LONGYEARBYEN, SVALBARD - VULNERABILITY AND RISK MANAGEMENT OF AN ARCTIC SETTLEMENT UNDER CHANGING CLIMATE - A CHALLENGE TO AUTHORITIES AND EXPERTS

Erik Hestnes*, Steinar Bakkehøi and Christian Jaedicke

Norwegian Geotechnical Institute (NGI), Oslo, Norway

ABSTRACT: Longyearbyen, the administrative centre of the Svalbard archipelago, is facing most types of natural hazards under a changing Arctic climate. The catastrophic avalanche in December 2015 led NGI to review our professional work during 30 years of research and consulting in the community. Hazard zonation in Longyearbyen has been a tool in area planning, not for hazard assessment of developed areas, and mainly done during the early 1990s based on current knowledge and methods. The procedures for avalanche warning in Longyearbyen reflect that avalanche release is primarily a consequence of drifting snow, embedded surface snow and collapse of cornices. The first indication in meteorological data of a change in climate was a heavy rainfall midwinter 1995/96, years before global warming of the Arctic was documented. Field research in the 1990s documented that runout in terms of α-angle is longer in cold regions than in other areas. NGI has advised the local administration to revise the old hazard zones taking changing climate and up-dated knowledge and methods into account. The worst-case scenario in Longyearbyen will be a change towards present-day Norwegian Coastal climate with corresponding large avalanches, as well as increasing depth of the active layer and ditto potential for larger and more frequent debris flows and rockslides. Authorities and experts are facing challenging and difficult decisions concerning hazard zoning in a changing climate, design of mitigative measures, removal of exposed houses and extensive costs.

KEYWORDS: Arctic environment, climate change, natural hazards, mitigation, research, consulting

1. INTRODUCTION

Changes in thermal regime and hydrological conditions in Arctic regions are a threat and a challenge to human activity. Longyearbyen, the administrative centre of the Svalbard archipelago, is located below steep mountain slopes on the banks of a braided glacial river (Fig. 1). Due to lack of space, avalanches, slushflows, debris flows, rockfall, gelifluction, creep, drifting snow and floods interfere with buildings, roads, bridges, pipes, masts etc. (Lied and Hestnes 1986, Hestnes and Lied 1991).

The Norwegian Geotechnical Institute (NGI) has studied natural processes at Svalbard and in Longyearbyen since 1985. Research reports and more than 75 consulting documents for the local administration and companies have thrown light on these problems. Education and assistance during critical weather periods are other professional services given. On 19 December 2015, a shocking avalanche demolished 11 houses, trapped 25 people, hereby 10 injured and 2 victims (Fig. 2). The potential hazard was known and evacuation routines established. So, why did it happen?

After the disaster, NGI has reviewed our professional role and recommendations given during these past years. This paper summarizes the actual processes dealt with, methods used and our advice to questions asked, in view of the currently available meteorological data and ongoing applied research on hazards related to Arctic environments.

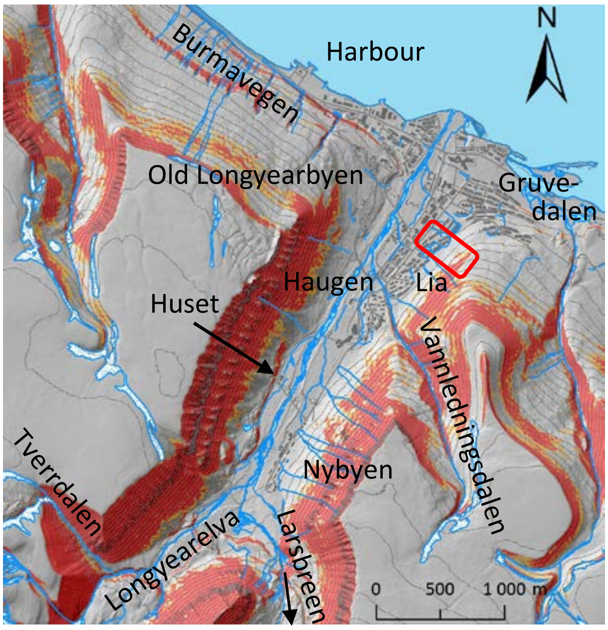

Fig.1: Longyearbyen. The town is located below step mountainsides. Names in the paper is shown.

