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Federal Department of the Environment, Transport, Energy and Communications DETEC
Federal Office for the Environment FOEN
Hazard Prevention Division

Dealing with ageing protection systems in torrents

Case studies and guidelines for practice in Switzerland



Flood hazard, mitigation works and residual risks: how can we manage changes over time?

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Content

- A look into the past
- Objectives, classification, procedure and concept of the practical guide
- Case studies Guppenrunse and Gürbe
- Publication
- Questions and discussion



A look into the past



Installation of a check dam in the Gürbe, 1900

- Structures to protect against floods have a long tradition in Switzerland
- Federal Forest Act 1876: prohibition of clear-cutting, afforestation programs, drainage of landslides, construction of series of check dams in torrents
- Replacement value estimated: CHF 35 – 40 billion Euro



Changing requirements for protection systems as a challenge

	Earlier times	Today and in future
Objectives	gain land for agricultural cultivation and for settlement	increased need for protection in densely populated and heavily industrialised areas
Technical means	Use of a lot of manpower Construction materials modest	Construction machinery of the latest technology Building materials stable, durable
Function	Stabilisation of channel and slope	Stabilisation channel and slope, robustness and overloading
Ecology	No consideration	Consideration of water ecology (fish passage, bedload passage) and landscape protection
Economic efficiency	Cheap manpower, employment programs	Financial resources limited
Climate	No consideration disaster gap 1900-1970	Climate change, extreme events, changing framework conditions



Practical guide for dealing with ageing protection systems in torrents - Goals

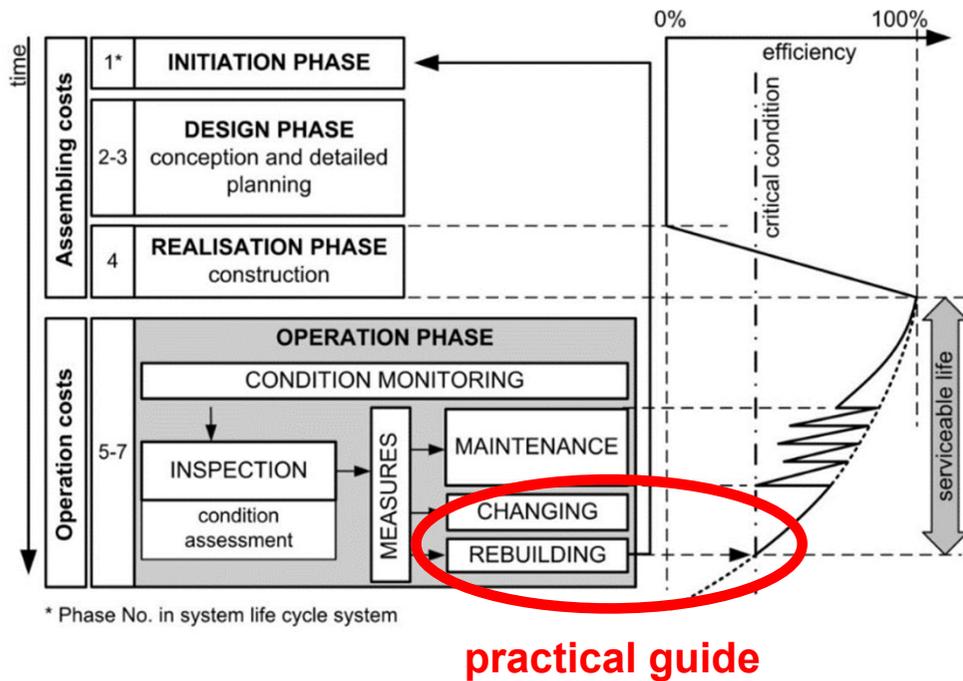
- share experiences and recommendations on how to deal with ageing* protection systems in torrents
- inspire a integrated system approach when reviewing protection systems in torrents and to encourage conscious reflection on system maintenance, system adaptations or system change

Target audience: Federal / cantonal / communal and private sector experts.

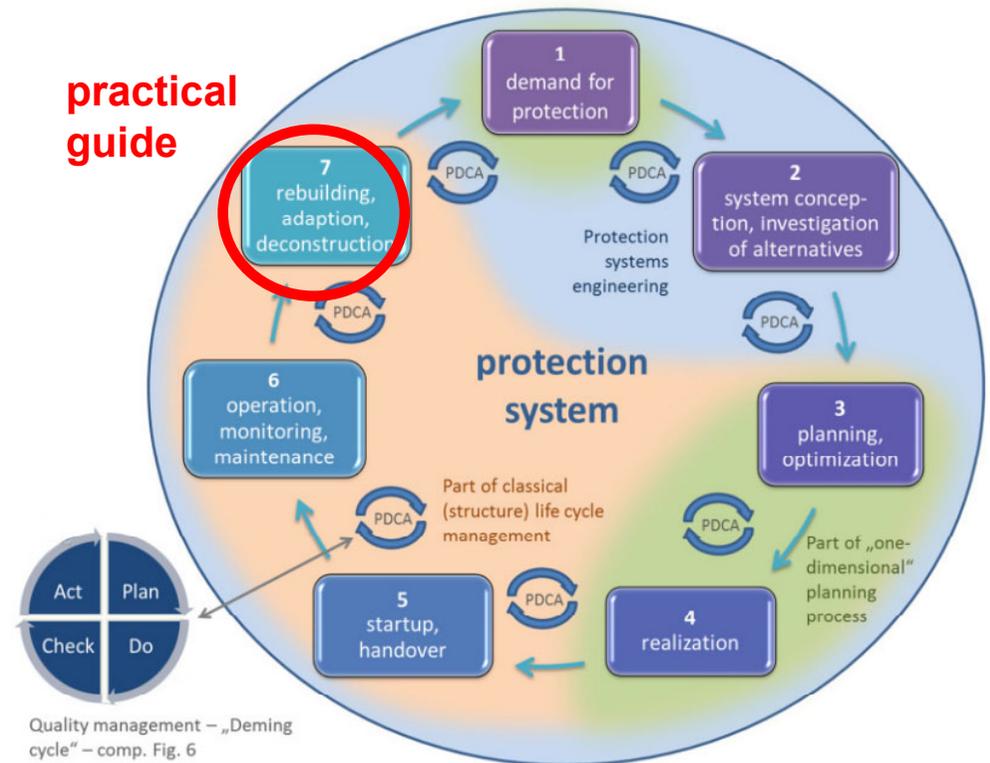
*not meant as an absolute age, but in the sense that they are no longer appropriate or no longer meet the requirements.



