

FLOOD RISK MANAGEMENT IN ITALY:

TOOLS FOR THE HYDROGEOLOGICAL LAND PLANNING



**Water is a vital element and a precious resource,
but, at times, a danger to be controlled and above all avoided.**

The natural phenomena and the hydrogeological instabilities

Floods are natural phenomena which periodically affect every part of the planet. Italy has a very long history of disasters caused by floods (Polesine 1951, Florence 1966, Genoa 1970, Versilia 1996, Sarno 1998, Piedmont 1994 e 2000) that invariably affected plains sweeping away houses and farmlands, damaging all properties and causing loss of human lives. Faced with certain events of great dimensions and high energies man is often unable to resist.



The concept of safeguard and protection

The safeguarding of human lives and the protection of properties and the environment from flooding events happens through the understanding of the phenomena, the land surveying, the simulations of the potential floods, the impact assessment on the built up areas and the consequent risk and the adoption of defence measures where considered worthwhile to avoid further calamities.

The principles and the rules

The safeguard protection concept has been implemented by establishing the rules responding to the appropriate land management principles.

The **river basin** has been identified as basic unit for developing the proper land management in an integrated, multisectorial way and through consultation. On this basis, in 1989, the first Law for the "soil protection" in Italy was enacted; the Law fixed **the rules for the actions** needed to guarantee the **hydrogeological land planning**, suitable to the safety of the population, the protection of the cultural heritage, the environment and human activities.

Later, in 1998, in order to strengthen and enhance the previous Law, a new Act has been issued, defining the procedures to obtain a hydrogeological land planning aimed at more clearly applying the concept of safeguarding and protection.

The concept of **risk** was introduced, occurring as a result of the combination of the **hazard**, the **value** and the **vulnerability** of the elements at risk.

The constraints for the land use were defined with the aim of avoiding new risk and also the measures to reduce the existing risk through its classification, so identifying the degree of attention and the priority actions.

The above rules and principles have been implemented by the **River Basins Hydrogeological Plans**: surveying and operating tools for an appropriate land management.

Flood hazard is the probability of occurrence of a potentially damaging flood event.

The hazard expresses the probability that a damaging flood of a given severity occurs in a given timeframe (return period T_r). The return period is statistically defined as an inverse function of the probability, which can be consequently identified by the frequency of the flood event:

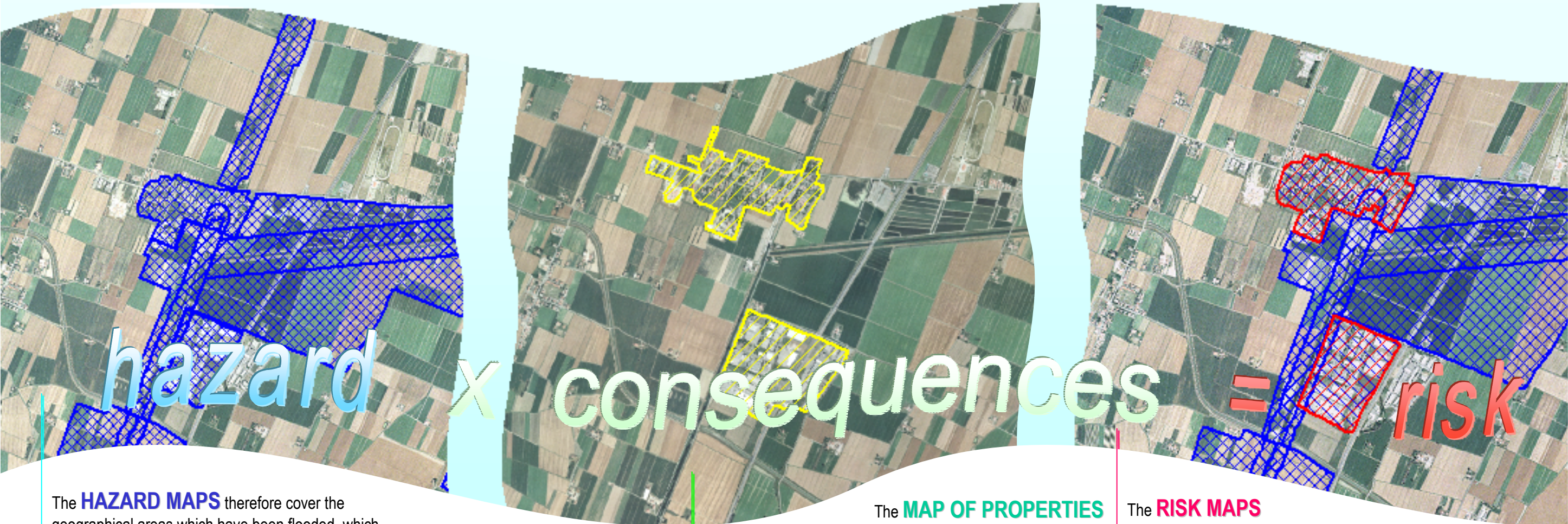
$$T_r = \frac{1}{P} \Rightarrow P = \frac{1}{T_r} = f$$