* *Corresponding author address:*
Erik Hestnes, Natural hazard Division, Norwegian Geotechnical Institute, PO Box 3930 Ullevål Stadion, 0806 Oslo, Norway.
Tel: +47 41857922, e-mail: eh@ngi.no

2. THE SETTLEMENT

The Arctic Coal Company established by US citizen J.M. Longyear started mining at the site in 1906. The company was sold to Store Norske Spitsbergen Kulkompani AS (SNSK) in 1916. The settlement at 78º north changed name from Longyear City to Longyearbyen in 1926. A large change took place on New Year 1989 when the company split in three divisions: Mining, business development and community administration. What previously was a company town, almost overnight became an open society. Today's Longyearbyen is an expansive centre of university education (UNIS), tourism and business, with a civil administration.

The location of the old settlement shifted with the opening and closing of adits in the mountainsides. The main part of the settlement moved to the east side of the river after the Second World War and a marked expansion in more hazard-prone areas started. The town has grown even faster after 1989, now constraining the floodplain and growing along the foot of the NE-facing mountainsides as well, i.e. in the harbour area and in Gruvedalen (Fig.1).

The Governor of Svalbard - the local authority and police of the Norwegian Arctic - is located in Longyearbyen. The Governor cooperate with and support the local administration when increased surveillance on potential hazards is needed.

3. DOCUMENTED PROBLEMS

Annals containing information on damage to people, buildings and infrastructure due to natural hazards have been inaccessible. However, NGIs research in 1985 including contact with the general manager of SNSK (Lied and Hestnes 1986,), and cooperation with the local authorities on such topics since 1990, have thrown light on the problems.

Avalanches and debris flows do occur from all mountainsides and smaller slopes steeper than approximately 27º (Larsson 1982, Lied and Hestnes 1986, Hestnes 1995, Eckerstorfer 2012). They may interfere with buildings and infrastructure close to the slopes all over the settlement. Damage to buildings and infrastructure as well as many narrow escapes are reported both on and below the western and eastern slopes. The access roads to the up-valley parts of the settlement are frequently closed by avalanches. The catastrophic avalanche of 19 December 2015 is a very sad reminder of the seriousness of the problems (Figs. 2-3,).

Break-off of cornices from the rim of the surrounding plateaus are a documented threat, as separate events and a trigger of larger avalanches (Hestnes and Lied 1991, Hestnes and Bakkehøi 2003, Vogel et al. 2012). The size and frequency of debris flows depend on the weather conditions, the depth and texture of the *active layer* and the soil-water content at the time of release (Fig. 4).

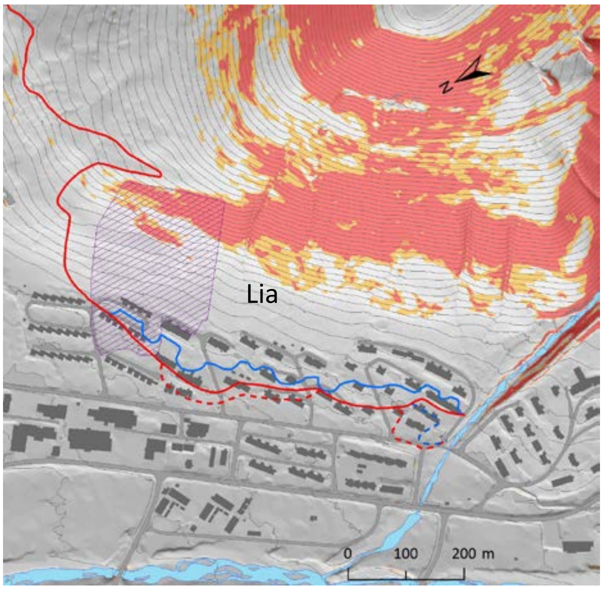

Fig. 2: Lia and Vannledningsdalen (right). The hazard zones of avalanches (red) and debris flows (red dotted). The disastrous avalanche 19 December 2015 (violet).

