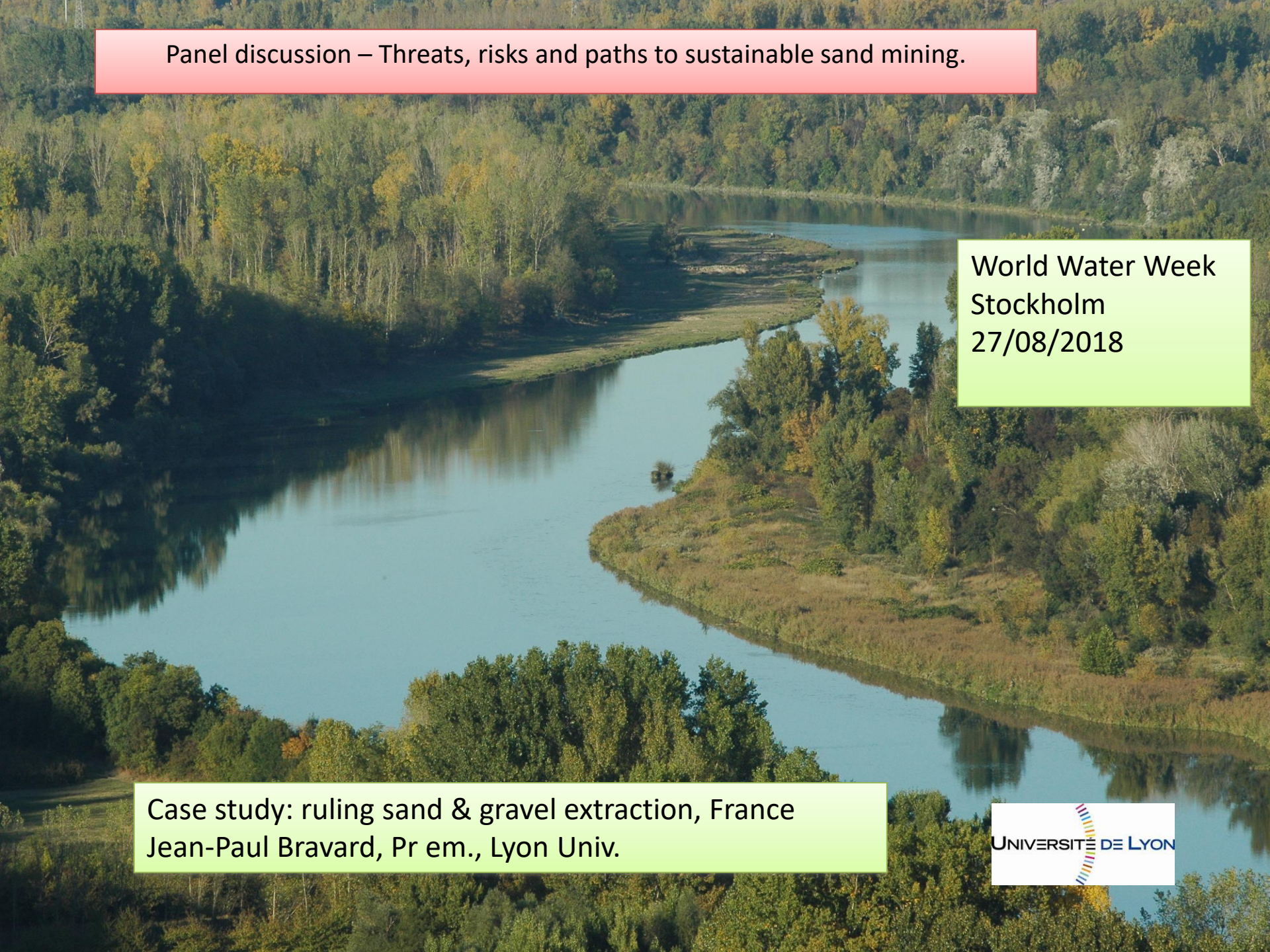
Panel discussion – Threats, risks and paths to sustainable sand mining.



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Case study: ruling sand & gravel extraction, France

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Large scale extractions occured in Western Europe
from the 19th century at least

River gravel was used for training roads…

Extraction of gravel out of the overloaded Drôme River in 1900
With hand-shovels and horse-driven carts

… and raising railway platforms in large valleys (thousands of m^3)

Rivers draining the Alps and their foreland were natural conduits transporting gravel eroded in the Alps due to the effects of Little Ice Age and to human-triggered erosion on slopes

The Tagliamento River, Friuli, Italy
Ph: JP Bravard

The Drôme River, Western Alps France

Ph: RN Ramières

Extraction was both useful for development and considered as a necessity for flood control along aggrading rivers

Extraction policy coordinated by public authorities for centuries in Europe

Building large infrastructures (motorways, power plants platforms, land reclamation for public infrastructure & industrial zones, protecting reservoirs from sediment filling, concrete for private construction) was considered of public interest in western countries.

