork and analysis of existing data before making specific recommendations. The steering group therefore concluded that a pre-project defining how to set the limits of acceptable change would be required.

The issues in the first bullet point that are linked to the more overall development of the environmental work in Ny-Ålesund will briefly be addressed in chapter 3.

## 3 General work on the environment in Ny-Ålesund

This chapter gives a brief update of development in activities in Ny-Ålesund since 2005, which was the last year of statistics in EIA 2006, and revises the implementation of its Environmental Action Programme and other recommendations.

### 3.1 Update on activities

Kings Bay has updated the statistics from chapter 7 of EIA 2006, which had 2005 as its final year. Here we show the most important ones with some brief comments on changes since 2005.

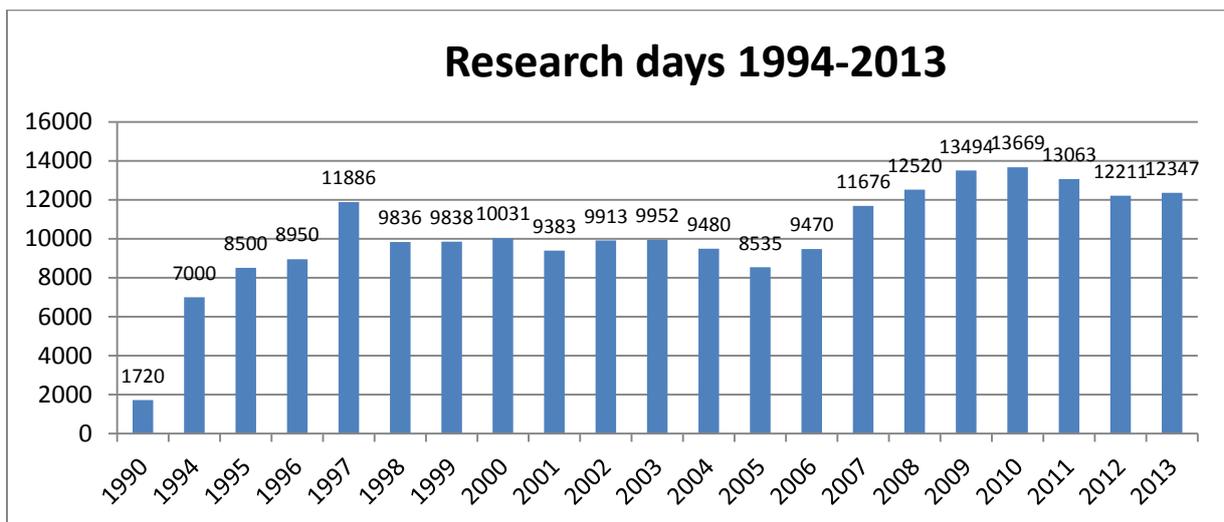
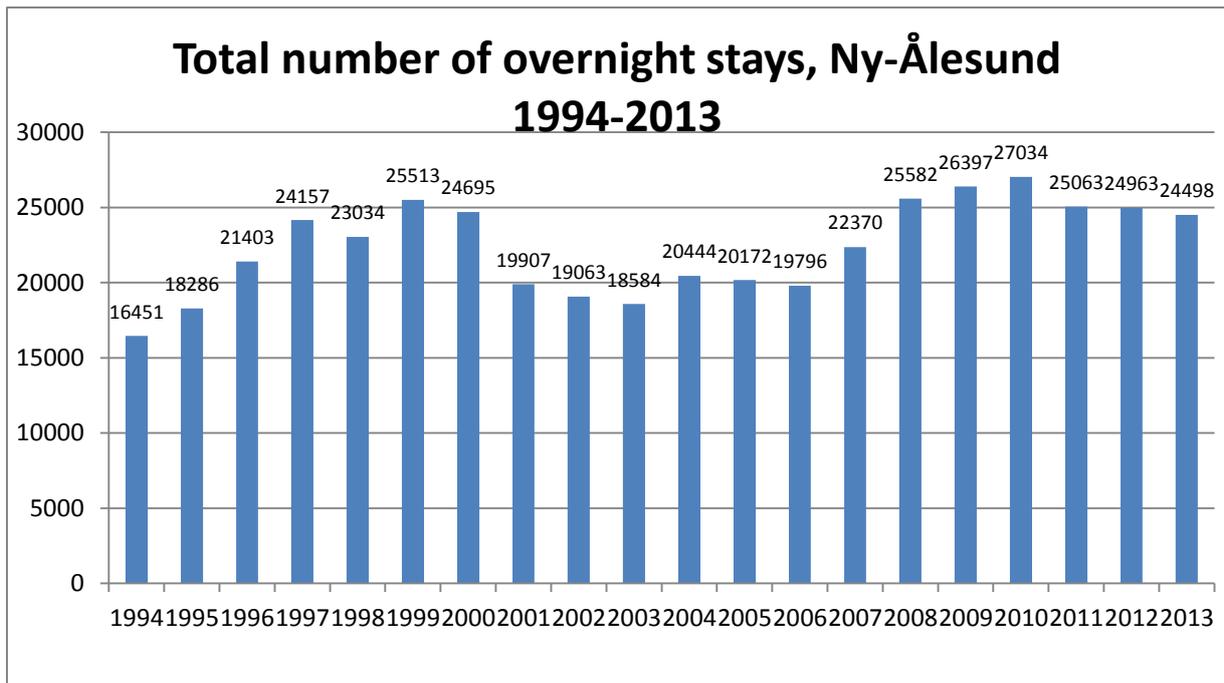


Figure 3.1 a and b Overnight stays in Ny-Ålesund by a) all visitors b) scientists

The International Polar Year 2007-08, which in reality lasted longer, is probably a main reason for the increased activity level after 2005. After a peak in 2010, activity level has dropped. However, the number of scientists visiting in 2013 was approx. 40% above 2005 (which was a low year), whereas the total number of visitors staying over was 22% higher. In the context of this report, this trend is a warning sign indicating that negative impacts may also increase and underscoring the need for improved management of environmental disturbances.

