

## NATURE HAZARD EMERGENCY PLANNING ON LOCAL LEVEL

### THE BOTTOM-UP APPROACH OF THE CANTON OF LUCERNE

René Graf<sup>1</sup>

#### ABSTRACT

Emergency plans are developed to draft an intervention against nature hazards following several escalation phases. The plans serve the local fire brigade as a device for the management of operations. They are elaborated in close cooperation between the local fire brigades and natural hazard specialists. Teamwork is regarded as a crucial factor of success. During the planning process probable scenarios of an event are anticipated based on hazard maps and on the experience of the fire brigade. The documentation mainly consists of waterproof task sheets, which can be issued to the staff, and of intervention plans, which show all planned measures in an overview. For the actualisation of the plans a comfortable online-tool will be implemented.

Compared to losses, that can be avoided, and the training effect on the involved personnel there is no doubt, that an emergency plan is worth its costs of 20'000 – 40'000 Swiss Francs.

**Keywords:** emergency plan, intervention, crisis management, fire brigade, flood, local, bottom-up

#### ENHANCING EMERGENCY PLANNING – LESSON LEARNT FROM THE 2005 FLOOD

One of the lessons learnt from the flood event of August 2005 was to push disaster preparedness and intervention capacities, as these measures have proved to be effective and can be implemented promptly and at reasonable costs. BEZZOLA/HEGG (2008) state, that emergency planning is a basic prerequisite for a successful intervention. Further, they note that education and training of fire brigades increasingly must focus on interventions against natural hazards, e.g. by the handling of emergency plans.

#### ORGANISATION OF INTERVENTION IN THE CANTON OF LUCERNE

Interventions against natural hazards are a core task of fire brigades. During the last years fire brigades in the Canton of Lucerne were more often called on to fight natural hazards, mainly floods, than fires. The commander of the fire brigade in charge leads the intervention. In case of an escalation two more elements will be activated:

- A Catastrophe Commander (Katastrophen-Einsatzleiter KEL) will assist the commander in charge by; consulting with him, organising the Local Emergency Management Authority (LEMA), or even taking over the lead. These Catastrophe Commanders are organised and trained in a pool by the buildings insurance monopole of the Canton of Lucerne.
- A LEMA consists of representatives of partner organisations such as, police, civil defence and public health care service, local political councils, and specialists for relevant issues, e.g. natural hazards. The LEMA's task is to support the leader in charge, who himself stays responsible for the decision making.

All of the 61 fire brigades in the canton are organised in a militia system: Only about 15 of the more than 6'000 firemen and –women are professionals.

---

<sup>1</sup> René Graf, Verkehr und Infrastruktur Kanton Luzern, Naturgefahren, 6010 Kriens, Switzerland, (e-mail: rene.graf@lu.ch)

## **AIMS OF EMERGENCY PLANNING**

The aim of natural hazard emergency planning is; to anticipate probable scenarios, to identify reasonable triggers for an intervention, to design appropriate interventions (tasks), and to document them in a way to enable efficient decision making and issuing orders. Another aim is to provide basic information for decision making in a standardised form. However, emergency plans do not restrain the commander's responsibility to make situational decisions, as an event probably will never occur exactly the predicted way. As floods are the main threat in the Canton of Lucerne and the occurrences of rock falls as well as landslides are difficult to locate, the natural hazard emergency plans put a strong focus on flood events.

Early warning systems are not an integrated topic of emergency plans. Separate projects are run to design and implement such systems. Though, interfaces are defined in the emergency plans including triggers for an intervention.

## **ESCALATION PHASES DEFINING THE STRUCTURE**

The emergency plans are structured according to three escalation phases:

- Phase 1 ("yellow"): An event is threatening to take place in the near future, maybe a specific warning has been received. Fire brigade officers are mobilised to observe the further development of the situation and to prepare for intervention.
- Phase 2 ("orange"): Fire brigade staff is activated. Interventions take place to avoid or limit damages. The scenarios are mainly based on the intensity map for an event which occurs with a probability of once in 30 years. Intensity maps are specific elements of the hazard map showing the strength of the impact of an event with a defined period of recurrence. Also the experiences the fire brigade made in recent events are integrated.
- Phase 3 ("red"): The intervention aims to combat against a catastrophic event (scenario 1/300 years).

