NWRM Mediterranean workshop

Alcalá de Henares, 28 January 2014

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Why are NWRMs needed? Key challenges in relation to flood risk management for joint WFD and FD implementation

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Some premises (1)

WHAT IS RIVER RESTORATION?

= (ECOLOGICAL) RESTORATION

MEASURES AIMING AT IMPROVING THE

ECOLOGICAL STATUS

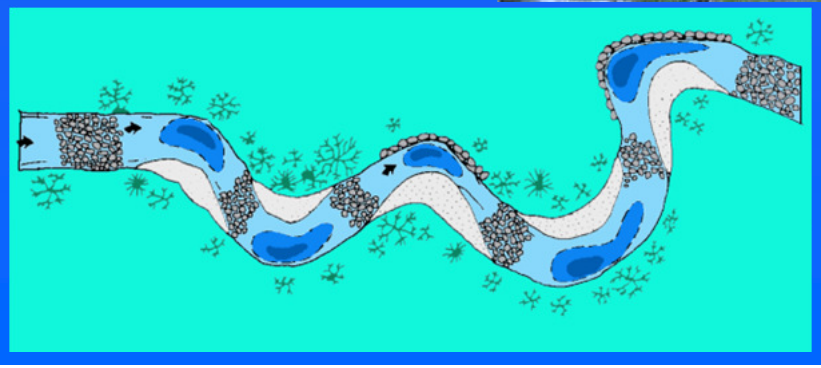
(ecological integrity) of rivers and connected ecosystems

WHAT IS RIVER RESTORATION?

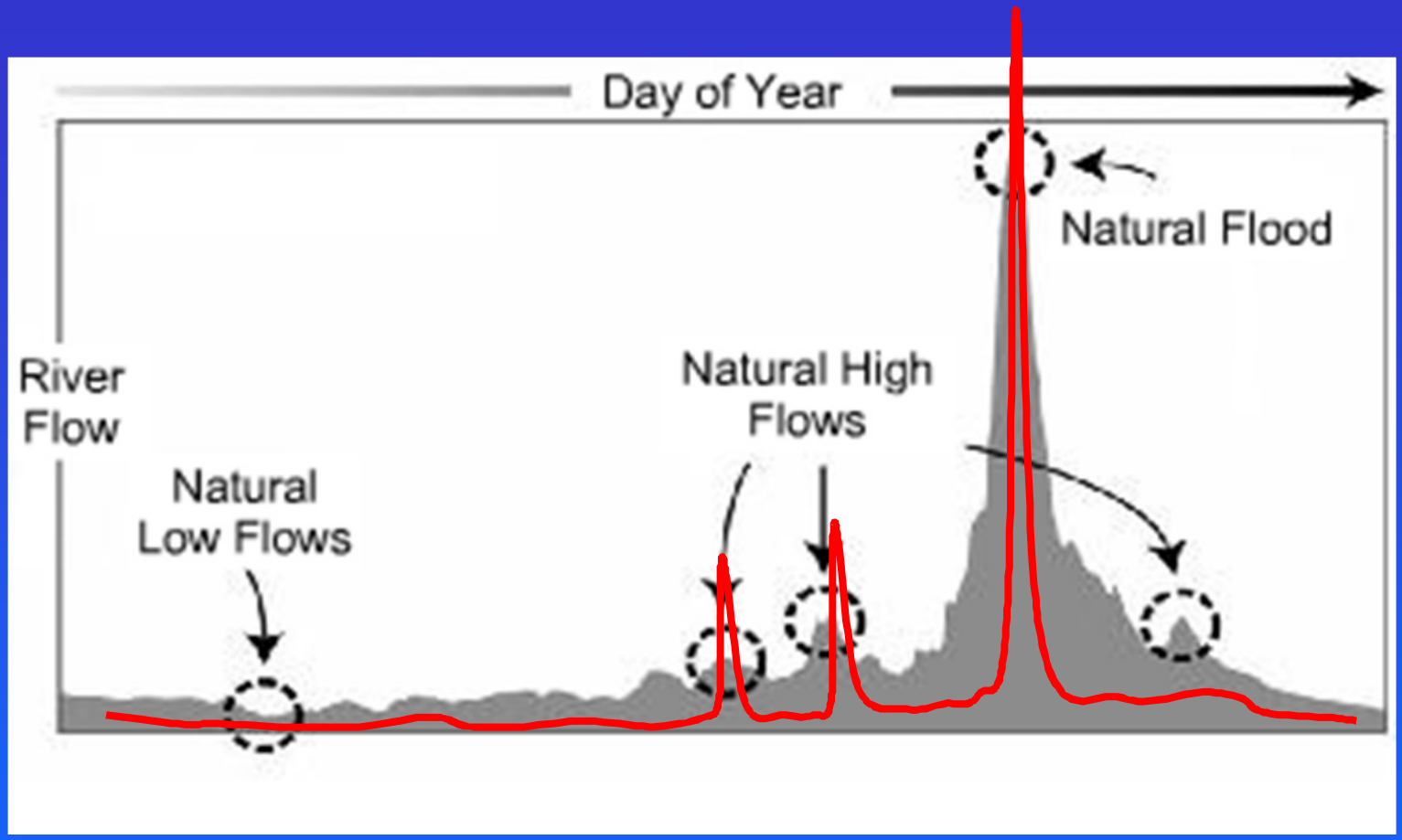
WATER PHYSICO-CHEM. QUALITY

BIOLOGICAL QUALITY

HYDROMORPHOLOGICAL QUALITY



HYDROMORPHOLOGICAL QUALITY

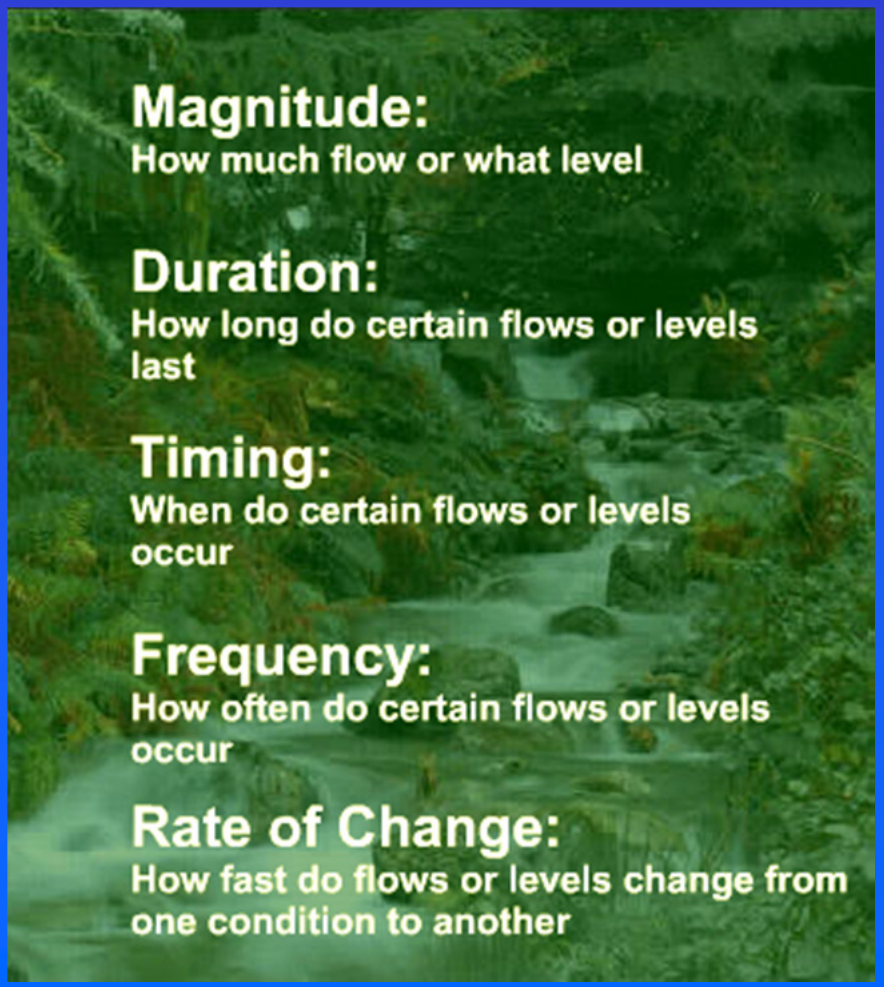


Typical RR measure:
restoring a more natural water flow regime

Floods, droughts and much more…

HYDROMORPHOLOGICAL QUALITY

IHA approach (Indicators of Hydrologic Alteration, Richter et al., 1996)



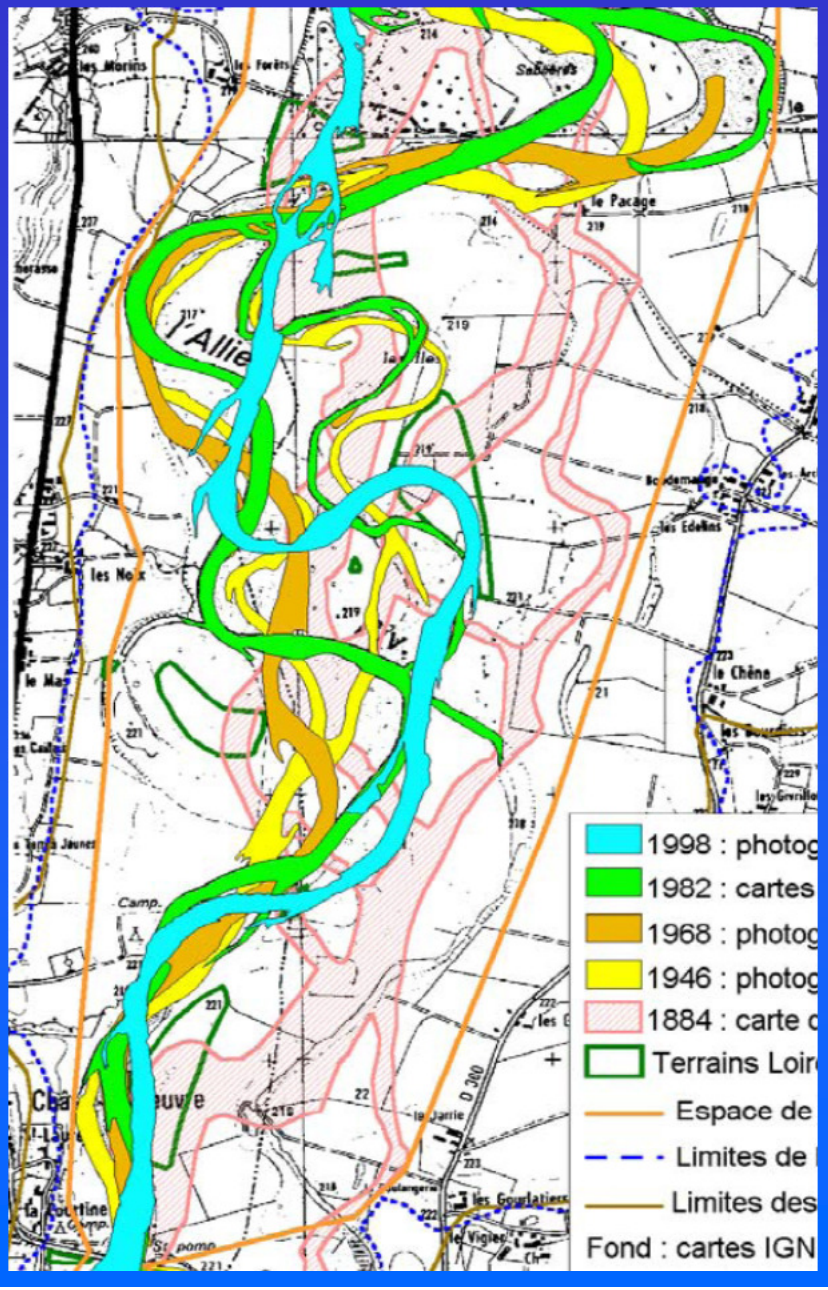
RR has often to do with increasing the flow retention capacity of the system, which has been artificially reduced

HYDROMORPHOLOGICAL QUALITY

A NATURAL river (with the exception of naturally confined ones):

- Creates a floodplain (which periodically is…flooded!)
- Has lateral, longitudinal and vertical connectivity of both WATER and SEDIMENTS
- Moves within its "mobility area"

Ecosystems are maintained thanks to this dynamics



Es: habitat for fish

Feeding habitat

Shelter

Low velocity zone and refuge

Local connectivity

Habitats for daily functions: Feeding and shelter

- **Feeding: e.g. riffles** (macrozoobenthos)
- **Low velocity zones:** reduce energy consumption
- **Shelter from predators**

Long distance connectivity (longitudinal and lateral)