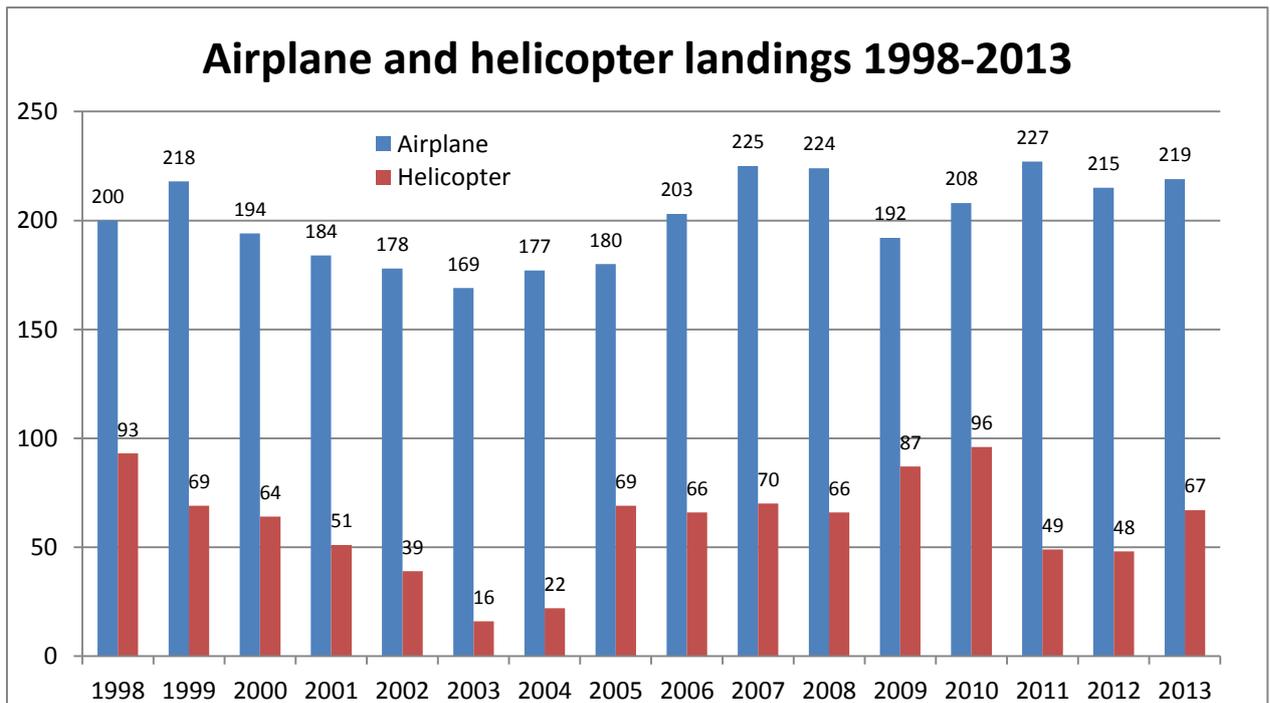


Figure 3.2 Airplane and helicopter landings in Ny-Ålesund.

The number of airplane landings has varied since 2005; in 2013 there were 22 % more landings than in 2005. Helicopter landings are on the same level in 2013 as in 2005.

