The Var River in Southern France

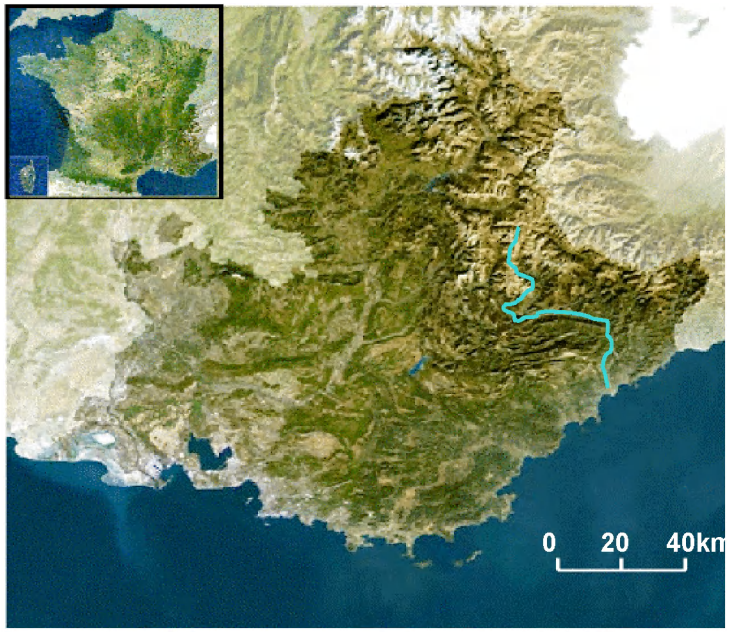
Conflicts between authorities and users - How local people fight to preserve their living environment?

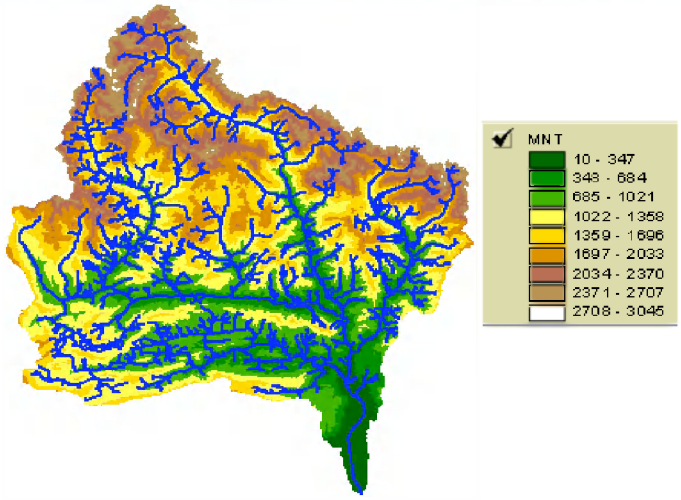
Facts

- A mountain river, which valley was deeply incised in the Alps, reached the large closed basin that was the Mediterranean Sea at the end of the Pleistocene, discharging in a big lake close to Sicily.

- Over the past 20,000 years, the oceans rose from about 125 m below the present levels and at one moment invaded the Mediterranean depression.