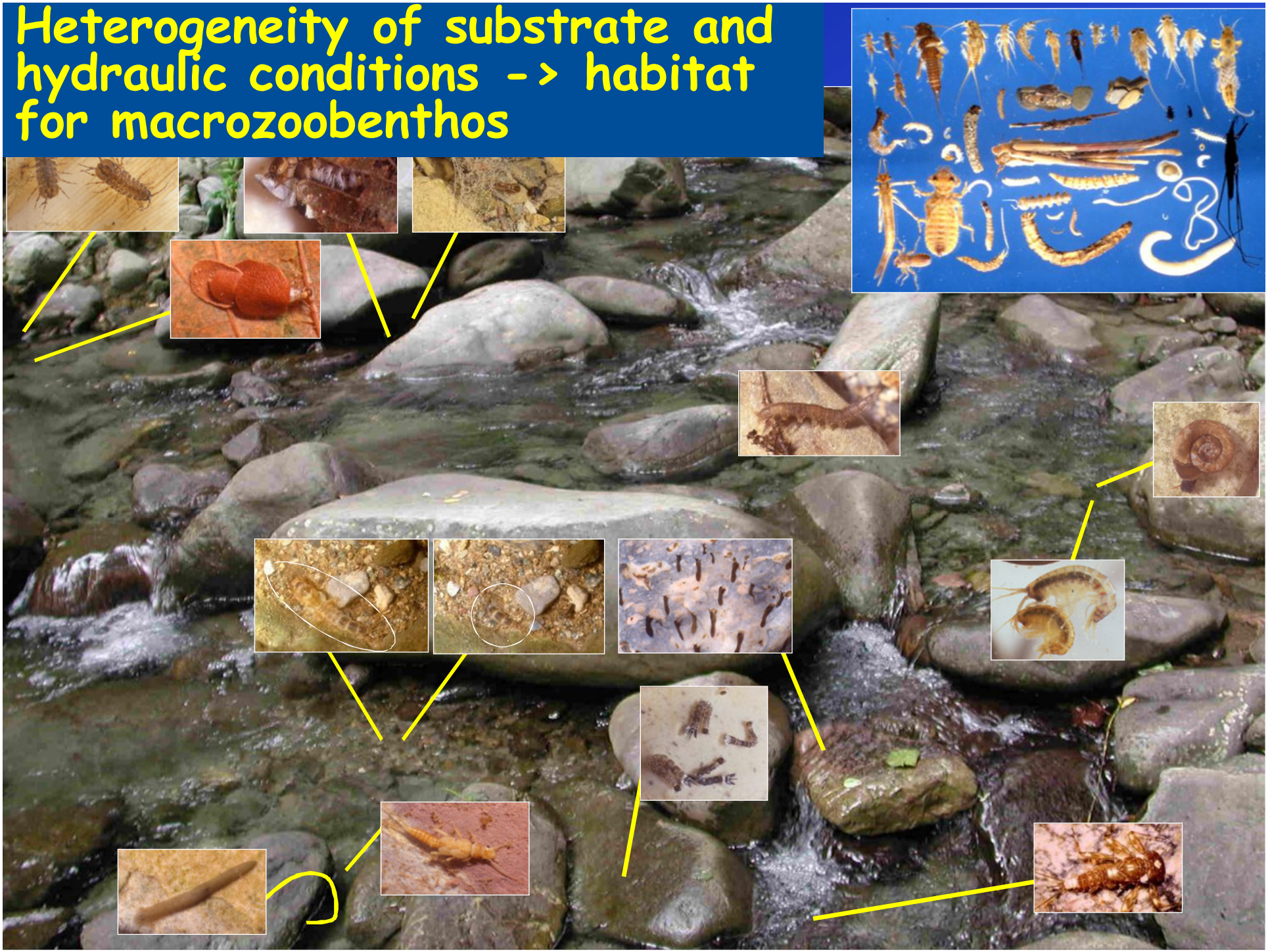
Pool

Spawning ground

Habitat for critical phases: breeding and refuge

- **Spawning substrate**
- **During extreme conditions** (e.g.: floods, droughts)

Heterogeneity of substrate and hydraulic conditions -> habitat for macrozoobenthos



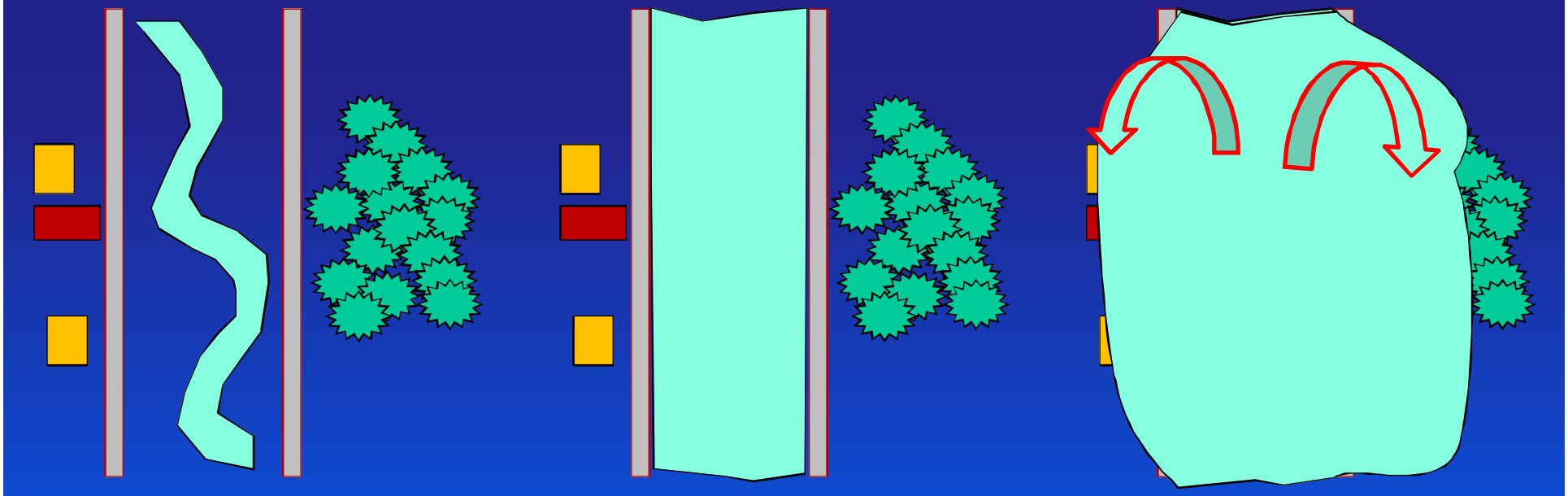
Some premises (2)

'FLOOD PROTECTION" ("SAFETY") vs. FLOOD RISK MANAGEMENT (and REDUCTION)

T_R = 1 year

T_R = 100 years

T_R = 101 years



Some premises (2)

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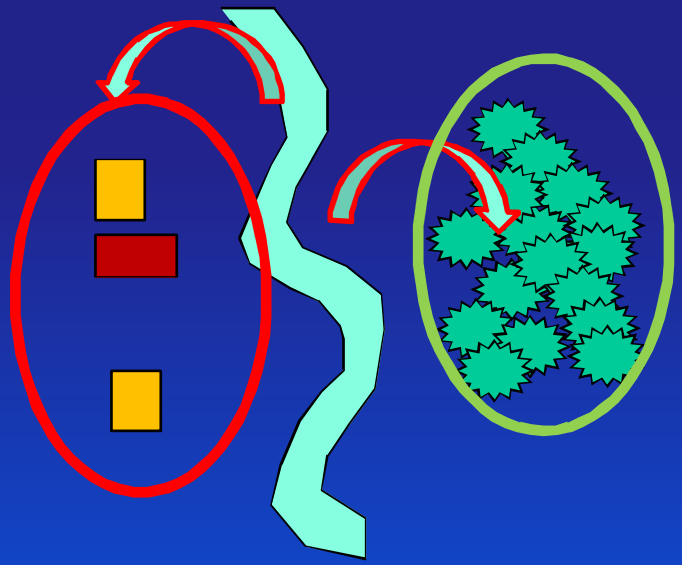


Not necessarily we have to ↓ hazard, we can

↓ vulnerability &/or

↑ resilience

Risk = Hazard x Vulnerability x Exposure

= Hazard x Potential damage

Two main components of "flood risk", generally interconnected

HYDRAULIC (flooding)

RISK

MORPHOLOGICAL (bank erosion due to lateral dynamics)

Flood risk "traditional" approach

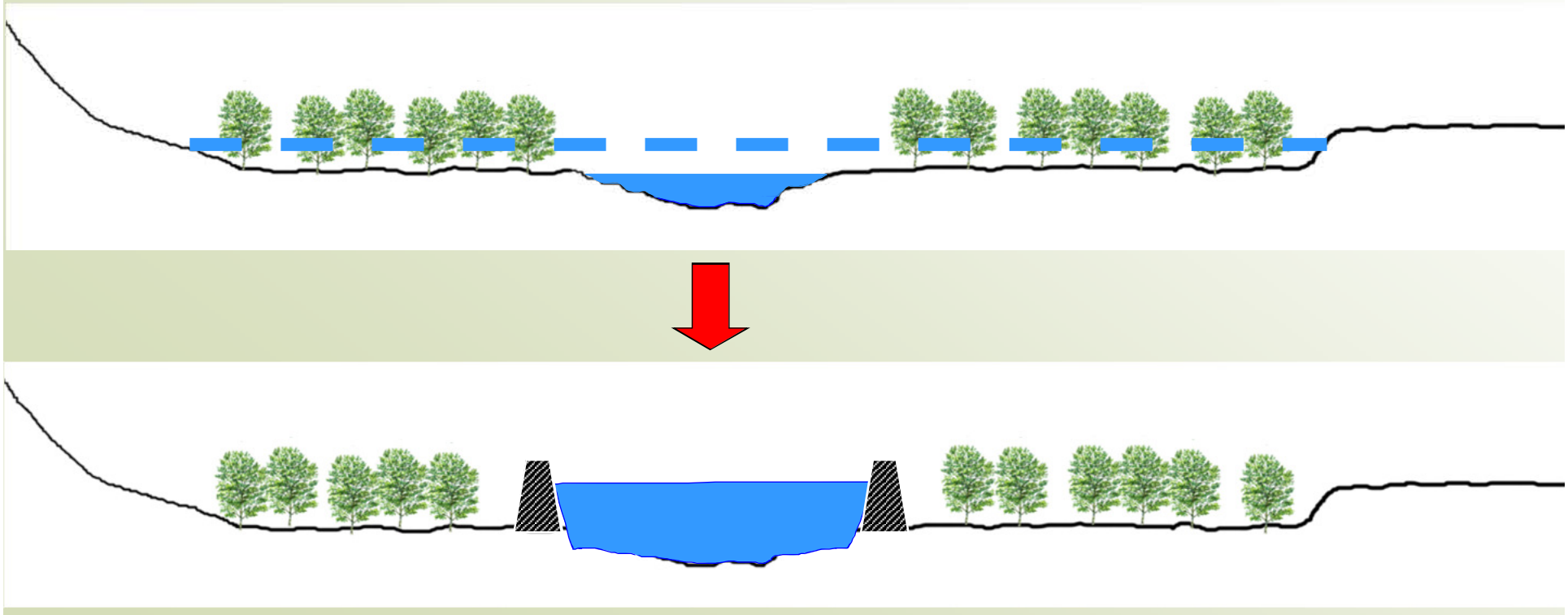
Speed up as much as possible the flow downstream and constrain it within a narrow channel

→ **Channelization of rivebeds**

Flood risk "traditional" approach

Speed up as much as possible the flow downstream and constrain it within a narrow channel

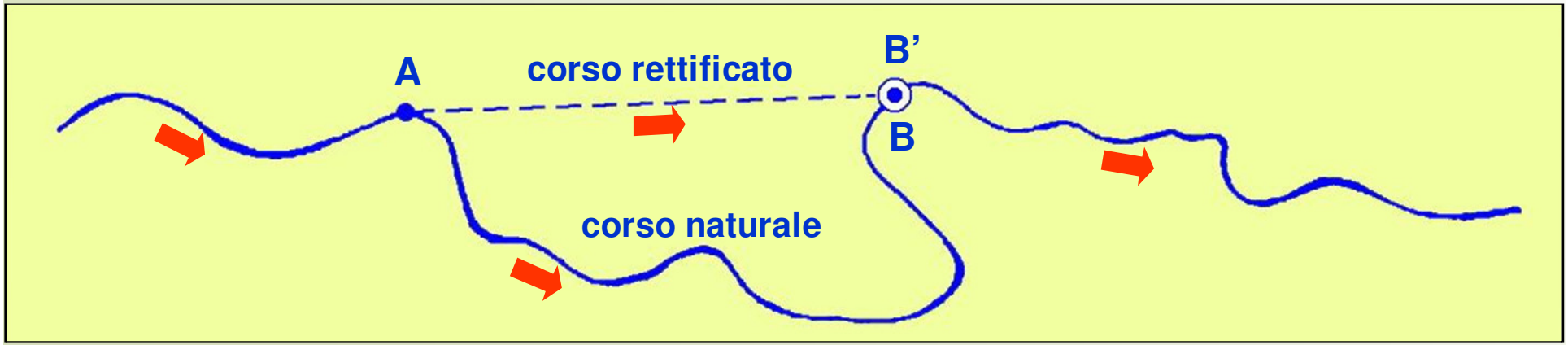
embankments



Flood risk "traditional" approach

Speed up as much as possible the flow downstream and constrain it within a narrow channel

straightening



Flood risk "traditional" approach

Speed up as much as possible the flow downstream and constrain it within a narrow channel

→ Sediment extraction

Flood risk "traditional" approach

Speed up as much as possible the flow downstream and constrain it within a narrow channel