Classification of the practical guide in life cycle models



Life cycle model of protective structures according to Suda (2012), adapted



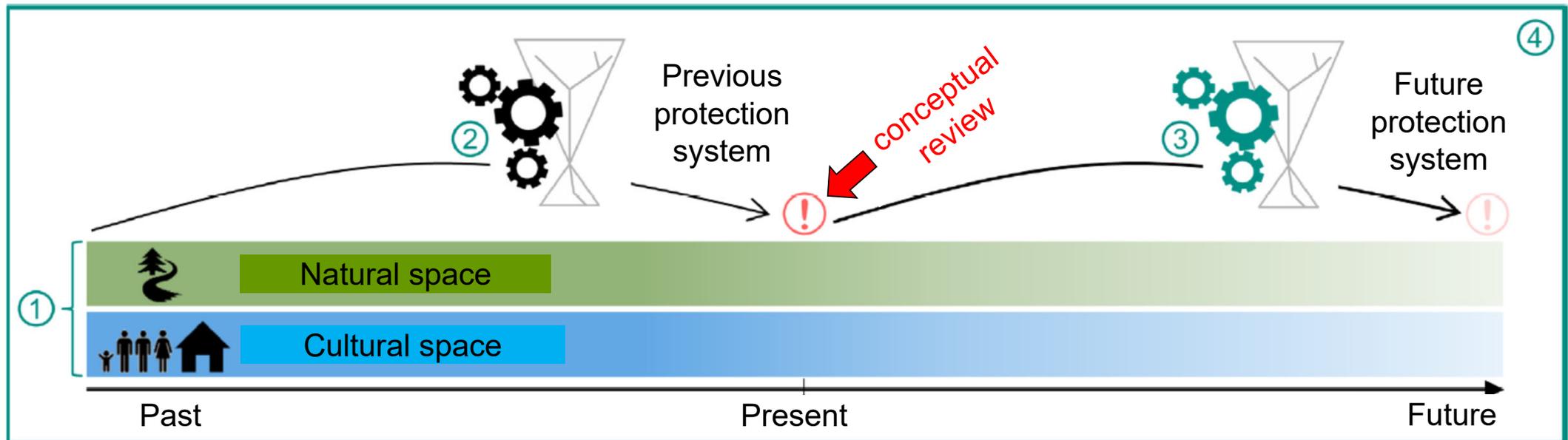
Life cycle model of systems engineering according to PLANALP (2014), adapted



Concept

Knowing history - understanding the present - planning the future

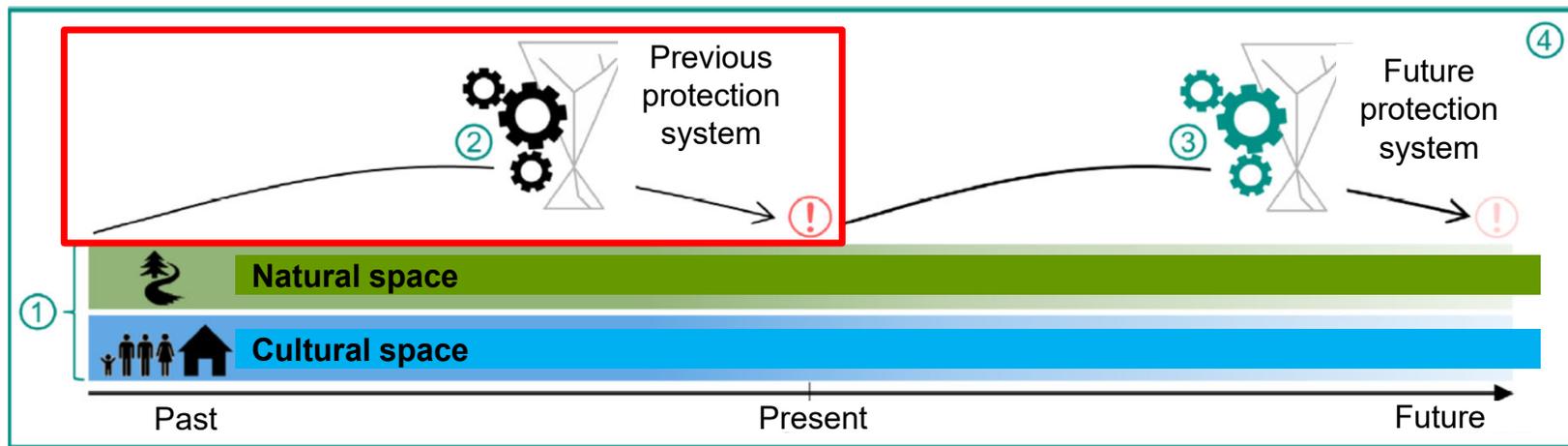
- four-step approach
- leads in a structured way through open-ended decision-making process
- takes place in the preliminary studies