Fig. 3: Lia. The SE wind is coming from the valley in the background and is mainly depositing snow in the low hillside above the houses to the left.
Photo E. Hestnes

Slushflows from Vannledningsdalen *(Water-pipe Valley)* have caused considerable damage three times, most recently in 2012. The most catastrophic one demolished the hospital, staff quarter and two more buildings on 11 June 1953. Three people died and 30 were injured, some severely (Ramsli 1953, Balstad 1955, Hestnes and Kristensen 2010). Interviews by Ramsli after the accident documented many similar events before the fan was urbanized.

Fig.4 Houses in road 226 are built on old debris and debris deposited in 1972, and hit by a debris flow in 1981. Photo E. Hestnes.

Debris from a far bigger slushflow surging across the floodplain smashed a window in a bakery on the opposite riverbank. Smaller slushflows have reached the location of the new harbour-area, and those from Tverrdalen interfere with the access to Longyearbreen, while potential slushflows from Larsbreen may reach Nybyen (Fig. 1).

Rockfall from the steep cliffs is frequent. So far, it presents a problem primarily to cableways and constructions by the adits below the cliffs on both sides of the valley, the community centre and restaurant, as well as the road on the western side (Fig. 5). If the permafrost horizon shrinks as predicted, *rockslides* from these cliffs might become a critical hazard in the future.

Gelifluction and creep are active processes in low-angle slopes of existing and abandoned parts of the town as well as in steep slopes (Washburn 1979, Lied and Hestnes 1986). They are not always taken properly into consideration during construction.

The glacier rivers from Larsbreen and Longyearbreen feed the floodplain. Masses are removed from the riverbed every summer to prevent damage to infrastructure and settlement. However, massive bedload transport events causing damage to infrastructure are common. The ongoing expansion onto the floodplain reduces the natural accumulation basin. The consequences during a future extraordinary flood might be catastrophic. The river from Larsbreen is also a potential problem to Nybyen, which is partly located on the fan. NGI has not been involved in consulting related to these problems.

Snowdrifts and poor visibility are a recurring problem on roads, service roads and doorways in Longyearbyen. Drifting snow is the main cause of

Fig. 5 The community centre and restaurant Huset is exposed to avalanches and rockfall. Cornices are built along the rim. Rockslides might be a future problem. Photo E. Hestnes.

snow deposition in starting zones and thus of avalanche releases. During windy weather, precipitation is not even necessary for avalanches to be released (see Tbl.1 Sec. 5).

4. CHANGING PREMISES AND REQUIREMENTS

NGI has had a frank and professional relationship with the local administration and the Governor's office during the past 25 years. However, relatively frequent replacements of key staff in the Arctic town are an obvious drawback when it comes to dealing with infrequent natural hazards.

After the reorganization of SNSK in 1989, the community administration made a foresighted decision that future development should take place according to the safety requirements of the Norwegian Building and Planning Act. However, not until 2003 were these regulations officially put into force.

The recurring headache of the local administration has been the safety of existing houses. Some safety plans have been sketched and others discussed, but financial support for implementing them has been missing, except for the contribution by SNSK to the safety of the Haugen area against slushflows (Fig. 6). Finally, at the end of 2013, the Norwegian government decided to incorporate Svalbard in the national all-around settlement of financial support for hazard evaluation and safety measures.

Fig. 6 Opening of the drainage channel in Vannledningsdalen by bulldozer before periods of run-off. Photo E. Hestnes

A summary of problems related to processes and climate in Longyearbyen was presented in 1994 (Hestnes 1995). Meteorological data available at that time went only 38 years back in time. NGI has registered a gradual change in winter conditions since 1995, accelerating after the turn of the century. Public information on warming of the Arctic appeared approximately 10 years later and was focused in the local newspaper Svalbardposten in 2006-07 (Hestnes and Bakkehøi 2012). Safety requirements related to global warming have only recently (2014) been implemented in the Building and Planning Act.

