

EXCURSION GUIDE



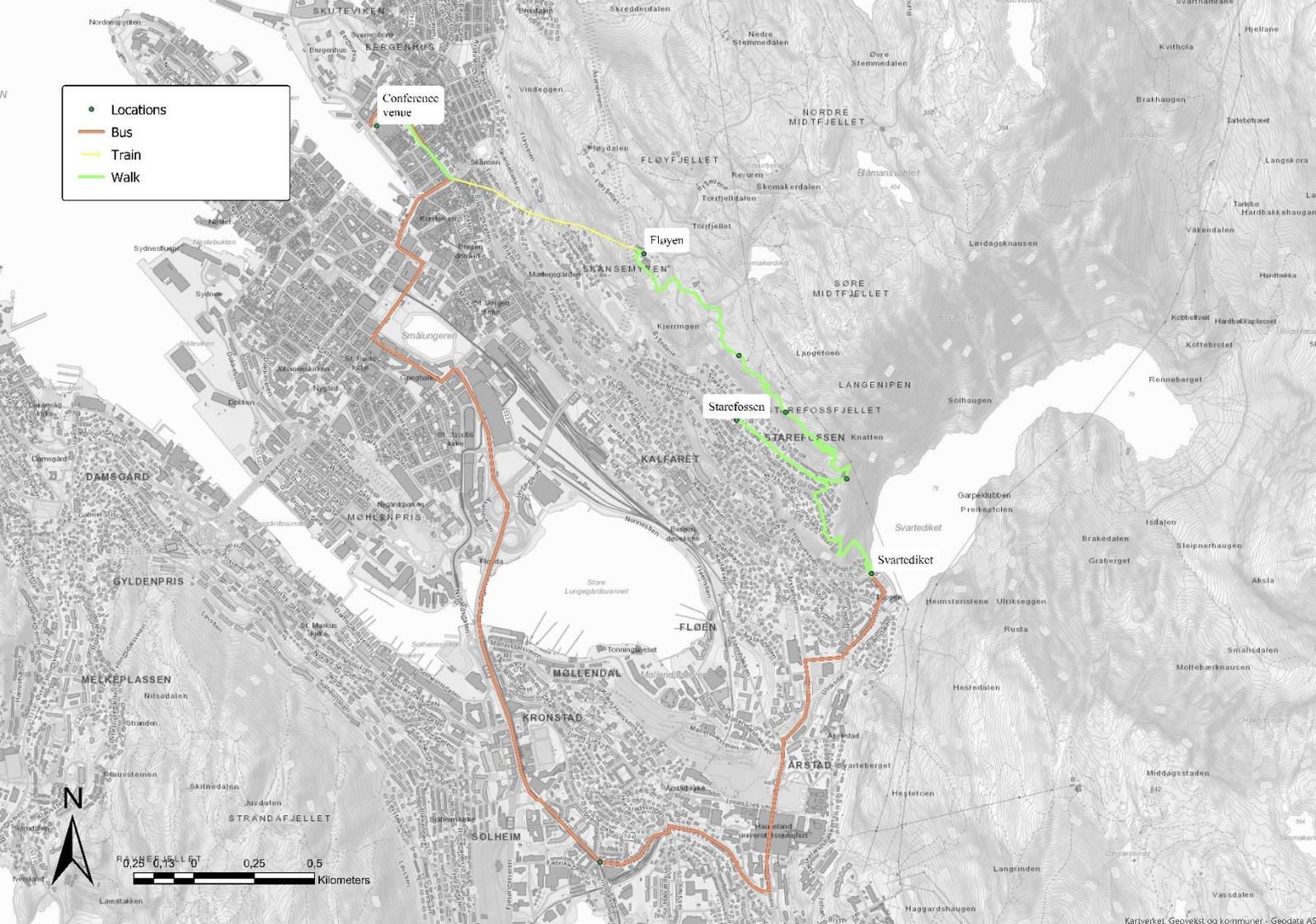
INTERPRAEVENT

2020 – Bergen, Norway

# URBAN FLOODING MITIGATION IN BERGEN

Date: May 13th





## INTRODUCTION

The cable car *Fløibanen* will take us to the viewpoint Fløyen, where the Municipality of Bergen and the Chief of Emergency Management will give a lecture. Focus will be on risk and emergency management connected to surface water in the city of Bergen.

From Fløyen we will walk to *Starefossen*. This is a location where a small river runs into the settlement. The river causes trouble during all heavy rain periods.