Situation of the Lower Valley



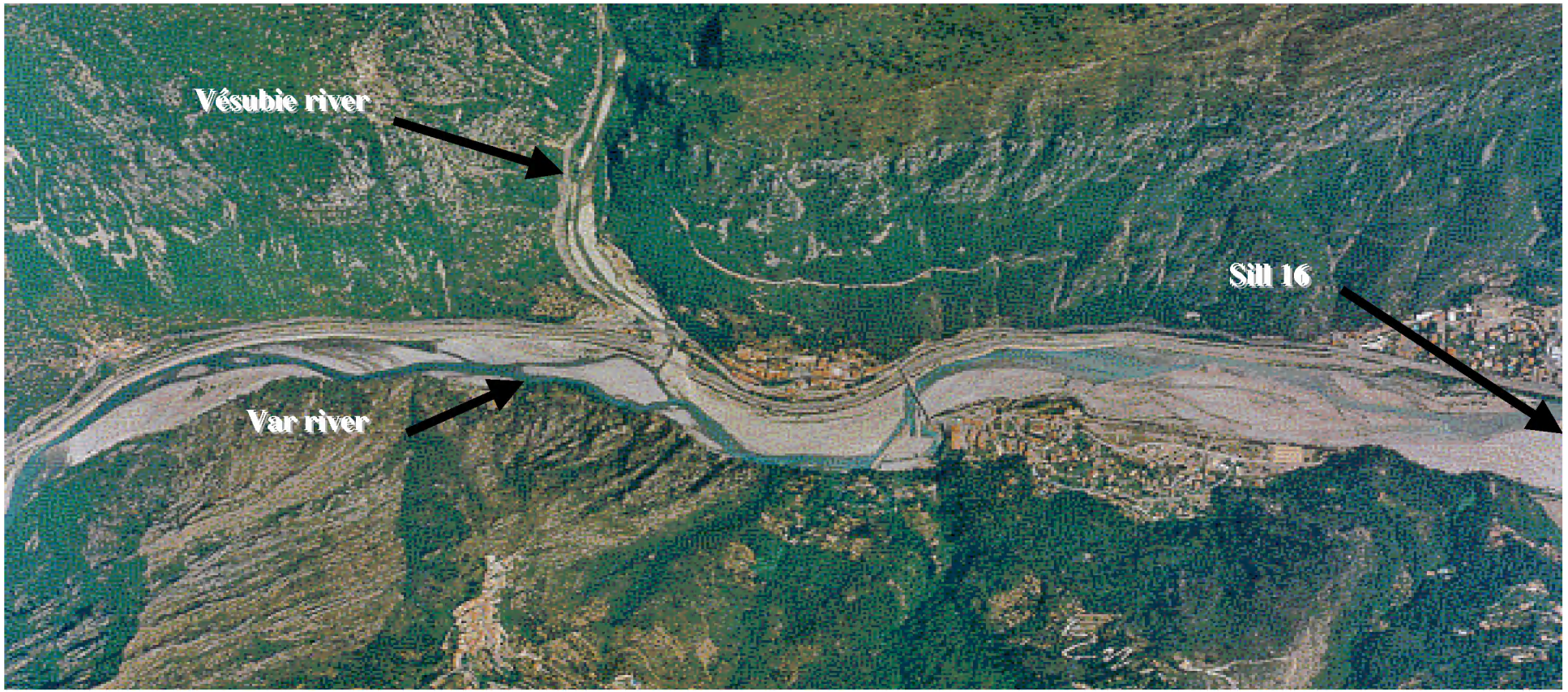


- The Var is a typical alpine river, carrying coarse bed material.
- It leaves the narrow gorges of Chaudan at only 25 km from the sea.
- The slope in the lower valley is about 5 to 6 m/Km.

Creating an artificial flood plain

- Originally, agriculture was in the river and population lived on the slopes (foothills).

- Over the past two centuries, an artificial floodplain was created by constructing sedimentation tanks in which part of the flood flows were diverted, so that ground level would rise by sedimentation of the fine suspended solids, creating good soils.



- In the Chaudan gorges, the river course is strongly controlled by valley borders, made of very hard rocks.
- The large gravel bars are very mobile and composed of very coarse bed material.