Concept

Step 2: Understanding the previous protection system

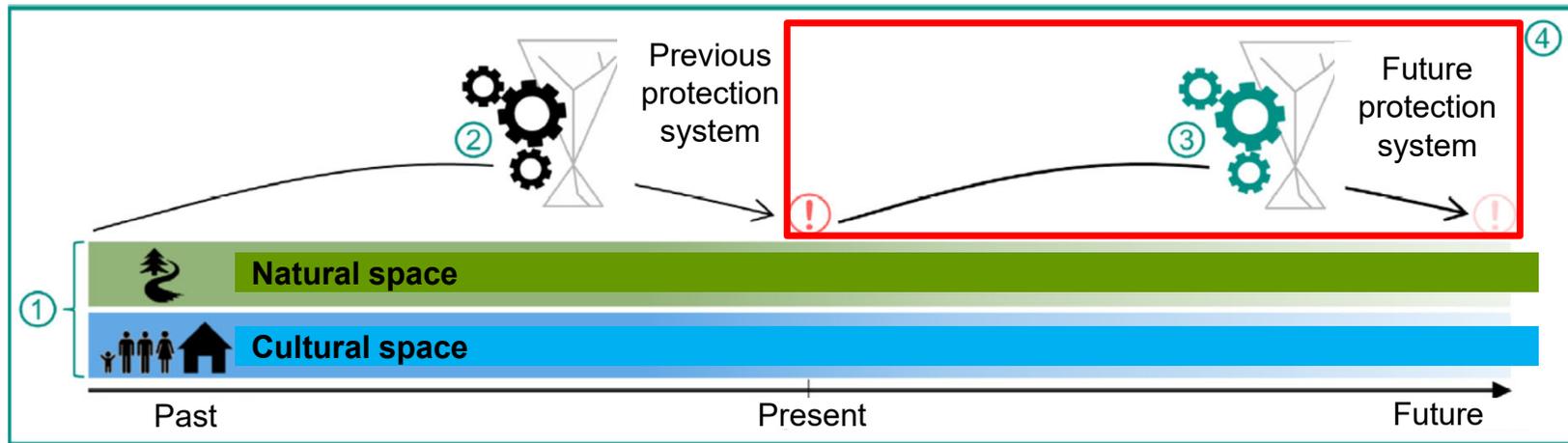


- What was the original protection concept and what protection goals were aimed at?
- Which protective measures exist, in what condition, with what function, reliability and effect and with what emotional significance for whom?
- Has the existing protection system met the objectives until today?
- What has triggered a conceptual review?



Concept

Step 3: Developing a future sustainable protection concept

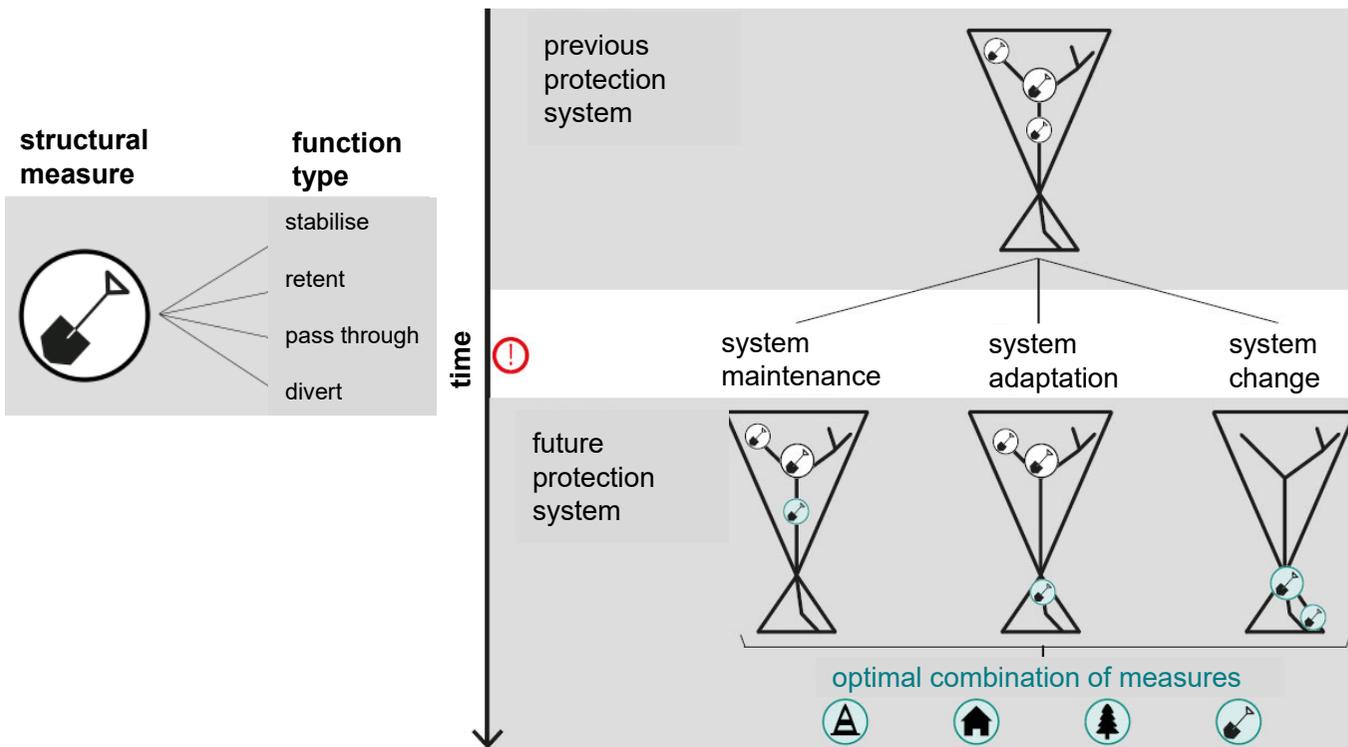


- What are the demands on the future protection system and the differences between these demands and the existing system?
- Is the best solution a system maintenance, system adaptation or system change?