French regulation

- *Mining laws date back as far* as the 14th c.; its modern fundamentals were established in 1810 (Imperial Law).
- The Mining Law took its modern aspect in 1956 for regulating extractions concessions; and was modified several times to adapt to changing conditions.

French sand mining operator were expected to provide 350-400 M tons/year to support the need of infrastructures development and construction

A bridge failure , Wilson Bridge (built 1765-1778), 434 m long, Tours on the Loire, due to bed lowering following intensification of in-channel sand mining, motivated expertise and was a mile stone for the concept of river protection

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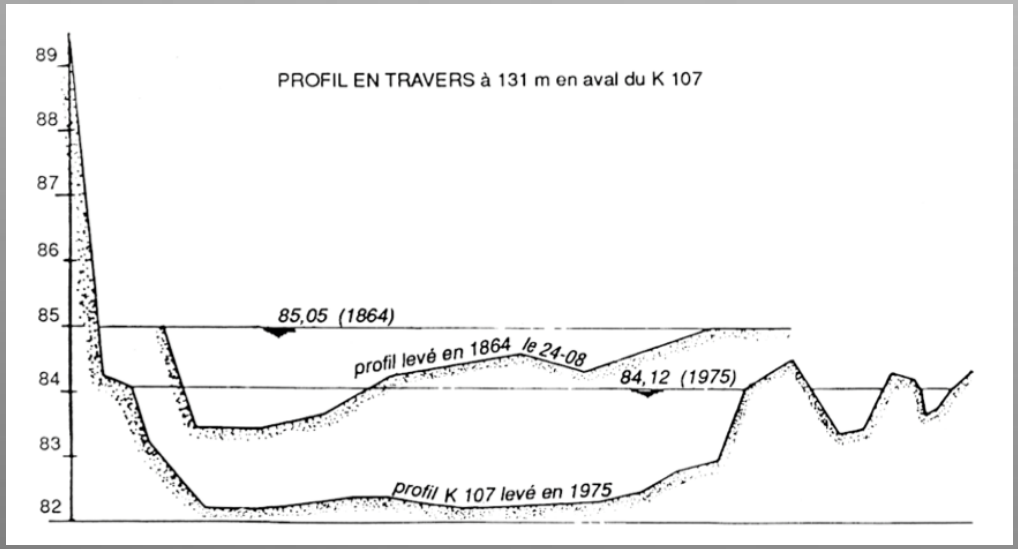
Wilson bridge, collapsed in 1978 after bridge piers undermining
Source: *La Nouvelle République*



The cross profile of the Loire River downstream of Orléans in 1864 and 1975 (- 1,50 m)
Source: Z. Gazowski, 1994

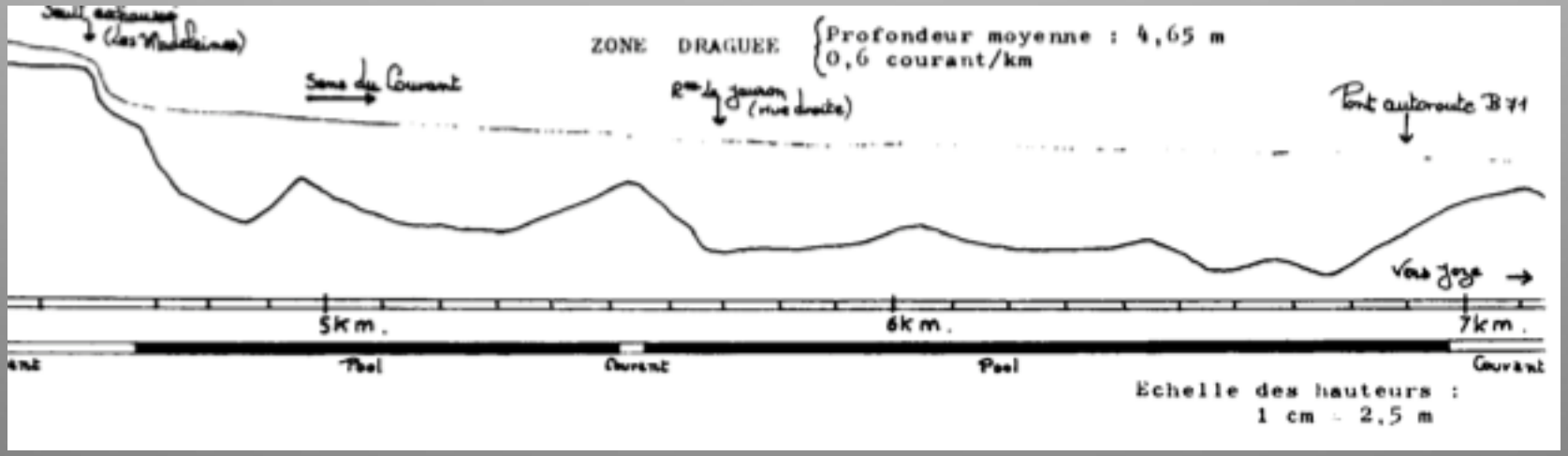
Impacts of sand and gravel mining

Impacts in-channel

- Longitudinal profile
- Destruction of fish habitat and spawning grounds
- Detrimental effects of gravel washing

