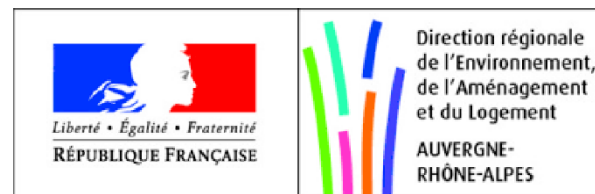


**Approche opérationnelle de caractérisation  
du risque de piégeage sédimentaire associé à la capture  
par des gravières en lit majeur : rivière Allier, France**

/

***Operational approach for assessing the risk of sediment  
trapping related to capture by former gravel pits in the  
flood plain: River Allier, France***

David Goutaland, David Bachellerie, Justin Lecomte, Catherine  
Franck-Néel



# Context

- Inventory of gravel pits situated within the mobility area of the river Allier

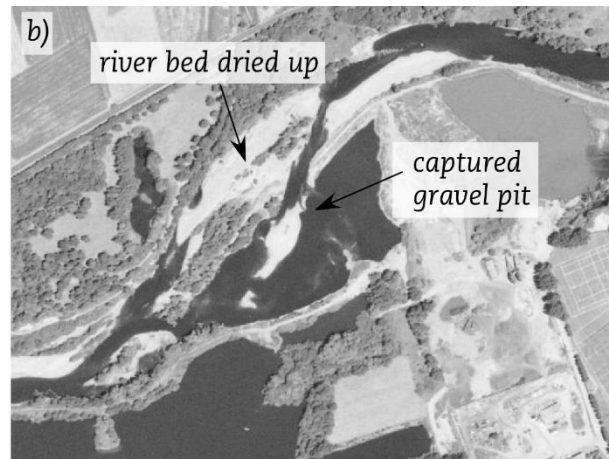
Gravel pits	Gravel pits exposing to a capture				
	High	Moderate	Low	Very low	Already captured
332	54	19	12	33	8
100 %	16 %	6 %	4 %	11 %	2 %
$\Sigma = 39 \%$					

- Aim of the study : improvement of knowledges on **gravel pits in floodplains** exposing to a **risk of sedimentary imbalance due to the capture** of the river bed of the Allier river

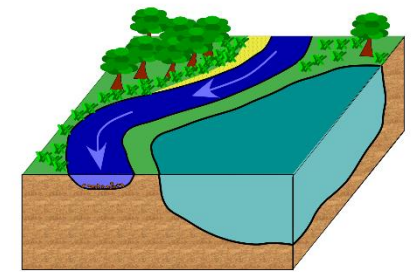


# Capture of a river bed by a gravel pit

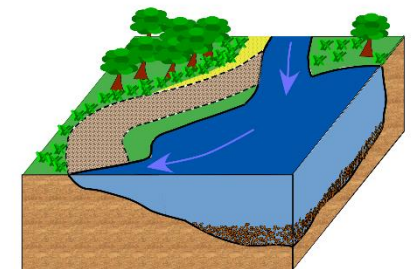
- The capture of a river bed by a gravel pit during a flood is an **extrem case where the flow is definitively modified**. The capture arises when both occur :
  - **connections between the gravel pit and the river bed** (upstream and downstream)
  - **a translation of the minor river bed in the gravel pit.**



Gravel pit of “Pont Lamothe” (Lamothe, France) : a) in 1992 and b) in 1995. The 1994 flood of the Allier river has caused the river capture by the gravel pit.



Before capture



After capture





# Methodology of risk assessment

- The methodology of risk assessment is adapted from that defined by the DREAL Centre-Val-de-Loire (2015). The proposed methodology consist in considering the risk of sedimentary imbalance consecutive to a capture as the **cross-referencing between an hazard (capture) and an issue (bed load trapping)**.

## Hazard of capture

### Probability \* of capture

\* Probability of occurrence of the phenomenon, estimated by a qualitative analysis of factors appropriate to various scenarios of capture

X

### Delay # of capture

# Significant deadline inside which the upstream and downstream connection between the river and the gravel pit can occur (expert judgment)

X

## Issues

### Direct issue of trapping of bed load and backward and forward erosion \*

\* Issue assessed by comparison between the annual bed load transported by the river and the volume of sediments potentially trapped by the gravel pit.

