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# **Countering the Impacts of Climate Change.**

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# Foreword

This study report surveys and investigates the local level responses to floods caused by climate change in Helsinki and Kittilä, Finland. The survey has been carried out in flood-prone municipalities (both inland and coastal) in order to identify the main (perceived) challenges and the current best practises. The main objective of the project is to develop, in cooperation with selected municipalities and other stakeholders, *Climate Change Guidelines for Flood-Prone Municipalities* specifically relating to the question of how to take into account the climate change related civil protection vulnerabilities, particularly rising water levels, drainage issues and the effect of heavy rains etc., in municipal spatial planning in a more integrated manner.

Study material for the report has been collected from several interviews and seminars, such as Climate Conference in Tampere in May 2008, organised by the Association of Finnish Local and Regional Authorities<sup>1</sup> and the CIVPRO Seminar on Climate Change and Floods held in Kittilä, 6 June.2008. Furthermore, the report analyses available written documents on this issue.

Some of the following questions have been addressed: How does climate change affect priorities in municipal policy? How comprehensively has climate change been taken into account in municipal work? What kind of situational awareness (or knowledge) do the municipal decision-makers have on the impacts of climate change? What are the main challenges related to tackling the floods caused by climate change? What are the best practises learnt from previous flooding incidents? How have policies developed since the last flooding incident? How does cooperation between organisations and different decision-making levels work?

We would like to thank all the individuals and institutions who have participated in the project and in the preparation of this report.

The Authors

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<sup>1</sup> Kuntien 4. ilmastokonferenssi. Tampere 6.-7. May 2008.

# 1. Introduction

It has become established scientific knowledge that the global climate is warming and that this change is mainly caused by human activities. The percentages of greenhouse gases (GHG) in the atmosphere are at the highest level ever recorded and are still increasing.<sup>2</sup> Even if the emissions were brought to the level of the strictest obligations established by international treaties, the effects of climate change could not be totally avoided, even though the severest ramifications can be reduced by cutting anthropogenic GHG emissions.<sup>3</sup> Thus, climate change has to be addressed, both by reducing GHG emissions (mitigation) and by planning strategies to adjust to its impacts (adaptation). Both means are necessary in order to reduce financial and humanitarian risks.

Increased flood risk is one likely consequence of climate change. The annual precipitation in Finland as well as in the whole Baltic Sea region, is likely to increase, especially during winter. Heavy rain together with more frequent storms cause an additional risk of flooding. Floods can have several effects: physical damage, casualties, water contamination, diseases, shortage of food crops, economic and psychological losses.

Risks caused by extreme weather conditions can be controlled with anticipation and planning. Risk management related to recent severe weather events caused by natural variation and those caused by climate change are somehow similar events and can be tackled by similar measures.<sup>4</sup> NaTech disasters, i.e. technological disasters caused by natural hazards are somewhat increasing and challenging the traditional risk map and the governmental, regional and municipal responses and preparatory plans.

## 1.1 Previous research and Methodology

There has been an increasing interest in climate change in recent years. Several policy-oriented studies have been made of adaptation strategies, including guidelines and recommendations for policy planners. For example, the Geological Survey of Finland has published a study titled "Towards Climate Change Adaptation Strategies in the Baltic Sea Region" as a part of the ASTRA project.<sup>5</sup> The ASTRA-project was partly funded by European Union and was led by the Geological Survey of Finland. The project partners

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<sup>2</sup> Carter T. R. (ed.). *Assessing the Adaptive Capacity of the Finnish Environment and Society under a Changing Climate*: FINADAPT. Finnish Environment Institute (SYKE) 2007, p. 11.

<sup>3</sup> Hilpert K., Mannke F., Schmidt-Thome P. *Towards Climate Change Adaptation Strategies in the Baltic Sea Region. Developing Policies and Adaptation Strategies to Climate Change in the Baltic Sea Region*. Geological Survey of Finland, Espoo 2007.

<sup>4</sup> Ministry of Agriculture and Forestry. *Finland's National Strategy for Adaptation to Climate Change*. Vammala 2005.

<sup>5</sup> Hilpert, K., Mannke, F., Schmidt-Thome, P. *Towards Climate Change Adaptation Strategies in the Baltic Sea Region*, Geological Survey of Finland, Espoo 2007.

came from six countries in the Baltic Sea region who addressed threats arising from climate change in the Baltic Sea area. The number of studies of adaptation and its cost and benefit estimates has also grown, though there are few comprehensive estimates of the costs and benefits of adaptation.<sup>6</sup> One of the most remarkable studies in this field is the Stern Review on the Economics of Climate Change, carried out for the British government by economist Lord Stern of Brentford.<sup>7</sup>

The Finnish Ministry of Agriculture and Forestry has published a comprehensive report on developing the preparedness for responding to flooding incidents and what to take into account regarding ageing infrastructures. The report was based on the findings of the working group in the Finnish Ministry of Agriculture and Forestry,<sup>8</sup> and it suggests that the aim should be to:

- 1) reduce the flood risks to infrastructures;
- 2) refrain from building any new infrastructures in flood-prone areas;
- 3) maintain the security of the water systems;
- 4) strengthen the response strategies so that even in the severest flood situations, prevention and rescue work can be done.

The pivotal recommendation is that there should be a coherent definition of risk levels. At the moment, buildings in Finland are secured from floods that occur approximately once a century. Some critical infrastructures should be secured from floods that occur even more rarely. However, even if rationalisation of the adaptive measures is implemented effectively, new construction in flood-prone areas should be avoided because of the increased risks that could thereby be caused.<sup>9</sup>

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<sup>6</sup> IPCC Fourth Assessment Report Climate Change 2007: Synthesis Report 2007, p. 56.

<sup>7</sup> Stern N. *Stern Review: The Economics of Climate Change*. Cambridge University Press 2007.

<sup>8</sup> Ministry of Agriculture and Forestry. *Suurtulvatyöryhmän raportti*. Helsinki 2003.

<sup>9</sup> Ministry of Agriculture and Forestry. *Suurtulvatyöryhmän loppuraportti*. Helsinki 2003.

# 2. Definition of Climate Change and Key Concepts

## 2.1 Climate Change

The Intergovernmental Panel on Climate Change, (IPCC) defines climate change as “a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external pressure, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.”The United Nations Framework Convention on Climate Change (UNFCCC) distinguishes climate change attributable to human activities, and climate variability attributable to natural causes. According to its definition climate change is “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. In this report, the IPCC definition of climate change will be used and will refer to any change in climate, whether human-induced or due to natural variation.<sup>10</sup>

The impacts of climate change on societies or natural systems can be either potential or residual. The potential impacts are those projected to take place if no adaptation measures are implemented. By residual impact is meant the consequences of climate change after adaptation measures are implemented. Impacts can be either positive or negative. Societies should prepare to take advantage of positive impacts and respond to negative ones.<sup>11</sup>

One of the most likely consequences of climate change is a rise in sea level. Already during the years 1961 to 2003 world sea levels have risen at an average rate about 1.8.mm per year. During the decade 1993 to 2003 the average rate was approximately 3.1.mm per year. So far, thermal expansion has been estimated to have contributed about 57%, to this rate, melting of glaciers and ice caps, 28%, with decreases in the polar ice sheets contributing the remainder of the increases. However, there is uncertainty whether the increase reflects a longer- term trend or a natural climate variation. The IPCC does not estimate the likelihood of the sea level rise because there is not enough understanding of all the drivers effecting sea level rise. Thermal expansion alone could cause arise 0.3 metres to 0.8 metres in sea level by 2300.<sup>12</sup>

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<sup>10</sup> IPCC *Fourth Assessment Report Climate Change 2007: Synthesis Report 2007* p. 4. See also: *Climate variability, Detection and Attribution. IPCC Fourth Assessment Report Climate Change 2007: Synthesis Report 2007* p. 4.