Concept

Step 3: Developing a future sustainable protection concept



System maintenance:

Maintaining the function type of the structural measures at their former geographical location.

Example: The series of check dams in the catchment area is renovated

System adaptation:

Partial change in the function type and/or geographical location of the structural measures.

Example: Only the key structures of the series of check dams in the catchment area are maintained. The system is supplemented by a sediment basin at the cone neck.

System change:

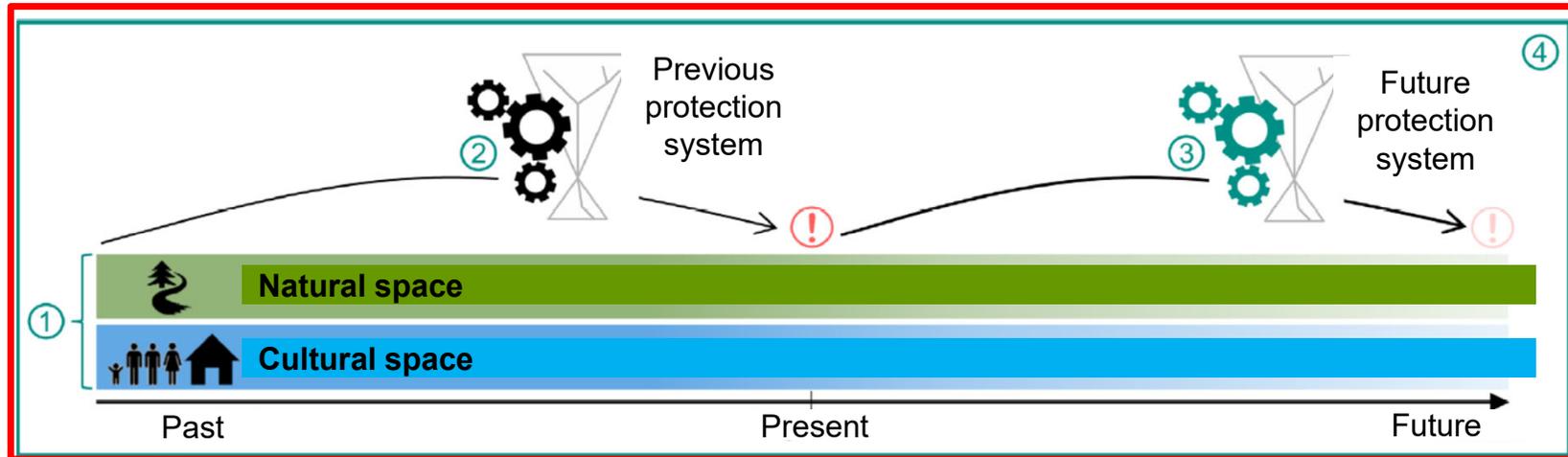
Change of function types and/or the geographical location of the structural measures.

Example: The series of check dams in the catchment area is completely given up. A new sediment basin is constructed at the cone neck.



Concept

Step 4: Overarching aspects



- Correct, comprehensible project bases
- Professional Communication



Case studies Guppenrunse and Gürbe

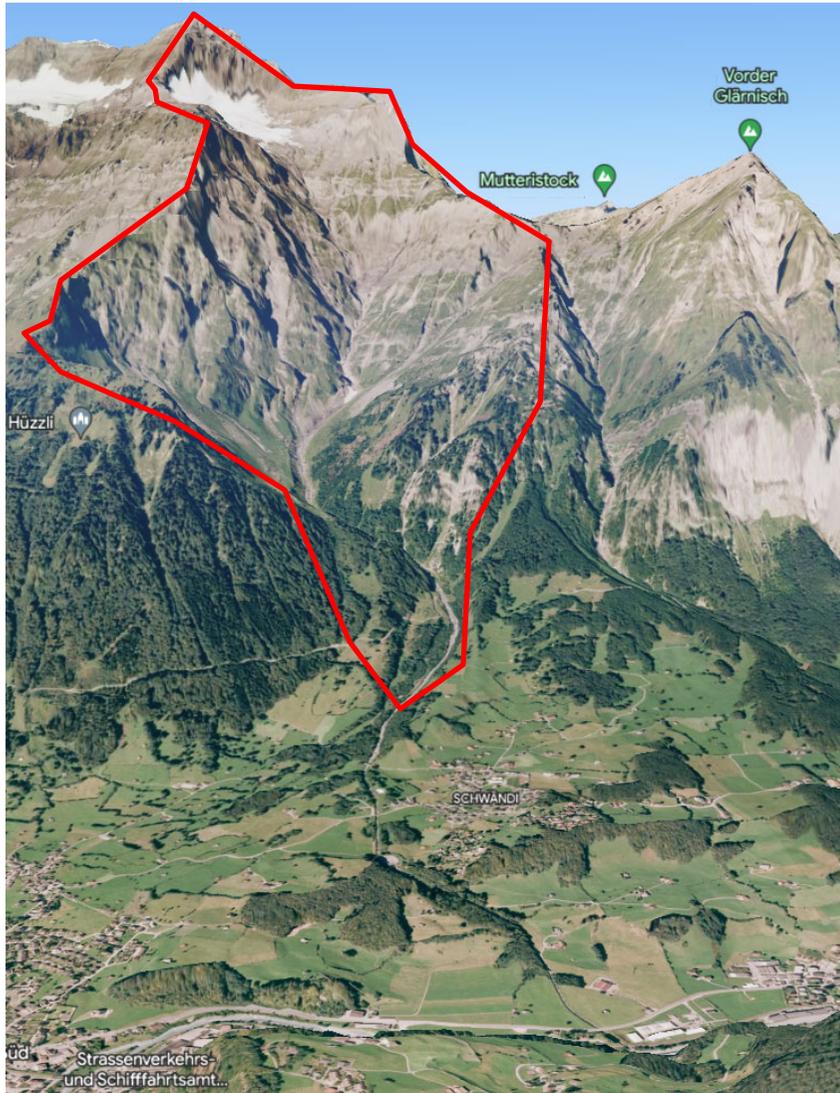
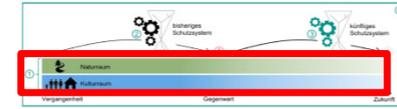