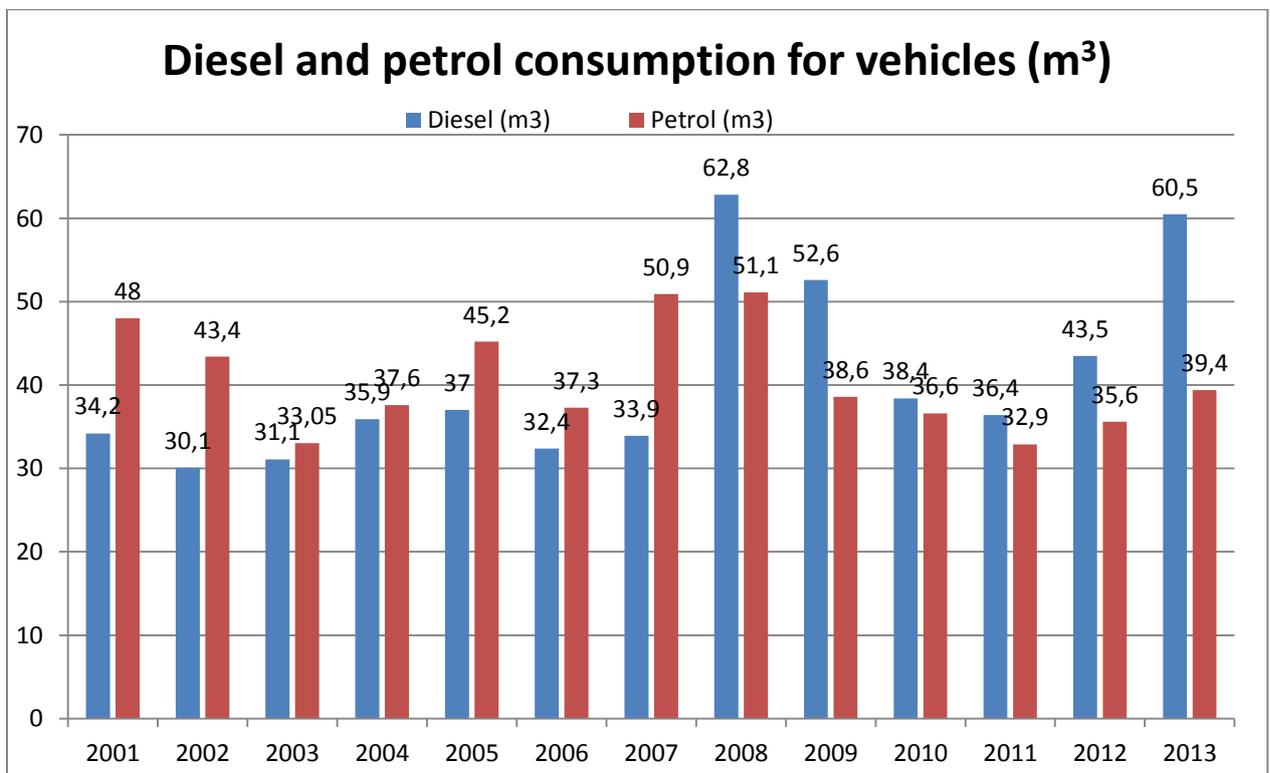


Figure 3.3 Diesel and petrol consumption for vehicles in Ny-Ålesund

The consumption of diesel for vehicles in 2012 was 18% higher than in 2005 after a peak in 2008 that probably was due to construction work. The new peak in 2013 is due to construction work with the

new road to Brandalslaguna. Petrol consumption has decreased since 2005 and was 13% lower in 2013.

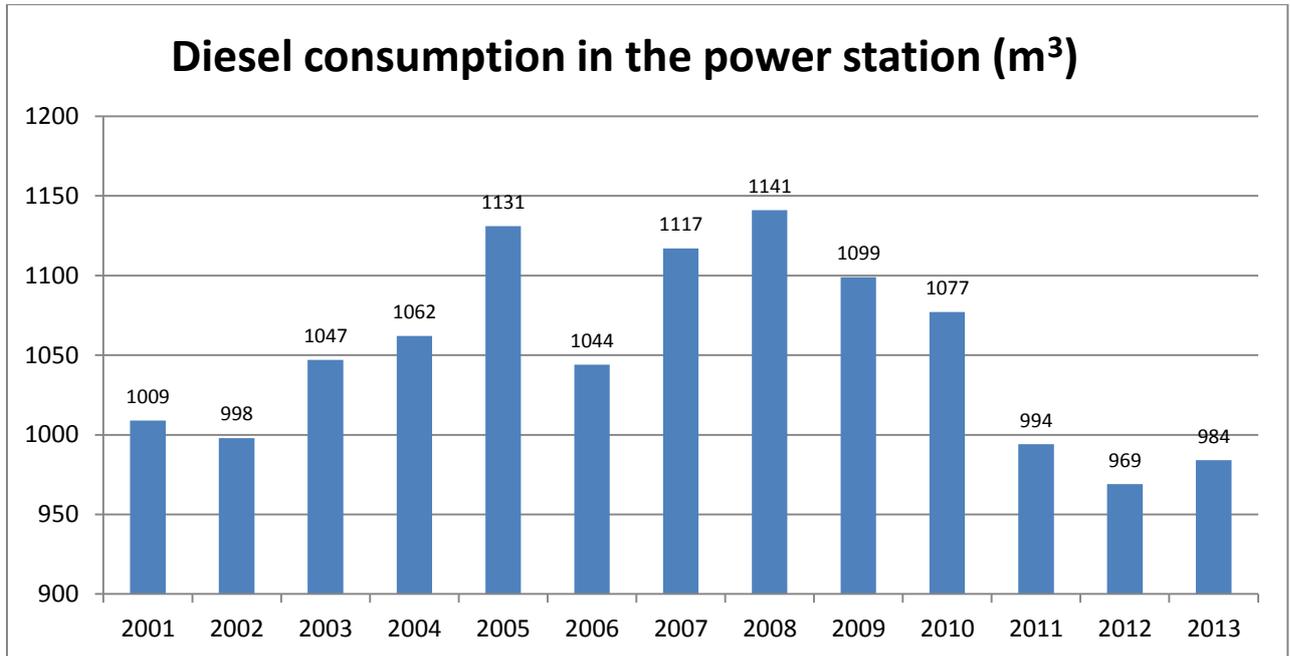
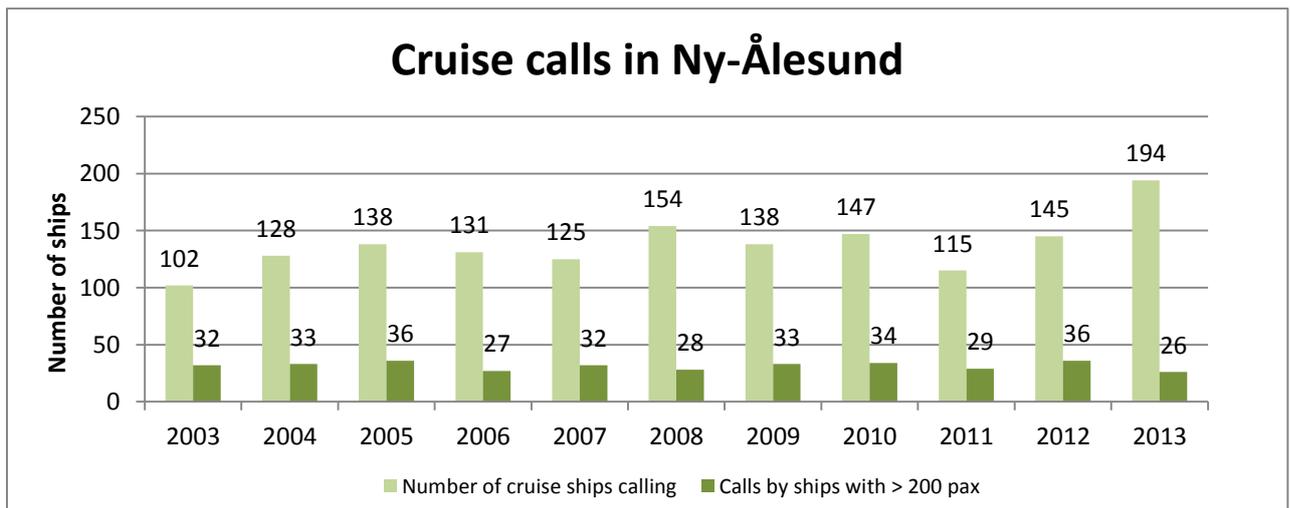