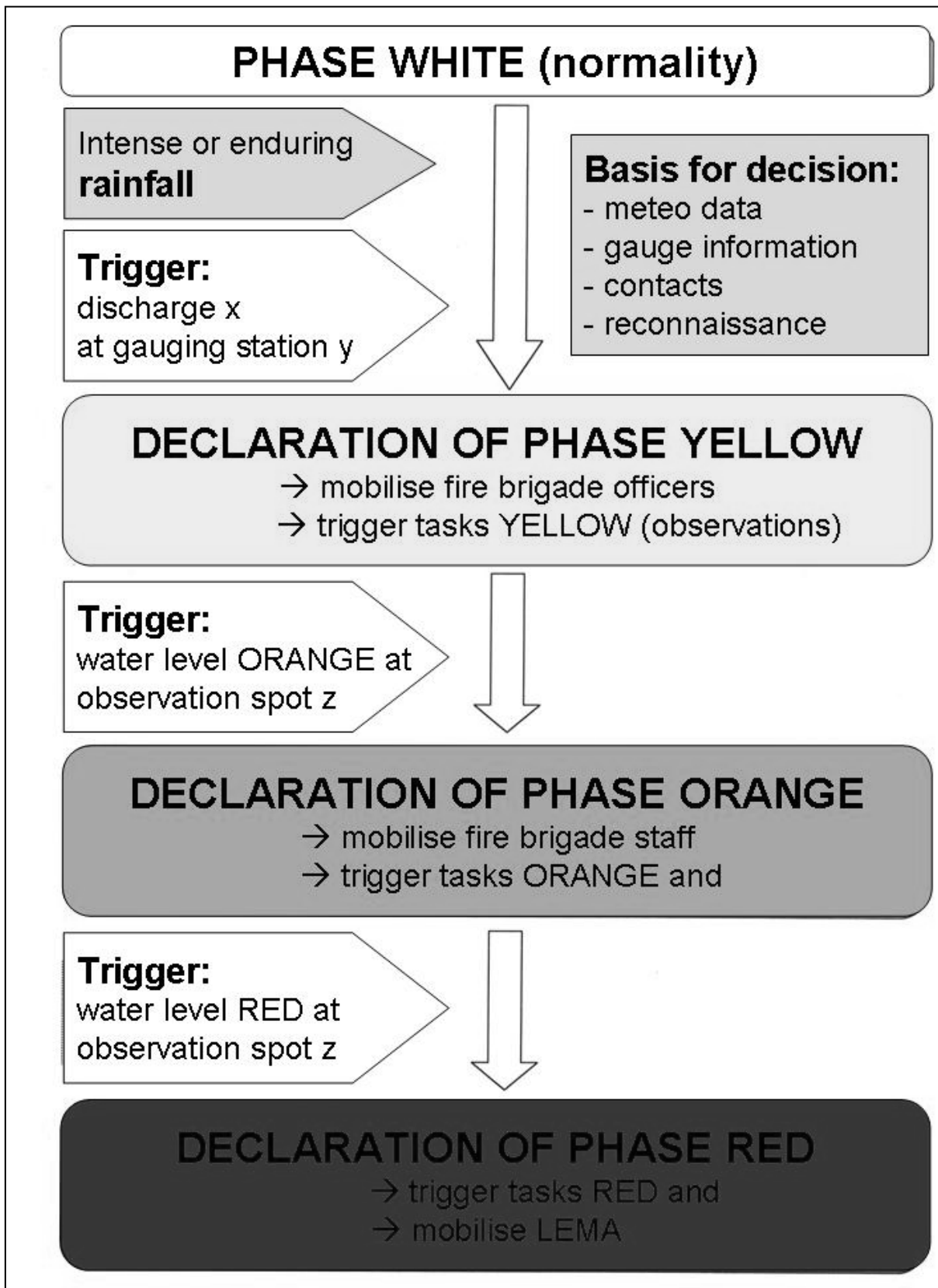
## **TASK INSTRUCTIONS AND INTERVENTION PLANS**

The emergency plans consist of mainly three elements:

1. General instructions
2. Task sheets
3. Intervention plans

Further elements of an emergency plans are lists of the manpower and material, which are needed to realise all the planned tasks, and a short report documenting the process.