The Chaudan gorges

Human impacts in lower valley

- Over its entire length of the lower valley, the river was canalized, reducing its width from about 1000 m (between valley slopes) to 300 m, and even 200 m close to the sea.
- The Esteron river is joining the Var in its lower valley.
- Sediments from the Estéron are different from those in the Var (more yellowish in Estéron)

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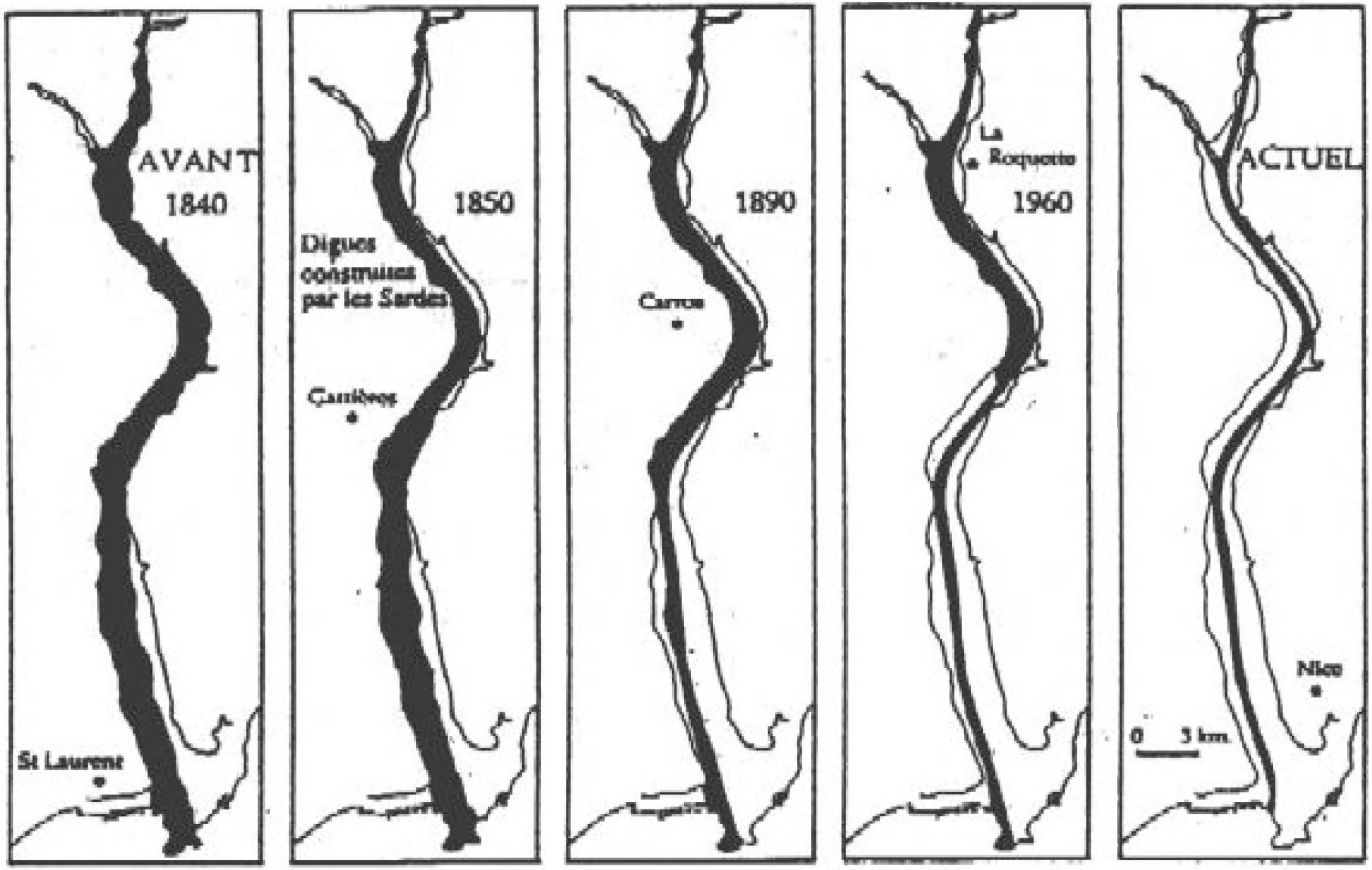
Progressive embankment of Var