<sup>11</sup> Ministry of Agriculture and Forestry *Finland's National Strategy for Adaptation to Climate Change*, p. 10.

<sup>12</sup> IPCC *Fourth Assessment Report Climate Change 2007: Synthesis Report 2007*, pp. 30, 45-46.

However, the IPCC argues with a high level of confidence that one of the most severe impacts of future climate changes will be the exposure of coastal areas to increased risks. It is also projected with very high confidence that the beneficial impacts in freshwater systems will remain marginal compared to the negative impacts, such as seasonal runoff of the water supply, weakening of water quality and flood risk. Societies and their critical infrastructures (CI) will face challenges from increased flood risk, inland flash floods, more frequent coastal flooding and increased erosion due to these climate changes.<sup>13</sup>

## 2.2 Impacts of Climate Change in Finland

The impacts of climate change will accelerate in Finland during the coming decades. The climate is expected to become warmer and wetter during all seasons. Also extreme weather events are becoming more common. In the recent years serious economic damage has been sustained in Finland due to exceptional flooding and storms consistent with projected climate scenarios. The changes depend on the development of future GHG emissions; there are uncertainties about the changes because of the limited scientific understanding of the global climate.<sup>14</sup>

In Finland, the distribution of work related to management of water resources and prevention of floods is relatively clear. The highest authority responsible for preparing for floods and the safety of dams is the Ministry of Agriculture and Forestry, which, together with the Ministry of the Interior is responsible for coordinating and legislating work in this field. Regional environment centres, in subordination to the Ministry of Agriculture and Forestry, are the most important parties engaged in water resource tasks. They are responsible for the use and care of water resources in their own territories and, along with the Finnish Environment Institute, evaluate the risks related to floods and dams. Cooperation with rescue services also plays a vital role in flood prevention.<sup>15</sup> In addition to the Ministry of Agriculture and Forestry and the Finnish Environment Institute, the Ministry of the Interior and state rescue services participate in preparedness planning. Dam owners also have an obligation to draw up safety plans in case of flood as do the industrial plants located near water which must take the possibility of flood into account.<sup>16</sup>

The Finnish Maritime Administration monitors sea level heights. When the sea reaches risk levels, the Administration informs the local rescue services. Also other authorities provide information on exceptional weather events to the local rescue services.<sup>17</sup> The European Union's new directive on flood risk management will provide a more comprehensive approach to flood preparedness. It will contain

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<sup>13</sup> IPCC Fourth Assessment Report Climate Change 2007: Synthesis Report 2007, p. 30, 48-50.

<sup>14</sup> Carter T. R. (ed.). *Assessing the Adaptive Capacity of the Finnish Environment and Society under a Changing Climate: FINADAPT*. Helsinki 2007, pp. 44-45, 54.

<sup>15</sup> Ministry of Agriculture and Forestry. *Finland's National Strategy for Adaptation to Climate Change*. Helsinki 2005, p. 196.

<sup>16</sup> Frinking E. et al. *Riskienhallinta Suomessa. Esiselvitys*. Sitra. Helsinki 2002, p.70.

<sup>17</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely. Esiselvitys*. Helsinki 2007, p. 6.

sdirections for flood risk assessment, flood risk mapping and flood risk management. The implementation of the new directive in Finland will clear up after the national amendment is ready in the year 2009.<sup>18</sup>

The Finnish Government adopted a resolution on the Strategy for Securing the Functions Vital to Society in 2006. Among other things, the Strategy determines the state's crisis management model. The current Finnish Prime Minister, Matti Vanhanen, established a crisis management working group in 2007 to develop a new model for state's crisis management and its implementation at the local level. The working group is also examining key development areas at the local level and in steering mechanisms. The group submitted its intermediate report on the state's crisis management model in April 2008.<sup>19</sup>

The objective of the group is to ensure that the state's crisis management succeeds at all levels of the administration. The key areas under review are the distribution of work, the renewal of the state's crisis management at the local level during 2009 and organisation renewal. Currently, the Preparedness Act is being renewed. The working group addresses questions related to developing communication in a crisis, developing a picture of a crisis situation and situation awareness of crisis leadership and assessment, both of which are necessary for taking specific action and succeeding in crisis management. One key problem is how municipal management is to be informed.<sup>20</sup>

The working group has suggested that the state's local administration should be reorganised. Because the administration at the municipal level has been seen as one of the key development areas, a sub-working group has been established to address the Municipal Act and the responsibilities of municipalities. The working group suggests that at the local level one official organisation would be responsible for crisis leadership. At the moment, the division into regions is somewhat unclear since the police and the Rescue Administration are divided into different regions. The role of residents, often the first responders in case of flooding, is presently not defined.<sup>21</sup>

## 2.3 Critical Infrastructure Protection

The concept of critical infrastructure (CI) is comparatively new. It is closely related to the concept of critical infrastructure protection (CIP), which highlights the vulnerability of critical infrastructures. The concept originated in the United States in the mid-1990s and has since become widely used as an

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<sup>18</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely. Esiselvitys*. Helsinki 2007, p. 3.

<sup>19</sup> Aalto, Jari. Prime Minister's Office. *Valtion kriisijohtamismallin toteutuminen alue- ja paikallishallinnossa*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008. Kittilä, Finland.

<sup>20</sup> Aalto, Jari. *Läänin varautuminen*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>21</sup> Aalto, Jari. *Läänin varautuminen*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

authorised policy concept in Europe as well. The term critical infrastructure refers to systems that are essential for the maintenance of vital societal functions, including the supply chain, health, safety and security, and the economic and social well-being of the people.<sup>22</sup>

According to the CIIP Handbook, “a critical infrastructure (CI) is commonly understood to be an infrastructure or asset the incapacitation or destruction of which would have a debilitating impact on the national security and the economic and social welfare of a nation”.<sup>23</sup> The emphases in the definition of CIIP can vary from political and economic to technical dimensions of the concept. There are also sub-sectoral divisions in the definitions, which depend on the predominant political priorities.<sup>24</sup> In this report, the concept of CI is understood more broadly from the earlier view of stable and concrete physical systems or information and communication technology systems. CI is understood holistically as networks and systems of vital functions on which the entire society depends.<sup>25</sup>

For example, climate change will have important consequences on the energy sector, one of the most critical sectors of modern societies. Frequently occurring severe weather conditions may threaten the distribution of electricity. That would also have ramifications on the distribution of water, the functioning of sewerage systems and telecommunications. One of the consequences is that the seasonal variations in energy consumption are likely to balance out.<sup>26</sup>

Adaptation to climate change is a relatively new issue on the political agenda, yet one which is becoming an integral part of policies. It is an issue that concerns both public and private sectors. Therefore, public-private partnership as well as cross-sector cooperation for addressing the emerging risks are inevitable. In addition, a holistic approach and policy integration are needed in adaptation strategies. Local administrations should take climate change into account in spatial planning as well as in analysing costs and benefits of climate change for all other sectors. On the other hand, climate change can also provide opportunities for a more sustained and coherent municipal strategy to tackle risks of natural and manmade origin, such issues are often characterised by administrative overlappings and difficulties in adapting new technological solutions and organisational culture.