From Starefossen we will walk to *Svartediket*, the drinking water reservoir of Bergen, where we will talk about a *Forest protection* project.

The Directorate for Cultural Heritage will give a guided walk, concerning safeguarding the world heritage site of *Bryggen in Bergen*.

## SCHEDULE

- 07:30** Meet at Bergen Bryggen hotel
- 08:00-08:30** Cable car to Fløyen
- 08:30-09:30** Lecture on Fløyen
- 09:30-11:30** Walk: Starefossen & Svartediket
- 11:30-13:30** Lunch
- 14:00-15:30** Guided walk Bryggen in Bergen

# Location 1: Fløyen

## FLØIBANEN

Fløibanen is a cable car that runs from the center of Bergen to the viewpoint Fløyen (figure 1). There are two carriages attached to a cable, which are driven by two large drive wheels located in the engine room at Fløibanen's upper station. The flow paths run on electricity and are led by the carriage driver. Fløibanen opened in 1918. It is Bergen's most visited tourist attraction. In addition, the Fløibanen is the natural means of transport for the residents along the mountain side and the kindergartens on Fløyen.



Figure 1. Restaurant on Fløyen (Municipality of Bergen).

## “RISK AND EMERGENCY MANAGEMENT IN THE CITY OF BERGEN”

The chief of emergency management / Municipality of Bergen will give a lecture about Bergen's risk and emergency management. Bergen Water and Sewerage department will give an introduction to the municipality's Master plan for Storm Water (figure 2).

*Starefossen* is given as an example of how Bergen municipality work with issues connected to surface water management.



Figure 2. Master Plan for Storm Water (Municipality of Bergen).

## Location 2: Starefossen

### AN EXAMPLE OF RUN-OFF MANAGEMENT IN BERGEN

Starefossen is a smaller watercourse that runs through older city areas (figure 3). During heavy rainfall, the watercourse regularly goes over its banks, finding new paths and causing damage – to the inhabitants' great frustration.



Figure 3. Starefossen (Municipality of Bergen).

The situation is not new: Because the responsibility and ownerships along the watercourse is divided between many different institutions/people, little has been done to improve. The City of Bergen will now take the overall responsibility for the watercourse. This means figuring out possible measures, giving orders to private and public actors, and implementing measures under municipal auspices cannot place responsibility on others.

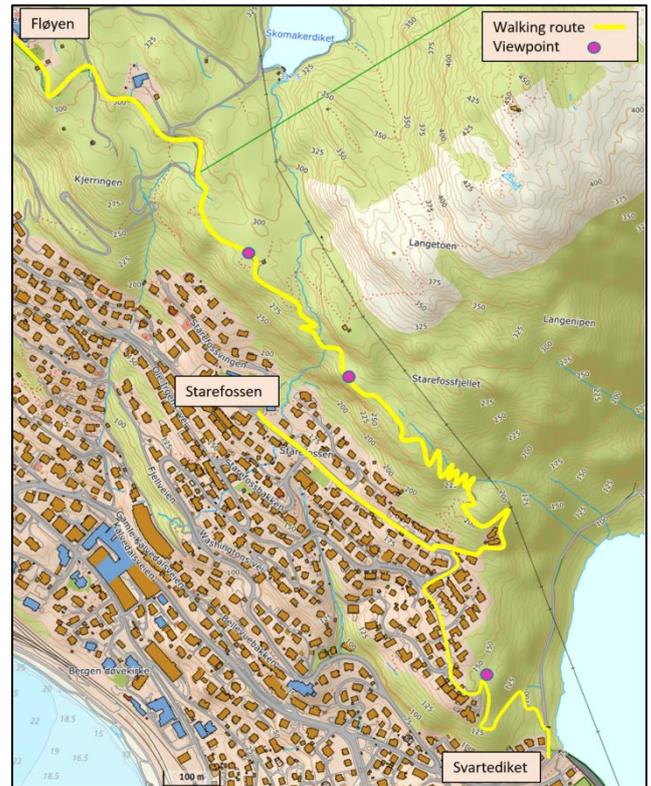


Figure 4. Walking route.

# Location 3: Svartediket

## AVALANCHE AND FOREST

Just after the Second World War Norwegian spruce, and to some extent Sitka spruce and other foreign tree species, were planted with high enthusiasm. With plenty of available space, huge subsidies, but limited knowledge the forest administration motivated the landowners to plant. Some of these forests were planted in steep slopes without infrastructure. This forest does today set the agenda for much of the debate about mitigation forest in Norway.