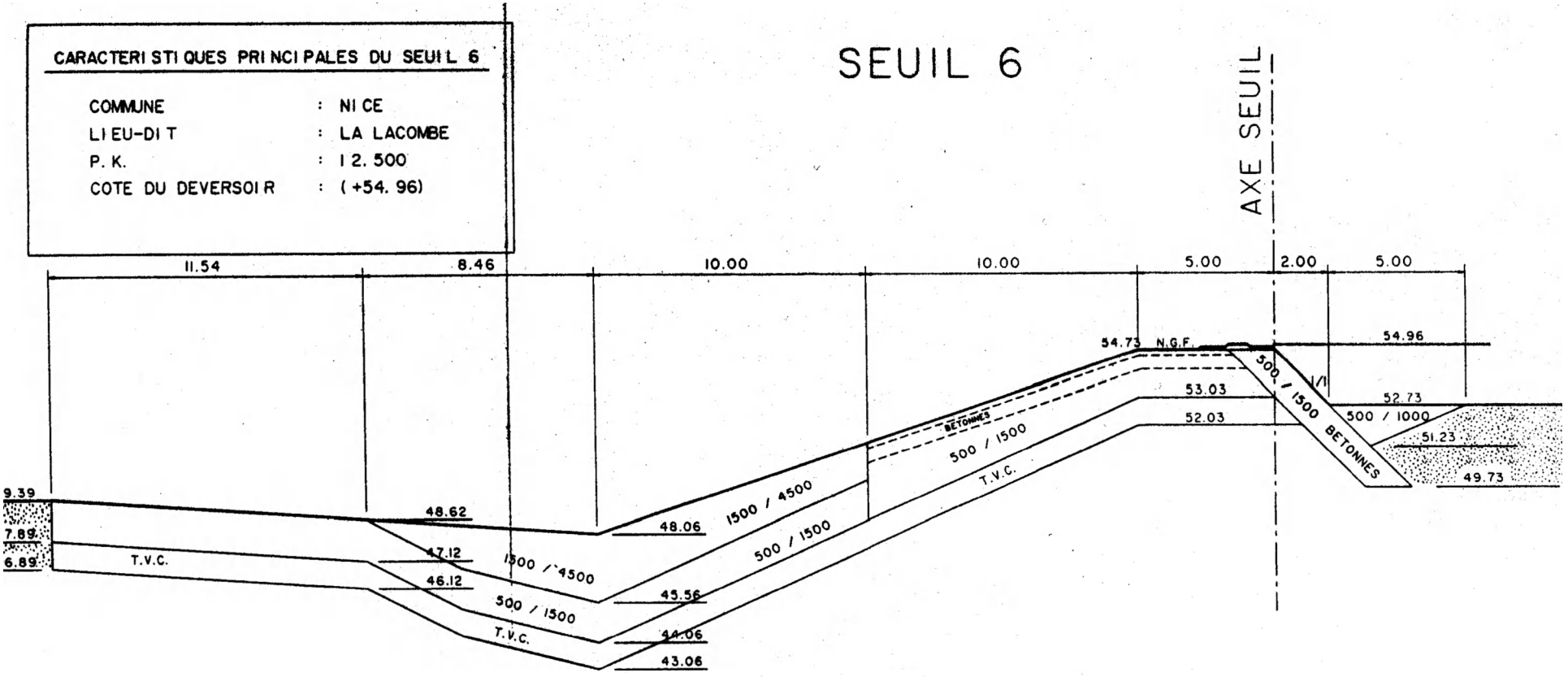


Gates controlling flow to artificial floodplain (sedimentation areas)