Finland’s National Strategy for Adaptation to Climate Change defines adaptation as follows: “...a process by which strategies to moderate, cope with, and take advantage of the consequences of climatic events are enhanced, developed, and implemented.” Adaptation not only means coping with new threats

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<sup>22</sup> Pursiainen, C. (ed.). *Towards a Baltic Sea Region Strategy in Critical Infrastructure Protection*. Nordregio Report 2007: 5.

<sup>23</sup> Dunn M. and I. Wigert. *International CIIP Handbook 2004*. Zurich: Swiss Federal Institute of Technology.

<sup>24</sup> Hagelstam, A. *Kriittisen infrastruktuurin suojaaminen. Käsiteanalyysi ja kansainvälinen vertailu*. Huoltovarmuuskeskus. Helsinki 2005.

<sup>25</sup> Pursiainen, C. (ed.). *Towards a Baltic Sea Region Strategy in Critical Infrastructure Protection*. Nordregio Report 2007: 5.

<sup>26</sup> Ministry of Agriculture and Forestry. *Finland’s National Strategy for Adaptation to Climate Change*. Vammala 2005, p. 135.

caused by climate change but also taking advantage of the changed environment.<sup>27</sup> By *adaptive capacity* is meant society's ability to not only to adjust to climate change and minimize or utilize the potential impacts of climate change but also its capacity to demonstrate resilience to the potential negative impacts or even catastrophes.<sup>28</sup>

Finland and Germany are the first countries in the European Union to have a national initiative for climate change adaptation.<sup>29</sup> In Finland, the Ministry for Agriculture and Forestry has published Finland's National Strategy for Adaptation to Climate Change. The strategy has been made in collaboration with other ministries, the Finnish Meteorological Institute and the Finnish Environment Institute. Each of the ministries and institutes involved was responsible for assessing the impacts and identifying adaptation dimension in its own sector.<sup>30</sup>

### 3. Municipal Responses to Climate Change

The focus of the present study is on critical infrastructure protection from climate change-induced emergencies and disasters. The preventive policies of selected municipalities will be evaluated. In addition, how policies have developed since the last flooding incident will be examined. The selection process for municipalities in the case studies involved consultations with the Association of Finnish Local and Regional Authorities and started by locating the flood-prone areas in Finland. Both inland and coastal municipalities were considered. The area best known for annual floods in Finland is Ostrobothnia. However, people of Ostrobothnia have been accustomed to dealing with floods for centuries, and floods there are not necessarily seen as being related to climate change.

The first criterion for selecting a municipality was that it has potential for a flood emergency due to climate change. Although in Ostrobothnia floods are becoming worse due to climate change, it was considered reasonable to choose a municipality where the floods have been extremely rare, since one of the objectives of this project was to raise awareness of climate change emergencies. In this way, the necessity for response to climate change emergencies was to be highlighted.

The second criterion was that there should be examples for both types of municipalities, i.e. which are located near inland waters and coastal municipalities. This way, the differences between floods caused by the rising sea level and, on the other hand, by flash flooding could be studied.

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<sup>27</sup> Ministry of Agriculture and Forestry. *Finland's National Strategy for Adaptation to Climate Change*. Vammala 2005, p. 10.

<sup>28</sup> Ministry of Agriculture and Forestry. *Finland's National Strategy for Adaptation to Climate Change*. Vammala 2005, p. 10.

<sup>29</sup> Pursiainen, C. (ed.). *Towards a Baltic Sea Region Strategy in Critical Infrastructure Protection*. Nordregio Report 2007: 5.

<sup>30</sup> Ministry of Agriculture and Forestry. *Finland's National Strategy for Adaptation to Climate Change*. Vammala 2005.

The main goal of this project is to develop guidelines for flood-prone municipalities. In order to ensure that the case study municipalities would be useful for that purpose, the third criterion of the selection was to choose municipalities that have been active in developing responses and strategies for adapting to climate change emergencies. It was also considered that there should have been a recent flooding incident so that information about what could have been done better and about the best practices in flood cases could be collected effectively.

### 3.1 Helsinki

The city of Helsinki is Finland's capital and located on the shore of the Gulf of Finland, which is part of the Baltic Sea. The city spreads around the coast line, and coastal architecture has been a growing trend in recent decades. There are several flood-prone areas in Helsinki, and the city is now planning to build flood protection dams in 13 of these.

This study will assess how well the city of Helsinki has reacted to climate change by focusing in particular on its preventive strategies and policies in respect of floods. The study is partially based on a previous case study on a flash flooding incident in Helsinki in 2005, entitled: "Breakers of the Century. Flash Flooding in January 2005 at the Gulf of Finland" by Timo Hellenberg and Johanna Kentala.<sup>31</sup>

Until recently, coastal flooding in Finland had been extremely rare. However, increasingly, the rising sea level has been causing difficult situations in Finnish coastal cities. Helsinki experienced the latest severe flood in January 2005. The sea level in the Gulf of Finland generally and at Helsinki specifically rose to record heights (1,51 metres), and the flood lasted for an exceptionally long time. In Helsinki, the district of Marjaniemi was among the areas to suffer the most severe damage. The reason was that the rescue services did not have a real-time map tool. Since then, the rescue services have a specific map tool acquired for this purpose illustrating the effects of the sea level rise at intervals of ten centimetres.<sup>32</sup> Furthermore, roads and traffic were cut off in 2005 by the flood waters in the coastal areas of southern Finland, but greater damage was avoided. It was really close that the nuclear power plant in Loviisa would have been closed down and secured.<sup>33</sup>

Given that the rising sea level presented a threat to the whole southern coastline, the City of Helsinki Rescue Department asked if the Ministry of the Interior was going to warn the whole area. The Ministry answered that each organisation was responsible for informing its own area. The City of Helsinki Rescue Department gave notice to the citizens of Helsinki about the coming flood and gave advice to citizens

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<sup>31</sup> Hellenberg, T. and Kentala, J. *Breakers of the Century. Flash Flooding In January 2005 at the Gulf of Finland*. CIVPRO Working Papers 1/2008. Helsinki 2008.

<sup>32</sup> Lilja, J. *Interview in Helsinki* 26. August 2008.