Many municipalities in western Norway see the need for to use the forest to mitigate natural disasters. Still, the logging volume has been rising the latest years and the clear cuts have increased in size. The municipalities are facing many questions; choice of tree species after logging, how to convert a monoculture forest into a more varied and stable forest (figure 5). Another issue is how to establish new forest roads without causing trouble.



Figure 5. Monoculture (a) vs a more varied and stable forest (b) (Norwegian Water Resources and Energy Directorate, NVE).

A clear legislation, smart delineation of important areas and good examples of forest management are missing in areas where forests are important for mitigating natural hazards.

Bergen city has chosen to be a pilot municipality in looking for practical solutions in some areas. The Svartediket valley, water supply source for the City of Bergen, is one of these areas (figure 6).



Figure 6. Forest around Svartediket (NVE).

Agency for Water and Sewerage Works in Bergen municipality see nature based solutions as a possible way of solving important public obligations. They aim to test natural solutions that are cost efficient compared to traditional technical mitigation measures.

Forest management, tree species mixture and logging types can both improve or reduce the forest's function as protection. Forest management, natural regeneration or banning large clear cuts would not prevent the forest owners from making a profit, but would call for more forest competence.

Until today, there has been little focus on integrating natural resource management in communal planning. Particularly in western Norway, the aim of the forest industry production of the biggest volume per hectare productive forest area. This shifts the activity towards the planted spruce areas, while the remaining area of fir and leaf woods see little activity.

A holistic area planning and ecosystem based management can reinforce the ecosystem's services. Forest as a natural ecosystem work as a buffer against floods, reduce runoff, depletion of nutrients and prevents 500-600 mm rainfall reaching ground yearly (by interception), binding earth particles and clean air and water, particularly in urban areas.

## **PROJECT GOALS**

The aim of the project is to make an overview of possible mitigating measures, and find necessary solutions to reduce natural hazards in areas where forests have considerable importance in protection.

The project will also aim to put forests in a financial context, increase risk knowledge, and show synergies related to forest management. And, at last, investigate the need for changes in forest management methods.

## **ACTIVITIES**

- Multidisciplinary discussions in field
- Expert exchange with forest management services from Bavaria and Switzerland
- Cost/benefit analysis in collaboration with Norwegian Institute of Bioeconomy Research (NIBIO).
- The Bergen forest and tree planting company, in collaboration with the County Governor of Vestland, wrote a note for the company board and Bergen municipality.
- Planning logging with cable crane in a demo stand. Primarily to prevent clear cuts, but also to facilitate natural regeneration and stabilizing tree species.
- Conduct logging in winter of 2019/2020.

# Location 4: Bryggen

## SAFEGUARDING THE WORLD HERITAGE SITE OF BRYGGEN IN BERGEN

The Directorate for Cultural Heritage will give a guided walk along Bryggen in Bergen and give an overview of an ongoing monitoring project as well as general history about the old buildings (figure 7).

The standing buildings, which were built after the fire in 1702, rest on archaeological deposits up to 10 meters thick materials, rich in organic content. The deposits consist of the remains of previous settlements and the people who lived and worked there from the 11<sup>th</sup> century.

Surveying of the buildings at Bryggen showed that there was considerable subsidence damage.

The rate of settling was so high that there was a need to find the reason for this. The purpose was to initiate mitigation measures to reduce the subsidence.

Groundwater and surface water is a prerequisite for ensuring that the rich organic cultural layers can be safeguarded and provide stable ground conditions for the buildings above. Sinking groundwater allows free access to air and microbes, and the organic deposits decay. A surface-water infiltration system has been established to ensure sufficient groundwater levels in the cultural deposits. In addition to perforated pipes in trenches, the system consists of rainwater gardens and swales in the park at the rear of Bryggen (figure 8).



Figure 7. Bryggen in Bergen (Municipality of Bergen).



Figure 8. Rain Garden behind Bryggen in Bergen (Municipality of Bergen).

## Authors

Hanne Merete Moldung (The  
Directorate for Cultural Heritage)

Hogne Hjelle (Municipality of Bergen)

Odd Are Jensen (NVE)

Simon Wolff (Municipality of  
Bjørnafjorden)

Front: High sea level at Bryggen in  
Bergen, Arthur Gebuys/Alamy Stock  
Photo.