### Complementary issues # due to sedimentary imbalance induced by the capture

# Scouring of anthropic structures, decrease of groundwater level

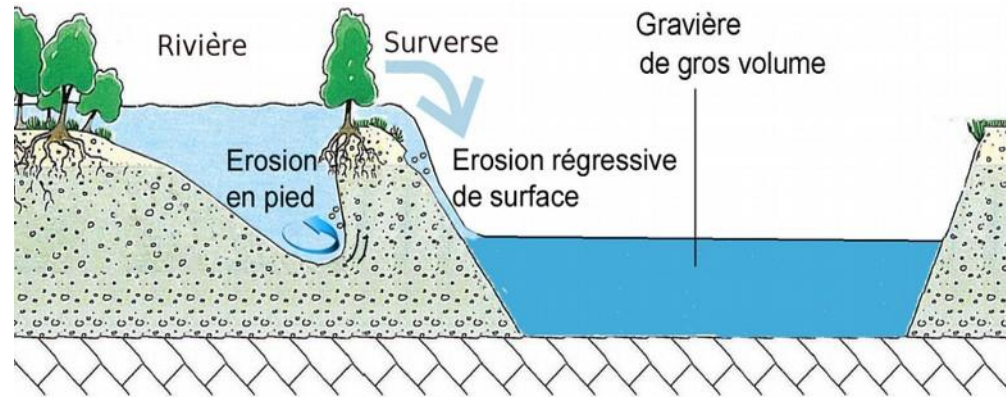
## Risk of capture

Sedimentary imbalance and alteration of the functions or “services” of the river



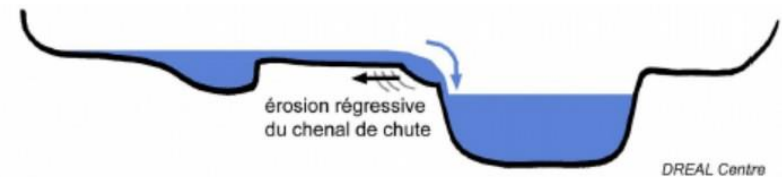
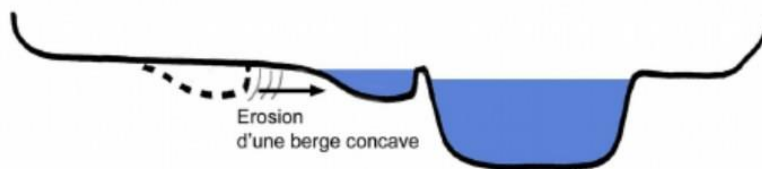
# Two scenarios are considered

- Scenario A : « levee »
  - **External erosion** (scouring)
  - **Overflow** (surface backward erosion)



Source : DREAL Centre (2015)

- Scenario B : « whitout levee »
  - **External erosion** (erosion of concave banks)
  - **Overflow** (backward erosion from the fall channel)



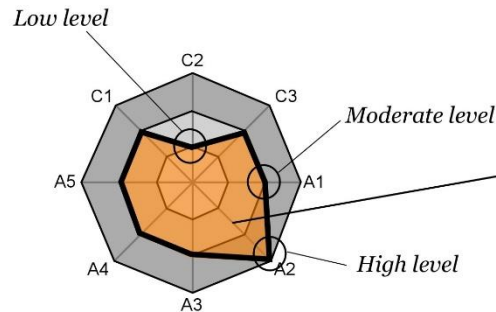
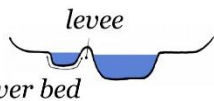
DREAL Centre

Source : DREAL Centre (2015)

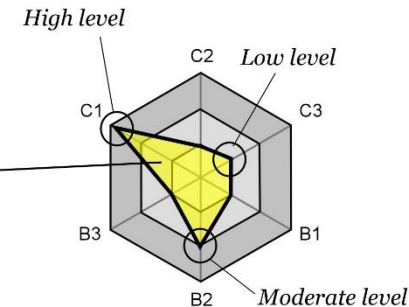
# Criteria of hazard assessment

- Hazard assessment : **cross-referencing the probability and the delay of occurrence of the capture** (expert judgment)
- Probability of occurrence : **qualitative estimation on the basis of factors determining the phenomenon** (related to the general dynamic of the river bed or to the hydromorphological control)

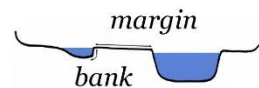
## Scenario A - “Levee”



**Global level retained for the probability of capture**  
(yellow = low, orange = moderate, red = fort)



## Scenario B - “Without levee”



**$A_i$ ,  $B_i$  et  $C_i$  : factors determining the assessment of the probability of occurrence of the capture**

**$A_i$  :** factors associated to the scenario A

- $A_1$  : erodability of the levee
- $A_2$  : state of bank protections
- $A_3$  : cross-section of the levee at the weakness point
- $A_4$  : rule of the vegetation relative to the levee
- $A_5$  : hydraulic head on the levee