1. **General instructions:** These contain the definition/description of the trigger of the phases (Fig. 1) as well as brief instructions on a specified tactic to fight nature hazards.



**Fig. 1** Instructions for triggering the phases

2. **Task sheets:** Each task is located, defined and numerated. It is documented in an unambiguous manner on one single sheet A4 (Fig. 2 and 3) and shaped as an order. Each task-sheet is framed in the colour of the respective phase (yellow, orange or red). Elements of each instruction are a short description of the aim of the respective charge, the measures to be taken, the manpower and material needed as well as a situation plan and photos of important spots and/or elements. As the sheets are laminated and therefore waterproof the command can be given by the officer by handing the sheets to the staff without further explanations. Each task-sheet is framed in the colour of the respective phase (yellow, orange or red).

Interventionsplanung Kleine Emme		MANNSCHAFT
<b>Task-Nr. 08</b>		<b>LITTAU / Thorenbergbrücke</b>
<b>PHASE: ORANGE</b>		Phase Red: no additional measures foreseen
<b>Legend</b>	  	Road block Excavator to keep free the waterway Protection of the building by the owner
<b>Aim</b>	Avoid flooding of Nidermatt and adjacent area	
<b>Actions</b>	<ol style="list-style-type: none"> <li>1. Shut Thorenberg Bridge</li> <li>2. Get excavator ready (Lötscher Construction Ltd.)</li> <li>3. Install stop-log (scheduled)</li> <li>4. Underground parking Nidermatt: Protection by the owner</li> </ol>	

Fig. 2 Example of a Task Instruction (front page)