→ Removal of bank and in-stream vegetation

River "cleanup" after the Magra flood, 2011

River "cleanup" after the Magra flood, 2011

Arcola, Oasi LIPU

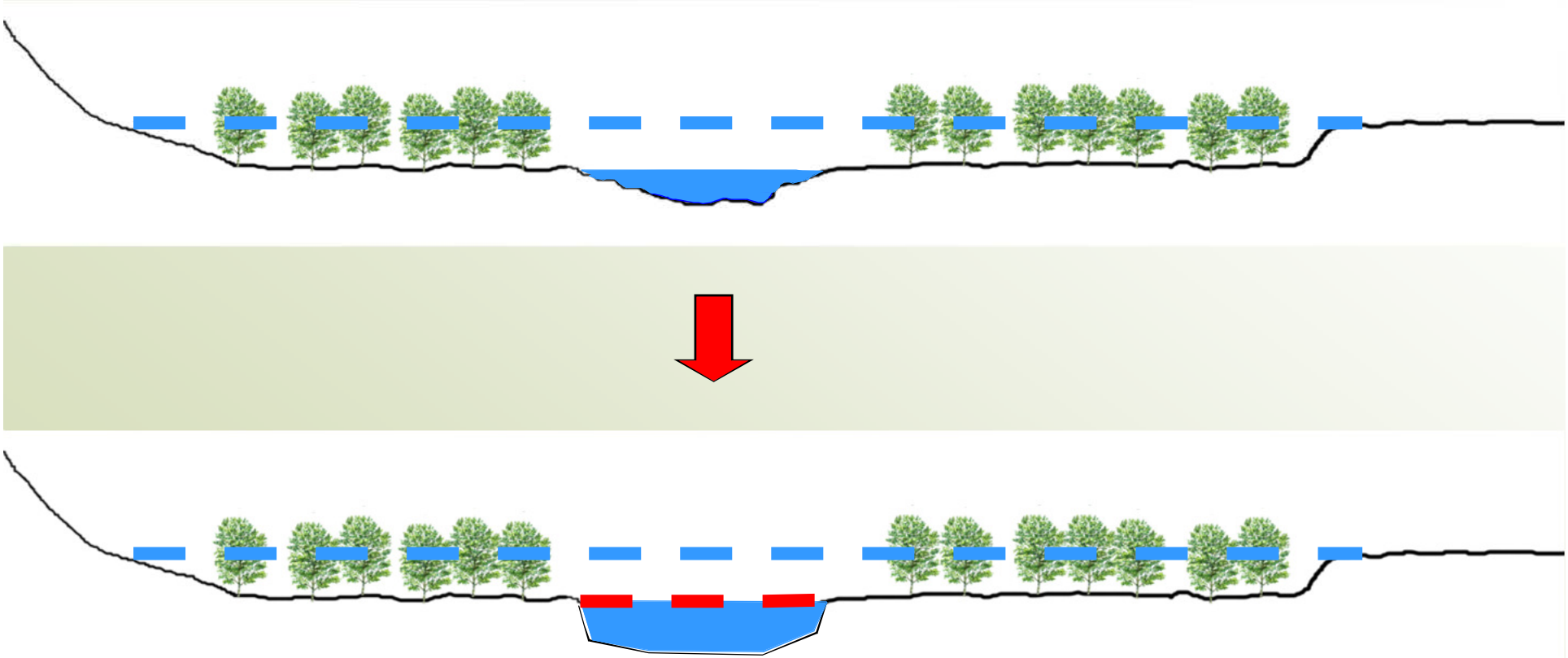
Flood risk "traditional" approach

The effect of vegetation removal

Loss of diffuse retention volumes

Flood risk "traditional" approach

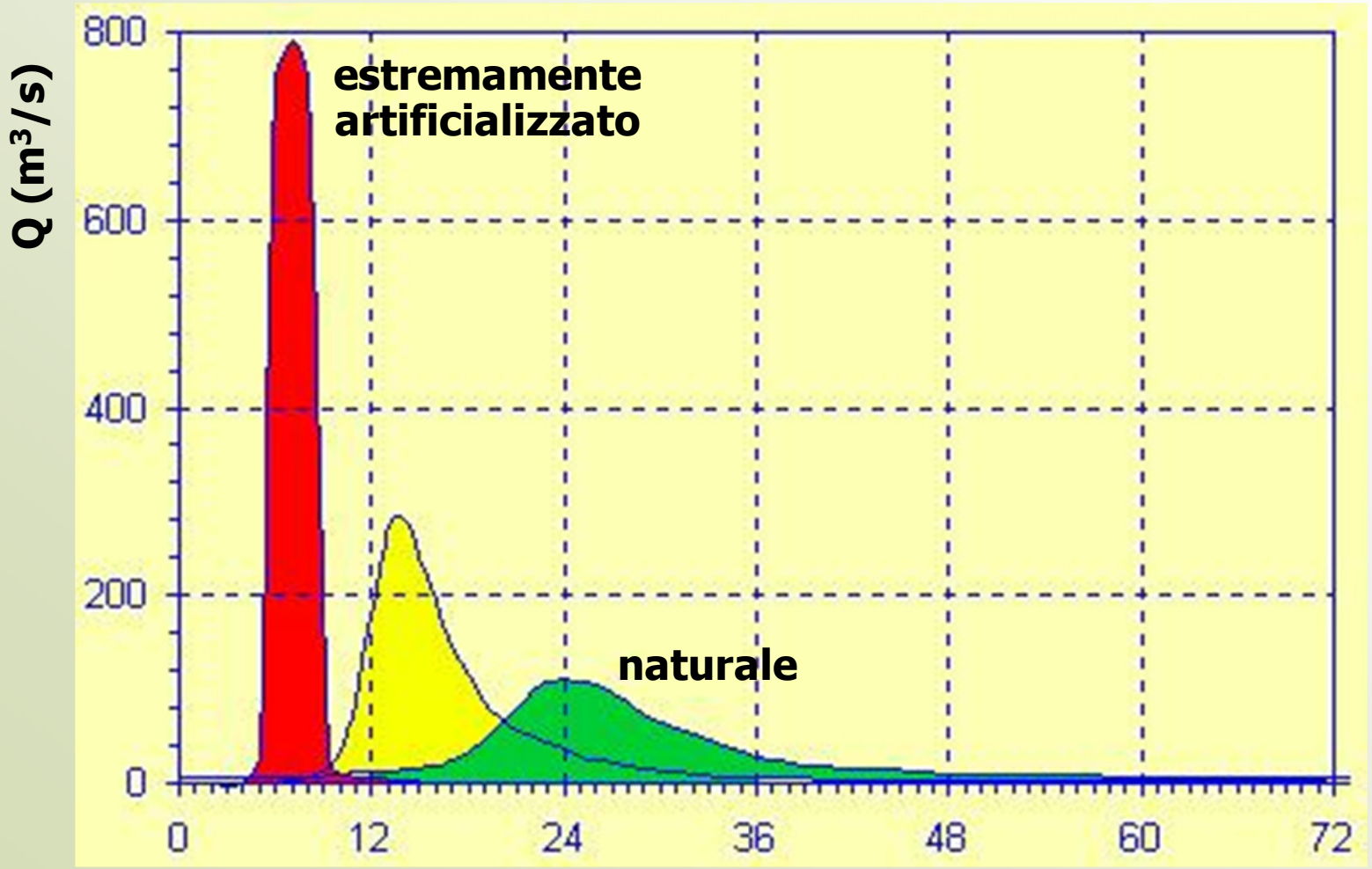
The effect of sediment extraction



Loss of diffuse retention volumes

Flood risk "traditional" approach

THE EFFECTS (downstream):



Flood risk "traditional" approach

THE EFFECTS:

"Flood protection":

⇒ Protect against events with $T_R \leq T_R^*$ (e.g.: 200 years)

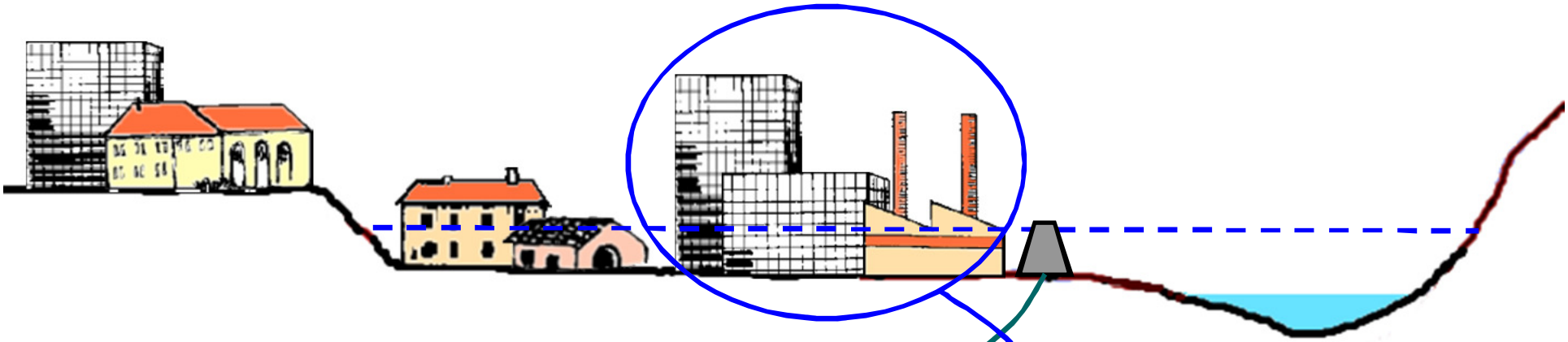
...≠ minimizing RISK !

Often the risk increases not only downstream, but also locally !

Flood risk "traditional" approach

Typical example: development in "protected areas"

THE EFFECTS:



Embankment → Probability of flood reduced by 5

New buildings → Potential damage multiplied by 10

Result → **Risk is doubled !**

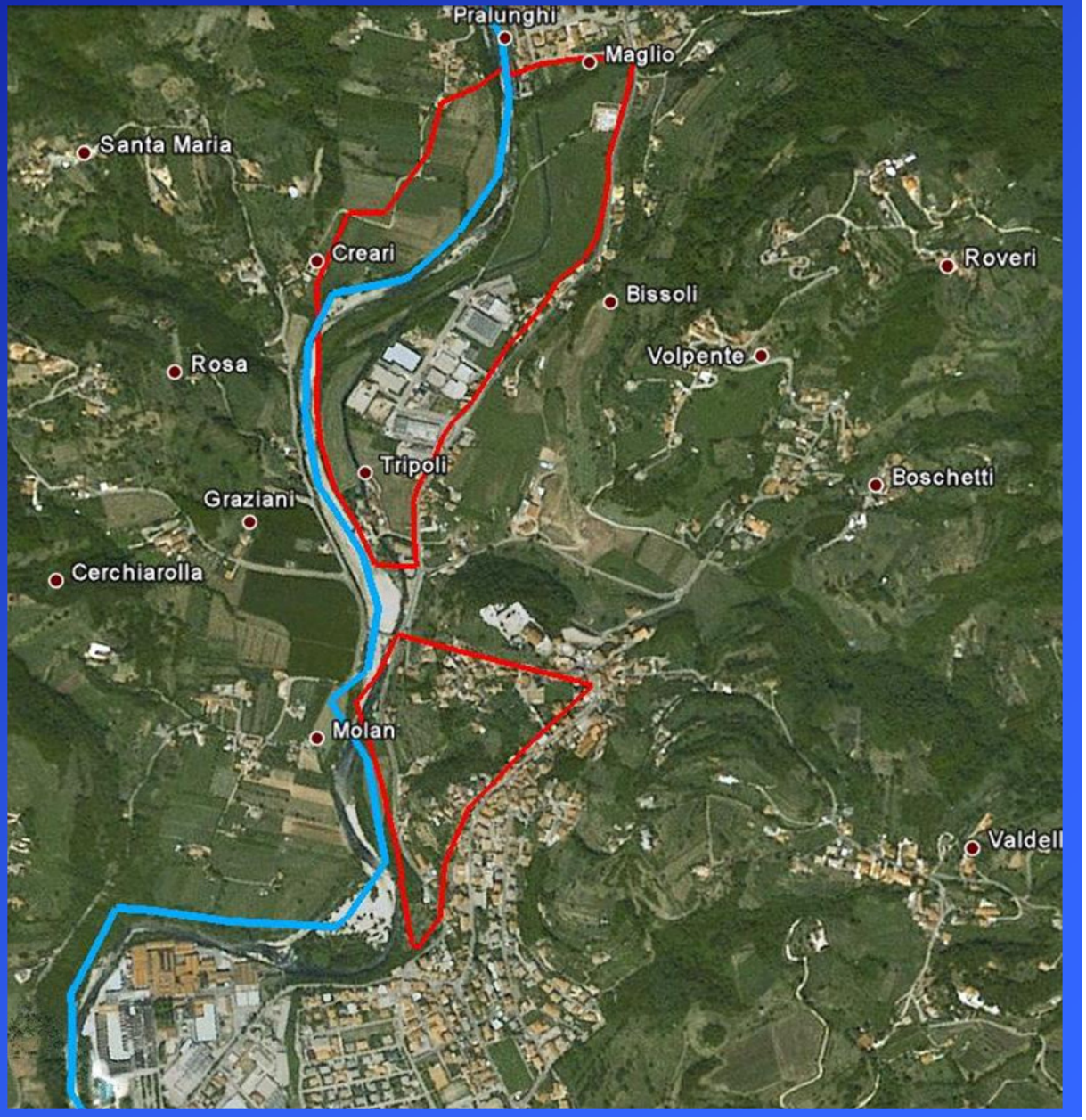
Hazard x Potential damage = Risk

Flood risk "traditional" approach

Typical example: development in "protected areas"

T. Astico near Lugo di Vicenza – red lines: areas flooded in 1966

N.1 measure is still STOPPING SOIL SEALING !



"Morphological" (erosion) risk "traditional" approach

Stop river dynamics (stabilize the riverbed, avoid bank erosion)

→ **Bank protection works** (also with bioengineering!), weirs, sills...