Figure 3.4 Diesel consumption in the power station in Ny-Ålesund

There has been a continuous reduction of diesel consumption in the power station since a peak in 2008. The volume in 2013 was 14% lower than the peak level. This has happened despite the increased number of visitors (figure 3.1 a) and thus has increased energy efficiency per visitor considerably. The fuel consumption in the power station is approx. 12 times higher than the combined diesel and petroleum consumption in vehicles.



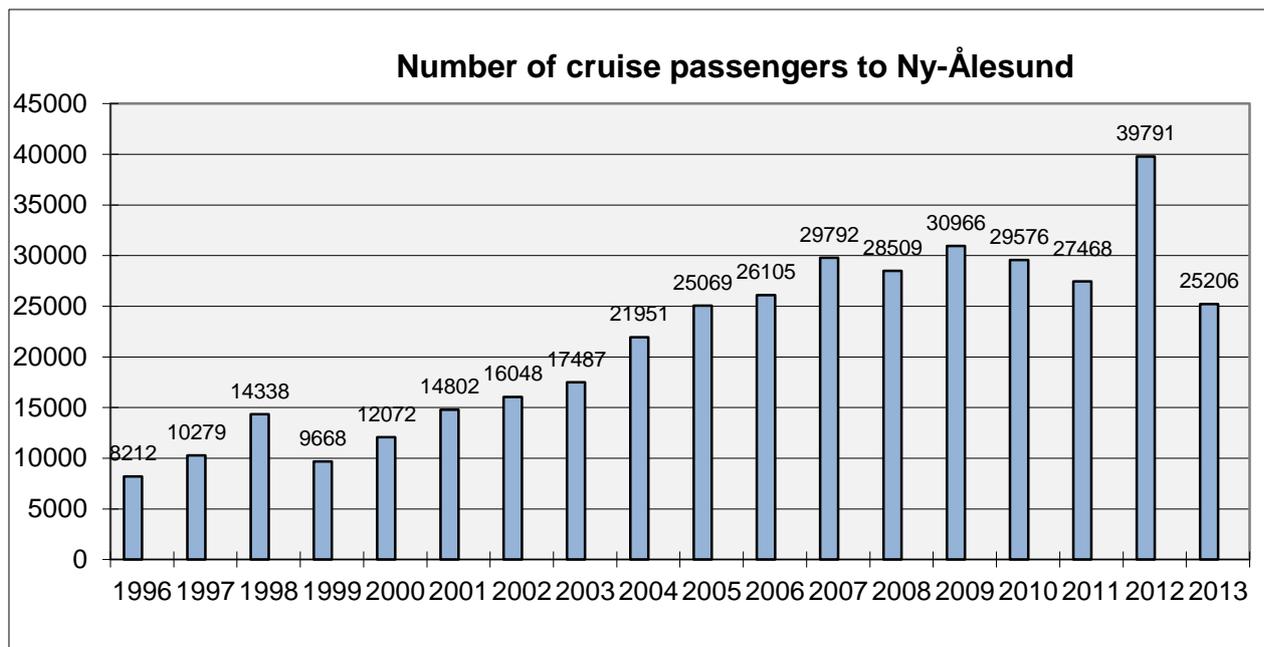


Figure 3.5 a and b: Number of cruise ships calling Ny-Ålesund and the number of passengers on board

The number of cruise passengers arriving Ny-Ålesund has increased over the period, with a remarkable growth between 2011 and 2012 – and a drop back to “normal” in 2013. The drop in passengers between 2012 and 2013 is due to fewer large tourist vessels arriving. The reason is probably the introduction of compulsory pilotage in internal waters for vessels over 150 m from the sailing season 2013.<sup>5</sup> On the other hand, the number of ships calling the port increased significantly in 2013 due to an increase in the traffic of yachts and research vessels that carry fewer passengers per ship.