<sup>33</sup> Hellenberg, T. and Kentala, J. *Breakers of the Century. Flash Flooding In January 2005 at the Gulf of Finland*. CIVPRO Working Papers 1/2008. Helsinki 2008.

living in the flood-prone areas. There was no coordination of information strategy between the neighbouring communities along the coastline. The city's crisis advisory board, on which every organisation in the city is represented and which is under the direction of the director of the Rescue Department, was the most important actor in countering the flood in 2005. Cooperation among different organisations in the city succeeded because of this arrangement.<sup>34</sup>

There are a great number of underground structures in the Helsinki city area. These include, underground service tunnels, pedestrian tunnels and cable lines located beneath the city, which are especially vulnerable to sea level rise. In 2005, there was leakage in some of the underground service areas, and Helsinki's underground metro service was in danger of being damaged by the rising water. If the water had risen some 20 centimetres higher, the metro of Helsinki would have been seriously damaged and would have had to close temporarily. This would have caused additional economic loss to the city. There was also the humanitarian risk, as some of the tunnels are for pedestrians.<sup>35</sup>

There are several factors contributing to the sea level rise in the Baltic Sea and exacerbating the forecasting. Some of the changes in sea level can be explained by air pressure, wind and currents coming through the Danish straits that affect the total amount of water and the percentage of salt water in the Baltic sea.<sup>36</sup> However, in the last flooding incident in Helsinki in 2005, the monitoring and forecasting of the upcoming natural hazard succeeded well. The Finnish Institute for Marine Research (FIMR) analysed weather forecasts and forecast sea level that exceeded previous records. It also forecast that storm winds would reach speeds of 25 metres per second and that the flood levels would last an unusually long time. FIMR gave an early warning signal to the Rescue Department of the Ministry of the Interior for the first time in its history, and the Rescue Department informed the local rescue services to prepare to take flood protection action. The fact that the FIMR gave an early warning signal to the Interior Ministry's Rescue Department illustrated the seriousness of the situation.<sup>37</sup>

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<sup>34</sup> Lilja, J. *Interview in Helsinki* 26. August 2008.

<sup>35</sup> Lilja, J. *Interview in Helsinki* 26. August 2008

<sup>36</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely. Esiselvitys*. Helsinki 2007, p. 2.

<sup>37</sup> Hellenberg, T. and Kentala, J. *Breakers of the Century. Flash Flooding In January 2005 at the Gulf of Finland*. CIVPRO Working Papers 1/2008. Helsinki 2008.

### 3.1.1 Planned flood protection in Helsinki

The city of Helsinki has developed its flood response system since 2005. The mayor of Helsinki established a working group consisting of municipal officials with the charge of compiling flood preparedness and response plans for the city. The final report of the working group concludes the planned flood preparedness and prevention measures for the city of Helsinki and its organisations.

Meanwhile, the Public Works Department has been mapping risks in the flood-prone areas and formulating plans including idea of erecting permanent barriers for flood protection. The flood prevention measures have been prioritised by estimating the value of the infrastructures located in flood-prone areas.<sup>38</sup> Flood risk has also been taken into account in the city of Helsinki's municipal planning. The Finnish Environment Institute establishes the minimum acceptable levels for construction. In Helsinki, the City Planning Department has compiled construction plans for different areas of the city depending on the significance of the building. If the building is considered to be part of the city's critical infrastructure, it should not be built in flood-risk area. Wind and other factors are also taken into account in new construction.

The mayor's working group drew up a plan for flood response and flood prevention. In addition, the working group's final report suggested that the city should prepare a strategic action plan for flood prevention, town planning and construction as a follow-up. The flood prevention strategy was scheduled to be ready in June 2007, but it is still being prepared.<sup>39</sup> Part of the city's strategic planning is flood-risk mapping and a general plan for immovable flood protection structures to be built by the Public Works Department.

The Street and Park Division of the Public Works Department is responsible for coordinating the construction of immovable flood protection structures. The options considered for protecting the city from flooding caused by a rise in sea levels are flood defence embankments, pumping stations and temporary flood-protection solutions. Criteria for selecting areas where flood defence structures were to be built were:

- City ownership of the protected area,
- width of the protected area,
- the protected areas are in residential use,
- strategic passages are located in the protected area,
- the value of the constructions in the protected area,
- flood defence structures fit the surrounding nature,
- there are technical and economic prerequisites for construction.

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<sup>38</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely. Esiselvitys*. Helsinki 2007, p. 2.

<sup>39</sup> Silfverberg, K. *Interview March 2008 at Aleksanteri Institute in Helsinki*.

For example, in the Laajasalo district in the eastern part of Helsinki, where the city of Helsinki has defined 15 different flood risk areas the flood protection embankments are already under construction. If the sea level rises 1.1 metres 17 buildings and road called Päätie would be flooded. These areas are already protected by flood embankments, but the embankments are now to be raised. In addition, two new immovable flood defence embankments are to be built in Laajasalo; other flood risk areas in Laajasalo are to be protected by temporary structures. Real estate owners have responsibility for the temporary flood defence structures.<sup>40</sup> Also the drainage system has been substantially renewed.<sup>41</sup>

Furthermore, every organisation in the city of Helsinki has a prepared rescue strategy, including the preparedness for the risk of flood. There have been several table-top exercises based on various scenarios in which representatives from different organisations participated in a crisis decision-making process. In the event of real crisis, every organisation in the city has the responsibility of deciding on its participation in the city's crisis advisory board.<sup>42</sup>

The biggest flood risk in Helsinki is caused by the sea level rise, but also the River Vantaa also threatens certain districts. Among these risk areas are the district of Savela and the allotment gardens in Oulunkylä. The Public Works Department in cooperation with the Uusimaa Regional Environment Centre have estimated different flood protection solutions for these areas. Heavy rain can cause River Vantaa to flood during winter as well as in the summer. It is estimated that the risk of flood is likely to increase both in winter and summer due to future climate change. The report of the Public Works Department and the Finnish Environmental Administration admits that the impact of climate change on the River Vantaa has not been sufficiently studied. The worst risk is downstream because the cities of Vantaa and Helsinki are located there. However, in Helsinki, only these two districts by the river Vantaa are prone to flooding.<sup>43</sup>

The flood protection options considered for the Vantaa River are: regulation of lakes in the river basin, river clearing, flood-water storage in the river basin, embankments, blocking the culverts and tubes, temporary flood-protection measures and zero option. Dense habitation, qualifications of the river basin and environmental impacts are the most decisive factors when choosing flood protection for that area. Also the expense and its amount vis-à-vis the objects to be saved have been assessed.<sup>44</sup> Since the main flood risk in the Helsinki area is caused by sea floods, the flood protection solutions by the seashore

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<sup>40</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely. Esiselvitys*. Helsinki 2007, p. 38.

<sup>41</sup> Lilja, J. *Interview in Helsinki*, 26. August 2008.

<sup>42</sup> Lilja, J. *Interview in Helsinki*, 26. August 2008.

<sup>43</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Oulunkylän alueen tulvasuojelun mahdollisuudet*. Uusimaa Regional Environment Centre. 2007.

<sup>44</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Oulunkylän alueen tulvasuojelun mahdollisuudet*. Uusimaa Regional Environment Centre. 2007, p. 27.

have been prioritised, and probable river flood prevention will be done on a slower schedule. On the other hand, these solutions would be smaller in scale and much cheaper and easier to put into practise.<sup>45</sup>

As the best option the report recommends building permanent flood embankments to protect the Oulunkylä and Savela districts from annual risk of flood. A cost-benefit assessment also supports this view. Without protection of the area floods may cause expenses annually whereas building the embankment has to be paid only once, and the annual costs of its maintenance are estimated to remain relatively low.<sup>46</sup>

The legislation on land use and building (The Land Use and Building Act) calls for the city to consider updating its town-planning regulations if the flood-risk increases dramatically, for example, due to clearly demonstrated changes in climate. However, the Land Use and Building Act leaves unclear just what actions the city should take if the flood-risk increases in an area that has already been constructed. It says nothing about who bears the costs or how the implementation could be forced.<sup>47</sup>

Also the owners of buildings, private organisations, public institutions or other corporations have the responsibility of enacting flood prevention.<sup>48</sup> According to the Rescue Act, owners of buildings are responsible for preventing hazards and should be prepared to undertake rescue measures to the best of their abilities.