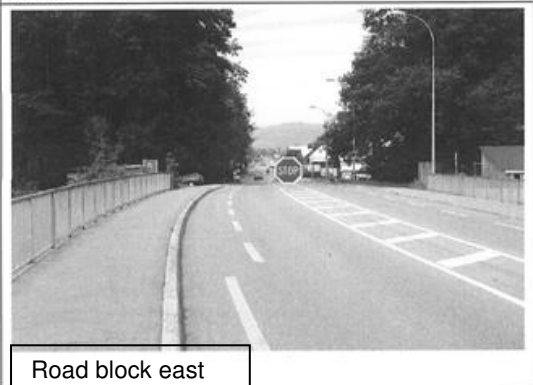
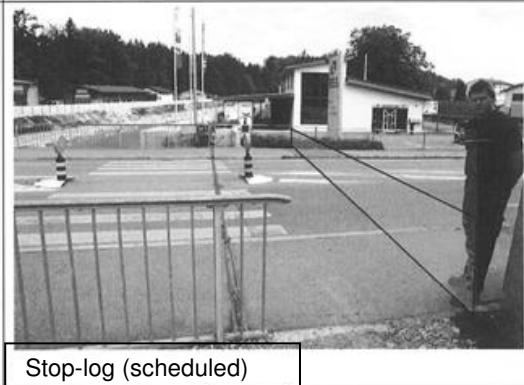
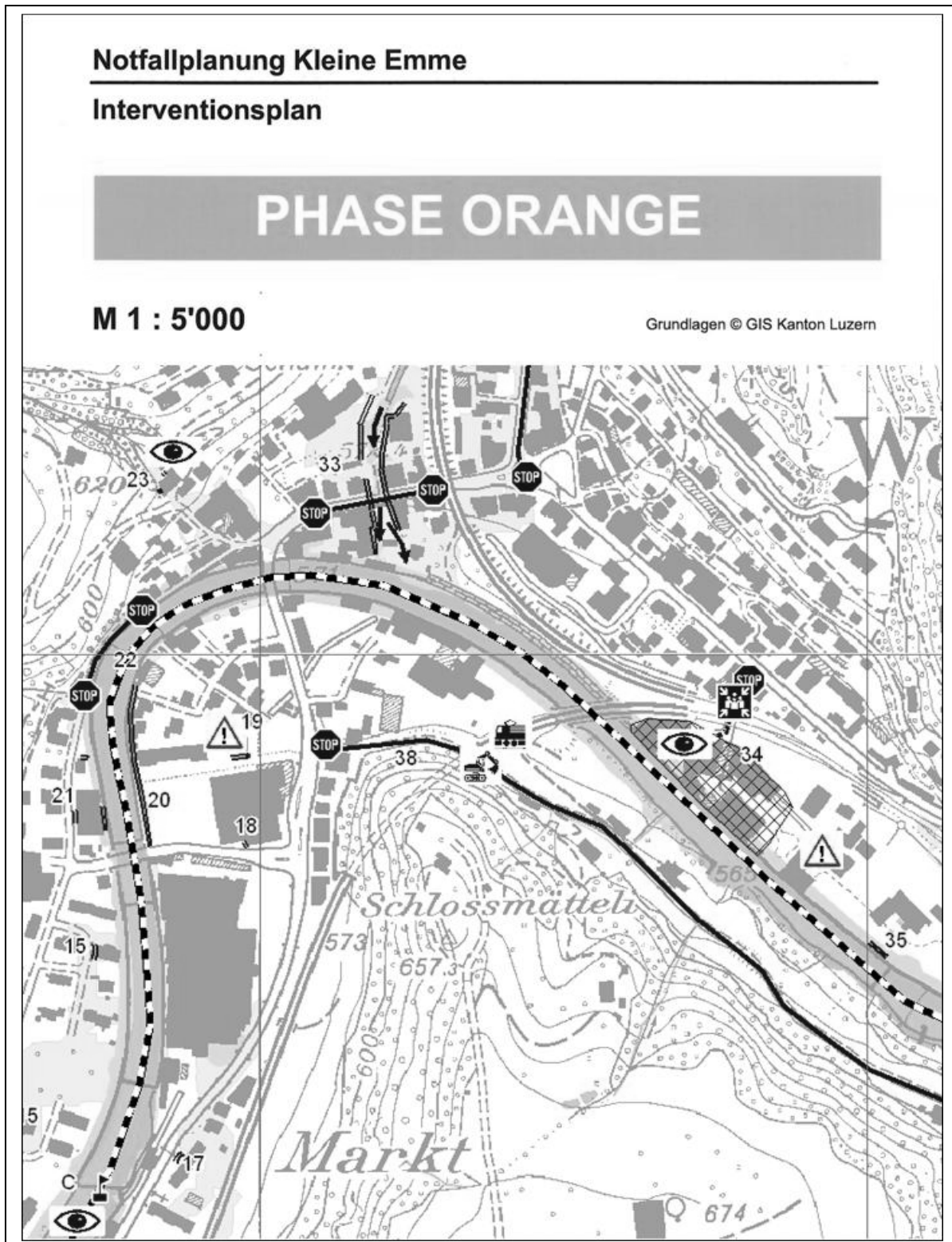
<p><b>Specific behavioural rules</b></p>	<p><b>Manpower needed</b></p> <p>Installation: 7 persons</p>
<p><b>Directives when task is achieved</b></p>	<p><b>Material needed</b></p> <p>2 folding grilles                  2 warning triangles with flashlights                  Warning tape                  1 excavator incl. operator</p>
	
<p>Excavator operation area</p>	<p>Road block west</p>
	
<p>Road block east</p>	<p>Stop-log (scheduled)</p>

Fig. 3 Example of a task instruction (back page)

3. **Overall intervention plans** (Fig. 4): All the tasks are registered on two separate plans: one for phase ORANGE and one for phase RED. These intervention plans allow the commander in charge to keep the overview and to document actions and developments.