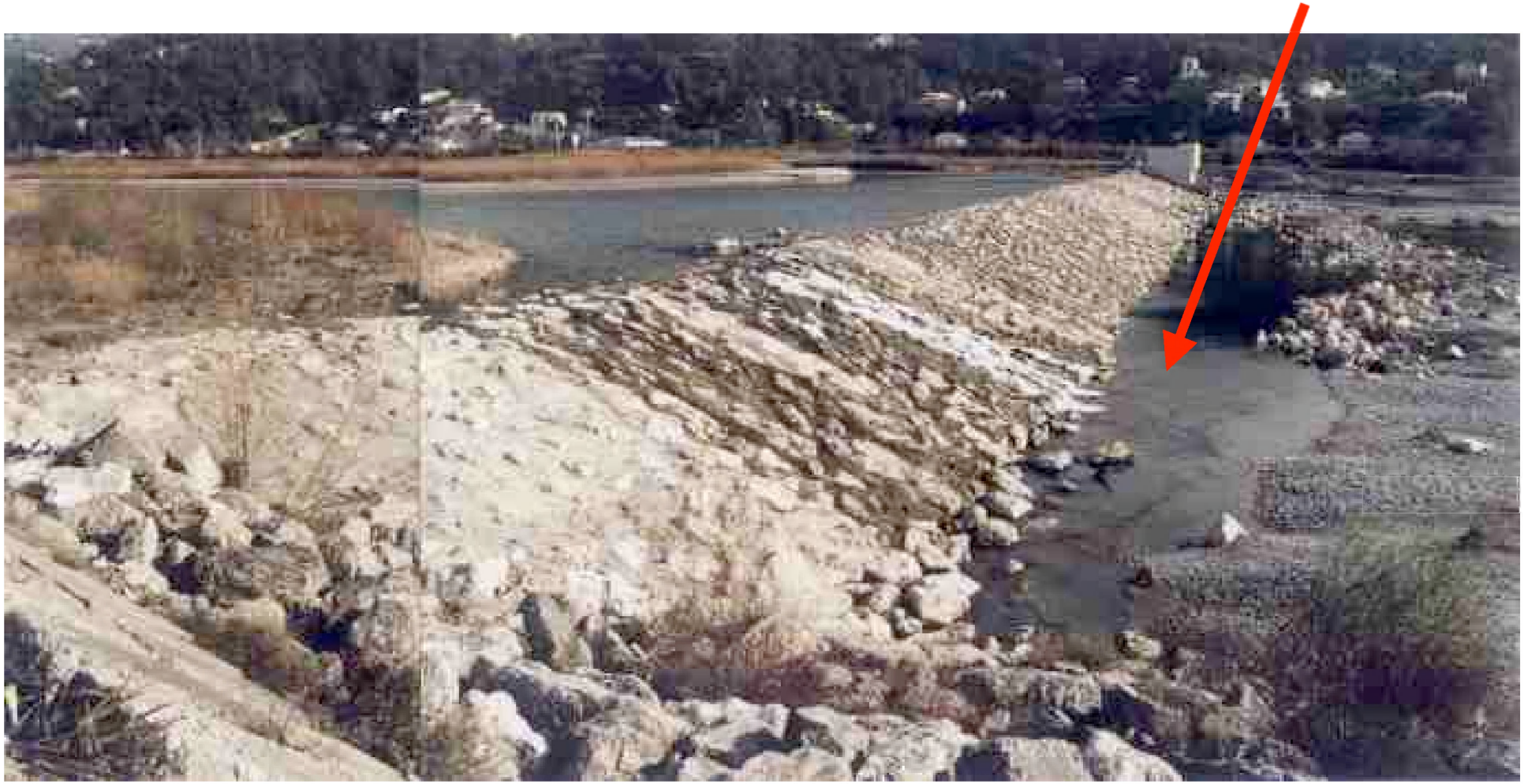
Controlling the slope with sills

- Rapidly increasing demand for building materials after World War II because of quick development of tourism ⇒ mining the river bed (cheap & easy)
- Mining of the riverbed material lowered the river, by 6 m in some places.
- Groundwater levels dropped, creating difficulties for water use by farmers.
- Engineers decided to stop the degradation of the riverbed by building fixed weirs (sills 2 to 16).

Original design of sill No. 6



Sill No. 8, showing damages at foot



Morphological impact of the sills

- Fine silt deposits changed the river environment: narrow channels bordered with lateral terraces.
- Dense vegetation grew on terraces in between sills, changing the flow resistance.