Discussion about a comprehensive early warning system for natural disasters also took place in the wake of South-East Asian Tsunami disaster of 2004 and the flash flooding in the Gulf of Finland in January 2005. FIMR, the Finnish Meteorological Institute and the Department of Seismology of the University of Helsinki along with Finland's environmental administration have put forward the idea of a warning centre for all kinds of natural disasters. The centre would produce weather forecasts and monitor natural disasters of all kinds in Finland and abroad around the clock every day of the year. The centre would distribute early warning information to authorities and citizens, receive emergency messages, enhance effective cooperation among different authorities and function as an information bank for authorities dealing with natural disasters. The centre would offer analysed situation awareness to the authorities so that they could generate their operational preparedness. However, the establishment of the centre has not yet received financial support from the Finnish government.<sup>49</sup>

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<sup>45</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Oulunkylän alueen tulvasuojelun mahdollisuudet*. Uusimaa Regional Environment Centre. 2007, p. 38.

<sup>46</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Oulunkylän alueen tulvasuojelun mahdollisuudet*. Uusimaa Regional Environment Centre. 2007. p. 42.

<sup>47</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely*. *Esiselvitys*. Helsinki 2007, p. 11.

<sup>48</sup> The Rescue Act 468/2003 8 §.

<sup>49</sup> Molarius R., Porthin M. and Wessberg N. *Luonnononnettomuuksien varoitussjärjestelmän (LUOVA) mahdollisuudet*. VTT Technical Research Centre of Finland, Tutkimusraportti 2007.

The metropolitan area of Helsinki, which includes the cities of Espoo, Vantaa, Kauniainen and Helsinki, has prepared a climate strategy in collaboration with civil protection experts, interest groups and other stakeholders from the aforementioned cities. In the strategy, cities of the metropolitan area define their common climate vision and set their greenhouse gas emission reduction goals. The goal is to reduce the per capita emission by the year 2030 by one third of the 2004 level. In many other countries cities have even more ambitious emission reduction objectives.<sup>50</sup>

Architect Kari Silfverberg of the Finnish Environment Institute has estimated that the number and area of new buildings constructed by the sea in the city of Helsinki between the years 1980 and 2020 will be equivalent to a medium-sized Finnish city. In the year 1989 when the IPCC published its first reports on climate change, the city of Helsinki organised a seminar on the impact of climate change on the environment and infrastructure in the Helsinki area and possible adaptation strategies. A main threat in the long-term was seen to be the sea level rise and the floods resulting from severe storms and heavy rain. After this seminar several follow-up studies were conducted in the municipal offices of the city of Helsinki; however, clear directions for town planning and construction remained inadequate. One reason was lack of awareness of climate change and its impacts at that time, even among city planning experts.<sup>51</sup>

In Helsinki, there are several districts along the shoreline constructed below this recommended level. One example is Eira, where the price of apartments per square metre is one of the highest in Helsinki. In the beginning of the 1990s an assessment of flood protection methods was made. However, these assessments have not led to a binding national strategy on flood management regarding, for example, local risk-mapping and construction legislation.

The current building code in Helsinki quotes the Finnish Environmental Administration's recommendations for the lowest building levels from the year 1999. The lowest recommended building level was 230 cm with the specific circumstances of the area also taken into consideration.<sup>52</sup> The Finnish Environment Institute considers these recommendations obsolete and says that the city of Helsinki should reconsider its building codes before massive new construction projects begin. In ten years the understanding of impacts of climate change has developed substantially.<sup>53</sup>

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<sup>50</sup> YTV Helsinki Metropolitan Area Council. *Climate Strategy for the Helsinki Metropolitan Area to 2030*. YTV publications 24/2007. Helsinki.

<sup>51</sup> Silfverberg, K. *Ilmastonmuutos ja Helsingin suuret rantarakentamishankkeet*. Arkkitehtilehden artikkeli 03/2008.

<sup>52</sup> The Public Works Department of the City of Helsinki (Rakennusvirasto). *Tulvakohteiden määrittely*. *Esiselvitys*. Helsinki 2007 pp. 54-55.

<sup>53</sup> Silfverberg, K. *Ilmastonmuutos ja Helsingin suuret rantarakentamishankkeet*. Arkkitehtilehden artikkeli 03/2008.

## 3.2 Kittilä

The municipality of Kittilä is located in northern Finland and is another municipal actor assessed in this paper. Kittilä is situated in latitudes where the climate warms at its most rapid rate, and biodiversity and local livelihoods are exposed to significant damage as climate change continues. In the first half of this century Kittilä will probably gain net benefits from the climate change, the tourist industry will benefit in particular. However, there is a growing flood risk due to climate change in Kittilä. Flooding is already a major threat in the area. The last severe flood was in May of 2005. In this paper the flood protection work in Kittilä in 2005 and its planned future flood prevention are evaluated.

In Kittilä, the impacts of climate change are seen by the municipal authorities as being mainly positive. Climate change will, however, according to the Lapland Regional Environment Centre and the Finnish Meteorological Institute, have a worsening impact on floods during the first half of this century. The average temperatures will raise and precipitation will increase, especially during the winter time. In the winter most of the precipitation will be snow, which could have positive effects on tourism and related industries. The annual spring flooding due to the snow melt is expected to become even more severe and threaten not only the population but also, for example, the functioning of the growing travel sector and the mining industry.

In May 2005, severe flooding took place in Kittilä as the Ounas River started to flood due to sudden snow melting. The water threatened the municipal centre of Kittilä. On Monday the 23<sup>rd</sup> of May, the Lapland Regional Environment Centre warned of exceptionally severe flooding in the Ounas River at Kittilä. On the 24<sup>th</sup> of May, the water level started to rise drastically at a speed of 3 centimetres per hour. The water level reached its peak on Friday afternoon. At that time the level had risen 1,78 metres in the observation site in the municipal centre of Kittilä.<sup>54</sup>

Cross-sectoral cooperation among different officials during the flood response operation in 2005 has been considered to have worked well. Also private organisations were involved offering their services and materials to the municipality of Kittilä. Stakeholders participating in the flood response included the Ministry of the Interior, the local media, the Finnish Defence Forces, the Border Guard, private organisations and health authorities.<sup>55</sup>

The municipal officials talked about the flooding of May 2005 as being comparable to a “war zone” and mentioned that there was a strong community spirit that reminded of the “spirit of the Finnish Winter War”. Kittilä’s Management Group was the most important actor in the flood response in 2005. The Management Group assembled for a crisis meeting three times a day. The Group also contacted the Minister of the Interior, the media, the Defence Forces, the Border Guard, doctors and other health

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<sup>54</sup> *Johtoryhmän kokospöytäkirjat 23.5.-14.6.2005*. The Municipality of Kittilä.

<sup>55</sup> Maula, S. *Interview in Kittilä* 7. March 2008.

authorities to ask for executive assistance and update their situation picture of the flood situation and, such things as the quality of the drinking water.