"Morphological" (erosion) risk "traditional" approach

Stop river dynamics (stabilize the riverbed, avoid bank erosion)

→ Sediment extraction

REGIONE VENETO La giunta ha deliberato un piano di regimazione per parte del Piave e del Cordevole. Il provvedimento sblocca il settore dopo tre anni di

Dal 2006 via libera alle escavazioni nei fiumi

L'obiettivo è ripulire gli alvei mettendo il territorio al riparo dalle alluvioni. Bond parla di circa 1 milione di metri cubi l'ar

Belluno

Dopo tre anni di stallo, la situazione delle escavazioni negli alvei fluviali si sblocca grazie al nuovo piano di regimazione del Piave e del Cordevole varato con delibera della giunta regionale. Sarà attivato entro il 2006, dando così la prima risposta alle pressanti richieste degli imprenditori del settore, ma anche, e soprattutto, e questa è la filosofia portante del piano, all'urgenza di regimare le acque mettendo il territorio al riparo dai disastri legati alla fragilità idrogeologica delle valli bellunesi. Vengono così semplificate le procedure per l'attività di escavazione, purché la richiesta si inserisca in un "progetto organico di regimazione" o in "piani-programmi di interventi urgenti". Da una parte ne beneficeranno l'ambiente e la sicurezza, dall'altro le imprese, oggi costrette ad acquistare gli inerti in Trentino o in Friuli. Tale apertura, spiega il consigliere regionale Dario Bond, che si dice padre putativo del provvedimento sposato poi dall'assessore Giancarlo Conta, consentirà di coprire il fabbisogno locale di inerti che si aggira sul milione di metri cubi l'anno.

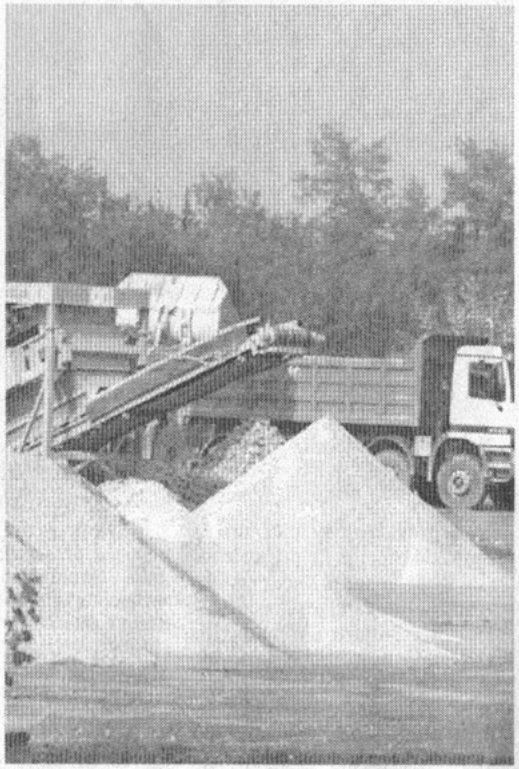
Il piano di regimazione interessa l'asta del Piave tra la confluenza con il Boite e la traversa di Busche, l'asta del fiume tra la traversa di Busche e quella di Fener e per il torrente Cordevole tra Caprile e la confluenza in Piave.

Le nuove disposizioni superano così le procedure precedenti che prevedevano autorizzazioni specifiche per interventi puntuali, svincolati da ogni programmazione, «talvolta anche controproducenti - ha fatto presente l'assessore regionale con delega per Belluno, Oscar De Bona - per l'equilibrio del fiume. Sulla base dell'esperienza maturata - ha aggiunto De Bona - abbiamo voluto dare più speditezza al tutto, contemperando la delicatezza della materia con la necessità di garantire efficaci e tempestive azioni per la sicurezza idraulica da parte delle strutture regionali».

La nuova procedura potrà essere utilizzata anche per altri bacini idrografici che presentino problematiche analoghe a quelle rilevate per il Piave.

Le altre integrazioni disposte dalla giunta regionale riguardano i sistemi di realizzazione dei "progetti organici" (comprendendo, oltre che la regimazione con interventi estrattivi, anche l'esecuzione di opere idrauliche o di altri interventi onerosi con corrispettivo a favore dell'esecutore), l'ampliamento degli interventi tramite "piani-programmi urgenti" a tutte le aree in quota a monte di invasi che possano bloccare il materiale prodotto dai relativi bacini, la definizione di procedure semplificate per alcune tipologie di interventi non rilevanti (asportazione di materiale per il ripristino funzionale di manufatti e opere presenti nell' alveo, per la pulizia e la funzionalità di opere di derivazione d'acqua, per l'utilizzo del materiale stesso, su richiesta di enti pubblici, nella realizzazione di opere di pubblica utilità).

Lauredana Marsiglia

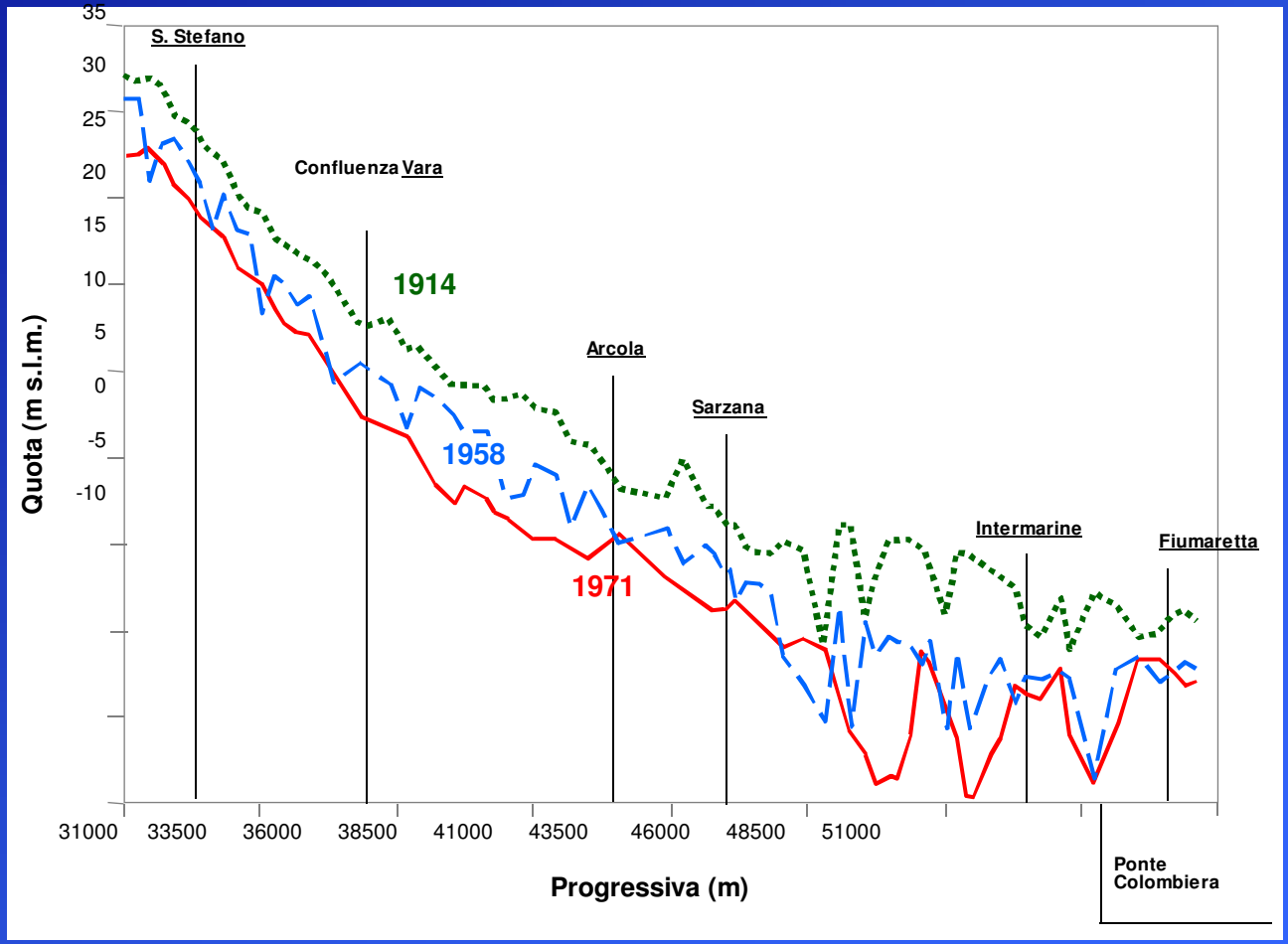


"Morphological" (erosion) risk "traditional" approach

THE EFFECTS:

Secchia downstream Castellarano

Most Italian rivers are strongly incised !



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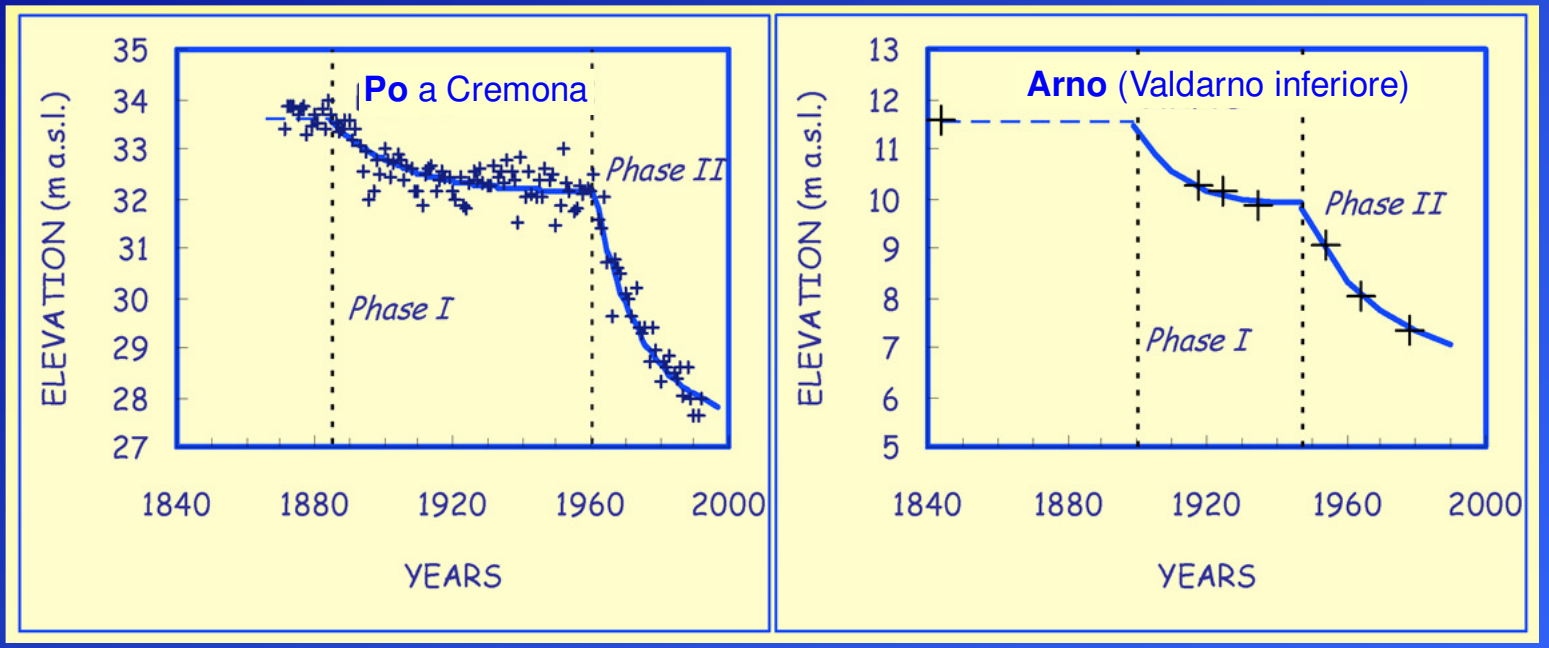
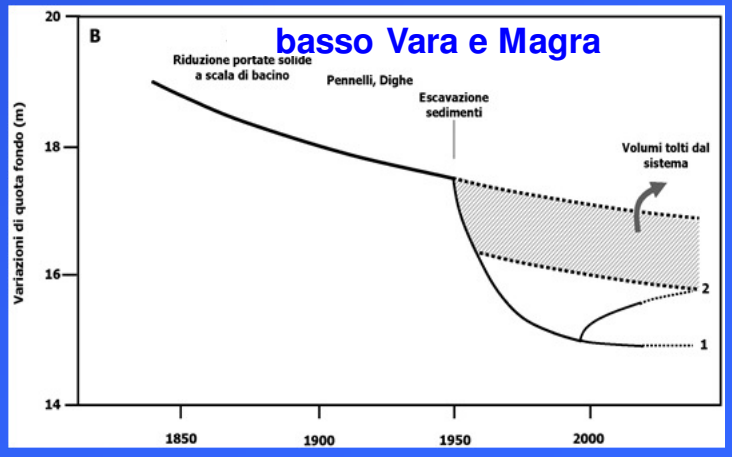


PHASE 1: reduction of sediment load at catchment scale (afforestation, stabilization works)