Unofficially, NGI has taken changing climate in Svalbard into consideration in hazard evaluation since 2005. When the local administration started work on a new land-use plan in 2008, NGI advised them to revise existing hazard zones in view of updated knowledge, methods and future climatic conditions. When asked to review the draft of their final land-use plan in September 2015, NGI repeated our advice about revision of the 15-25 year old hazard zones.

5. RESEARCH AND CONSULTING

NGI's research and consulting in Svalbard over the past 30 years has greatly contributed to our knowledge of natural processes in Arctic environment and of natural hazards in general. Better modelling tools and better programmes for analysing meteorological data have continuously been implemented. Changing climate and weather conditions are now taken into consideration, but the future consequences are still highly uncertain (Hanssen-Bauer et al. 2015).

Detailed mapping of periglacial processes documented consequences to buildings and infrastructure, and ice wedges and large lenses were found to constitute a critical foundation problem (Fig. 7). Gelifluction and creep within the housing area have been monitored by inclinometers, and thermistor strings to a depth of 75-100 m in Longyearbyen and Svea have recorded changes in temperature (Lied and Hestnes 1986, Bakkehøi 2005). Problems related to periglacial processes will accelerate as the depth of the active layer increases.

Fig. 7 Large ice-wedges in a foundation cavity on road 232. Normally traceable by ground inspection. Photo O. Gregersen

The significance of drifting snow and wind speed to avalanche hazard in Arctic environment was documented early on as unexpected avalanches occurred four times within three years in Lia, Longyearbyen (Tbl. 1). One of these avalanches stopped close to one of the houses that were destroyed by the catastrophic avalanche of 19 December 2015 (Fig. 8). NGI's research also indicates that approximately 10% of naturally released avalanches in Svalbard may have an α-angle of 20° or less. The smallest registered runout angle (the angle between crown surface and toe of deposit) was 15° (Hestnes et al. 1999). This corresponds well to documentations of runout on level ground in the mountains of the mainland. Neither precipitation intensity nor the Norwegian α/β-model based on registered extreme avalanches in the fiordland and valleys of western Norway are valid for avalanche evaluation in Arctic environments.

Tbl. 1: Meteorological data from Svalbard Airport prior to avalanches in Lia, Longyearbyen

Date of avalanche	Precipitation mm				Average wind direction & speed and max. temperature deca-grades · metre/sec · °C		
	24hrs	48hrs	120hrs	240hrs	0-24 hrs	24-48 hrs	48-72 hrs
05.04.91	0.7	0.7	0.7	13.4	16 · 11.0 · -13.5	15 · 9.0 · -17.3	14 · 5.0 · -18.2
19.11.91	0.5	2.6	2.7	6.5	30 · 5.0 · - 3.5	25 · 8.5 · - 2.1	15 · 4.5 · -10.0
05.11.92	0.0	0.1	10.1	11.5	15 · 5.0 · -14.4	15 · 4.5 · -10.0	28 · 6.0 · - 2.1
16.03.93	0.1	0.2	16.6	17.7	16 · 9.0 · - 6.0	16 · 8.5 · - 5.8	16 · 8.5 · - 5.4

Fig. 8 Avalanches do occur almost every year in this part of Lia. This one was released 5 April 1991. Photo E. Hestnes (12 June 1991).

On 14 June 1989, just five months after the reorganization of the coal company (SNSK), a small slushflow from Vannledningsdalen hit the Haugen area damaging one house, and destroying the main water and heating pipes. NGI offered straight away our service to the new community administration, knowing from experience that many houses were at risk and that the existing protection measures were mismanaged (Figs. 9a-b). As a consequence, a wide variety of practical problems related to rapid mass movements and drifting snow were dealt with during the early 1990s, including establishing routines for handling acute problems and evacuations (Hestnes 1993). NGI has later on complemented and extended previous work, and private developers and enterprises have been served as well.

