

# **INTEGRATION OF FLOOD RISK INFORMATION INTO LAND USE PLANNING IN NORWAY**

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A major flood affecting large parts of the south of Norway in 1995 represented a watershed in Norwegian flood risk management. This paper gives a brief overview of the development of flood risk management in Norway since 1995 with special emphasis on how flood risk information is integrated with land use planning.

## **INTRODUCTION**

Norway has a long tradition in managing floods due to its wet climate, many rivers and mountainous terrain. Flood risk management consisted in the main part before 1995, of traditional physical flood protection works such as flood levees and erosion protection consisting of stone rip rap. In fact much of the know-how on construction and engineering in Norway was actually obtained from the river engineering communities in Austria and Southern Germany. There are records as far back as the 1700's of contact between Norwegian and German engineers. The major actor at the national level dealing with flood risk management, The Norwegian Water Resources and Energy Directorate (NVE), dates back to 1804.

Norway experienced a major flood in the south-eastern part of the country in 1995. The total economic damage of the flood was USD 250 mill and 7000 people were evacuated. A Commission on Flood Protection Measures was established by Royal Decree after the flood. The Commission produced an Official Norwegian Report (NOU 1996:16) and the report was followed up by a government White Paper (nr 42 1996-1997 – Measures against floods). The White Paper is regarded as a nation action plan for Norway on measures against floods.

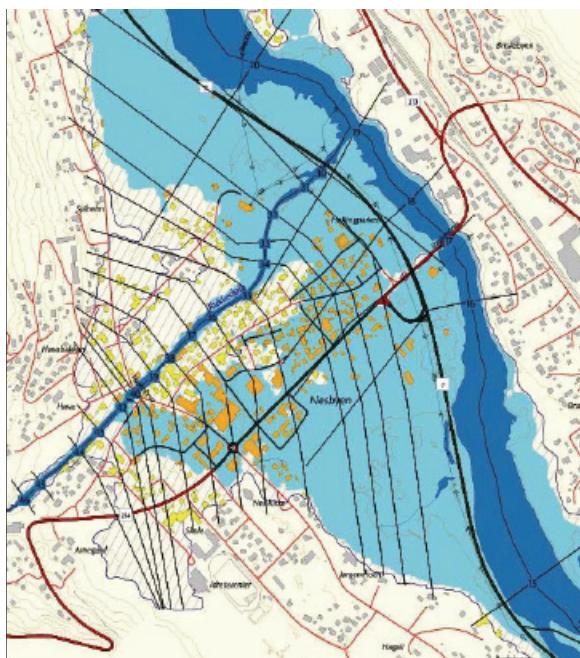
## **MANAGEMENT TOOLS - FLOOD INUNDATION MAPPING AND GUIDELINES FOR LAND USE**

A central message in the commissions work was that an integrated approach is necessary in planning and carrying out flood protection measures and that the 'most important measure to reduce flood damage in the future is to improve land use planning in flood prone areas'. The report and White Paper initiated a major research programme (HYDRA), and the flood forecasting system was continued and strengthened and extra funding for physical protection works was provided. Most importantly however was that a flood inundation mapping programme was initiated and 6 new positions as land use planners was provided to strengthen NVEs role as the national authority responsible for ensuring acceptable land use in areas with a risk of flooding.

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The overall objective of the flood inundation mapping programme is to reduce flood damage through improved land use planning. The programme started in 1998 and will continue through 2007. A total of 134 areas covering approximately 1100 km of river length will be mapped and 100 maps have been produced so far. The maps are provided digitally to enable users to make their own presentations in combination with other information. The method includes flood frequency analysis, hydraulic simulation based on surveyed cross section of the river bed, GIS analysis identifying inundated areas based on a digital elevation model with high resolution (5x5m) and vertical accuracy (+/- 30 cm).



**Fig. 1:** Flood inundation map

2006/2007. The main philosophy behind the guidelines is to quantify and define acceptable risk for different types of assets. The guidelines define safety standards for three types of hazard (floods, debris flows and quick clay slides). They also outline recommended procedures for risk assessment at different planning levels for floods and quick clay landslides. NVE uses its right to object to plans contradicting the guidelines actively as a measure to hinder development in flood risk areas and as a tool to enter dialog with local authorities on best practice land use.

## CONCLUSIONS

It is difficult to exactly measure the effect of measures such as flood maps and guidelines on land use planning but the response of local authorities has been positive. In several cases these have either hindered new development in flood risk areas and led to restrictions on land use. In other cases it has led to flood protection of existing development where this has not been sufficiently safe. It is our impression that local authorities are becoming more aware and willing to take flood risk into account due to both the maps and guidelines.

**Keywords:** flood management, land use planning

The main target groups are municipalities and county officials, who are responsible for land use planning and emergency planning at local and county levels respectively. The modelling is performed for six different flood levels, the 10-, 20-, 50-, 100, 200- and 500-year floods.

All maps are officially presented to the local authorities and a press conference is held. They are presented by a representative of the group that has produced the map and a land use planner. This is to ensure that the maps are to be understood and used as tools in land use planning.

NVE is responsible for land use planning in flood risk areas at a national level and guidelines for land use in flood risk areas were issued in 1999. These were revised in