Wildbach	Kanton (Gemeinde)
Formigario	Tessin (Faido)
Guppenrunse	Glarus (Glarus Süd)
Gürbe	Bern (viele Gemeinden vom Gantrischgebiet bis Wattenwil)
Kleine Melchaa	Obwalden (Giswil, Sachseln)
Lammbach	Bern (Brienz, Hofstetten, Schwanden)
Merdenson	Wallis (Val de Bagnes)
Nasenbach	St. Gallen (Wildhaus – Alt St. Johann)
Palanggenbach	Uri (Seedorf, Attinghausen)
Ri del Bess	Graubünden (Mesocco)
Steinibach b. Hergiswil	Nidwalden (Hergiswil)



Guppenrunse, Glarus-Süd, GL

1



Natural space

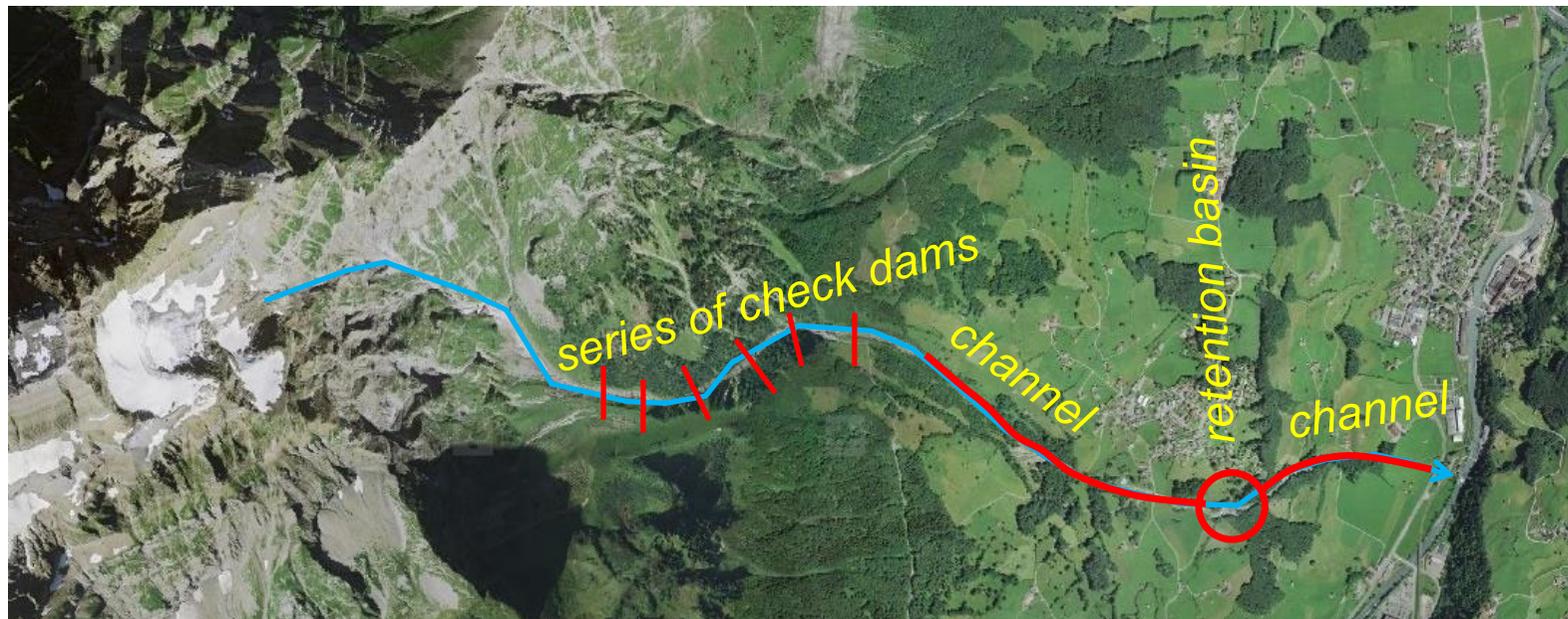
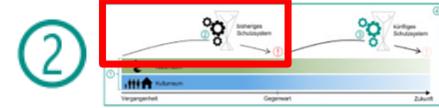
- steep catchment area 3 km²
- glaciated (Guppenfirn)
- permanent bedload delivery
- two cones
- debris flows and snow avalanches
- Future: higher runoffs; glacier will melt and release more bedload

Cultural space:

- villages of Schwanden, Schwändi and Mitlödi are at risk from debris flows and avalanches that can break out at the cone neck.
- Future: Increase in damage potential, especially in the valley



Guppenrunse, Glarus-Süd, GL



- Previous protection system: series of check dams in the catchment area and channel on the alluvial cone (after big event 1890) and small retention basin (built 1987) with the goal to protect the settlement
- The protection goals have been well achieved for over 100 years with only few minor events. Two big events in 2010 and 2011 → destruction of series of check dams.