## 3.2 Accomplishment of the Environmental Action Programme

The information in the table below is provided by Kings Bay and NPI.

Recommendations/measures (see two last columns in table 9.1 in Sander et al 2006 for full text)		Actions taken
1.	Precautionary upper limit for total activity/number of people	<ul style="list-style-type: none"> <li>The current project addresses the issue</li> </ul>
2.	Stabilise and reduce local emissions, ref EIA98, prioritizing: <ol style="list-style-type: none"> <li>Improved energy supply;</li> <li>Reduction in local energy consumption;</li> <li>Reduce emissions from ships;</li> <li>System for monitoring and modelling of air quality</li> </ol>	<ol style="list-style-type: none"> <li>Alternative energy sources have been assessed. Conclusion: continue with diesel-powered energy supply.</li> <li>Reduced energy consumption is a strategy. Measures:               <ul style="list-style-type: none"> <li>Upgrading in Servicebygget, Samfunnshuset, London1 and soon the Marinlab (windows, insulation and/or ventilation).</li> <li>Zeppelin station: more effective energy use</li> <li>Transport: Bicycles to all employees, first electric car</li> </ul> </li> <li>Heavy fuel oil has been banned in national parks since 2010. The exception for traffic to Ny-Ålesund will expire 1 Jan 2015.</li> <li>Campaigns with local measurements of air quality in town have been undertaken. No modelling system is in place.</li> </ol>

<sup>5</sup> See announcement of the new rules here (Norwegian text): <http://www.kystverket.no/Maritime-tjenester/Farledsbevis/Svalbard---Losplikt-og-Farledsbevis/>

3.	<p>Protect flora and fauna, re-vegetate degraded tundra areas:</p> <ol style="list-style-type: none"> <li>GIS for changes in tundra;</li> <li>Research activities in GIS;</li> <li>Construction work;</li> <li>Remove redundant infrastructure (roads);</li> <li>Channel pedestrians, build paths;</li> <li>Coordinate field activities;</li> <li>Research on effects of science;</li> <li>Codes of conduct for science;</li> <li>Document effects of noise and lights on local fauna;</li> </ol> <p>General: field work to update previous studies on degradation of the tundra</p>	<p>a + b: Planning of a GIS system started. Data on instruments in field collected, but not of research activities.</p> <p>c. Kings Bay focuses on vegetation under construction work. Contractors working with the new road to Brandalslaguna will undergo a green training seminar.</p> <p>d. Infrastructure has not been removed</p> <p>e. There are signs and paths to keep tourists off the tundra.</p> <p>f. Research in Svalbard is an important tool that facilitates coordination. Actual coordination seems modest, see 10 c.</p> <p>g + i. There are few projects documenting such impacts</p> <p>h. Codes of conduct not elaborated</p> <p>Field work on tundra not initiated</p>
4.	<p>Information to all visitors and residents – reducing environmental impacts and minimize conflicts:</p> <ol style="list-style-type: none"> <li>Continue established information measures</li> <li>Electromagnetic noise: info + enforcement of restrictions</li> <li>Not feeding animals</li> </ol>	<p>a. Information briefing to all new employees.</p> <p>a. Information to cruise ships prior to arrival. Info signs in town.</p> <p>a. Safety course to all employees. This is also offered to all scientists, and required for renting rifles in the reception.</p> <p>c. Previous practice has been stopped</p>
5.	<p>Incorporate the key results from EIA to the Land Use Plan:</p> <ul style="list-style-type: none"> <li>Use EIA and monitoring in revisions of land use plans</li> </ul>	<ul style="list-style-type: none"> <li>The land use plan of Ny-Ålesund will be revised in 2014. Results from the EIA will be incorporated. Monitoring is not established.</li> </ul>
6.	<p>Prevent fuel spills and establish a station fuel spill contingency and clean up-plan:</p> <ol style="list-style-type: none"> <li>Revise Emergency plan for pollution incidents</li> <li>Inspect polluted ground regularly, measure concentrations every 5-10 years</li> </ol>	<p>a. A general Emergency plan for all types of incidents from 2007 was revised in 2010. The Emergency plan for acute pollution from 2003 has not been revised.</p> <p>b. No inspections/measurements of polluted grounds</p>
7.	<p>Maintain a high level of waste management:</p> <ol style="list-style-type: none"> <li>Minimize waste generation</li> <li>Continue high standards for recycling</li> </ol>	<p>a. No measures reported.</p> <p>b. Focus on recycling and waste management, information to employees, scientists and tourists. Extensive sorting, all fractions are sent to Tromsø. No local deposition.</p>
8.	<p>Establish the Kongsfjorden area as a “scientific research area”:</p> <ul style="list-style-type: none"> <li>Contribute to Governor</li> </ul>	<ul style="list-style-type: none"> <li>Trawling in Kongsfjorden is no longer allowed</li> <li>No general reservation of the area for research; a “case-by-case approach” has been preferred</li> </ul>
9.	Reduce environmental impacts	