The local fire brigade called in excavation companies from Lapland to assist in the flood protection and to build embankments on the river banks. The municipality covered most of the expenses of these actions. Also the fire brigades from neighbouring municipalities joined in the flood management assistance. External material assistance was transported to protect the centre of Kittilä from flood damage. Additional personnel, especially command officers, were brought from other municipal regions, as working in 24/7 shifts required more personnel. The Finnish Defence Forces and the Border Guard assisted in evacuating and guarding buildings, as the residents had to leave only with their essentials. They also helped with the actual work of flood response. The Defence Forces and rescue department also prevented individuals from coming to the flood prevention site. The executive assistance work was evaluated by the municipal directors as a success. One challenge that disrupted the flood assistance was created by curious locals, who obstructed some important passage lines from rescue workers and caused a potential danger to themselves. At the flood protection site behind the embankments, there was the danger of collapsing walls, which would have caused a powerful wave on the flooding river. Also the local radio informed people to keep away from the dangerous areas.

The quality of drinking water stayed good although the sewer system was severely disrupted. Some of the waste water had to be pumped into the river when the water started to come into the houses from the drains; otherwise the pressure would have burst the buildings. One of these buildings was Kittilä's health centre. Since the flood, the sewerage system has largely been renewed.

Risk awareness and situational knowledge among citizens of the Kittilä municipality has been substantially raised since flooding of 2005. Unfortunately, past floods are easily forgotten, and information and constant education is needed. In the flood of 2005 the role of the private sector has been regarded as controversial by the municipal authorities. On the other hand, the private-public cooperation has been described with the rhetoric of the "Winter War"; some private entities joined in the prevention work within volunteer fire brigades and were willing to commit both financial and operational assistance. Besides private companies, citizens themselves actively participated by securing their houses with plastic and sand bags, provided by the municipality of Kittilä. Residents assisted each other, when the flood embankment failed. On the other hand, some people caused problems by intruding on sites of the authorities. Also, when the first flood forecasts were made and the evacuation began, some of the locals refused to believe that a flood was actually coming because it was not yet evident.

Ultimately, risk awareness among the local people could be better. For instance, there could be more information available about what individuals can do to protect private property. Many people did not realise, for example, that pumping water out of a house and letting it flow in again before pumping it out again, would eventually break the foundations. In the aftermath of the flood when the Lapland Regional Environment Centre had their informative meetings in Kittilä in 2008, some people seemed to have

already forgotten the flood of 2005. In addition, understanding the severity of flood has been inadequate, as the local people have resisted the planned embankment walls and have made alternative flood protection suggestions. On the other hand, the municipality has received approval for building the flood embankments from almost every landowner concerned with the building project in Kittilä.<sup>56</sup>

Ironically but not surprisingly, the flood of 2005 severely affected the most vulnerable part of the local population: the aged and the disabled. The sheltered homes of both groups, located on a scenic bank of the Ounas River, Pääskylänniemi, had to be evacuated and residents placed in temporary accommodation. Luckily the municipality had prepared for that and was able to arrange temporary places comparatively easily. One of the places was a former high school residence hall, in which the disabled were placed. The elderly were placed in the health centre with some of them settled in a former residential building for older people on the other side of the Ounas River.

The local media was described as irritating and disrupting the flood response operation as municipal authorities had to give interviews several times a day. The local radio meanwhile helped to keep the municipality informed, and its role was seen as important in providing an updated picture of the flood situation to the local people.

### 3.2.1 The Planned Flood Protection in Kittilä

The flood of 2005 made a significant impact on municipal planning in Kittilä. It had to be taken into account in municipal budgets during the following years, even as late as the year 2008. The reparation work of the material damages, the extra personnel costs and other necessary material acquisitions caused most of the expenses. The municipality of Kittilä had to assist Elderly Home Association, because three terrace houses in the Pääskylänniemi area were lost. The houses had been built in the 1970s and after the flood were considered to be in too poor condition to be worth restoring; even before the water damage they had been in need of renovation. The Elderly Home Association decided to construct a new residential building in a new place near the local health centre. The new building, named Kullervo, was opened in April 2008. The residential building for disabled people, named Metsola, also suffered water damage, but it was renovated over a nine-month period. This caused some loss of rental income and serious problems for the association, as it is non-profit organisation. The municipality also assisted in this project contributing almost 100000 euros. After the flood the welfare and health care sectors increased by 15 professionals, causing municipal budget to be affected up to the year 2008. The

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<sup>56</sup> Mäkinen, E. Municipality of Kittilä. *Kittilän kuntasuunnittelun näkökulma – padot vai tulva-altaat?* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

technical branch of the municipality also needed extra resources because the sand bags had been used for flood protection.

Municipal authorities in Kittilä view the structure of the liability questions and flood anticipation as being problematic. A need for a clear action plan was recognised, even though the municipal officials who experienced the flood of 2005 know how to act in event of a similar disaster. It is important to share the experience, local knowledge and lessons learned with new municipal officials who have no personal experience in flood prevention as well as with other municipalities in Finland and abroad.

Questions that still need to be addressed involve especially the crisis management: Who is responsible for the actions to be taken? From where will executive assistance be asked? How will publicity and information about the crisis situation be handled? How will an evacuation be organised? A central question still unanswered is the mitigation of losses: Who will pay all the bills, and how will psychological support to those who have lost their homes be offered?

The municipality of Kittilä has two alternative plans for flood defence and managing flood risks. One is to build flood protection walls on the river banks mainly to protect the municipal centre of Kittilä and other risk areas. The walls, however, would exacerbate the flood risk in Rovaniemi, especially, if there were simultaneous flood on the Kemi River. This option would cost approximately two million euros. The other solution would be to build small dams upriver. This option would cost approximately five times more than building flood protection walls, but if the dams could be utilised to produce energy by Kemijoki Oy, a hydropower company, then the funding question would be solved. At the moment the Ounas River is strictly protected by legislation. The problem is being discussed with environment officials and the Finnish Ministry for Agriculture and Forestry.

In collaboration with the Lapland Regional Environment Centre the municipality is planning solutions for flood prevention, mitigation and protection in Kittilä. Final decisions have not yet been made, as various options are being examined. In addition to embankments and dams the options being studied include: cleaning the river bed, temporary flood protection solutions and the so-called zero option. The embankments would cause changes to the river scenery since they would need to be up to four metres high to offer protection from floods such as the one of 2005. Paradoxically, one of the reasons for locating the house for the elderly on the river was its scenic view; it was seen as a beneficial living environment. As the climate warms floods may become even more common and flooding can be even worse than in the year 2005.<sup>57</sup>

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<sup>57</sup> Mäkinen, E. *Kittilän kuntasuunnittelun näkökulma – padot vai tulva-altaat?* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

There are several arguments against constructing flood protection embankments. One is that the embankments are to protect only the centre of Kittilä, whereas in 2005, there were also other villages in the municipal area that suffered damages. For example, Levi, Köngäs and Tepasto all had extensive damage. As mentioned, flood protection embankments in Kittilä, would also exacerbate potential flooding in Rovaniemi, which is located at the intersection of the two largest rivers in Lapland, Kemi River and Ounas River. Although the Kemi River is regulated by Kemijoki Oy, Finland's largest hydroelectric power producer, flood levels have become so high in recent years that a simultaneous flood on both rivers might mean disaster for Rovaniemi.

Some individuals are also against building flood protection embankments. A demand has been made to the municipality for reconsideration. The municipality of Kittilä needs permission from thirteen landowners to be able to build the embankment. One landowner has refused to give his permission, and now the municipality is forced to examine other sites where the embankment could be built. The village association of Kittilä also objects to the embankment plans. The association has presented an alternative plan, involving clearing the bushes and constructing culverts to the bridge downriver from the Kittilä centre in order to reduce flooding. However, engineers have estimated that the benefits of these solutions would be insubstantial given the amounts of water involved in event of a severe flood.