where
 P = probability of flood event occurrence
 T_r = return period
 f = frequency (the number of the occurring events in a given timeframe)

When for instance we estimate that the return period of a flood event in a given area is 30-50 years, the probability of occurrence of such event is high; consequently this area can be defined a "high (flood) hazard area".

Vice versa, the probability of a flood occurrence with an estimated return period of 300-500 years is low; consequently the area affected can be defined a "low (flood) hazard area".

Flood risk is the damage expected to people, properties, the environment, infrastructures, industrial activities, considered as the combination of the probability of a flood event (**hazard**) and of the potential adverse **consequences** (value x vulnerability) to human health, the environment, the infrastructures and the economic activity associated with a flood event.



The **HAZARD MAPS** therefore cover the geographical areas which have been flooded, which could be flooded with an indication of the probability, taking into account the existing flood defence structures. These areas shall be shown according to the three following scenarios:

- Frequently occurring flood events (**HIGH PROBABILITY**, likely return period 30-50 years);
- Less frequently occurring flood events (**MEDIUM PROBABILITY**, likely return period 100-200 yrs);
- Extreme flood events (**LOW PROBABILITY**, likely return period 300-500 years).

For each scenario the degree of danger will also be provided by expressing the water depth, the flow velocity or the combination of these and the identification of areas which could be subject to bank erosion and debris flow deposition.

The **MAP OF PROPERTIES EXPOSED TO FLOODING**

shows the properties identified within the "flood hazard areas", as the properties exposed to flooding, since potentially affected by that event.

The elements defining the exposed properties are: the **value** (people, properties, infrastructures, industrial activities, the environment) and the **vulnerability** (the capability of the properties to withstand the forces due to the event). The combination of these elements are understood to be the **consequences**, in other words the effect of the event on the exposed properties.