Fig. 9a The small slushflow 14 June 1989 climbed the old guiding dam and damaged a private home. It went on to the floodplain breaking the water and heating pipes and closing three roads.
Photo K. Anthonsen

Fig. 9b The guiding dam in August 1987. The channel filled with debris and water has undercut the side. The channel and dam are maybe not maintained since construction in 1953. Photo K. Lied

6. KEY FACTS CONCERNING CONSULTING

Hazard zoning in Longyearbyen has been a tool in area planning, not for hazard assessment of developed areas. It was primarily done during the early 1990s based on current knowledge and methods. In 2015, NGI recommended a revision of the old zoning based on today's knowledge, models, and the new requirements related to global warming in the Building and Planning Act. However, the request for financial support was declined by the granting authority.

Mitigative measures against slushflows from Vannledningsdalen have been a recurrent question, especially in land-use planning. In 1990, NGI recommended guiding dams in the runout zone and stabilizing the snowpack in the flat basin up-valley by strong wire-nets. Due to lack of financial resources, the community had to carry on opening the drainage channel by bulldozer before the melting season in May (Fig. 6). A review of the established routines in 1994 showed no failure vis-à-vis meteorological data over the last 38 years, but human negligence had resulted in slushflows in 1960 and 1989. NGI recommended an important supplement to those routines, expressing: *If the weather forecasts indicate potential hazard earlier in the winter season, opening of the channel will be carried out.* Already the following year, a critical rain-on-snow event occurred in December, and such events have occurred many winters after the turn of the century. The most recent destructive slushflow occurred on 30 January 2012 (Hestnes and Bakkehøi 2012). Since then, the local community has planned permanent safety measures as advised by NGI in 1990. The construction plans are now completed, but financial support is still missing.

Safety measures against avalanches and debris flows have been on the agenda since 1990. A few plans are completed, others set apart. Routines for controlled release of cornices from the rim above Nybyen, as SNSK had done when the mine below was in operation, was promptly dismissed as unfit for use (Fig. 10, Hestnes and Lied 1991). The catastrophic event in December 2015 has renewed the focus on the safety of existing houses. It is evident that in some areas houses will have to be removed, in some cases to make room for safety structures for other houses. According to a previous consulting report by NGI may slushflows and avalanches reach the new quay area (Fig.1, Bakkehøi 2008).

Snow fences were considered in 1990-1992 for reducing cornice formation and accumulation of snow in the most critical starting zones. In the same period, plans for using fences and redesign of roads to reduce problems with snowdrifts in doorways, on service roads and roads were drawn. The plans that have been implemented have proved successful. The established fences are with vertical boards to prevent children from using them as climbing frames. However, the builder did not take the indicated wind loads into consideration, so the constructions had to be strengthened after partial failure (Fig.11).

Fig.11 Snow fence before strengthening the construction and adjusting the ground clearance. Photo E. Hestnes

Fig.10 Nybyen 27 February 2003. Mid-winter and very little snow. Only small cornices along the rim above. The starting zones and paths for avalanches and debris flows below the rim are easily observed. Rockslides might be a future problem. All houses are within the hazard zone. Photo E. Hestnes

Besides the routines for controlling the slushflow hazard from Vannledningsdalen, an operational programme for handling potential avalanche situations in Lia was prepared by NGI (Hestnes 1993). Training of key personnel was part of the programme. The programme was soon modified for use throughout town, and since the basics of the program were general it was functional for forecasting and handling other natural hazards (slushflows, debris flows) as well. Even though the recommended instrumentation in the field was never completed, the routines seemed to work well, and an information pamphlet was prepared in 1996.

7. THE WARNED CATASTROPHE

A disastrous avalanche in Lia was foreseen. NGI had noted during our research work in 1985 that all houses closest to the hill foot were endangered. The safety deputy of the community confirmed our opinion in 1990. He assumed that the houses on roads 228 and 230, which were hit in 2015, were the most exposed ones. These houses were built in 1976. There was an unconfirmed report that at least one of them had been hit before 1990. In the early 1990s, NGI examined deposits from another avalanche that had stopped less than 5 m from one of these houses. The frequent occurrence of small avalan-ches on this low hillside is the reason why the local administration focused on safety measures above these houses, and that the initial procedures for handling avalanche hazard were specifically developed for this area (Hestnes and Bakkehøi 1992, Hestnes 1993) (Fig. 8, Tbl. 1).