**$B_i$  :** factors associated to the scenario B

- $B_1$  : margin width
- $B_2$  : bank erodability
- $B_3$  : rule of the vegetation relative to the bank

**$C_i$  :** factors associated to the both scenarios

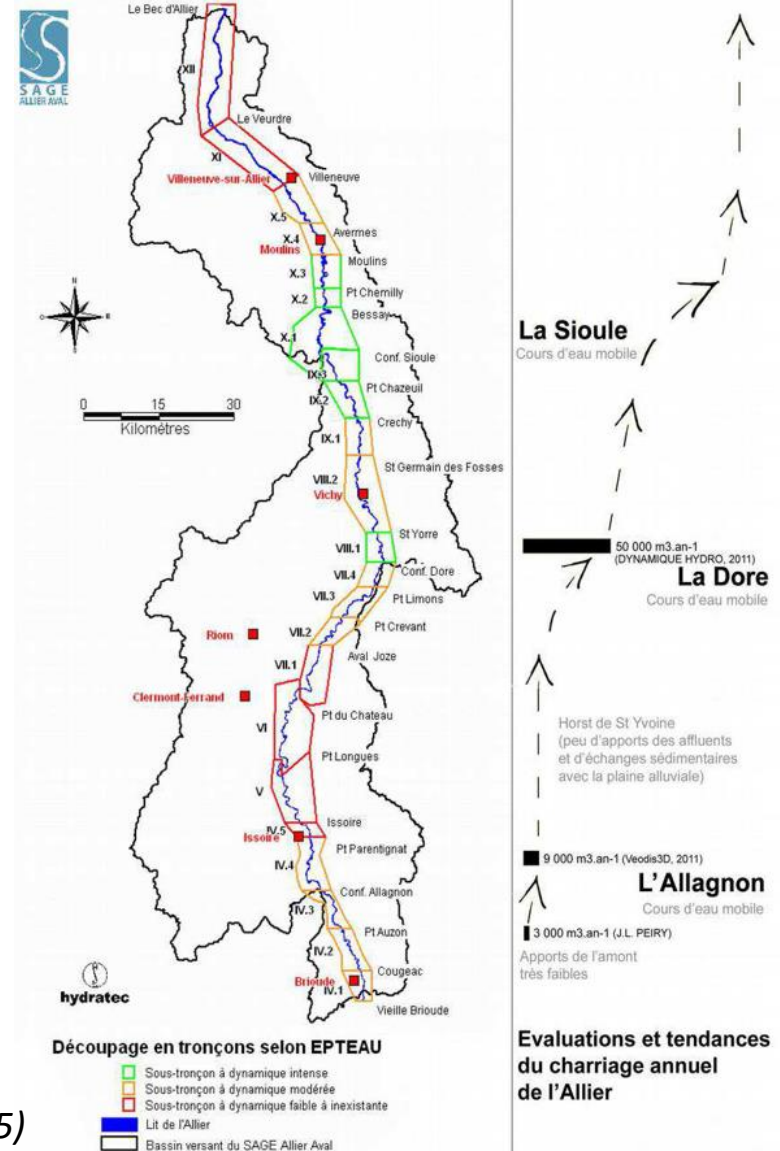
- $C_1$  : lateral general dynamic
- $C_2$  : slope of water surface
- $C_3$  : angle of incidence



# Criteria of issues assessment

- Issues assessment : **duration of interception of the bed load by the gravel pit** (DREAL Centre-Val-de-Loire, 2015) calculated by the comparison between :
  - the annual volume of the river bed load
  - and the total volume which can be trapped by the gravel pit.
- Possible consideration of **complementary issues** (anthropogenic structures, water withdrawal)

Source : DREAL Centre (2015)