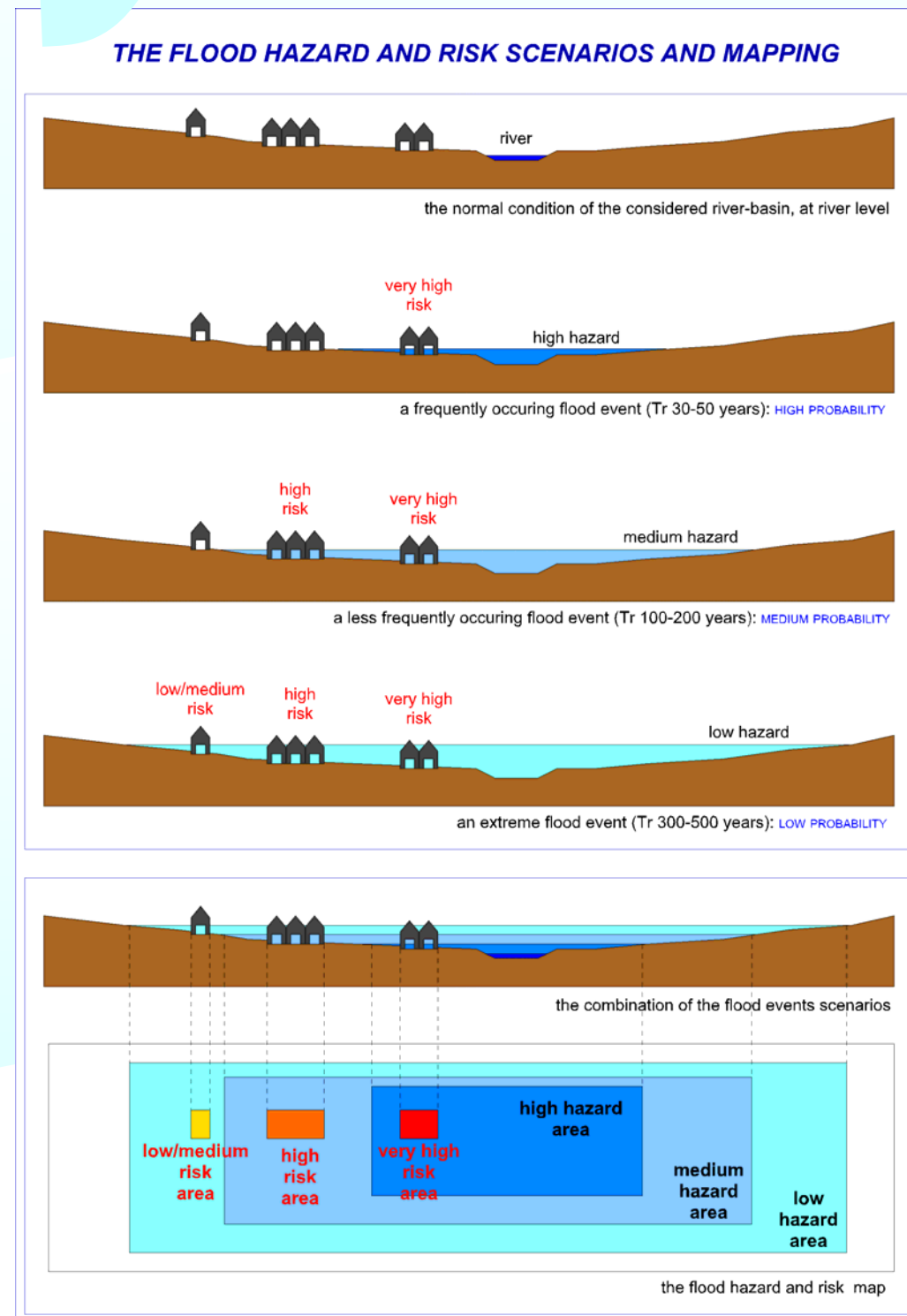
The **RISK MAPS**

are provided, according to the following four risk classifications:

- R1 – moderate risk:** social, economic and environmental damages are low;
- R2 – medium risk:** probability of minor damages to buildings infrastructures and environment, not compromising human safety, use and economic activities;
- R3 – high risk:** envisaged problems to human safety; damages to buildings and infrastructures compromising their use and provoking hold-up of socio-economic activities and severe damages to the environment;
- R4 – very high risk:** envisaged losses of human lives and severe lesions to persons; severe damages to buildings, infrastructures and the environment and socio-economic activities destruction.

The assessment of the priority actions

The attention level and the priority actions are identified on the basis of the hazard degree determining the degree of risk.



A **very high risk** contains also **medium** and **high risk**, hence represents the objective of the priority actions.