In 1992, NGI suggested that the probability for avalanches reaching the houses on road 228 and the eastern end of road 230 to be 1/20-1/30 per year, and that evacuation due to potential avalanche danger would be necessary once in five years on average. The angle between the expected position of the fracture crown and the uppermost houses was 20-21º. The avalanche velocity at the location of the houses was estimated to 10-15 m/s, increasing from NW towards SE. Different safety measures were optional (Hestnes and Bakkehøi 1992). However, snow depth in the starting zone varies greatly from winter to winter and more than 4 m of snow (measured normal to the terrain) has been documented. This implies that standard supporting structures were not a viable alternative unless snow accumulation could be reduced considerably by means of snow fences.

Lack of financial resources forced the community to stop further work on safety measures. But why were the existing procedures for handling potential avalanche hazard suspended? Why did nobody take action based on the exceptionally bad weather forecast? NGI has always taken immediate action when asked for help. We got no request this time and we did not know that the routines were off use.

8. THE EXPERTS REFLECTIONS

The catastrophic avalanche in 2015 stopped 25-60 m beyond the hazard zone based on the experience and runout models available in 1992. The registered runout coincides well with back-calculations based on today's knowledge and models (Fig. 2). The α-angle was approximately 16º, not a surprising value in Arctic environments.

The strength and attaching to the foundation of the demolished wooden houses were clearly overrated in the zonation (Hestnes and Bakkehøi 2001). It is likely that saved lives. People were rescued from wrecked houses moved 30-80 m. NGI approached the local administration in 2008 and again in 2015 concerning up-dating of the hazard zones based on current knowledge and requirements. We did not contact the community when strong gales and periods of hurricane-force winds from SE were forcasted by the Norwegian Meteorological Institute on 18 December 2015, since routines for handling such situations existed in Longyearbyen. When and why were these routines suspended? Why did nobody initiate evacuation in Lia and Nybyen on 18 December?

The worst-case scenario in Longyearbyen will be a change towards Norwegian Coastal climate with corresponding large amounts of snowfall and large avalanches, accompanied by an increasing depth of the active layer and concomitant potential for larger and more frequent debris flows and maybe rockslides. Authorities and experts are facing challenging and difficult decisions concerning hazard zoning in a changing climate, design of mitigative measures, removal of houses and the financial consequences of these measures.

ACKNOWLEDGEMENT

The authors wish to thank the SNSK, the community administration and the Governor's office for their obligingness and pleasant collaboration during 30 years of work at Svalbard. We also gratefully acknowledge D. Issler for his thorough discussion of the manuscript, colleagues and local informants for their contributions, and T. Gregory and G.K. Hestnes for devoted help.

REFERENCES

Bakkehøi, S. 2005: Presentation of data from the NGI permafrost station in Svea, Svalbard. International Conference on Capasity of Roads, Railways and Airfields (BCRA'05). Pre-Conference Workshop, 1, Airfields in Cold Climates. Longyearbyen. *NGI-Report 527014-02*, 5 pp.

Bakkehøi, S. 2008: Burmavegen. Vurdering av skredfare. (The Burma road. Evaluation of hazards.) *NGI-Report 20081311-1*, 33 pp.

Balstad, L. 1955: *Nord for det øde hav*. (North of the desolate ocean.) J.W. Eides forlag, Bergen, 428 pp.

Eckerstorfer, M., 2012: Snow avalanches in central Svalbard: A field study of meteorological and topographical triggering factors and geomorphological significance. *Ph.D. Thesis*, UNIS/UiO.