Morphological impact of the sills

Sills / weirs, for what?

- To control the water levels.
- To generate hydropower.
- Negative impact was not anticipated.

Impact on transit of sediment

The Var river at
Bridge La Manda

- Only fine material passed the sills after these were constructed.
- Deficit in sediment created scouring downstream of lowest sill (Nr. 2), which head passed from 6 to 12 m.

The project for a new road

- Because of the high traffic on road RN 202 (on the left bank), the Ministry of Infrastructure has a project to build a new road RN 202Bis (for largest part on the right bank), that will encroach in many places on the riverbed, and two bridges with piles in the river bed.
- After the 1994 flood, there was fierce resistance against this project.
- Meanwhile, one bridge was built, not the other bridge and not the road RN 202Bis

The legal framework

- France has since 1992 a good water law, which is internationally often taken as an example for a sound management of the water resources.

- The institutional setting has not been adapted for easing the management of the water systems: the responsibilities are spread over (too) many authorities.

Legal & institutional framework

- The management should be framed in a “General Water Management Frame” (Schéma Général d’Aménagement des Eaux - SAGE)

- The SAGE is in principle the responsibility of the “Local Water Commission” (Commission Locale de l’Eau) in which are represented all stakeholders.

Legal & institutional framework

- Among ministries sharing responsibilities, the one for Equipment and Transport is the most powerful (DDE).
- In the past, local farmers had the duty to maintain the river banks.
- DDE gave authorisations for modifying the river course, exploiting the bed material as building material, building low-head hydropower stations.

Social & socio-economic aspects

- Land reclamation by local farmers from 1840 till 1960.
- They wanted to create a fertile artificial flood-plain in the lower valley.
- They acquired interesting local knowledge on how to manage the river banks (protection against erosion).

Social & socio-economic aspects

- Development of tourism after second World War required the use of building materials.
- DDE authorised exploitation of river bed.
- Lowering of bed resulted in lowering of water table and damaged agriculture.
- Decision of DDE to build small dams (grade-control structures).