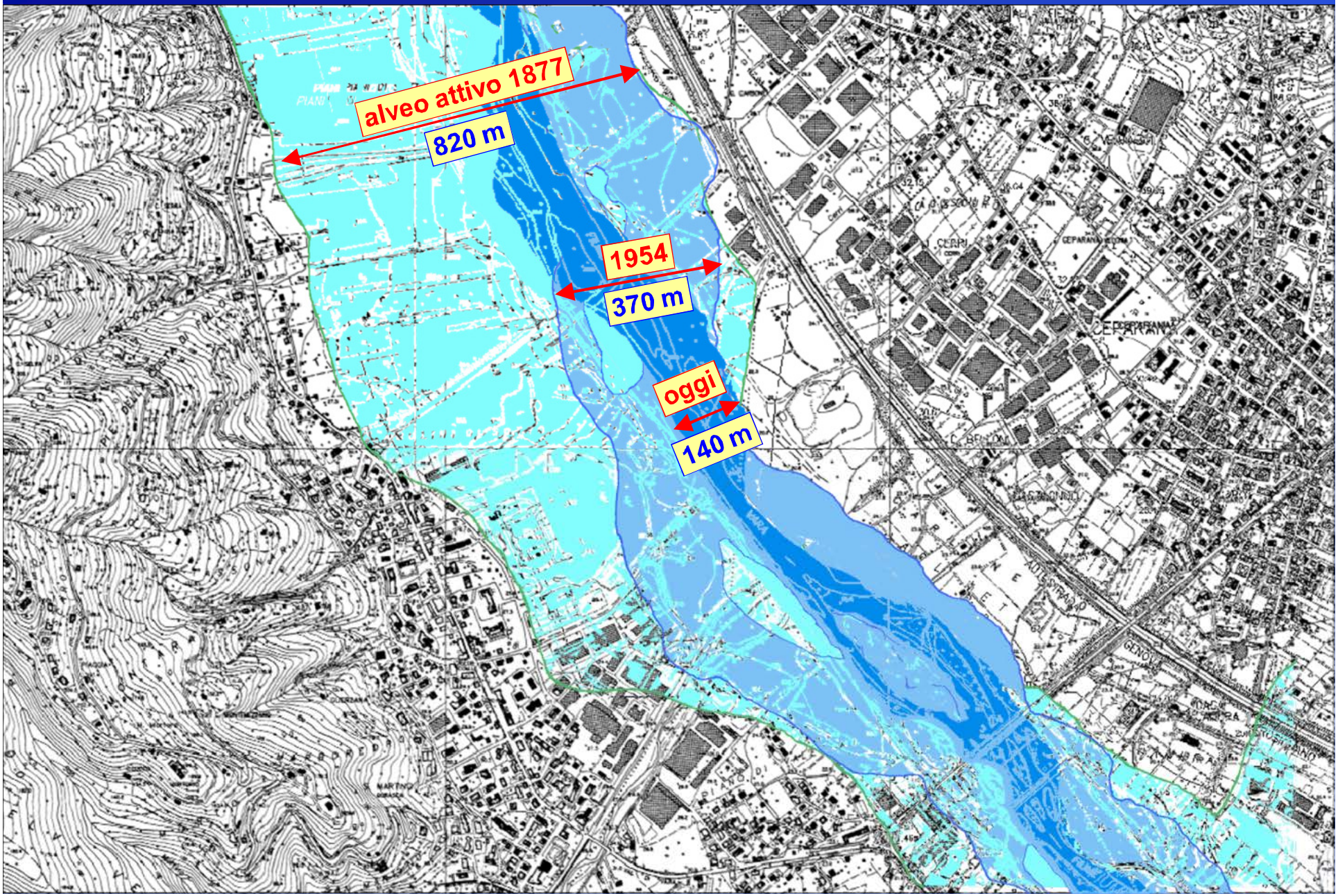
PHASE 2: sediment extraction, dams, bank protections

PHASE 3: partial recovery ?



Narrowing of riverbeds

(Image: Rinaldi M., 2005 - Autorità di bacino del Fiume Magra - Modified)

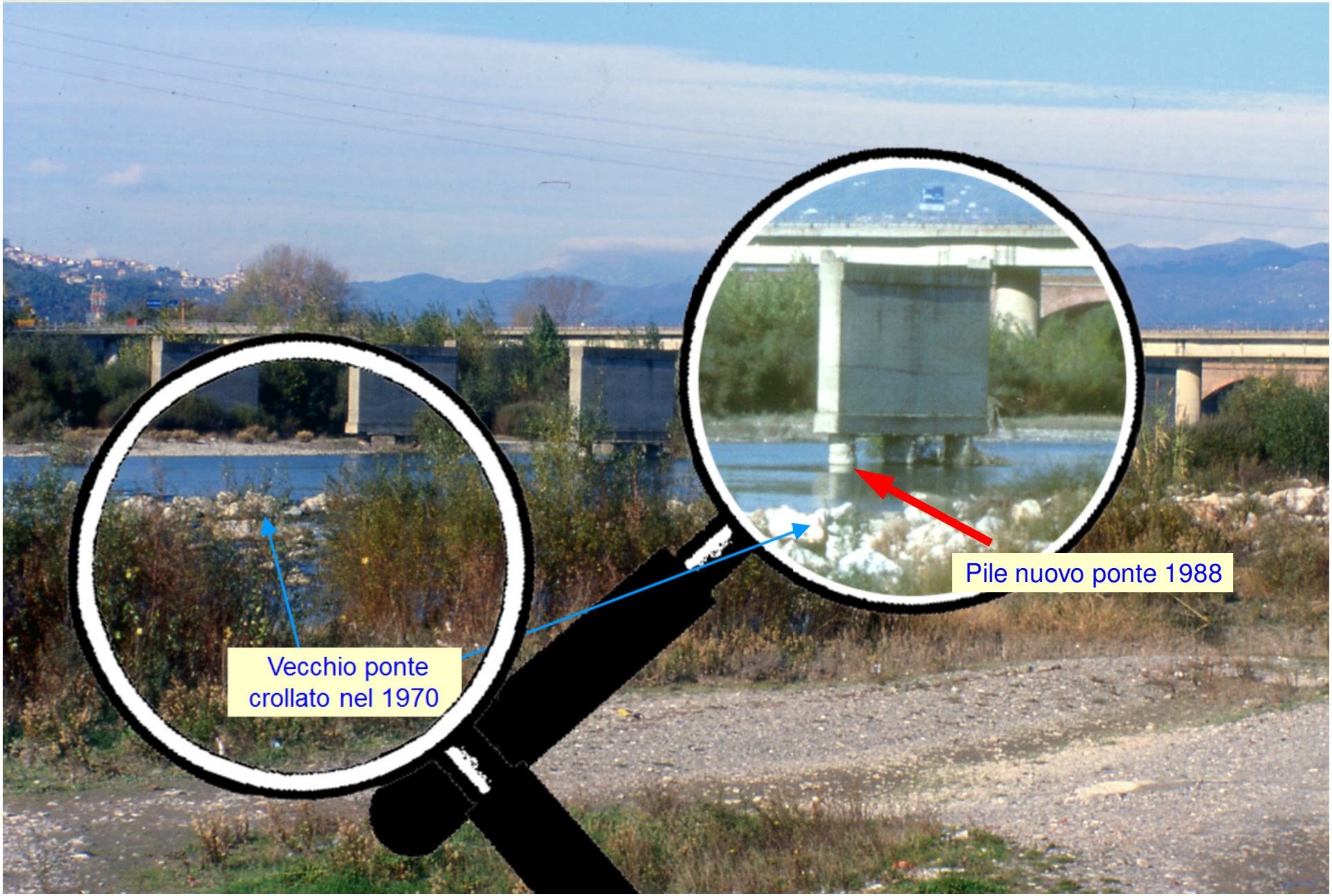


Change of typology

(Image: Rinaldi M., 2005 - Autorità di bacino del Fiume Magra - Modified)

1829 (Carta degli Stati Sardi) → **2006** (Google Earth)

Sediment extraction → riverbed incision → collapse of structures

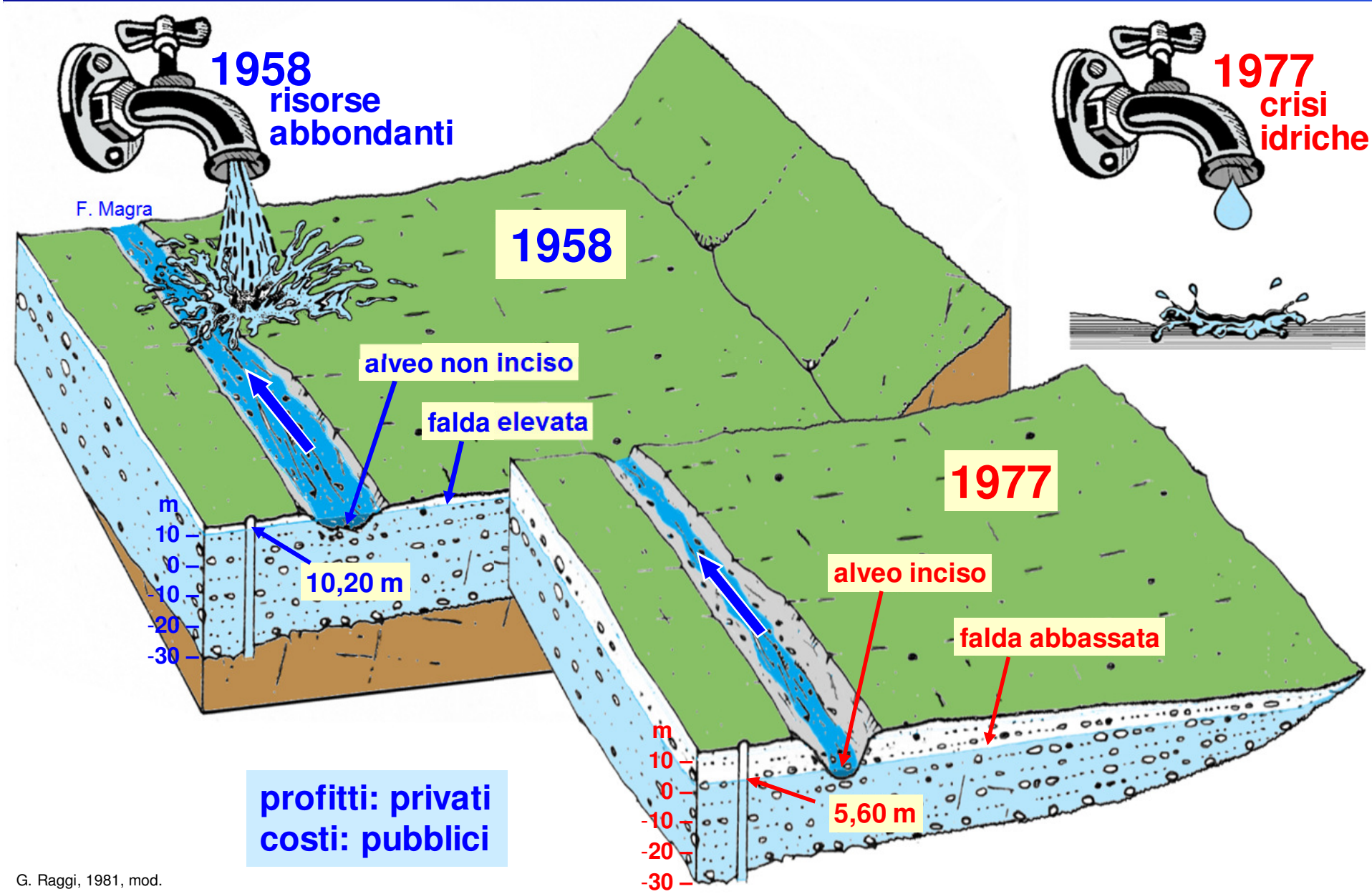


Sediment extraction

→ reduce sediment load

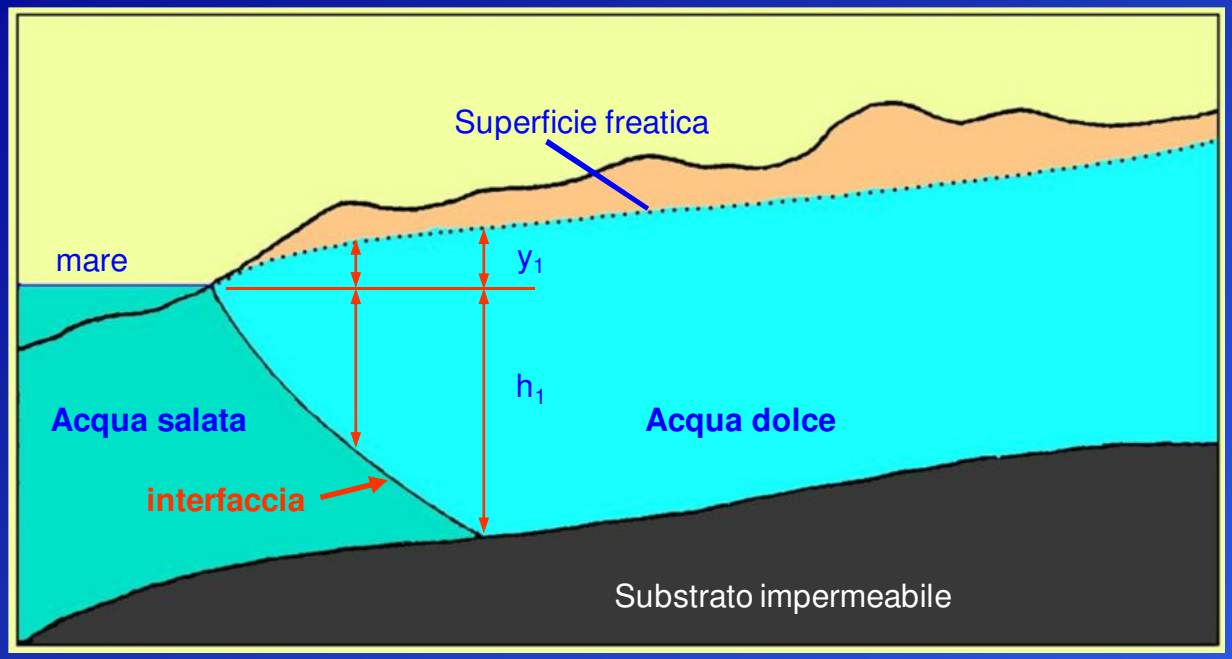
→ coastal erosion

Riverbed incision→ lowering of the aquifer
(+ reduced recharge if floodplains are lost)