Guppenrunse, Glarus-Süd, GL

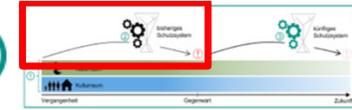
before 2011

after 2011



Source: Marty Ingenieure AG

2

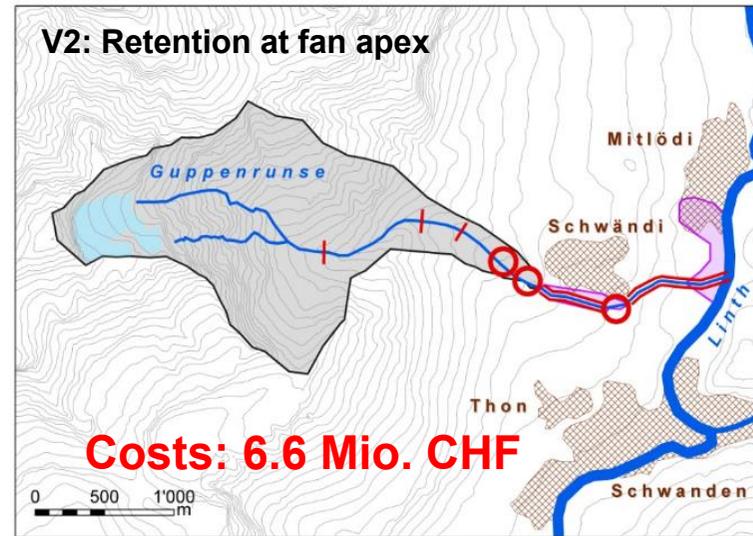
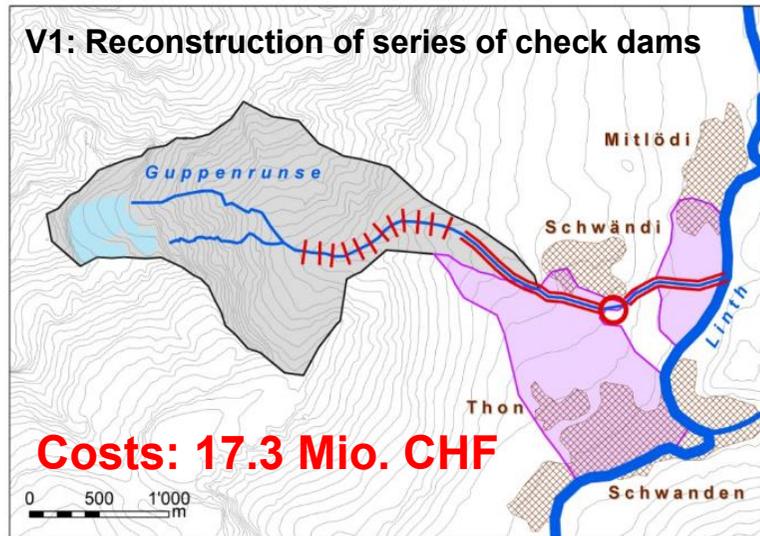


Trigger of conceptual review:
Debris flows in 2010 and 2011, which destroyed completely the series of check dams.



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3



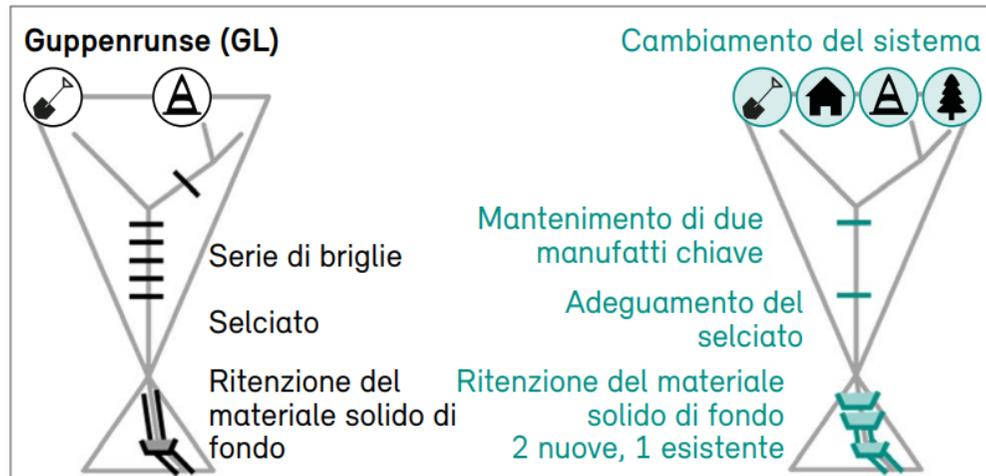
Future protection system:

Advantages of V2:

- Better security in case of over load events
- Higher robustness respecting natural variety in runoff process and uncertainties in hazard assessment and climate change
- Combined protection against debris flows and snow avalanches
- Better cost-effectiveness



Guppenrunse, Glarus-Süd, GL

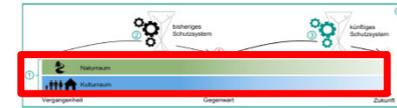


- Prime example of system change
- Decision was relatively undisputed due to complete destruction during event
- Arguments of economy, robustness, safety at work, flexible system were convincing
- Landowner was the municipality
- Comparatively "simple" conditions



Gürbe, Wattenwil, BE

1



Natural space

- pre-alpine torrent near Bern
- catchment area 12 km²
- flysch area with active permanent landslides (20-30 m deep horizon)
- sediment related floods
- Future: Possible larger extreme events due to climate change, activation of large landslides