For the time being the Lapland Regional Environment Centre will continue preparing plans to construct embankments. The municipality views providing security for the most vulnerable groups in Pääskylänniemi as its pivotal duty. Although the embankments are to some extent only a temporary solution, the other options are more expensive, and implementation may take time, given that, for example, petition proceedings for constructing reservoirs are complex. One reasonable, albeit temporary solution is to build smaller embankments that would be elevated by temporary protection measures in case of flood. A preliminary schedule for the embankments has already been set, and the construction is planned to get underway by the summer of 2009.<sup>58</sup>

Building dams and reservoir lakes upstream from Kittilä is an alternative solution for flood protection. As mentioned above, this solution would be much more expensive and there is uncertainty if the permission to build dams and reservoirs will be granted due to the strict legislation regulating the Ounas River. However, this option is being examined in parallel with the embankment building plans, because this option would provide a permanent solution for flood protection in Kittilä and also indirectly for Rovaniemi. Dams are planned to be built in the mouths of two upstream tributaries in the northern part of Kittilä, Tepasto River and Loukinen River. Behind the planned dams where artificial lakes would form are great swamp areas. In the past, there have been dams in the mouths of these rivers in order to create means of floating logs downriver. According to local knowledge, earlier floods have been substantially longer,

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<sup>58</sup> Mäkinen, E. *Kittilän kuntasuunnittelun näkökulma – padot vai tulva-altaat?* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

these days the same amount of water pours in a single week. Draining in the upstream glades is believed to be one reason for this development.<sup>59</sup>

The artificial lakes and dams upstream are preferred solution, because these would be permanent and would protect the larger river basin and other areas besides the centre of Kittilä. This solution would also be congruent with the recommendations of the flood working group for the whole river basin area. It could be financed by Kemijoki Oy if the company can be persuaded that the artificial lakes are beneficial for its business.

The political will to build flood protection dams is still needed. First of all, the municipal council should have a majority decision on this question and the Lapland Regional Environment Centre and finally the Ministry of the Environment should also support this view. The whole process would take several years before construction could start. If this alternative receives enough support in the Municipal Council and if the municipality decides to apply for a building licence during the application process, then municipality flood protection would be in status quo.<sup>60</sup>

Cleaning the river bed downriver has been viewed as one option for solving the flood problem in Kittilä, enabling larger amounts of water to pass Kittilä without flooding. However, this option is estimated to be too expensive. Moreover, cleaning river bed causes serious environmental impact. Meanwhile the Ounas River is strictly protected by legislation. There is thus little support for this option.

The planning of municipal land use has changed since Finland's new Land Use and Building Act entered into force in 2000. Nowadays most of the work consists of preliminary assessment and mapping. For example, flood risk mapping, as well as environmental and landscape impact assessments are needed to provide detailed local plans for controlling land use and building. The flood of 2005 also changed regulations for land use in Kittilä, since after the flood, building permits were no longer issued for the same places as before. If there is no local detailed plan regulating building in a given area, then a special permit from the Lapland Regional Environment Centre is needed. The case also goes to the municipality officials, the Building Supervision Committee and to Municipal Executive Board, all of whom will give their statements on the issue. If the construction is planned in an area of flood risk, then their verdict will not be favourable. Individuals are not permitted to build summer cottages on the river banks as freely as before. The municipality of Kittilä has been accused of having permitted building on levels too low, but the municipal officials observe that these regulations were in force before 2005 and were based on previous flood incidents. The present regulations will be in force as long as there is the risk of an even worse flood

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<sup>59</sup> Honka, A. *Tulvanhallinta Ounasjoella*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>60</sup> Mäkinen, E. *Kittilän kuntasuunnittelun näkökulma - Padot vai tulva-altaat?* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

than in the year 2005, which, according to municipal officials of Kittilä will not be likely within the next 20 years.<sup>61</sup>

The Emergency Department of the County Administrative Board of Lapland is one of the most important actors in risk management in Lapland. The Department assesses the risks in the area of Lapland, as well as in everyday life, and makes these assessments known for the benefit of political decision-making. The Emergency Department also supports other local actors in promoting preparedness as well as in the actual event of a crisis. One of the duties of the County Administrative Board of Lapland is to anticipate the needs of the municipality and, in the event of a crisis collect information and update the situation picture to pass on to other actors. The County Administrative Board has to be aware of its area's security situation and the pathways of its projected future development. The Emergency Department also has to know how to implement measures supporting positive security development in its area. It is fundamental that measures or decision-making that would be harmful to the area's security development be not implemented.<sup>62</sup>

The Emergency Department of the County Administrative Board of Lapland has adopted a cross-cutting approach, as it is an organisation with multiple authority and has connections with other actors. The practical measures and methods affiliated with the risk assessment of the Emergency Department consist of exercises, cooperation agreements and ensuring that the work of the management centre is available at all times. For example, a field exercise in a crisis management incident will be organised in the autumn 2008 in eastern Lapland. The scenario will be a severe autumn storm. The lessons learned from this rehearsal will be disseminated to all municipalities in Lapland, including Kittilä.<sup>63</sup>

The Lapland Regional Environment Centre in Lapland plays a key role in flood prevention. It gives advice, for example, on how to construct flood-safe buildings; the purpose of its work is to diminish flood damage. The Lapland Regional Environment Centre determines the lowest possible construction heights and establishes building codes to prevent structures from being built in flood-prone areas. Other flood protection measures include: cleaning the river beds, building embankments on the river banks or regulating the water system with natural lakes or artificial lakes. The Finnish Environment Institute in Helsinki is responsible for flood forecasting and issuing warning formulated on the grounds of information on water levels obtained from the Regional Environment Centres. Forecasting information is available to the Regional Environment Centres. In the flood protection and mitigation work in the event of a flood, the Emergency Services have the main responsibility.<sup>64</sup>

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<sup>61</sup> Mäkinen, E. *Kittilän kuntasuunnittelun näkökulma – padot vai tulva-altaat?* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>62</sup> Tervo, V-P. *Läänin varautuminen.* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>63</sup> Tervo, V-P. *Läänin varautuminen.* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>64</sup> Honka A. *Tulvahallinta Ounasjoella.* CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

The Lapland Regional Environment Centre describes the flood in Kittilä in 2005 as having come as a surprise. For example, in research on the major floods in Finland conducted by a working group of the Ministry of Agriculture and Forestry in Finland in 2000, Kittilä was not mentioned among the major flood risk areas. However, the flood of 2005 in Kittilä was classified as one of the worst in the world in that year by the World Meteorological Institute .