Hanssen-Bauer, I., E.J. Førland, I. Haddeland, H. Hisdal, S. Mayer, A. Nesje, J.E.Ø. Nilsen, S. Sandven, A.B. Sandø, A. Sorteberg and B. Ådlandsvik, 2015: Klima i Norge 2100. Kunnskapsgrunnlag for klimatilpasning oppdatert i 2015. (Climate in Norway 2100. Basic knowledge for climatic adaptation updated 2015.) *NCCS report 2*, 204 pp.

Hestnes, E. 1993: Lia, Longyearbyen. Rutiner for akutt skredfarevurdering. Forslag til hjelpemidler, observasjonsprogram, evaluering av innsamlede data og tiltak. (Lia, Longyearbyen. Routines for acute hazard evaluation. Suggestions of remedies, observation program, evaluation of collected data and measures.) *NGI-Rapport 904025-7*, 29 pp.

Hestnes, E. 1995: Impact of rapid mass movement and drifting snow on the infrastructure and development of Longyearbyen, Svalbard. Proceedings of the *Tenth International Northern Research Basins Symposium and Workshop*, Spitsbergen, Norway 1994, 23-46.

Hestnes, E. and S. Bakkehøi, 1992: Lia, Longyearbyen. Vurdering av snøskredfare og tiltak for å hinder ulykker ved veg 226-230. (Lia, Longyearbyen. Evaluation of avalanche hazard and mitigative measures for preventing accidents in road 226-230.) *NGI-Rapport 904025-2*, 26 pp.

Hestnes, E. and S. Bakkehøi, 2001: Vannledningsdalen--Gruvedalen. Skredfarevurdering, (Vannledningsdalen--Gruvedalen. Hazard evaluation.) *NGI-Report 20011167-1*, 71 pp.

Hestnes, E. and S. Bakkehøi, 2003: Nybyen, Longyearbyen. Skredfarevurdering. (Nybyen, Longyearbyen. Hazard evaluation.) *NGI-Rapport 20031134-1*, 21 pp.

Hestnes, E. and S. Bakkehøi, 2012: Vannledningsdalen. Et sammendrag av tidligere vurderinger av sikkerhet og tiltak. (Vannledningsdalen. A summary of previous evaluations of safety and mitigative measures.) *NGI-Rapport 20120153-00-2-R*, 43 pp.

Hestnes, E., S. Bakkehøi, K. Brattlien and K. Onarheim, 1999: Snø og snøskred på Svalbard. Registrering av snøforhold, snøskred og utløpslengder. (Snow and avalanches in Svalbard. Observations on snow conditions, avalanches and runout lengths.) *NGI-Report 589100-4*, 43 pp.

Hestnes, E. and K. Kristensen, 2010: The diversity of large slushflows illustrated by selected cases. Proceedings of the *International Snow Science Workshop*, Squaw Valley, CA, 348-355.

Hestnes, E and K. Lied, 1991: Vurdering av tiltak mot snøskred, sørpeskred og drivsnø i Longyearbyen. (Evaluation of mitigative measures against avalanches, slushflows and drifting snow in Longyearbyen.) *NGI-Rapport 904025-1*, 61 pp.

Larsson, S., 1982: Geomorphological effects on the slopes of Longyear Valley, Spitsbergen, after a heavy rainstorm in July 1972. *Geogr. Ann.* 64 A, 105-125.

Lied, K. and E. Hestnes, 1986: Geomorfologisk kartlegging av overflatestrukturer i Longyearbyen, Svalbard. (Geomorphologic mapping of surface structures in Longyearbyen, Svalbard.) *NGI-Rapport 52703-1*, 62 pp.

Ramsli, G. 1953: Skredet i Vannledningsdalen, Longyearbyen 11. juni 1953. (The slushflow in Vannledningsdalen, Longyearbyen 11 June 1953.) *Notat, Statens Naturskadefond,* 3 pp.

Vogel, S., M. Eckerstorfer and H.H. Christiansen, 2012: Cornice dynamics and meteorological control at Gruvefjellet, Central Svalbard. *The Cryosphere*, 6, 157-171.

Washburn, A.L. 1979: *Geocryology, a survey of periglacial processes and environments.* 2nd edit. Edward Arnold, London.