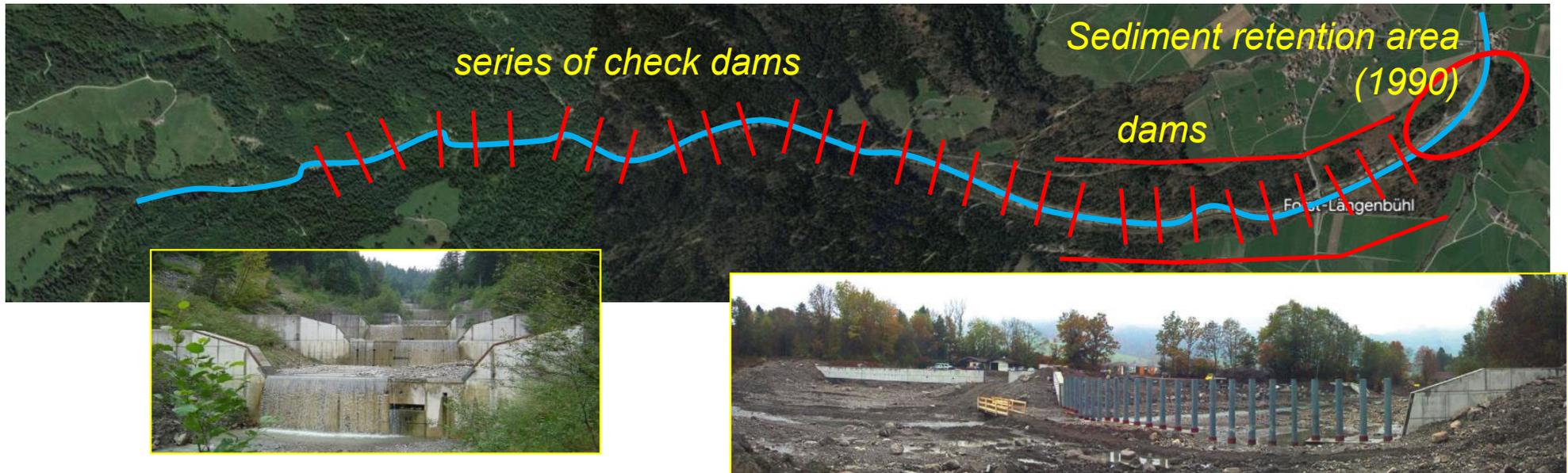
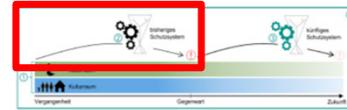
Cultural space

- Alpine farming and forestry in catchment area, alluvial cone sparsely populated, used agriculturally
- local recreation and leisure use in the catchment area is high, access dense (hiking, biking, bathing & BBQ in the series of ckeck dams in summer)
- Future: Hardly any changes to be expected



Gürbe, Wattenwil, BE

2



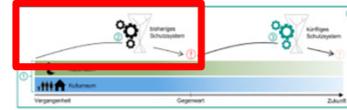
Previous protection system

- Big event 1850 → 1858-1881 installation of 120 wooden check dams in catchment area and dams at cone with the Goal: flood protection Wattenwil/ Blumenstein and villages downstream as well as land acquisition for agricultural use
- Event 1881 → many of wooden check dams destroyed → new construction of check dams with quarry stones
- Events 1927, 1929, 1938 → Further renovation of check dams with concrete
- Very big event in 1990 → Flooding on cone and in the lower reaches of the Gürbe → installation of additional flood, wood and bedload retention area in the lower cone area (retention).



Gürbe, Wattenwil, BE

2



Triggers of conceptual review:

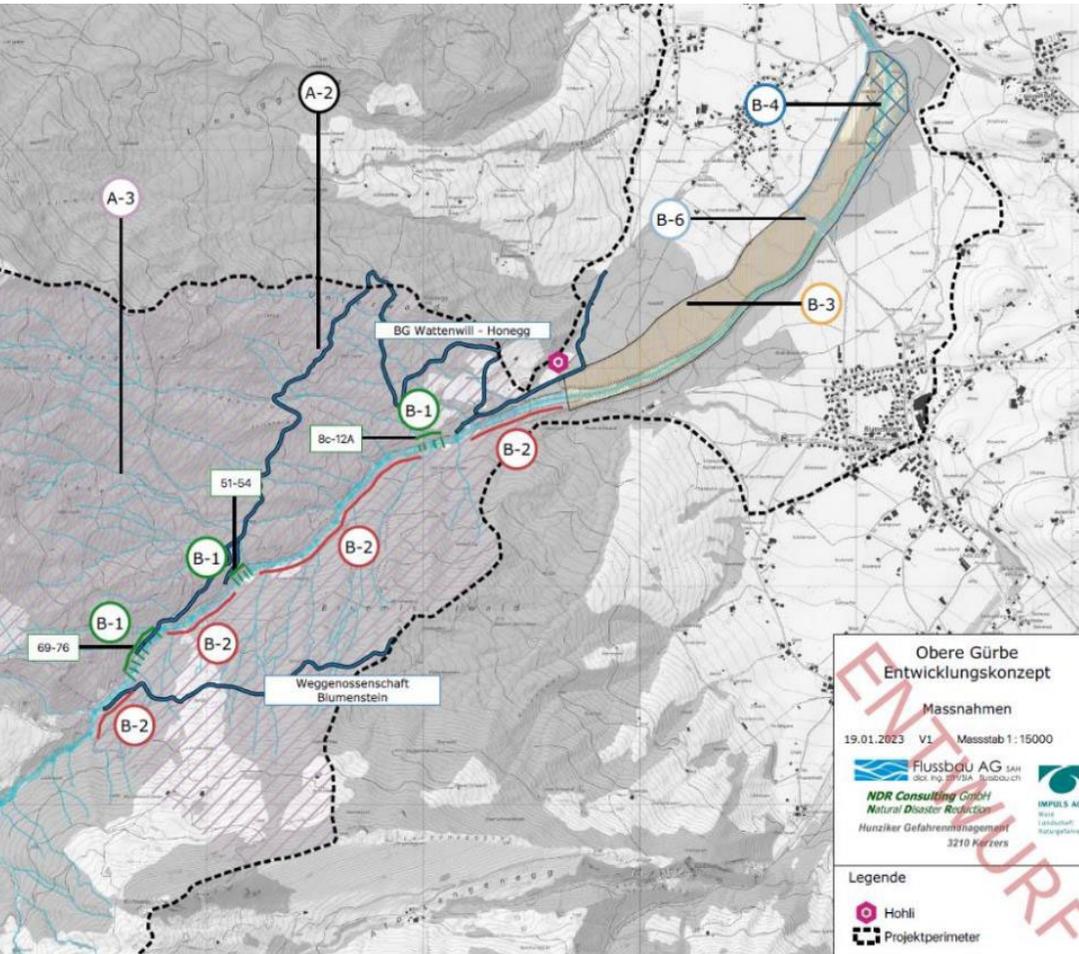
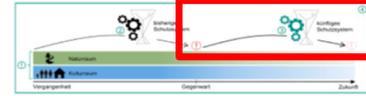
- 2012-2016: Planning of a maintenance and renovation project for the series of check dams
- The canton/federation required proof of the effectiveness and economic efficiency of the renovation
- The study showed that the repair is not economical and that the series of check dams is not appropriate. It also showed that there is redundancy in the protection system. The retention area alone can provide the necessary protection, but the series of check dams cannot.
- This meant no more future subsidies for maintenance and replacement from the canton and the federal government, with a strong reaction from the local authorities and the population.
- Spring 2018: “Meierisli landslide” was activated (5 million m³), destruction of 14 barriers in 2 months