Social & socio-economic aspects

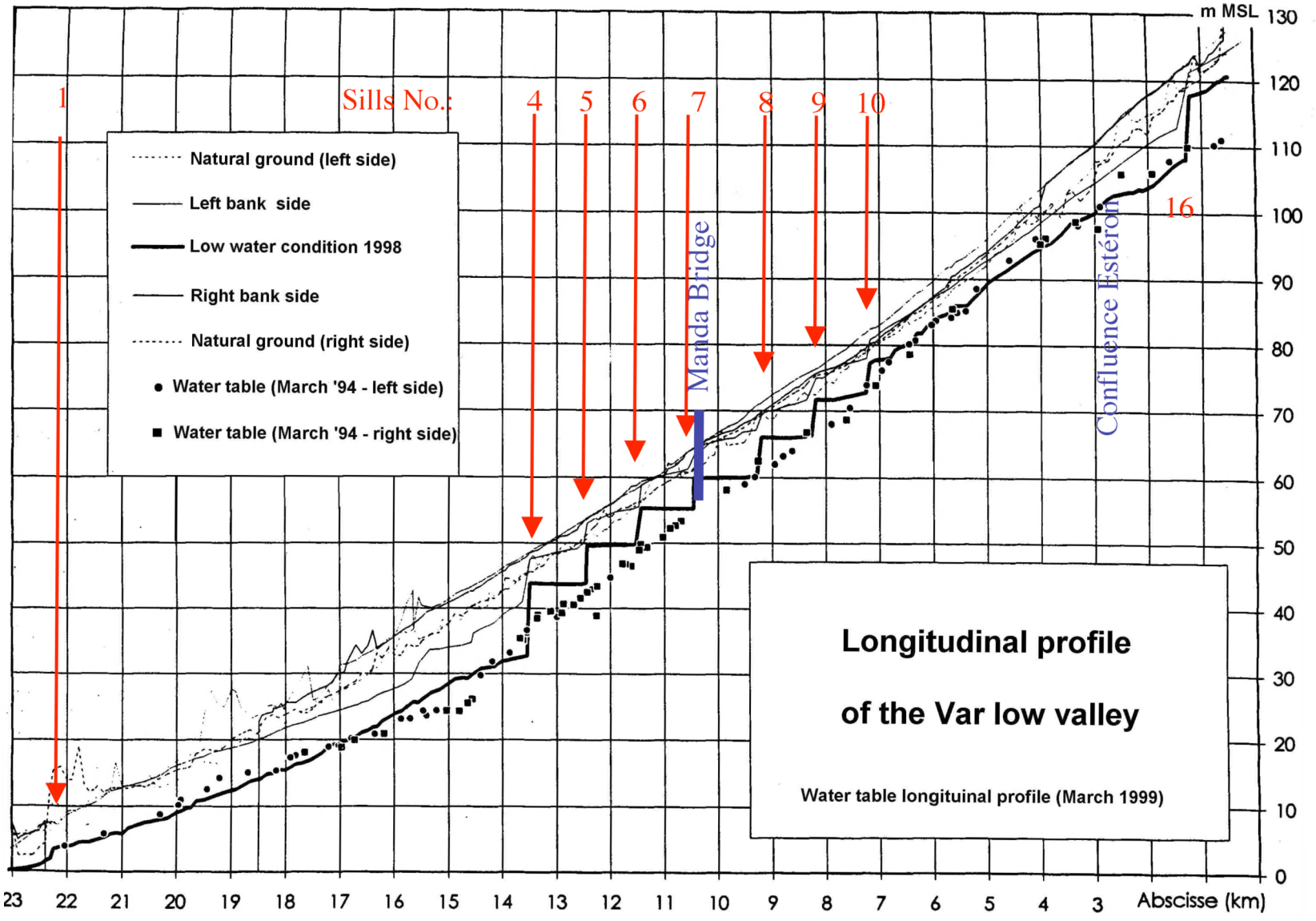
- DDE authorised even to continue lowering the riverbed by 6m below initial bed level.
- DDE authorised building low-head power stations on the dams.
- Sedimentation of fines between the dams changed the river environment, with forest instead of gravel-bed river course.

The 1994 flood & inundation

- The storage of coarse river sediment upstream the dams made the riverbed drop at the foot of last dam, the head passing from 6 to 12 m in 12 years

- On 5 November 1994, an extreme flood event produced the collapsing of the lowest and the second-lowest dam, the flood wave inundating Nice's international airport.

Longitudinal profile 1998



The collapse of sills 2 & 3

- During the flood event of 5/11/94, sills 2 & 3 collapsed and the flood wave inundated part of the city and airport.
- Sill 4 is in danger of collapsing because of high head.

Downstream: Sill 4 in great danger

Still sediment deficit below sill 4

Upstream: Sill No 10 in 2002

Sediment passing sill No 10 in 1997

Increasing flood risk upstream

- Some contractors want it (they can build levees …)
- Locals opposed this project and set up defence committees.
- Ministry threatened local communities with blocking projects if continuing opposition.