Dreal Centre-val de Loire, 2015





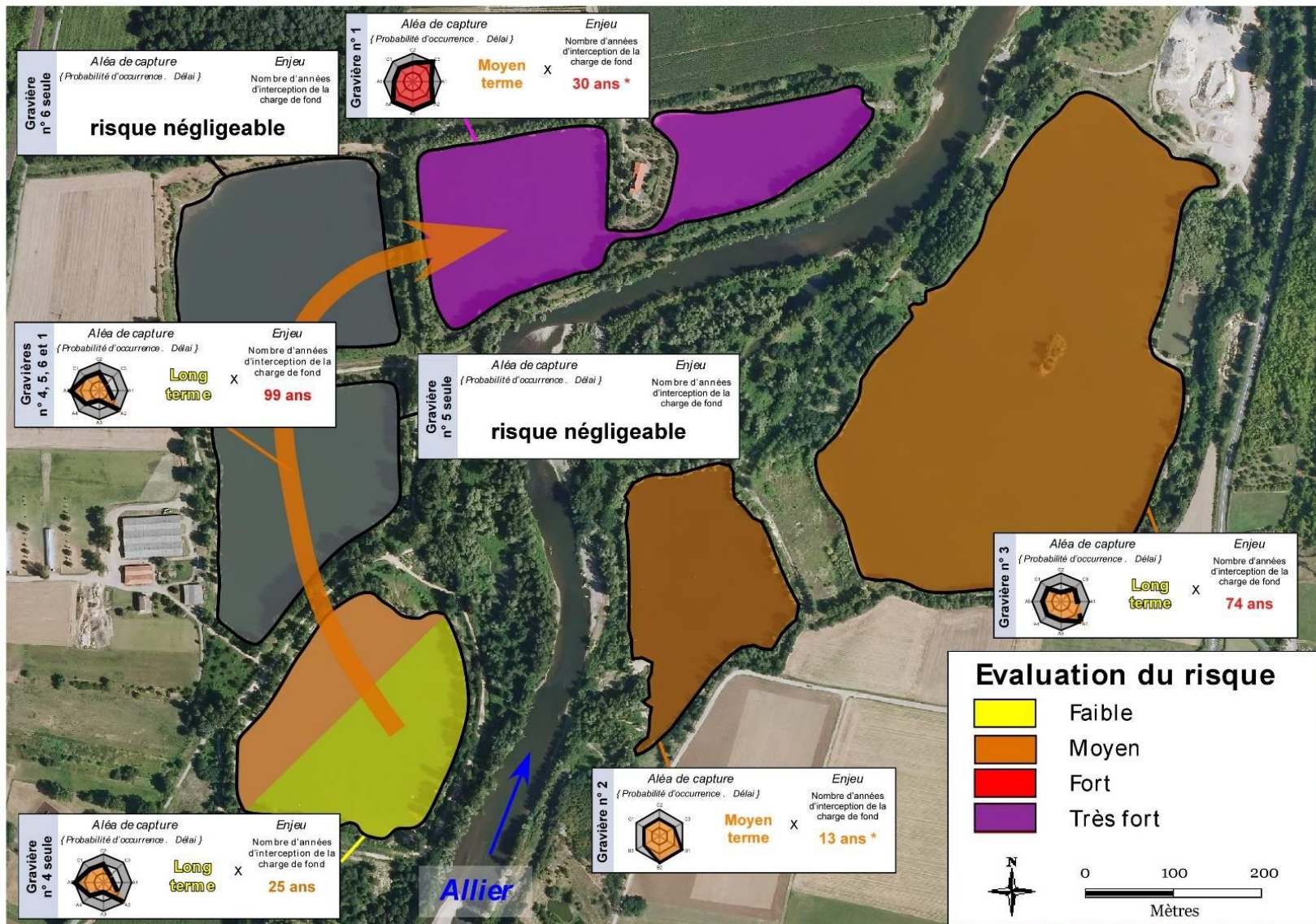
# Risk assessment

- Risk assessment of sedimentary imbalance

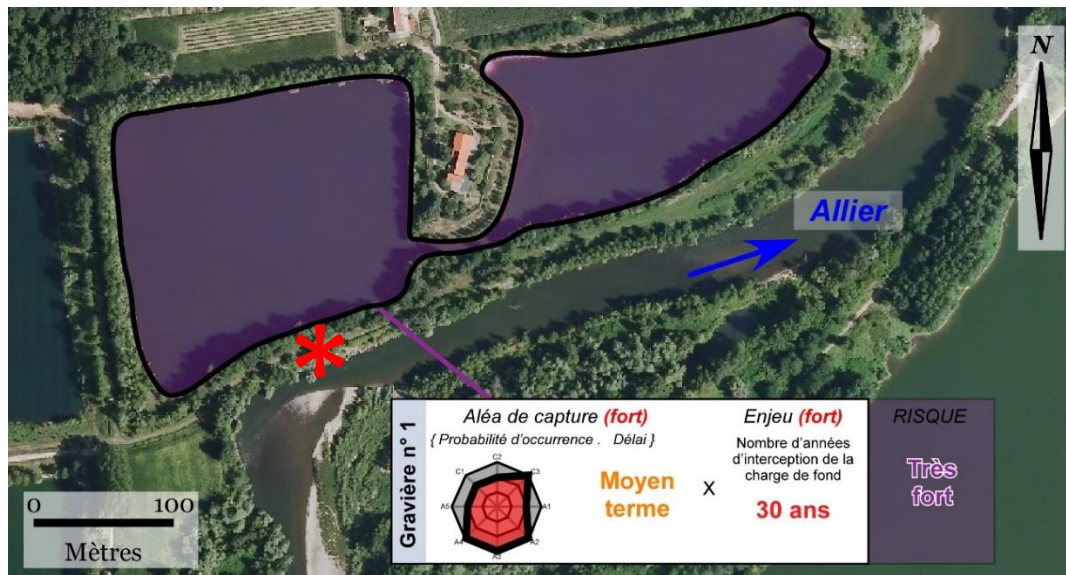
Risk assessment of sedimentary imbalance		Hazard of capture				
		Very high	High	Moderate	Low	<i>Negligible</i>
Issues	High	Very high	Very high	High	Moderate	<i>Negligible</i>
	Moderate	High	High	Moderate	Low	
	Low	Moderate	Moderate	Low	Low	