	<p>from tour ships:</p> <ul style="list-style-type: none"> <li>a. Continue work on info</li> <li>b. Reduce emissions</li> </ul>	<ul style="list-style-type: none"> <li>a. See 4 above</li> <li>b. No local measures introduced in Ny-Ålesund (ref. 2c for HFO).</li> </ul>
10.	<p>Introduce stricter controls over activities:</p> <ul style="list-style-type: none"> <li>a. Project database</li> <li>b. Research GIS associated with database</li> <li>c. Increase coordination and control through science plan</li> </ul>	<ul style="list-style-type: none"> <li>a. An extended Research in Svalbard (RiS) database and portal is established<sup>6</sup>. Potentially a good tool with limited local application in Ny-Ålesund for environmental purposes.</li> <li>b. Initiatives to create a GIS database to register all research projects and all new research equipment;</li> <li>c. Science plan and flag ship programs promote coordination. Practical coordination modest. Few incitements or tools to do.</li> </ul>
11.	<p>An environmental monitoring documenting pressures on and state of the local environment:</p> <ul style="list-style-type: none"> <li>a. Fulfil selection of indicators and parameters with responsibilities – also for assessment work</li> <li>b. Display indicators</li> </ul>	<ul style="list-style-type: none"> <li>a. No monitoring programme across the individual research stations has been established. A workshop will be convened autumn 2014, hopefully also incorporating impacts of local activities</li> <li>b. No system for disseminating indicators to the community working in Ny-Ålesund</li> </ul>

Table 1: Actions taken to follow up the Environmental Action Programme from EIA 2006.

### 3.3 Comments on achievements and status

Looking at both the changes in activities and measures as reported above, a brief analysis is:

*Local emissions:* The effort to make the energy system more efficient and even reduce the total energy consumption has been a successful move in the right direction. However, the primary local concern has been the effects of the emissions on the air measurements, and there is still no cleaning of the fumes from the power plant. Besides, emissions from cruise ships probably have increased. One should recall that EIA 1998 recommended 99% reduction in emissions of NO<sub>x</sub>, soot, VOCs and SO<sub>2</sub> compared to 1996. Though the background for setting these numbers in reduction can be questioned, the basic problem of disturbances of the measurements still persists (see project on air quality in appendix 1).

*Protect flora and fauna:* In the town, some measures are in place on information and channelling of tourists. Data about research infrastructure has been collected for inclusion in a GIS and will be used in the local management of installations in the field, including removal of equipment that is no longer in use. Recommendations not implemented include removal of unnecessary infrastructure (roads) and additional channelling of visitors/building of paths to sites with a high number of visitors, like Amundsenmasta. Outside town, there is little information available on the effects of traffic and trampling and what eventually has been done to reduce negative impacts.

*Information to residents and visitors:* This is apparently functioning well. Special needs, like electro-magnetic noise, however should be addressed.

<sup>6</sup> The RiS portal is available at: <http://www.researchinsvalbard.no/>

*Fuel spills:* The major physical improvements were done before EIA 2006. Revision of the contingency plan may further reduce the risks of new accidents. Inspections and measurements should be set in system.

*Waste management:* The system for recycling is well developed. No activity is reported about attempts to reduce the overall amount of waste, which would reduce environmental impacts further.

*Better coordination and stricter controls over research activities:* The Research in Svalbard (RiS) Portal is an important tool that may provide useful background information about projects' potential environmental effects. Registration is now mandatory for all fieldwork that needs permission from the Governor, in practice also for all projects booking in Ny-Ålesund. The routines for checking whether registered projects actually receive permits and whether all activities undertaken actually have the permits needed seem to be insufficient.

The Governor sometimes encourages logistical coordination of fieldwork. That is a major strategy also for reducing environmental impacts from field-based activities (Nordisk ministerråd 2004). There are informal mechanisms for coordination of field activities in place at least among ornithologists and glaciologists working in Ny-Ålesund, but in general, coordination seems modest. Practice, tools, incitements and authority should be discussed.

EIA 2006 proposed a GIS system of the research activities linked to "Research in Svalbard". Content should include coordinates of instruments, description of activities and precise area of work. If combined with data on the vulnerability of the local environment and historical research plots, this can be a valuable tool to limit conflicts with natural assets and between research projects. So far only locations of instruments have been collected.

Procedures for prior assessment of impacts of the research projects and the mandate to say yes, no or set conditions for approval is important. The Governor has authority and processes for handling the legal requirements for protection of the environment applying all over Svalbard appropriately. NySMAC has established a system for internal hearing of new research projects that should address the specific requirements for science.<sup>7</sup> It is unclear how this system works in practice; there are examples of projects that have ended up in Longyearbyen because of potential conflicts, and there are examples of initiatives causing conflicts where applications have not been sent for review before realization.

*Monitoring programme:* The lack of a monitoring programme for local impacts is a major weakness for a systematic approach to the environmental work in Ny-Ålesund.

#### **Overall conclusion on environmental management:**

As demonstrated above, several measures are in place and new initiatives have been taken, though there are still recommendations that have not been followed up, even on issues of high significance. A major shortcoming is the lack of an environmental planning system that should embrace these individual actions (ref section 1.2): Operational environmental targets have not been defined, monitoring of the state of the local environment and the impacts of the research station is not implemented, there is no systematic review of the environmental performance of the station and no

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<sup>7</sup> See "Visitors to Ny-Ålesund stations - approval process" and "Research project approval" in (NySMAC 2013)

joint, updated environmental action programme (the closest is in Kings Bay's strategic plan). It is therefore hard to evaluate the effectiveness of the measures implemented. Lack of environmental data also makes it impossible to assess status and trends after the first EIA from 1998.