The RN202-Bis road project

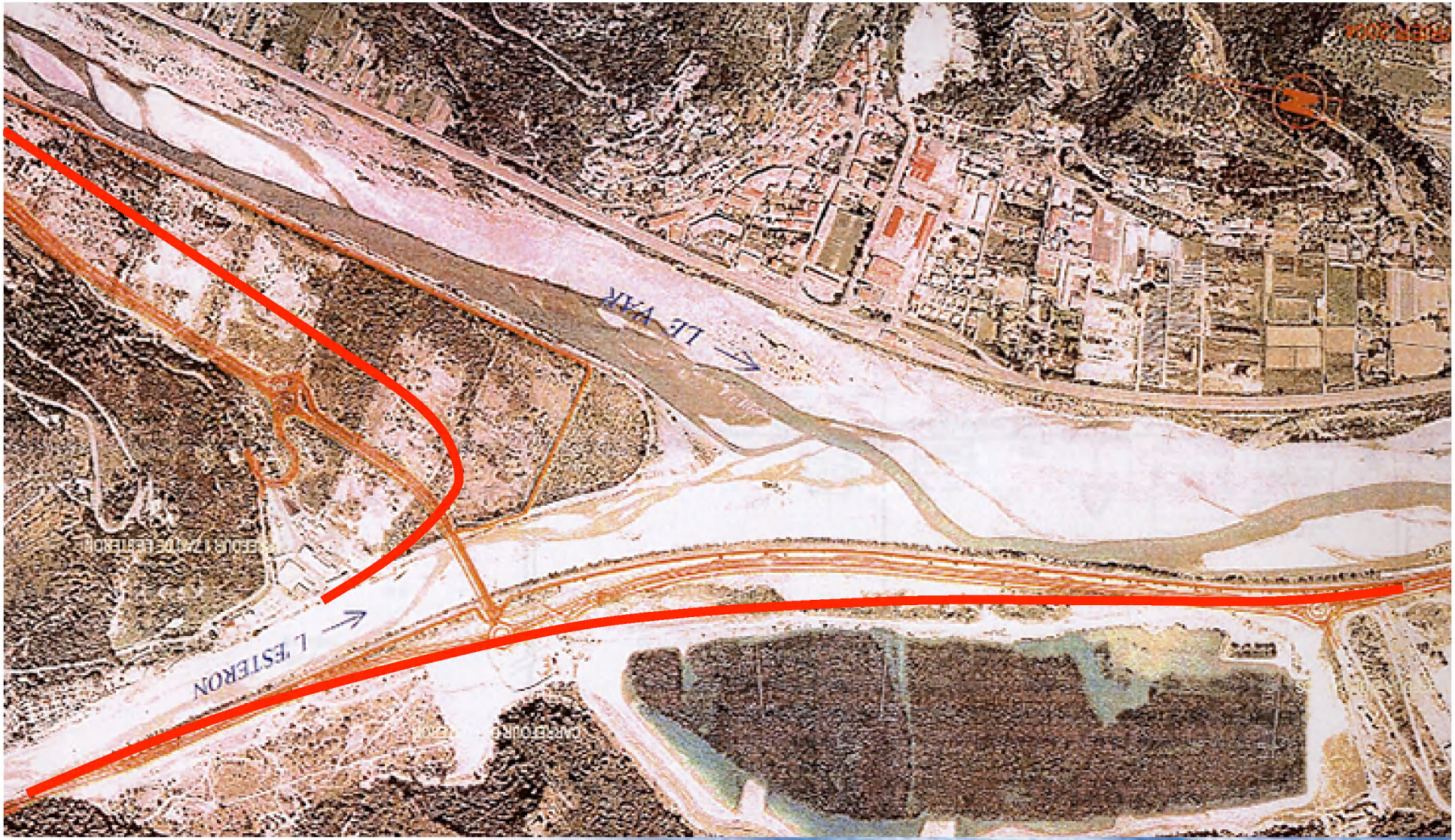
- The DDE wanted to double the capacity of a highway along the river by build a second road on the other bank, but encroaching on the river.
- Locals opposed this project and set up defence committees.
- Ministry threatened local communities with blocking projects if continuing opposition.

The RN202-Bis road project

- Central administration (Paris) concerned about issue, decides to have experts assessing situation.
- Institutional changes ⇒ transfer of responsibilities DDE to provincial and local administrations
- Legal battles in administrative courts to block construction of new road.
- Outcome still uncertain …

Banc protection:
Concrete blocs on concrete revetment
“old” method or “local knowledge”?

Redesigning the Estéron-Var confluence



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Caso de estudios : río VAR, FRANCIA