Gürbe, Wattenwil, BE

3

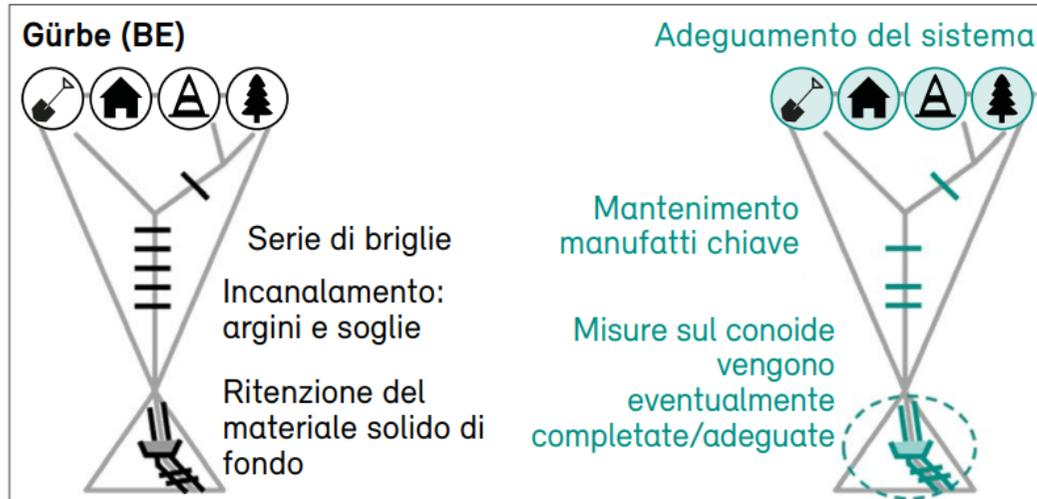


Future Protection system

- “Upper Gürbe development concept“ finished 2023 after several years of discussion
- Participation process with more than 30 citizens and stakeholders:
 - Giving up a large part of the series of check dams in the catchment area (red sections)
 - Moderate maintaining of check dams only in 3 key sections (check dams on rock) and ONLY UNTIL they suffer structural damage (green sections)
 - Regular reassessment of whether there are really no protection deficits.
 - If necessary, removal of the damaged check dams.



Gürbe, Wattenwil, BE



- System adaptation in the short term, system change in the long term.
- Transition phase results in a smoother transition and is inevitable for acceptance.
- System change takes several decades.
- Very challenging case in terms of strong connection of the population to the protection system, trust in experts and communication.

Success factors were:

- Involvement of local leaders who are positively opposed to system change and of critical citizens in the decision-making process
- Allowing time (years, decades) for the local population to think about and come to terms with the new situation and future changes.



Conclusion

- The question of how to deal with ageing protection systems is highly relevant. Risks are increasing, finances are becoming more limited. It is essential to critically review the existing protection system if new investments are necessary. In doing so, the options of system maintenance, system adaptation and system change should be consciously analysed and evaluated.
- Every example is different! Just as every torrent is an individual, its protection history and conditions as a basis for a generational change in the protection system are also unique.
- When deciding how to deal with an ageing protection system, not only technical criteria have to be considered, but also economic, ecological and social aspects.
- FOEN's open-ended approach structures the procedure and supports experts in designing the transition of a protection system into the next life cycle in an optimal and sustainable way.



Publication in D, F and I



Thank you!
Grazie mille!

- Deutsch auf der Homepage des BAFU www.bafu.admin.ch/uw-2210-d
- Français sur le site de l'OFEV www.bafu.admin.ch/uw-2210-f
- Italiano sulla homepage dell'UFAM www.bafu.admin.ch/uw-2210-i