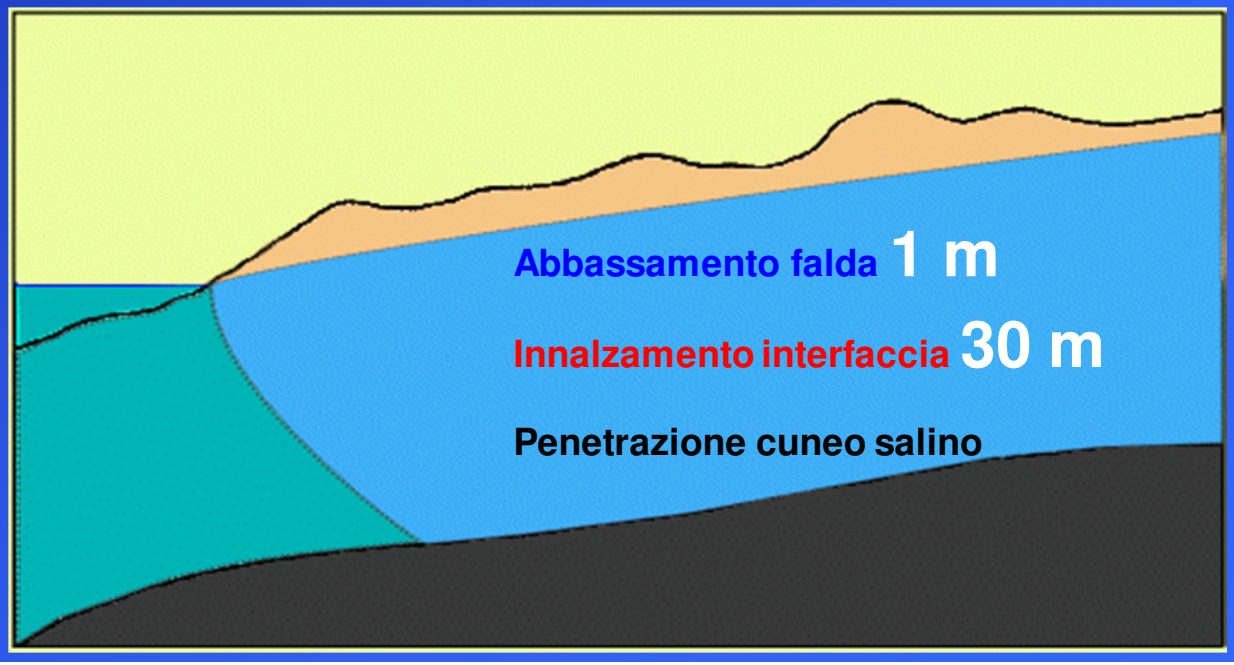


G. Raggi, 1981, mod.

Riverbed incision → salinization of surface and groundwaters



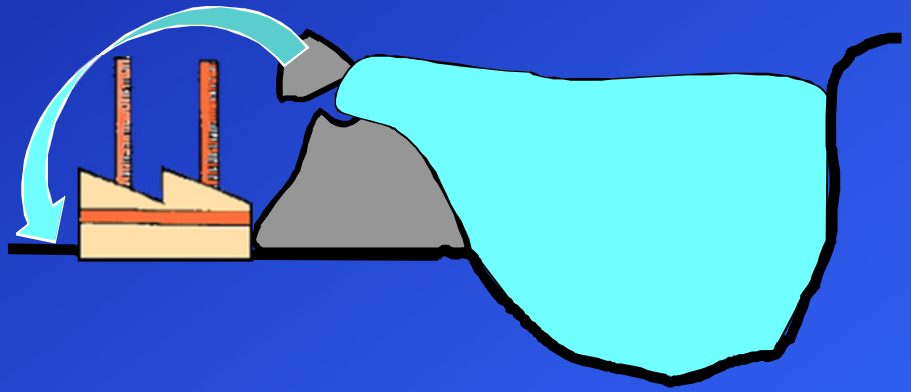
$$h = y^* d_d/(d_s-d_d)$$



A flood risk management strategy based only upon engineering works is intrinsically FRAGILE

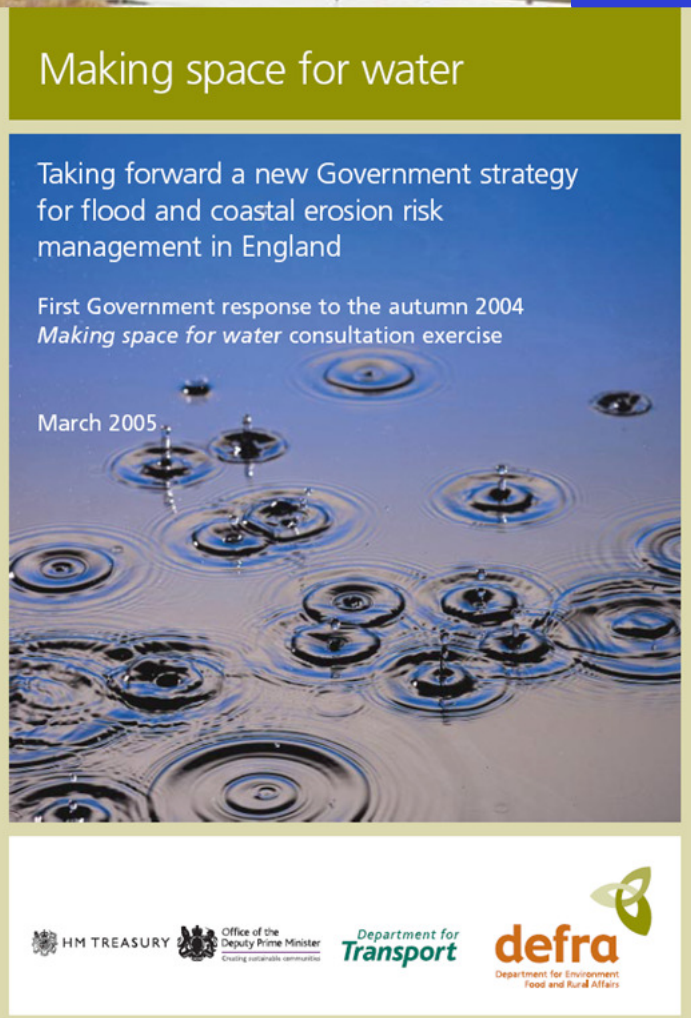
- an event with a higher recurrence time than the reference one is always possible (-> overflows)
- protection works need maintenance, therefore each new work = further costs on next generations
- the population forgets more easily about "residual risk"

- Failure of embankments and other protection structures cannot be excluded -> if all the protection strategy is based upon them, in case of collapse a disaster is ensured



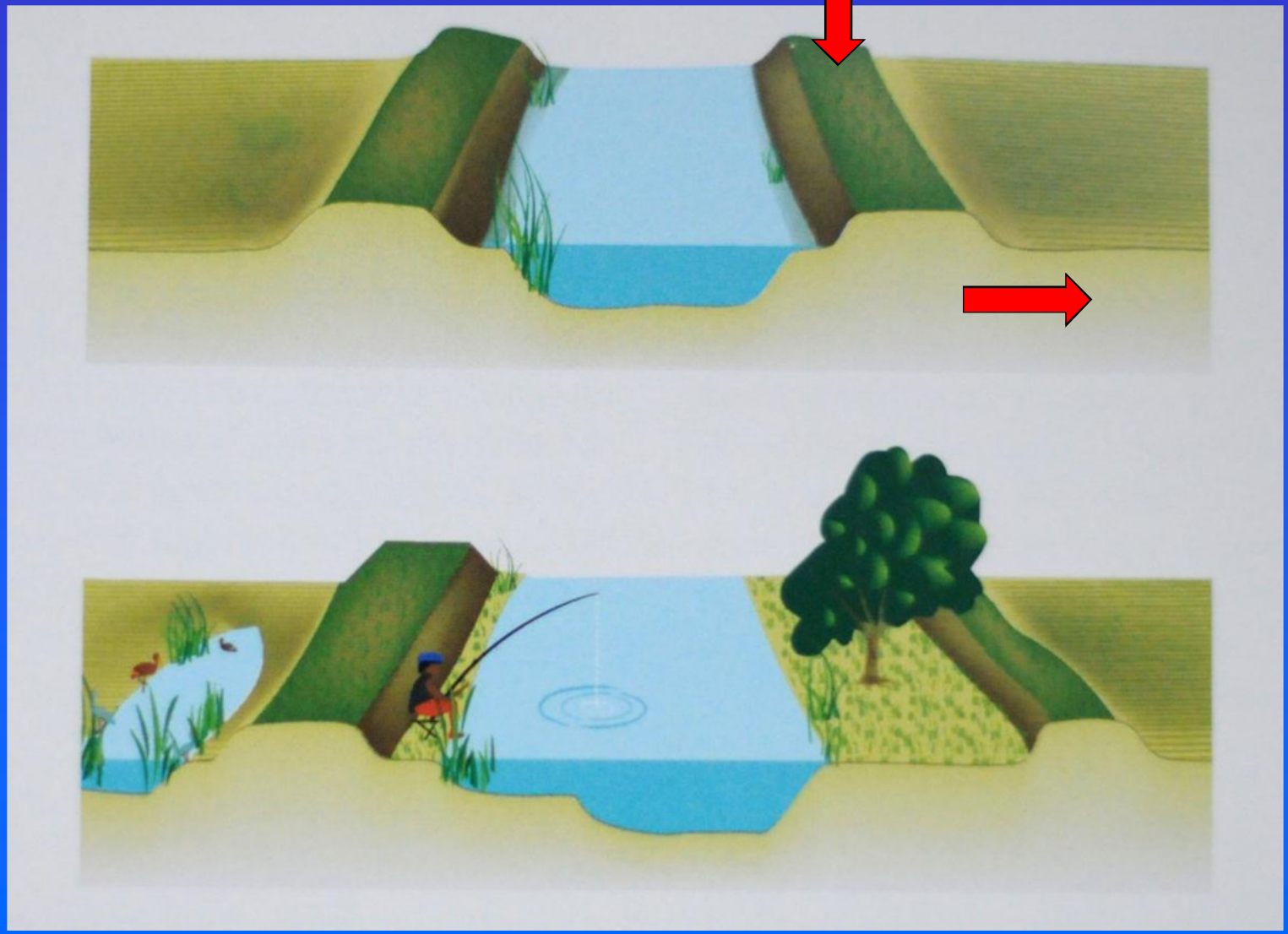
Roncajette

RR for flood risk reduction: "more space for the rivers"