**Fig. 4** Example of an intervention plan  
 plots (light grey): areas expected to be flooded (intensities according to hazard map)  
 signatures: tasks-with respective numbers and action symbols according to the task sheets, see Fig. 2

## **EARLY WARNING AND INTERVENTION TRIGGERS**

In an ideal situation the triggering of an intervention would be supported by an early warning system. The specific geographic situation of the Canton of Lucerne makes this impossible:

- The size of the catchment areas that are relevant for a local fire brigade – which means the catchment area above the respective settlement area at risk – varies from a very few to some ten square kilometres. Only a few towns lie at the lower reach of mid-size rivers.
- A bigger part of the loss events are triggered by thunderstorms with very localised extents. It is highly difficult to predict, where these storms will cause intense rainfall.

These two determining factors mean meteorological forecasts are not precise enough to be put into operation for alerting fire brigades (GRAF, 2008). Regular false alarms can not only be tolerated as they cause costs: They also undermine the motivation of the fire men and their employers and therewith the entire militia intervention system.

It is therefore a real challenge to find appropriate triggers for an intervention or a new escalation phase. In reality it is up to the commander and his officers to consult meteo- and discharge-forecasts, to watch the weather “from their own windows”, to monitor now-casting-data, to contact colleagues in the upper part of the catchment area and to listen to their own experience and intuition. Thus it even occurs that an intervention is triggered by the first call for help. All the more it is important to be prepared in the sense of keeping the phase of decision making as short as possible.

## **BOTTOM-UP PLANNING PROCESS**

The emergency plans are elaborated in close collaboration with natural hazard specialists and fire brigade officers. Together they locate every critical spot along a riverbed, on a slope or at a rock face, known from past events or indicated by the hazard map. On-site they discuss probable scenarios (including escalating developments) and define intervention measures. Thereby, both players bring in their respective resources: members of the fire brigade their experiences from past events and interventions, specialists the interpretation of the hazard maps and their hydrological knowledge. For a successful collaboration, two mindsets are indispensable

- Mutual respect: Each involved person has to value the counterpart’s approach, pragmatic down-to-earth-experience on one side, scientific derivation on the other side.
- Modesty: Neither of the partners knows “the truth” – because there is none. Both partners can contribute a handful of scenarios which show, how an event has proceeded or probably will proceed, but the next event will differ as well from the last one as from the prediction of the hazard map.

Finally, it is the fire brigade officers who decide where an intervention is planned and which measures are foreseen, as it’s the fire brigade’s requirements which must be satisfied by the contingency plan.

## **PROJECT ORGANISATION**

After the realisation of a pilot project, the authorities of the Canton of Lucerne implemented an overall project for all 61 fire brigades in the canton. The lead is with the department for natural hazards, the main partner is the fire brigade inspectorate. The enterprise which carried out the pilot project was mandated to coordinate all activities and to ensure a good quality and an equal standard of the processes as well as of the products. Five more companies were mandated to execute the planning processes with the fire brigades. A crucial criterion for the choice of these specialists was their expected ability to act as a coach and a partner at the same time, responding to the specific demands and mindset of fire personnel. Therefore explicit references were asked for activities in a fire brigade or a comparable social field, as characteristics of the behaviour and mindset (“habitus”) of social actors are strongly interlinked with the social field they live in (Bourdieu, 1997).

The natural hazard specialists are charged with the following tasks:

- Locate critical spots according to the hazard map.
- Prepare maps, forms and hardware (e.g. cameras) for the field day.
- Design and organise field work (number of groups and allocated areas, time schedule, reconnaissance of selected hotspots, preliminary talk with the commander of the respective fire brigade).
- Manage field work (usually one day per fire brigade): Introduce and instruct the fire brigade officers, coordinate group work, lead the groups as a coach and resource person in one. Each group is supported by a recording secretary who also has some basic knowledge in natural hazard management.
- Develop a blueprint of the documentation for the attention of the fire brigade.
- Review the documentation according to feedback from the fire brigade.
- Produce and distribute the emergency plan (usually one folder).