The Lapland Regional Environment Centre started to map comprehensively the flood risks in the whole upper river basin at the same time the flood protection embankments were being planned for to Kittilä. The directive on the assessment and management of flood risks that entered into force in November 2007 requires that such flood risk assessment and flood risk mapping to be done. The geography of Kittilä has been mapped by using GIS-based laser scanning methodology providing specific analysis of the topography. The mapping has also been checked by manual measuring. The EU directive on the assessment and management of flood risks concerns all water areas in EU member countries, and its implication is determined by each country based on local and regional circumstances. Finland is now integrating the implementation of this directive into previous legislation. The implementation should be completed by the year 2015. Preliminary flood risk assessment should be done by year 2011, a flood danger map and flood risk map by 2013, and plans on managing flood risks should be completed by 2015.<sup>65</sup>

## 4. Concluding Remarks

One of the key challenges is for each actor to recognise and shoulder his responsibility in determining the overall picture of a risk situation before the specific response starts. In a multiple authority situation it is vital that the expertise and duties are clearly defined, and it is not assumed, for example, that the Emergency Services will take care of the whole situation. The fact that human beings are responsible for communication and situation knowledge makes the response operation vulnerable to misunderstandings and even mistakes. Unfortunately, these mechanisms cannot be automated. Quality thinking that could be integrated into a security approach is important. Among the best practises should be evaluating the lessons learned from previous crisis management situations by local actors. These lessons should be also integrated into the development work at the municipal level.<sup>66</sup>

When a concrete crisis management action takes place, it is not a problem if several organisations take responsibility for action. On the contrary, it is problematic when none takes any responsibility. It is also important that a common situation picture is formed among different actors. Many exercises have been

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<sup>65</sup> Honka A. *Tulvahallinta Ounasjoella*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>66</sup> Tervo, V-P. *Läänin varautuminen*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

all about forming the situation picture and the real problem-solving methods and local level actions have remained reactive, not proactive. In addition, the preparedness culture in Finland could be more far-reaching. Even though information and statistics are available, concrete actions for addressing the problems as reflected by the statistics are lacking.<sup>67</sup>

## 4.1 Economic Dimensions

Economic questions are among the most important factors when municipalities decide on flood prevention measures and prioritise the infrastructures that are to be protected. The objects to be saved should be valuable enough to be worth expensive flood protection investments. Cost-benefit evaluations are thus necessary.

The Ministry for Agriculture and Forestry established a working group in 2005 to prepare a new statement on the compensation system for flood damages in Finland. The working group studied the possibility of private insurance companies or funds compensating for flood damages. The legislation on these issues and procedures in other EU countries was also investigated. The working group coordinated its work with that of the major flood working group.<sup>68</sup> The working group also emphasised the importance of developing flood risk management. Flood risks should be assessed intensively; risk mapping and plans for flood risk management procedures should be.<sup>69</sup>

The working group suggested new periodically implemented legislation for compensation of flood damages. It also suggested that compensation would be based on flood insurance combined with fire insurance. These arrangements would clarify and fasten the compensation procedures and ease the burden of municipalities work in the event of a major flood. Municipalities as well as the government would save money through these arrangements. The insurance costs of individuals and companies would increase 1-2.5 percent. In the suggested legislation rare floods would be defined so that the impact of climate change would be taken into account. The legislation is suggested to expire in eight to twelve years to facilitate the emergence of the desired insurance market system. Thereafter, private insurance companies could evaluate the markets based on this experience and develop their own insurance policies.<sup>70</sup>

These case studies show that risk prevention solutions should be made at the local level and that the participation of local actors in risk prevention should be enhanced. Also the flood damage compensation

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<sup>67</sup> Tervo, V-P. *Läänin varautuminen*. CIVPRO Seminar on Climate Change and Floods. 6. June 2008, Kittilä, Finland.

<sup>68</sup> The Ministry of Agriculture and Forestry. *Tulvavahinkotyöryhmä. Työryhmämuistio*. MMM 2006: 16. Helsinki.

<sup>69</sup> The Ministry of Agriculture and Forestry. *Tulvavahinkotyöryhmä. Työryhmämuistio*. MMM 2006: 16. Helsinki.

<sup>70</sup> The Ministry of Agriculture and Forestry. *Tulvavahinkotyöryhmä. Työryhmämuistio*. MMM 2006: 16. Helsinki pp. 47–49.

system should be arranged at the regional level. One solution would be a regional reimbursement system coordinated by the Regional Councils instead of a governmental insurance system.

## 4.2 Policy Dimensions

The municipality of Kittilä has adopted a cross-cutting approach to flood prevention as all the sectors of municipal planning, from land use to geriatric work, take flood protection into account. Many officials have real-life experience in flood protection. However, there is a need for a flood strategy to cover the entire river basin area, since for the time being, the municipality is planning protection only for the municipal centre by means of the embankments.

There are also still unanswered questions at the municipal level and a need for a clear strategic and comprehensive action plan. For example, the following practical crisis management actions should be planned in advance: Who is responsible for all the actions to be taken? From where will executive assistance be asked? How will crisis publicity and information about the crisis situation be handled? How will the evacuation work be organised? One big question from Kittilä's point of view still unanswered is what happens after the flood: Who pays all the bills, and how is psychological support to those who lost their homes to be offered? There is also need for increasing risk knowledge among citizens to enable them to make their properties more resistant to the effects of flooding, support their participation in the crisis management and reduce risks in the event of flooding.

In Helsinki, the city is preparing a strategic comprehensive action plan for flood prevention, town planning and construction. A flood prevention strategy is still being prepared.<sup>71</sup> The city has also adopted an active approach to climate change mitigation questions as it prepares its climate strategy. However, its greenhouse gas emission reduction goals could be more ambitious.

The impacts of climate change should be taken into account more comprehensively in strategic municipal planning, given that understanding of climate change has developed substantially in recent years. Finland's Land Use and Building Act mandates that should the flood risk increase dramatically, for example, due to changes in climate, then the city should consider updating its town planning regulations. For example, the construction recommendations of the city of Helsinki have been criticised as being obsolete. And although Kittilä has participated in several climate change projects, it has no comprehensive municipal climate change strategy. Planning in the municipalities is based more on historic rates rather than projections of future climate variability. There seems to be a need for aggregated, analysed and management-relevant information on climate change-related issues at the municipal level.

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<sup>71</sup> Silfverberg, K. *Interview at Aleksanteri Institute in Helsinki* 03/2008.

It is vital that at the municipal and regional levels' investments in first responders', i.e. citizens', risk awareness in order to avoid greater risks and financial losses. Education, information campaigns and exercises are measures that support citizens' participation in crisis management.

### 4.3. Resolving Conflicts of Interest

Finland's new Land Use and Building Act requires more attention to be paid to environmental impact assessment land use planning in municipalities. Also landscape impacts are assessed more thoroughly than before. In Helsinki, city planners have seemed to concentrate on building city's maritime image and offering beautiful views for its citizens. However, a more integrated approach to city planning is needed. In planning land use, adaptation to climate change should be taken into consideration along with the landscape and sea views.

The Lapland Regional Environment Centre has assessed the environmental impacts of potential flood protection solutions in Kittilä. The option of cleaning the river bed has been dismissed, not only because it is an expensive solution, but also because it would have adverse effects on the river and its ecosystems. The embankments are opposed, mainly because of the impact on the scenery.

Building dams for flood protection can be utilised in production of hydropower, but dams also have disadvantages. Reservoirs cause a number of adverse environmental impacts. Ecosystems will be affected upstream and downstream. More over, dams pose a barrier to migrating fish, and biomass releases greenhouse gases (GHG) as it decomposes in reservoirs. The reservoirs can also affect people's livelihoods.<sup>72</sup>

Conflicts of interests are going to emerge in decision-making on flood protection solutions. On the one hand, beautiful scenery should be maintained, yet on the other hand, the value of a society's infrastructure must be protected. Different sectors have different perspectives on these questions, and it is essential that comprehensive assessment of different stakeholders' points of views is made. Balancing between response to and prevention of high-probability risks, such as floods, is important.

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<sup>72</sup> NATURE. *Electricity without Carbon*. Vol 45/14 August 2008, p. 817.



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