### **3.4 Recommendations for environmental management**

Establishing an Environmental Plan followed by monitoring should have high priority for Ny-Ålesund. It is suggested that there are at least two major obstacles that must be overcome:

First, it has been unclear who has the responsibility to follow up the EIAs and the general work on the environment. When it comes to infrastructure, Kings Bay has the responsibility whereas NySMAC can give advice. When it comes to scientific activities, responsibilities are shared between the Governor for general legal requirements concerning the environment, and Kings Bay, NySMAC and NPI for locally following up with additional scientific considerations. Responsibility to collaborate on the overall environmental management should be ensured, as should the individual mandates and roles.

The second observation concerns the resources allocated to work systematically with environmental issues. A recommendation in EIA 1998 was to "employ a senior scientific/environmental manager at the station". That is not in place any longer; the environment is a part-time responsibility for the scientific advisor. Competence on environmental management and capacity to do the work then may lag behind, depending on the priorities for the position. Another type of resource is money to finance continuous work, projects and measures. Kings Bay is one organizational entity with its responsibilities, plans and budgets. NySMAC is a collaborative and weaker structure, mostly providing in-kind contributions from members who are willing to undertake work for the common benefit. Allocation of sufficient resources from several institutions is necessary in order to improve the systematic environmental work in Ny-Ålesund.

A structural problem when it comes to decisions on all types of changes to the infrastructure is the need to create mechanisms that can elucidate the benefits for science versus the monetary costs for Kings Bay. At least for larger investments that go beyond the economic capacity of Kings Bay's normal budgets, cost-benefit analyses could be made and brought up for the owner. Cleaning equipment for the power station is a prominent example. For all the smaller, continuous decisions on changes at the station, Kings Bay must have the competence and instigate procedures that ensure that they consider the overarching environmental goals for the station in addition to the budgets.

Increased attention should be paid to the environmental footprint of the scientific activities, particularly field work. We suggest evaluating the procedures for assessing impacts and selecting individual research projects and other developments at the national stations that are below the threshold of triggering formal EIAs from the governor (ref previous section).<sup>8</sup> Depending on the outcome of the evaluation, improved procedures could be developed.

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<sup>8</sup> Questions could address screening criteria for subjecting projects/installations for comments in NySMAC, type of documentation required, experience with the hearing process, treatment of conflicts and decision processes.

## 4 Proposed project: Limits of acceptable change in Ny-Ålesund

### 4.1 From precautionary to knowledge based, adaptive management

The EIA 1998 proposed to set a precautionary upper limit on the total activity/numbers of people at the station. This approach could be a first step in limiting unwanted impacts when knowledge is scarce (ref Hagen et al 2012). However, it raises a lot of questions and objections:

A major objection is that such an approach is not specific since it does not distinguish between what causes significant impacts and what does not. Different activities lead to different impacts; there is for example a difference between personnel working in the offices and scientists doing fieldwork in a bird colony. Further, the sensitivity of the environment also varies, meaning that the same type of activity may lead to different impacts according to its location and timing of the operations. Examples are traffic in breeding colonies during the nesting season or snowmobile traffic on wetlands in spring; negative impacts can be avoided or reduced by changing site or timing. This also illustrates that the behavior of the visitors and the procedures for operating the station affect the impacts. Wiser behavior and effective mitigation measures can decrease the environmental footprint per visitor over time, as the improved energy efficiency in Ny-Ålesund illustrates. Another complicating factor arises from the fact that the environment is not stable over time, as illustrated by the diminishing glaciers, the increasing grazing pressure from reindeer and removal of bottom trawling from Kongsfjorden. Hence, new ecological interactions may occur over time, and the negative impacts from the same activity may increase - or decrease – with the changing environment. For all these reasons, there is no simple linkage between a fixed number of visitors and their impacts. Specific analyses of sensitivities towards particular activities are needed to find out what should warrant which types of measures.

Another type of objections is related to the often underlying assumption that there is a carrying capacity in the environment that needs to be found. This raises a fundamental question about how to determine what is acceptable and what is not. Nature does not speak; there is no inherent quality of a particular site that can be revealed. Science can inform about facts like cause-effect relations and thresholds, but we end up with normative judgments and decisions that are based on values and societal choice.

Initially, this project was named “Tålegrenseprosjektet” – pointing to what nature may tolerate from humans and carrying capacity. During the course of discussions, it was decided to use the term “Limits of acceptable change” instead. This refers to a framework that was introduced for managing visitors to natural parks and wilderness areas (Stankey et al 1985), a situation that has many parallels to Ny-Ålesund. The term acceptable, clearly points to the normative task of defining what are desired conditions. This is a part of the planning system in the approach, following a nine step procedure and using a terminology that is not always easy to grasp. The essence of it, however, is adaptive management led by objectives: Monitoring of measurable parameters over time lead to the evaluation of management effectiveness and identification of new actions necessary to achieve acceptable conditions. That is the same approach that has been recommended in the EIAs for Ny-Ålesund. Limits of acceptable change therefore can serve as an inspiration for the work in Ny-Ålesund and be modified to the local situation.