The role of the involved fire brigade officers is strictly limited to “watch, discuss and decide”. They are free of all other tasks to ensure the best concentration possible.

### **COSTS AND BENEFIT**

External costs– mainly the fees of the mandated specialists – will add up to 1.7 million Francs. Including the personnel costs of the implemented government boards and local fire brigades, but excluding the costs for the actualisation tool, the overall costs of the project will not exceed 2.0 million Swiss Francs. Thus, an emergency plan for one fire brigade will cost between 20'000 – 40'000 Swiss Francs. According to the Building Insurance of the Canton of Lucerne the loss of building substance in a flood event adds up from 8'400 to 23'000 Swiss Francs per house (Oral information by the head of the loss damage department, figures dating of the events in Menznau, Willisau and Aesch (all 2007) and Horw (2011)). In addition further damages must be included like the damage on the building contents and indirect losses like interruptions of business activities. Thus the cost of an emergency plan can be amortised by saving one single house! The costs can also be compared with the cost of training courses, as the planning process contributes a lot to the knowledge management of the fire brigade involved. It is beyond any doubt, that this project is worth its costs!

### **ACTUALISATION OF THE EMERGENCY PLANS**

One of the biggest challenges is to ensure a sustainable actualisation of the emergency plans, keeping up their quality as well as the standardised design. For this purpose an IT-tool will be developed to allow online creation. A high comfort must be provided as the production will be made by the militia officers in their spare time. Most of these people must be considered to be IT-laymen.

What sounds so simple will be tricky to achieve as the following demands have to be fulfilled:

- The design of the entry mask must be absolutely identical with the design of the analogous products (task sheets, intervention plans).
- Outdated plans must automatically be replaced by the actual version.
- Handling options should mainly be limited to delete, create or adapt task sheets. Modifications of the plan section should automatically lead to an identical modification of the respective intervention plan.
- Functions should mainly be limited to text modifications and “Drag and Drop” (pictures, symbols).
- A print function for the task sheets (A4) must be available as well as a generator function for print files of the intervention plans.



## QUALITY ASSURANCE

To assure a good quality and a uniform design of the emergency plans the mentioned mandate for an overall coordination and coaching was given to an experienced expert.

A special aspect of quality management is given by the fact that natural sciences are regarded to be “exact sciences”. As natural hazard specialists are trained in natural sciences they strive for precise results (which probably is one of the important differences in the habitus of a scientist and that of an average member of a fire brigade). Yet, the basis “data” for the emergency plans comprise a lot of fuzziness, as hazard maps show only the effect of one single combination of selected scenarios out of infinite possibilities. The observations and experience of the fire personnel also contain a lot of vagueness. Under this premise quality is not a question of precision in the sense of scientific derivation. The challenge still is to achieve a precise and “easy-to-communicate” result (in fact a task sheet), but its derivation has to be made on the basis of a responsible argument about how to deal with uncertainty and vagueness.

Another aspect of quality management is the acceptance of the plans by the fire brigades. The experience in the Canton of Lucerne so far shows an almost enthusiastic acceptance. The main reason is located in the fact that aspects of social competence and behaviour are regarded as a key factor of success: Cooperation on eye-level let the militia officers feel a great respect for the effort they perform and responsibility they accept in favour of the society.


## BENEFICIAL SIDE EFFECTS

Emergency planning is a process which creates many desirable side effects:

- Strategic and tactic peculiarities of natural hazard fighting are discussed and documented (Fig. 5).

**Tactic peculiarities  
of interventions against nature hazards**  
(floods, landslides, rockfall)

**1. Watch source and development of hazard**




Are there trends that may threaten the safety of the intervention forces?

If there are any doubts:

- Take worse cases in account!
- Request nature hazard specialists at the headquarterfor for an indeep assessment.

**2. Question offensive tactic!**



Is there a warranty for the predominance of the resources over the power of the nature processes?  
Can it be judged responsible to fight the hazards at close range?