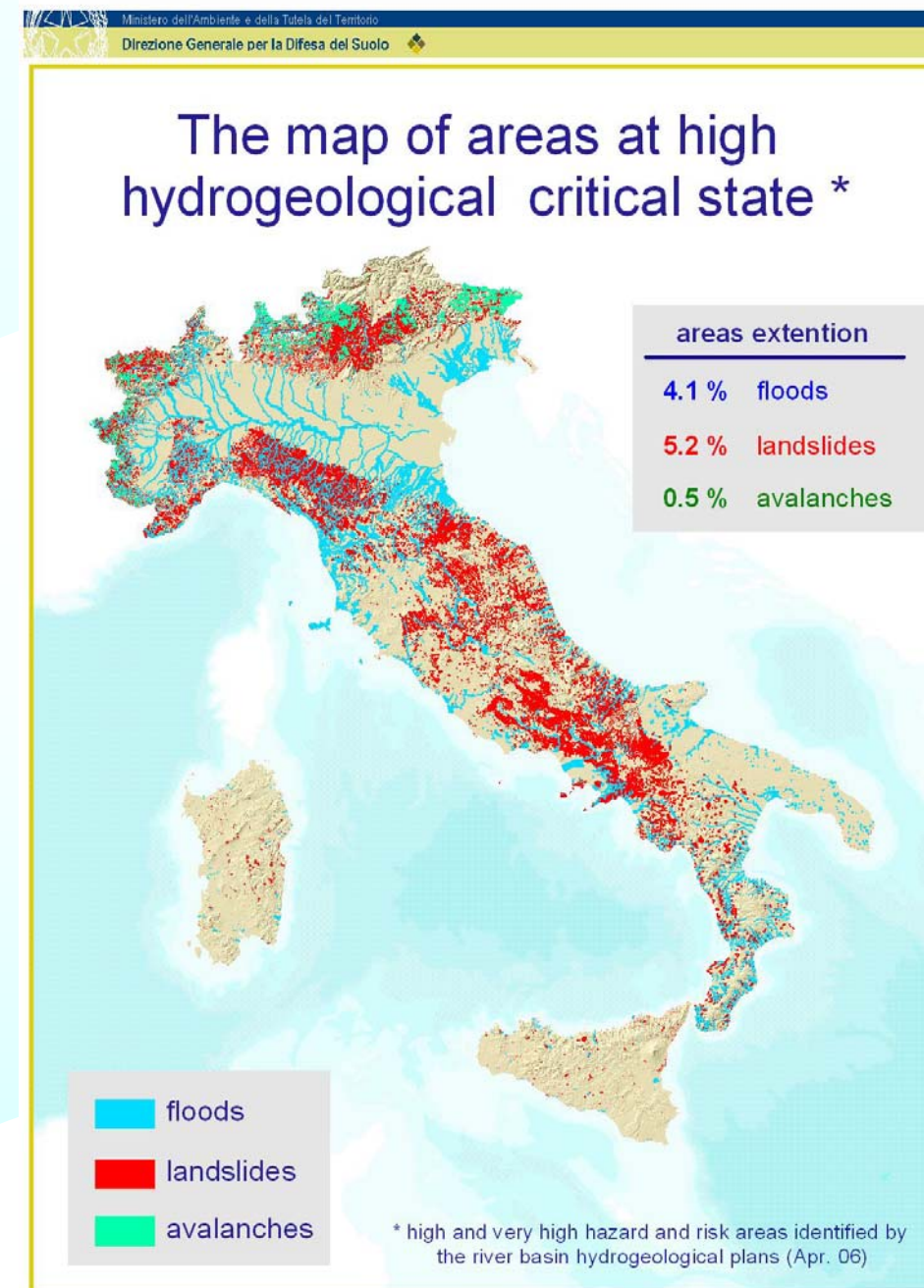
A **high hazard** contains also **medium** and **low hazard**, hence represents the priority objective of attention to avoid the risk which doesn't exist.

Prioritizing actions and scheduling allocation of financial available resources.

We must not generate the risk which does not exist.

The results achieved towards the hydrogeological risk management

Italy has completed the hydrogeological land planning allowing the **floods**, landslides and avalanches risk management. The **River Basin Hydrogeological Plans** provided the following results:



- hazard and risk maps for **floods**, landslides and avalanches, showing all scenarios;
- provisions regarding land use in **"high risk"** and **"high hazard"** areas to prevent the increasing or generation of risk;
- priority actions for risk reduction, identified according to the degree of risk (over No.10.000 for a value of more than 11 billions Euros);
- budgeted expenses for all the actions identified and required (over 40 billions Euros).

On the basis of the Plans, the Map of the areas at high hydrogeological critical state has been prepared to support the priority actions. Only to face up these actions, a planned strategy of the required initiatives will be needed, to be financed by EU, National, Regional, Local and Private Funds.

The Ministry of the Environment and Land Protection – Directorate for Soil Protection plans, finances and controls the actions aimed at the hydrogeological risk reduction.

Surveying, monitoring and land management are continuous actions which, time after time, must go on.

**Respecting rules contributes to a
more lasting and secure socio-economic development.**



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