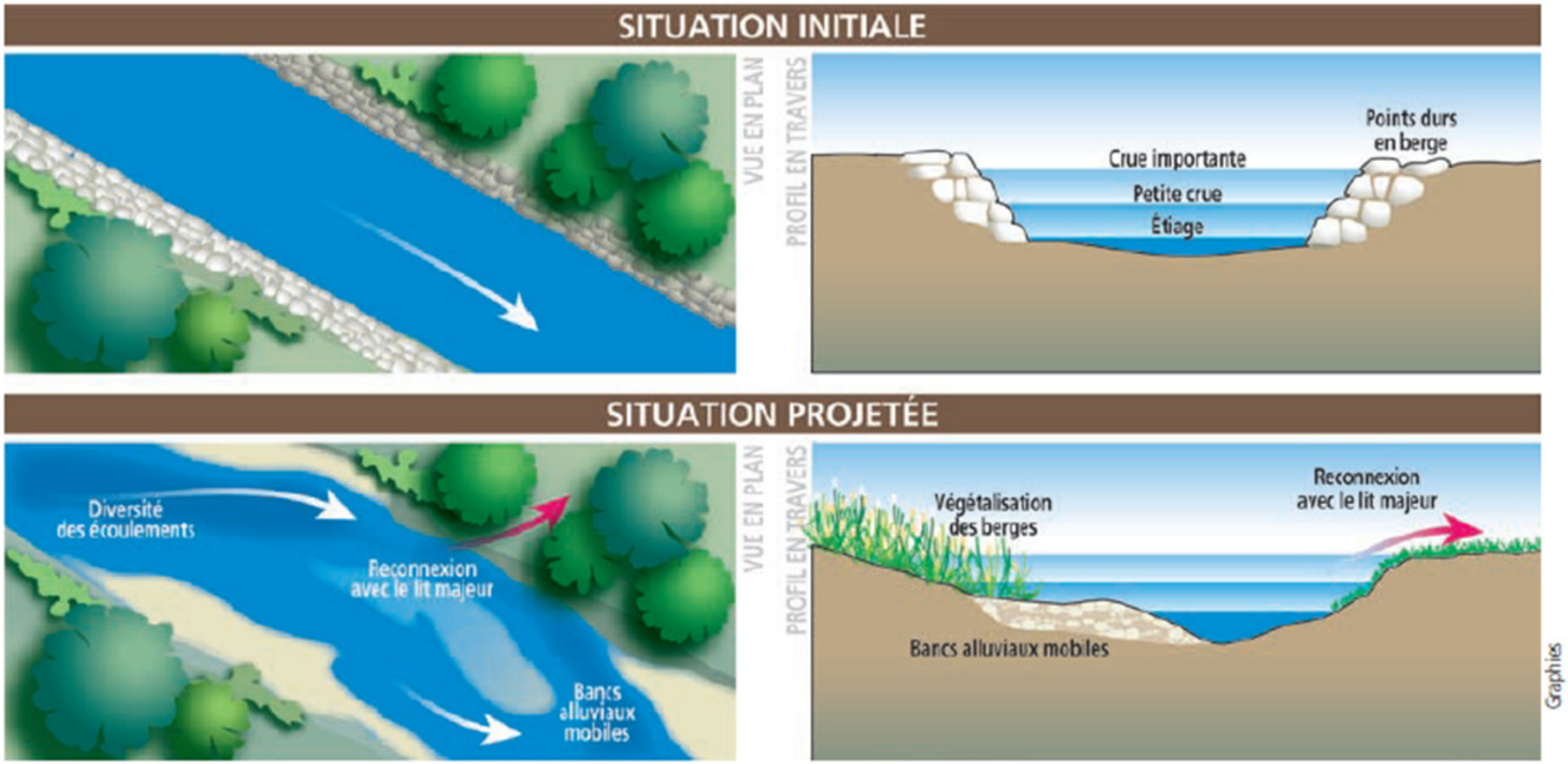
RR MEASURES

Removal/retreat/lowering of EMBANKMENTS



RR MEASURES

Removal/retreat of BANK DEFENCES



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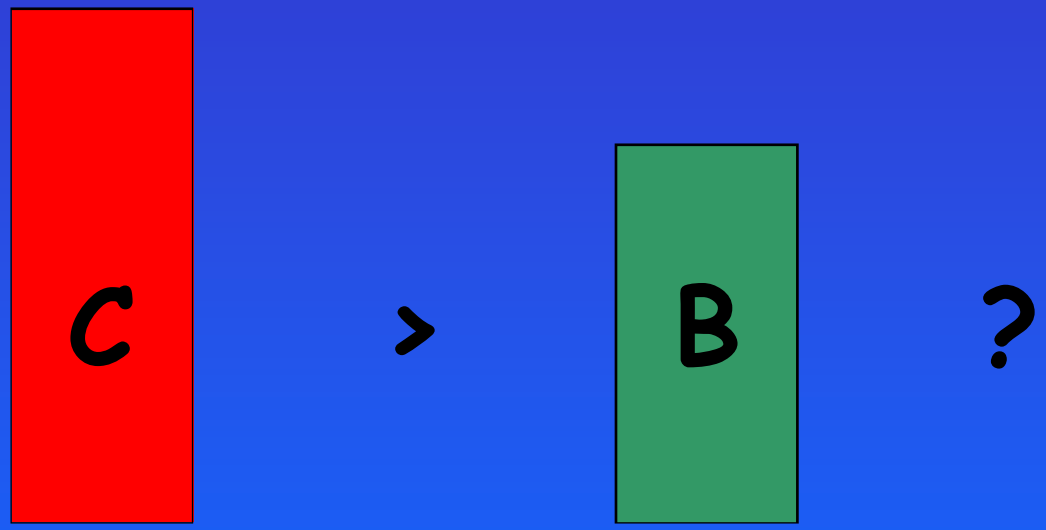
RR MEASURES

Removal/retreat of BANK DEFENCES + reopening of secondary channels

RR MEASURES

Removal/retreat of BANK DEFENCES + reopening of secondary channels

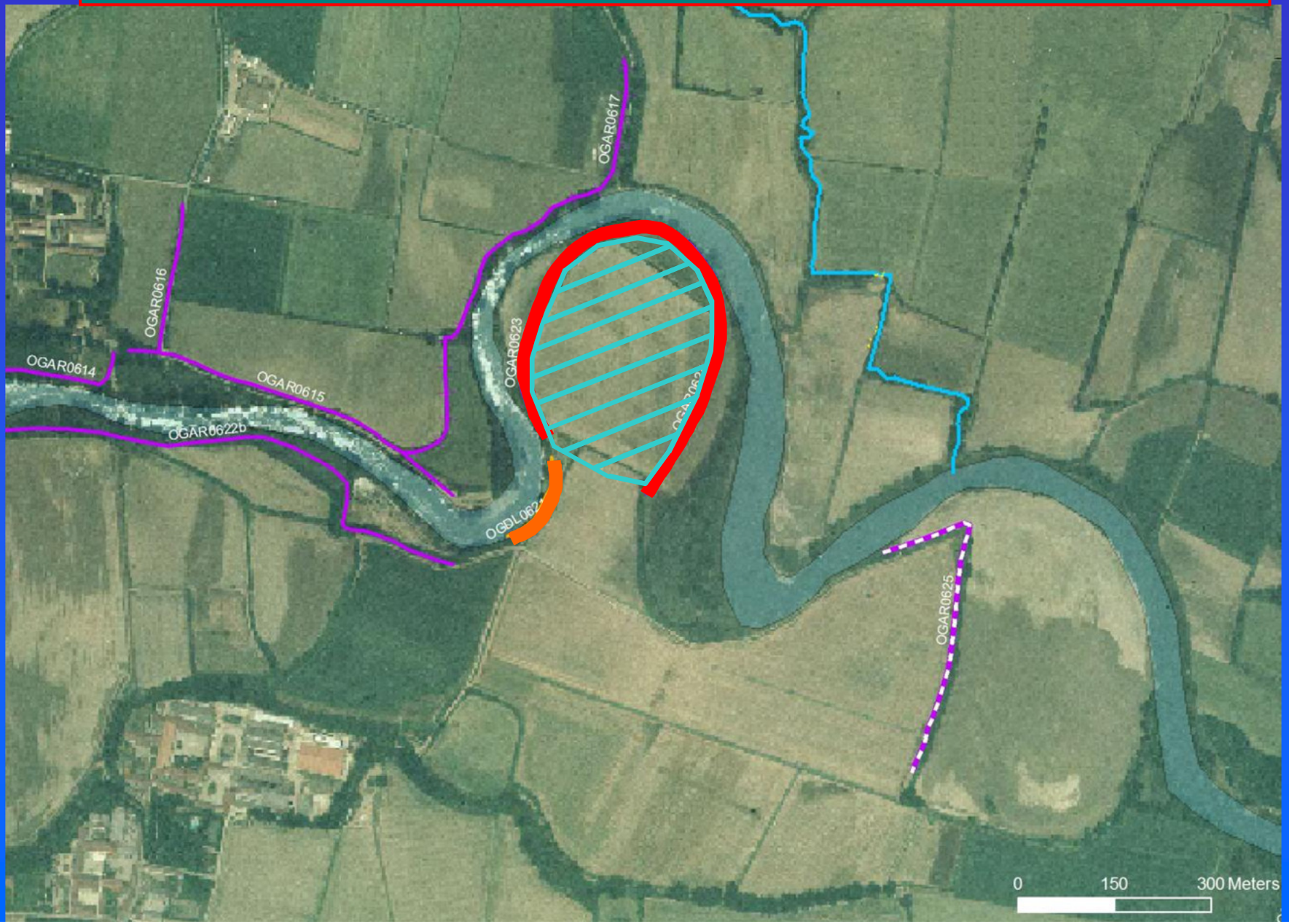
Are there cases where it is clear that restoration economically convenient (even without taking into account all related ES) ?



€ (construction & OMR of works)

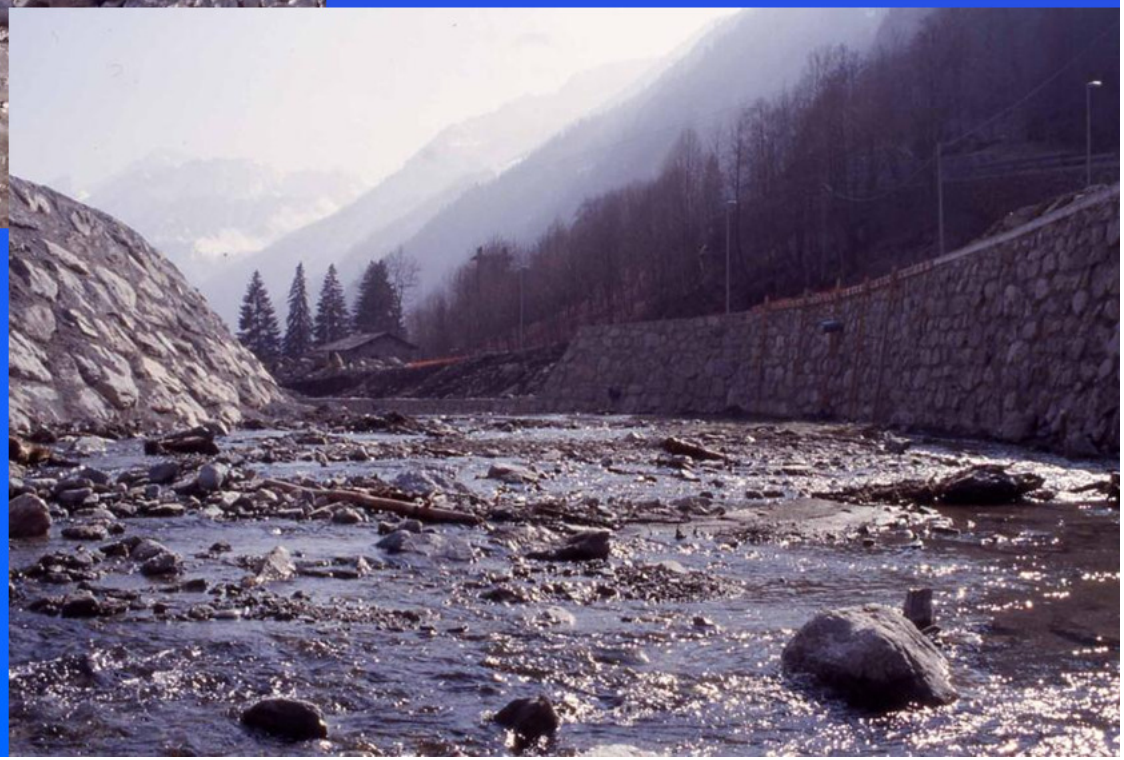
€ (avoided damage)

Leave the river flood/erode agricultural land instead of (re)constructing embankments/bank defences

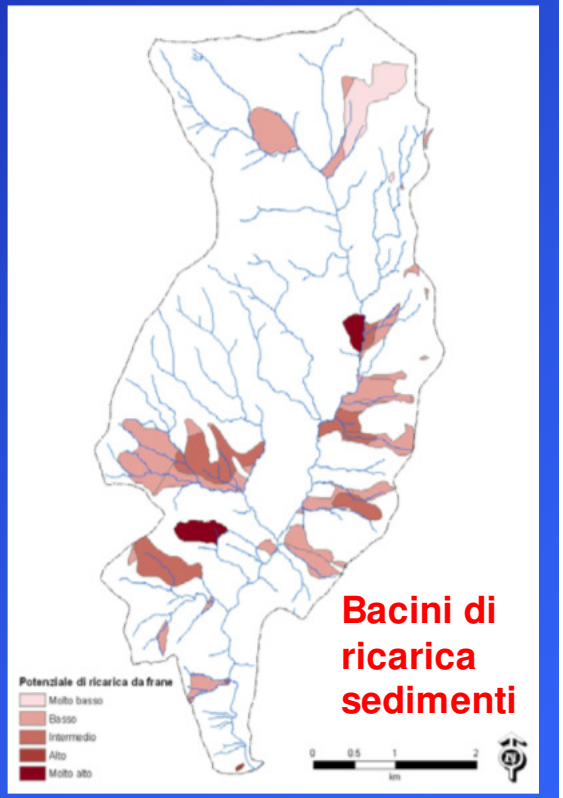


Relocate, where possible and convenient, roads and other infrastructure, instead of struggling to relocate the river

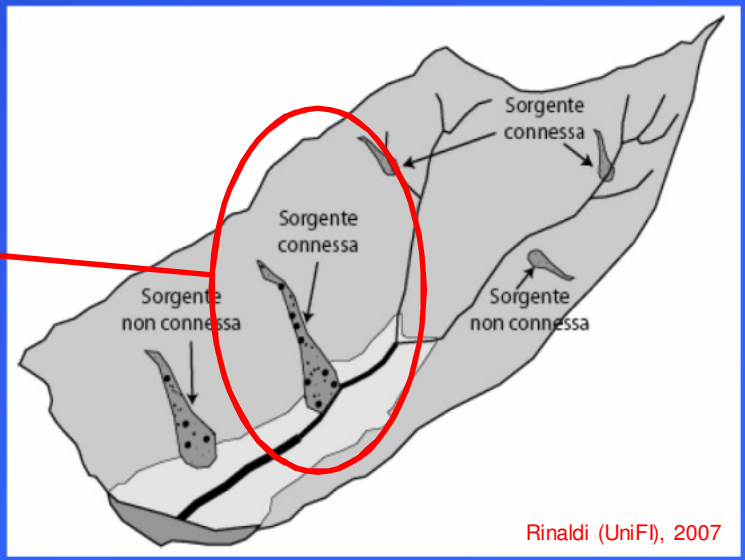
When possible, relocate exposed goods instead of protecting them increasing risk downstream



Restore sediment load, both directly and avoiding hillside protection against landslides