# Example of risk assessment

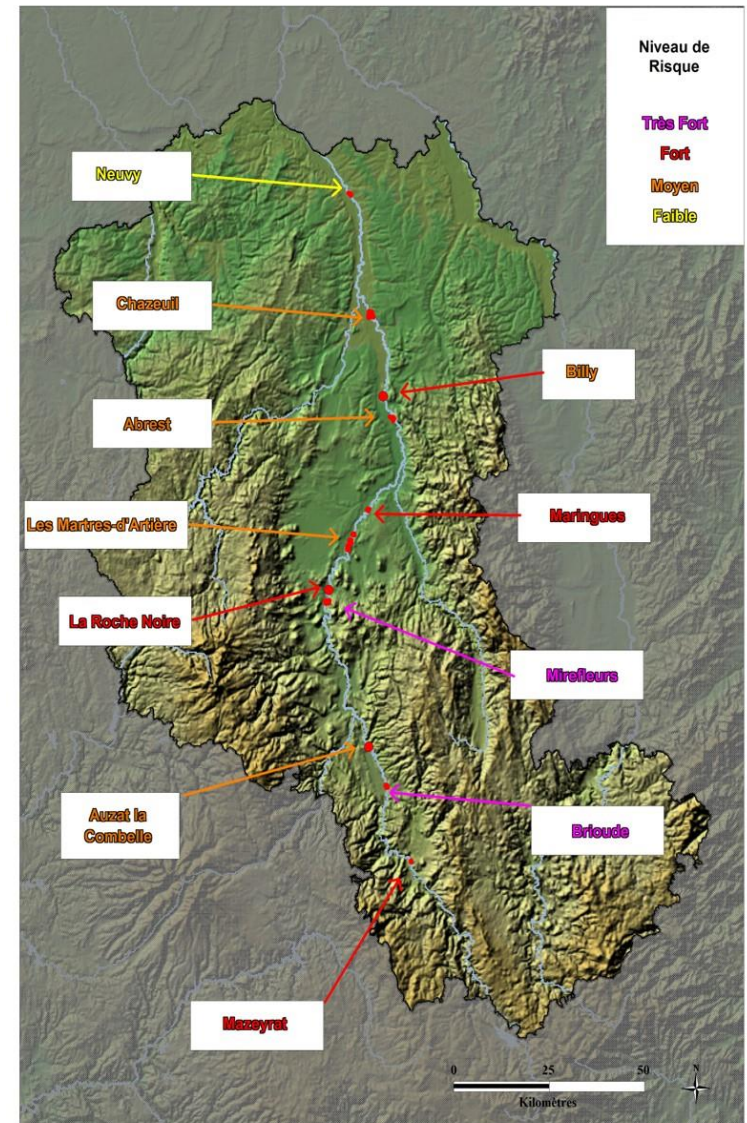


# Example of risk assessment



# Results

	Site	Risk
1	Neuvy	Low
2	Chazeuil	Low to Moderate
3	Billy	Moderate to High
4	Abrest	Low to Moderate
5	Maringues	High
6	Martres d'Artière	Low to Moderate
7	La Roche Noire	High
8	Mirefleurs	Low to Very high
9	Auzat la Combelle	Moderate
10	Brioude	Very high
11	Mazeyrat	High



# Conclusion

- The methodology allows to **identify high risk gravel pits** and to **prioritize preventive actions** on the river banks
- The operational methodology is **applicable to mobile rivers** comparable to the Allier river
- The application of the methodology **requires to know the annual river bed load**



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## Thanks for your attention !

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