Impacts on floodplain ecology

- Frequency of floods
- Groundwater levels & volume of ground water reserves
- Health of alluvial forest and adjacent wetlands +/- connected to the river



Dredged pools in the Allier River in 1974-75. Clavel, 1979

The 1980's: toward regulation changes

Other consequence of unsustainable sand mining: costly counter-measures: transverse weirs, embankments, dredging of side channels

But State benefited taxes from sand-gravel extraction, a reason for delaying suspension of many sand mining operations despite acknowledgment of negative impacts!

- Regulations were poorly respected due to a lack of enforcement & monitoring from public authorities
- Sand & gravel in channel stocks were becoming almost exhausted in many rivers
- Spawning grounds of migratory fish were altered
- At the local scale (department), private business operations were progressively banned from operating in the active channels and thus relocated in the floodplains (mid-1980's to early 1990's)
- The Ministry of Environment opposed publically owned mines operating along some rivers (Gave de Pau). Concessions were cancelled.
- The 1992's French Water Law considered rivers as a national heritage

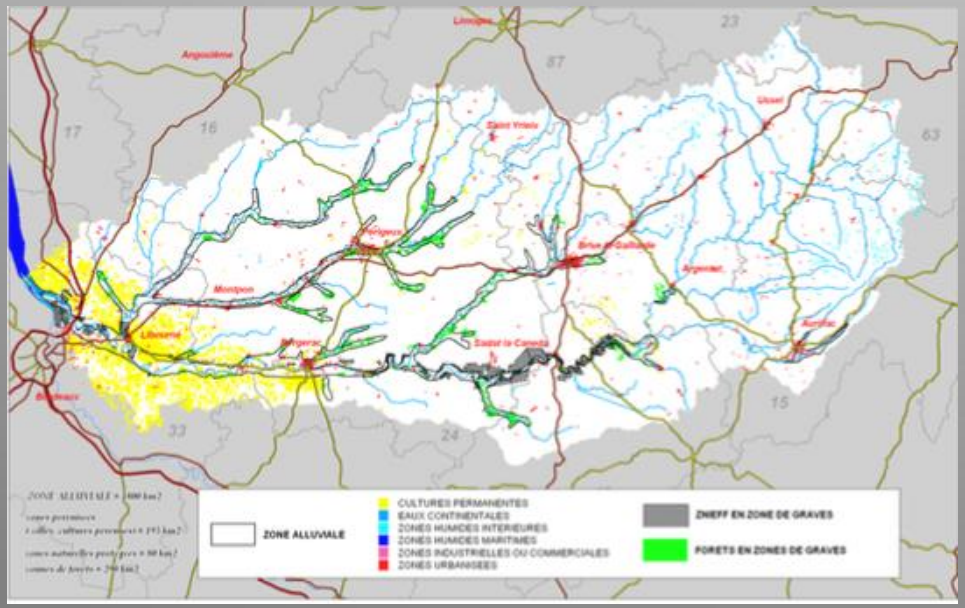
Recent regulation developments

- The *Mining Law* was improved, notably in 1994 to include tougher provision for environmental protection.
- Extraction operations need to comply with the *Environmental Law* (1977, last revision in 2017)
- Since 2013, gravel and rock extractions for construction (quarries) are no longer considered as mines. They are ruled under the ICPE (*Facilities Classified for Environmental Protection)* to better account for possible specific threats to the environment.
- Local administrations (Prefecture and Equipment/ department) allocate concessions and enforce the extractions

Territorial management :
From *Departmental Extraction Schemes* to *Regional ES*

In 1994, each department had to elaborate a *DES* in order to provide and secure resources for construction (gravel from the floodplain alluvium, rock crushing + recycling since 2000)

- The DES maps:
  - the potential resource in the alluvial zone (but active river channels are excluded)
  - the existing constraints : roads, environmental protection of rivers (35 m wide buffer zone between extraction pit and river channel), ZNIEFF & Natura 2000 zones, forests, vineyards, landscapes, urbanized land and PLU (Local Urban Plan) at communal scale



- The DES is elaborated under the control of the Bureau of Geological and Mine Research and decentralized ministries in region (Industry & environment)

- At the larger watershed scale the DES must comply to the SDAGE (Water Management Directory Scheme)

* DES will be replaced by *RES* at the regional scale (2015 Decree). More in line with the concept of *circular economy*.

I thank you for your attention