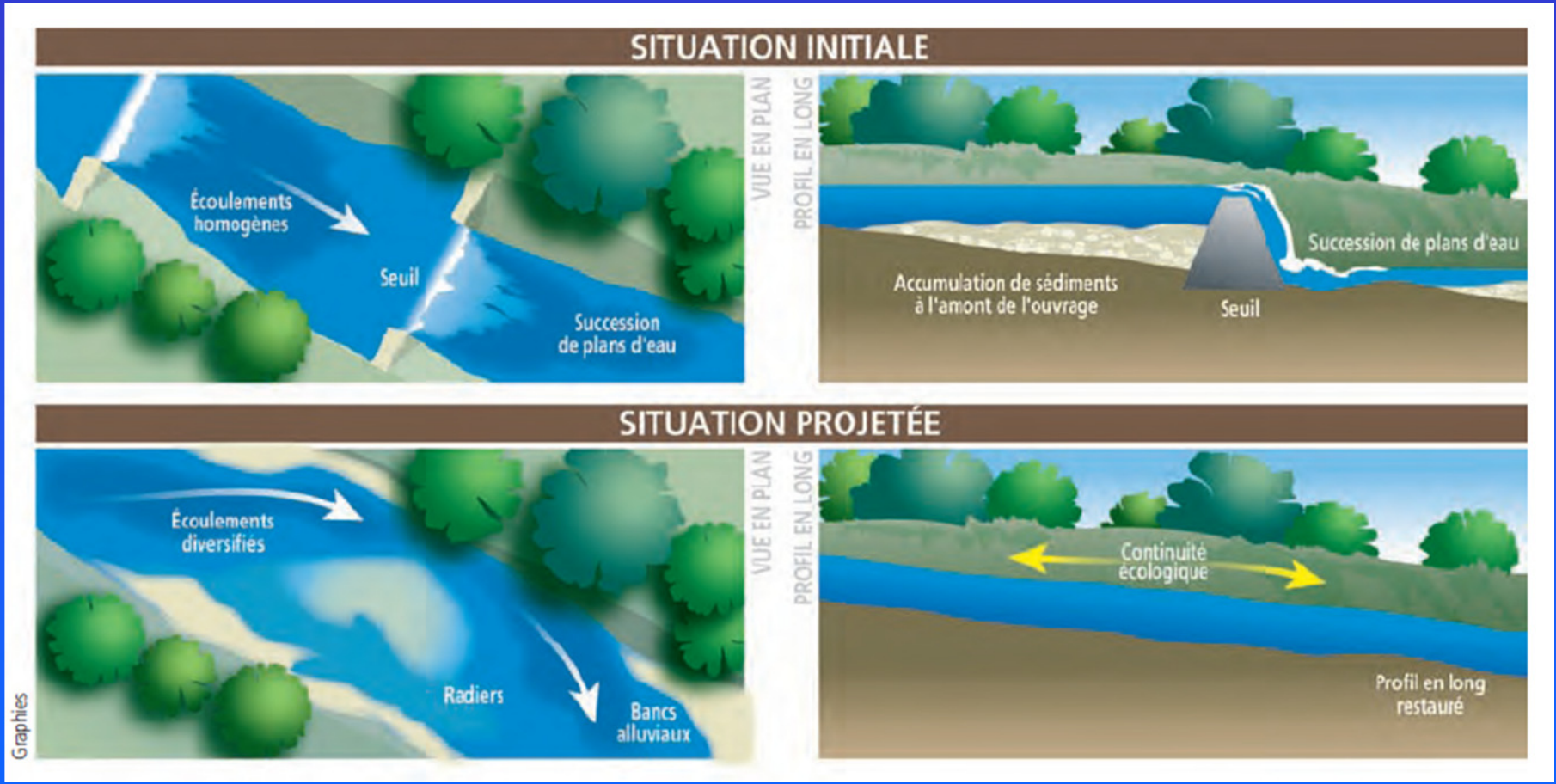
Bacini di ricarica sedimenti



Rinaldi (UniFI), 2007

RR MEASURES

Removal of dams/weirs



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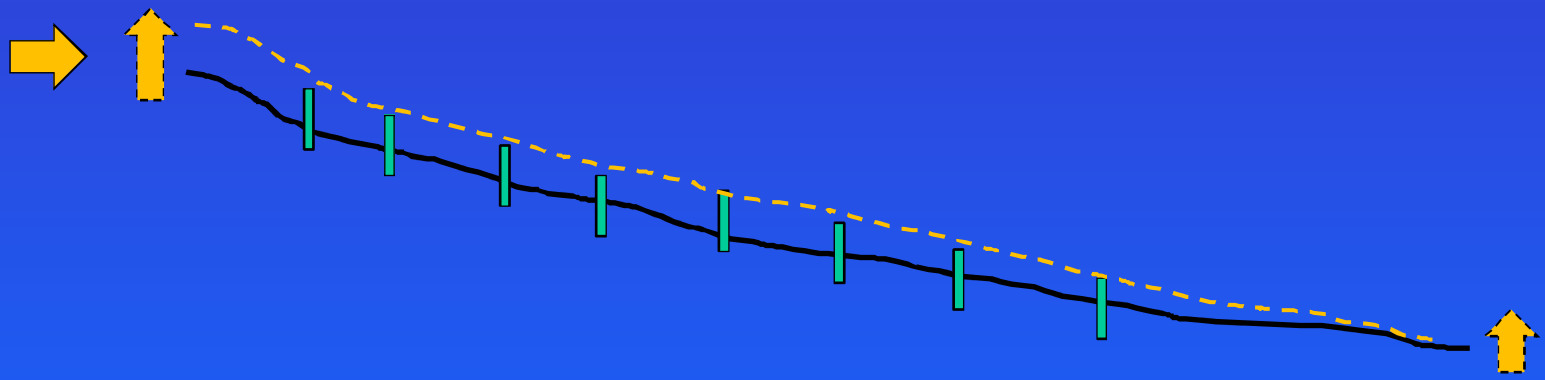
Removal of the Saint-Etienne-du-Vigan dam, on the Allier river, France

© ONEMA – image from *La restauration des cours d'eau - retour d'expériences sur l'hydromorphologie*

RR MEASURES

Construction of transversal structures to help raising the riverbed

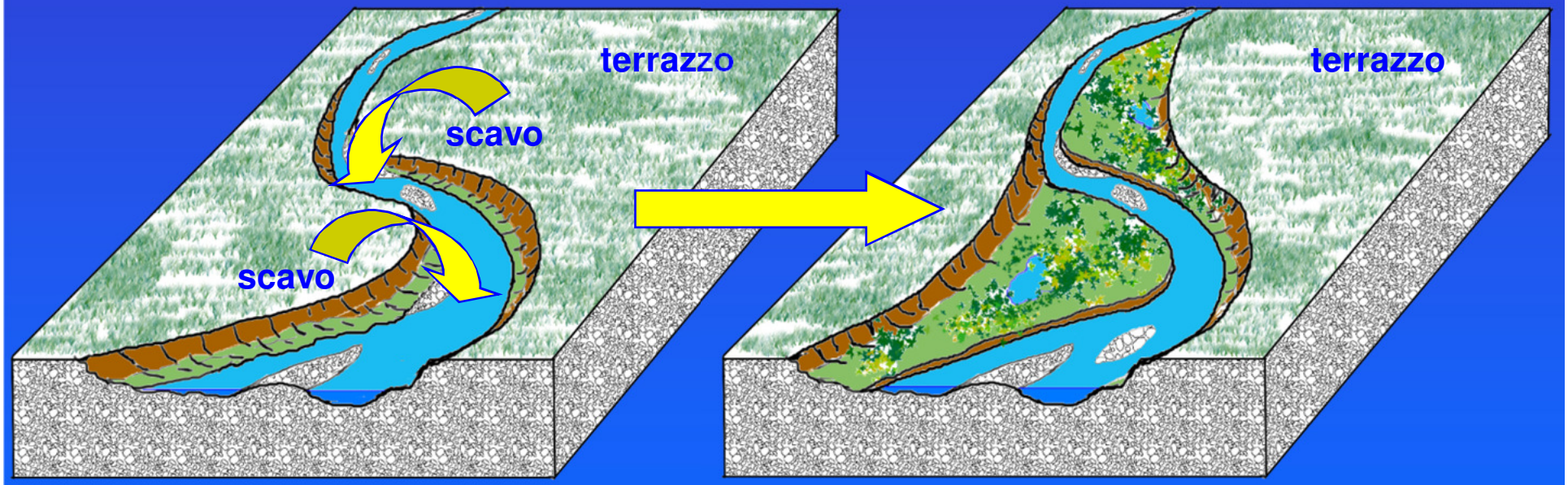


!

Potential negative effect on longitudinal continuity and temporary sediment deficit downstream

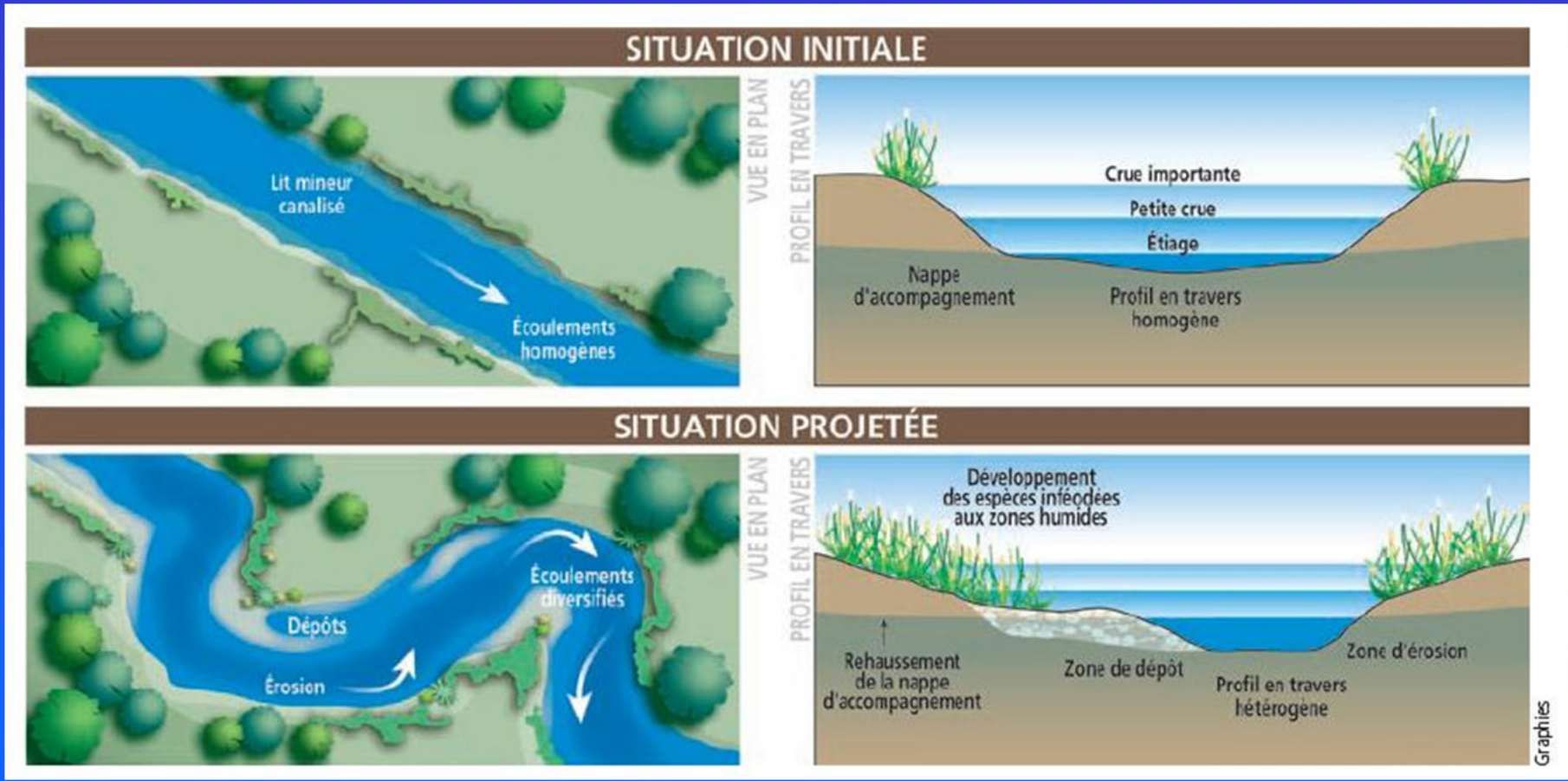
RR MEASURES

Restoration of floodplain lowering terraces (former floodplain now outside river dynamics)



RR MEASURES

REMEANDERING



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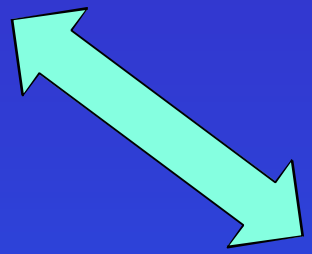
2007/60/CE – FD

- Explicitly requires to develop synergies with 2000/60 goals, e.g.: restoring floodplains (MORE SPACE TO THE RIVER)
- RISK maps (not only hazard)



2000/60/CE - WFD

GOOD status
-> HYDROMORPHOLOGICAL restoration
(+ ECONOMICAL analysis)

RBMPs and POMs

SOME EXAMPLES FROM ITALY

Restoring Europe's Rivers

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Map of case studies

From the RESTORE wiki:
http://riverwiki.restorerivers.eu

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- Please also add your own river restoration scheme to the database: click here to create a new case study.
- Provide us with your feedback: click here to take the survey or add to the discussion pages.

CRITICAL ISSUES for floodplain restoration:

AVAILABILITY OF THE AREAS (former floodplains are mostly private now):

- Expropriation? (unsustainable costs, especially in Italy: funding?)
- Land swapping?
- Compensation to farmers/owners? (CAP? PES (e.g. at catchment scale)?)

CRITICAL ISSUES for floodplain restoration:

POPULATION's SUPPORT

- Cultural shift needed
- Public participation (e.g.: river contracts)
- Need of specific know-how within public authorities

CRITICAL ISSUES for floodplain restoration:

CLEAR LEGISLATIVE SUPPORT FOR THE REMOVAL OF PROTECTION WORKS

- Responsibility in case of subsequent damage?

CLEAR POLICY SUPPORT FOR RR vs. traditional protection strategies

- Dedicated (favoured) funding streams?
- Conflicts between different policies/sectors
- CBA (or pre-conditions) for State funding of protection works?

CRITICAL ISSUES for floodplain restoration:

TECHNICAL ISSUES RE PLANNING AND IMPLEMENTATION

- Suitable framework for ES assessment?
- Prediction capacity?
- Good practice?

Forest management

Do active management and "cleaning" of forest areas always increase the ecosystem services related to flood and landslide risk? Or at least in some contexts a natural forest is more effective?

Retreive and maintain abandoned agricultural land

One of the main causes of natural disasters is the ABANDONMENT of agricultral land, especially in the MOUNTAINS

Is this always true?
Which practices are really useful?
What are the most effective measures that should be carried out by farmers?

NWRM Mediterranean workshop

Alcalá de Henares, 28 January 2014

Why are NWRMs needed? Key challenges in relation to flood risk management for joint WFD and FD implementation

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