## 4.2 Objective and tasks

The objective of the main project proposed here is to contribute to developing the environmental management system for Ny-Ålesund with an Environmental Plan and subsequent monitoring. A part of the task will be defining targets for what to achieve regarding impacts on the local environment that can guide the operations of the activities at the station.

As described above, such analysis must be specific. Based on the ranking of significance of impacts from EIA 1998 and knowledge about later developments,<sup>9</sup> we have decided to focus on three issues: emissions to air in relation to monitoring of air quality, vegetation and birds. For all these, significant impacts from station activities are likely to occur. The fourth issue with high significance in EIA 1998, cumulative impacts on both the environment and research, should be considered at a later stage. Other issues may also warrant further analysis in the future.

We suggest organizing the project through a coordinating module and three sub-projects for each of the topics. The sub-projects should conduct the following tasks:

- Elucidate how the local human activities in Ny-Ålesund affect environmental and scientific interests or qualities related to air quality, birds and vegetation, respectively
- Analyze how impacts from local activities can be measured and suggest a set of indicators for a monitoring program to follow development over time.
- Discuss alternative objectives for what are acceptable conditions, preferably with related target values for the state of the indicators, and conclude with a recommendation
- Suggest measures that are needed in order to reach the desired objectives and target values.
- Where relevant, suggest research needs for better understanding of local impacts

Figuratively speaking: In order to move forward with the appropriate measures, we need a map (understanding impacts), a compass pointing out the direction (objectives and targets) and a log measuring how we move compared to the desired direction (monitoring). At regular intervals, we must assess where we are, readjust the direction and designate new steps forward (measures). The three projects suggested here thus will deliver key input to the Environmental Plan suggested in EIA 2006, thereby laying the foundation for adaptive management of human activities in Ny-Ålesund as a continuous activity. The project thus can be a vehicle for developing the system, though further initiatives covering the breadth of issues should be developed in parallel.

It is suggested that adopting elements from the Adaptive Environmental Assessment and Management (AEAM) framework would be helpful in understanding impact mechanisms, designating monitoring and eventually research. The method offers a systematic approach where important information is documented and clear priorities are made, thereby facilitating adjustments in the future. A Svalbard-specific AEAM was developed by Hansson, Prestrud and Øritsland (1990). It established a general framework for assessing and managing impacts of industrial activities in Svalbard. However, this must be tailor-made to the specific situation in Ny-Ålesund. This has been done for the two sub-projects on vegetation and birds in scoping their work (see appendix 2 and 3).

Alternative objectives and target values will lead to different needs for management measures and hence costs. This should be a part of the discussion in the sub-projects. If possible, advantages for

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<sup>9</sup> See table 8 and 9 in EIA 1998 and conclusions in section 7.9 and 8.13 in EIA 2006

science should be compared to the costs (not only monetary) of the measures associated with different acceptable conditions.

### 4.3 Organisation

We suggest organizing the project with a steering group comprising of representatives from Kings Bay, NySMAC and NPI. One institution should be responsible for coordinating the activity through a designated project manager. Participants in the three sub-projects have already been identified from the research community in Ny-Ålesund, and are as such prepared to bring the project forward should funding become available.

Outreach aiming to provide information about the project activities to all parties working in Ny-Ålesund is important. The individual sub-projects must ensure that results are discussed with scientists from the broader research community, eventually organized as smaller reference groups for each. A joint web site for the general environmental work in Ny-Ålesund including this project would be beneficial and should be considered established. A web site also could be used for retrieving information from users in Ny-Ålesund, for example uploading of GPS logs from traffic, which has been proposed in the projects on both vegetation and birds.

A joint meeting for all the three projects could be arranged for example back-to-back with the workshop on long term monitoring, tentatively in Tromsø in the autumn of 2014.

Results should be circulated to relevant stakeholders for comments. Finally, there need to be a policy decision to determine the objectives/acceptable conditions – and the other outcomes of the projects.

### 4.4 Costs

The table below summarizes the costs calculated for the three sub-projects and the coordination:

Sub-project	Year 1	Year 2	Year 3	Sum
Air quality	450	450		900
Vegetation	500	850		1 350
Birds	1 200	1 200	1 200	3 600
Co-ordination, meetings etc	200	200	200	600
Total				6 450

*Table 2: Summary of costs for the main project of “Limits of acceptable change in Ny-Ålesund”. Costs in 1000 NOK*

A few comments to the cost calculations:

For air quality, measurements of the local situation as recommended in EIA 2006 were conducted in 2008-2010. The financial needs are for analyzing data on the influence of local emissions on the air measurements and addressing the other tasks. The projects on vegetation and birds require initial fieldwork. Whereas the vegetation project requires two seasons, the project on birds has planned for three in order to achieve better baseline-data. Project plans and costs should be redefined after the first field season.

Kings Bay has allocated 500 000 NOK to get the work started in 2014. The money will be used on the sub project on vegetation to get fieldwork started. There may be shifts in the allocation between years on all the sub-projects according to the financial situation of the project. It will be advantageous to have a joint period where all the three sub-projects run in parallel in order to address common issues across them. That will require the project to be fully financed. Further considerations and work will be needed to assess funding opportunities.

The Limits of acceptable change project will establish the basis for a long-term work to monitor and reduce the negative human impacts from the station activities. When finished, there will be recommendations for monitoring and measures that should be implemented. That will require additional long-term funding. Other financial needs may also come from a broader environmental work than the three issues prioritized here (ref section 3.4.).

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