If one of these questions must be answered **NO** it is compulsory to choose a defensive tactic.

**3. Adapt defensive tactic**

**See page 2**

Fig. 5 Excerpt of specific tactic advices for fighting natural hazards

- The education and training of firemen and -women – so far focussed on fighting fires – is directed towards the fighting of natural hazards.
- The emergency plans serve as basis for the design of field training: By distributing the task sheets the officers can assess how easy these orders can be understood. They can observe the ability of the staff to fulfil the orders and identify needs for further training on the one side and the necessity to readjust certain task sheets on the other. Also the trainings provide photos of measures realised which can be used to replace the draft photos in the emergency plan which were taken during field work.
- The planning process leads to knowledge management, as members of a fire brigade get into discussions with one another. Young officers learn from more experienced ones. Officers, who during the last event served at one end of town, get to know experiences made by those at its other end. Fire men and women learn about natural hazards, natural hazard specialists learn about intervention strategies, tactics and techniques.
- Fire personnel and natural hazard specialists get closer to each other by discussing and understanding the proposals and arguments of the respective counterpart. As during an intervention the need for support by specialists may arise there will be a pool of people who know each other, or at least each others habitus, means mindset, and code of behaviour and language.

## CONCLUSIONS

According to the character of the project the conclusions are not the outcome of scientific investigation. All the same they are of great value because they base not only on comments of the involved specialists, but mainly on feedbacks of the fire brigades – that is of the ones that have to rely on the plans in case of an emergency. The core findings are:

- Emergency plans draft an intervention against natural hazards following several escalation phases. They reflect the state of the art of the preparedness of the respective fire brigade, though during a real event they will never supersede situational decisions by the commander in charge. Therefore it is important that the legal effect of the emergency plan is cleared: The commander must be sure that they will not be prosecuted for taking decisions that are not in accordance with the emergency plan.
- Emergency plans allow efficient command operations such as coordination, issuing orders and situation mapping. Therefore the officers must be familiar with the plans. This goal is achieved by involving the fire brigades in the elaboration of the emergency plans as well as by specific training.
- As emergency plans give an overview of all measures intended, they point at measures which need to be coordinated.
- Emergency plans show the need for manpower and specific material for each fire brigade. Consequences must be implemented, which means an upgrade of staff, the purchase of additional material or a streamlining of the planned measures.
- Emergency plans have to be actualised according to new information and experience. To ensure regular updating by militia officers a comfortable tool has to be developed and implemented.
- The mentioned Crisis Commanders (KEL) must find equally designed emergency plans wherever they will take over a charge. Thus the project must cover the whole area of their responsibility, which in the presented case is the whole Canton of Lucerne.
- As the planning process is organised in a bottom-up approach the coaching abilities of the mandated nature hazard specialists – and especially a positive and natural response to the specific mindset, code of behaviour and language of the fire fighters – must be considered as a key factor to successful emergency planning.. In return it fosters the mutual understanding and collaboration between intervention units on one side and nature hazard specialists on the other side not only during the planning process but also during an intervention against a hazardous event.

## REFERENCES

- Bezzola G.R., Hegg C. (Ed.) (2008). Ereignisanalyse Hochwasser 2005, Teil 2 – Analyse von Prozessen, Massnahmen und Gefahrengrundlagen. Bundesamt für Umwelt BAFU, Eidgenössische Forschungsanstalt WSL. Umwelt-Wissen Nr. 0825: 429 S.
- Bourdieu P. (1997). Zur Genese der Begriffe Habitus und Feld. In: Bourdieu, P. Steinrück, M. (Hrsg.) 1997: Der Tote packt den Lebenden. Schriften zu Politik & Kultur 2.. VSA-Verlag Hamburg, 205 S.
- Graf R. (2008). Wetteralarme – eine Herausforderung für eine wirksame Intervention. Ein Praxisbeitrag aus der Zentralschweiz. Interpraevent 2008, Dornbirn. Conference Proceedings Vol. 2.