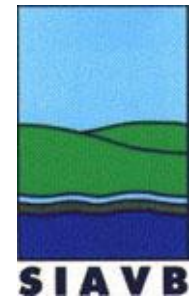


# The automated regulation system for the Bièvre river



**SIAVB - Syndicat Intercommunal d'Assainissement de la Vallée de la Bièvre**  
**Veolia**





## ► Context

- The Bièvre river
- The floods of the Bièvre river
- The 1982 flood

## ► Investment plan and challenges

- The storage basins
- Challenges and solutions

## ► The automated regulation system

- The principles and system's components
- The regulation performances

# Context: location

1. Context

2. Investment plan and challenges

3. The automated regulation system

The catchment area concerned by the regulation system implemented is located at the crossroads of three departments: Essonne, Yvelines and Hauts de Seine

It is located South West of Paris and involves 14 municipalities which constitute the Inter-communal Authority for the Wastewater management of the Bièvre Valley

**S I A V B:** The client for the operation





# Context: the Bièvre river

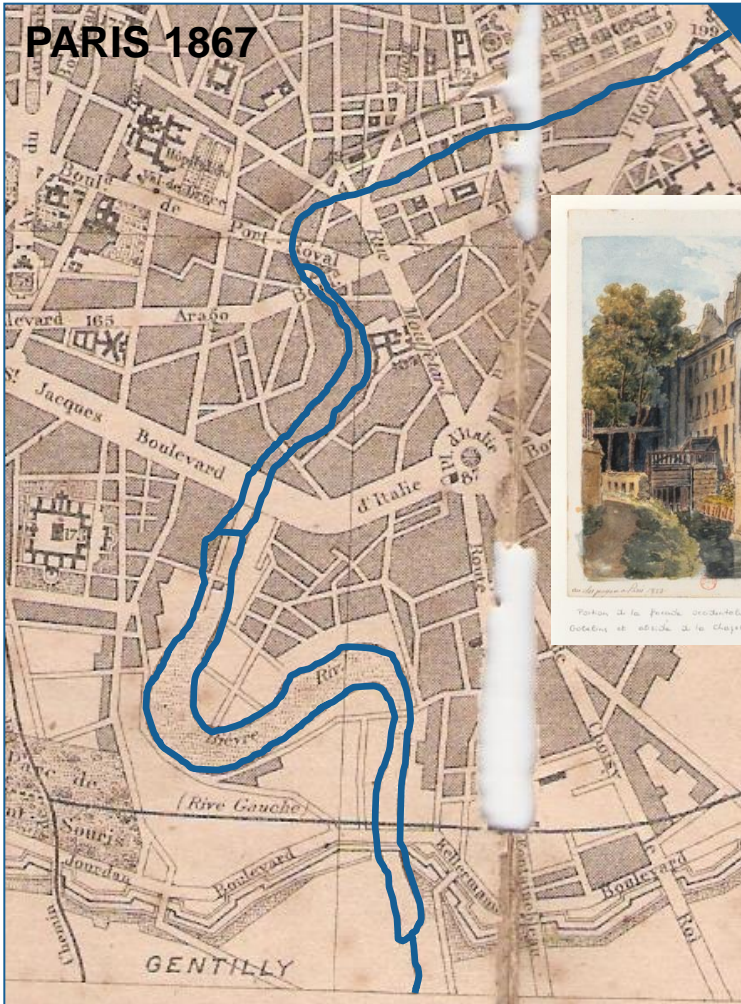
1. Context

2. Investment plan and challenges

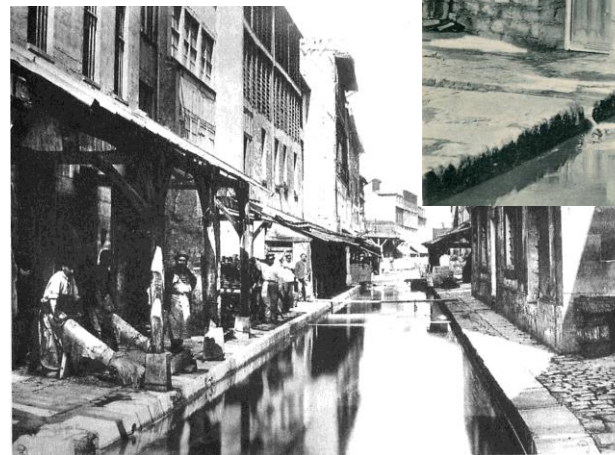
3. The automated regulation system

- Originally and until the beginning of 20th century
  - A tributary of the Seine river
  - 33km long
  - Flowing openly in Paris
  - Draining into the Seine near Austerlitz

Rain  
Gain



Scan of a map of Paris from the guide Paris-Diamant, Alfred Joanne, Collection des guides Joanne, Hachette, Paris, 1867

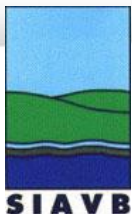


Tannery next to the Bièvre river. End of 19th century, Photo Charles Marville,



Postcard. Scanned by Claude Shoshany. The Bièvre river, Early 20th century

VEOLIA





# Context: the Bièvre river



1. Context
2. Investment plan and challenges
3. The automated regulation system

## Nowadays

- The Bièvre river flows openly from its source situated in St Quentin en Yvelines down to Antony, a 18 km stream
- Downstream of Anthony, it is culverted and drains into the sewers of the SIAAP with a flow limitation (12 m<sup>3</sup>/s)



Image : ©Mbzt

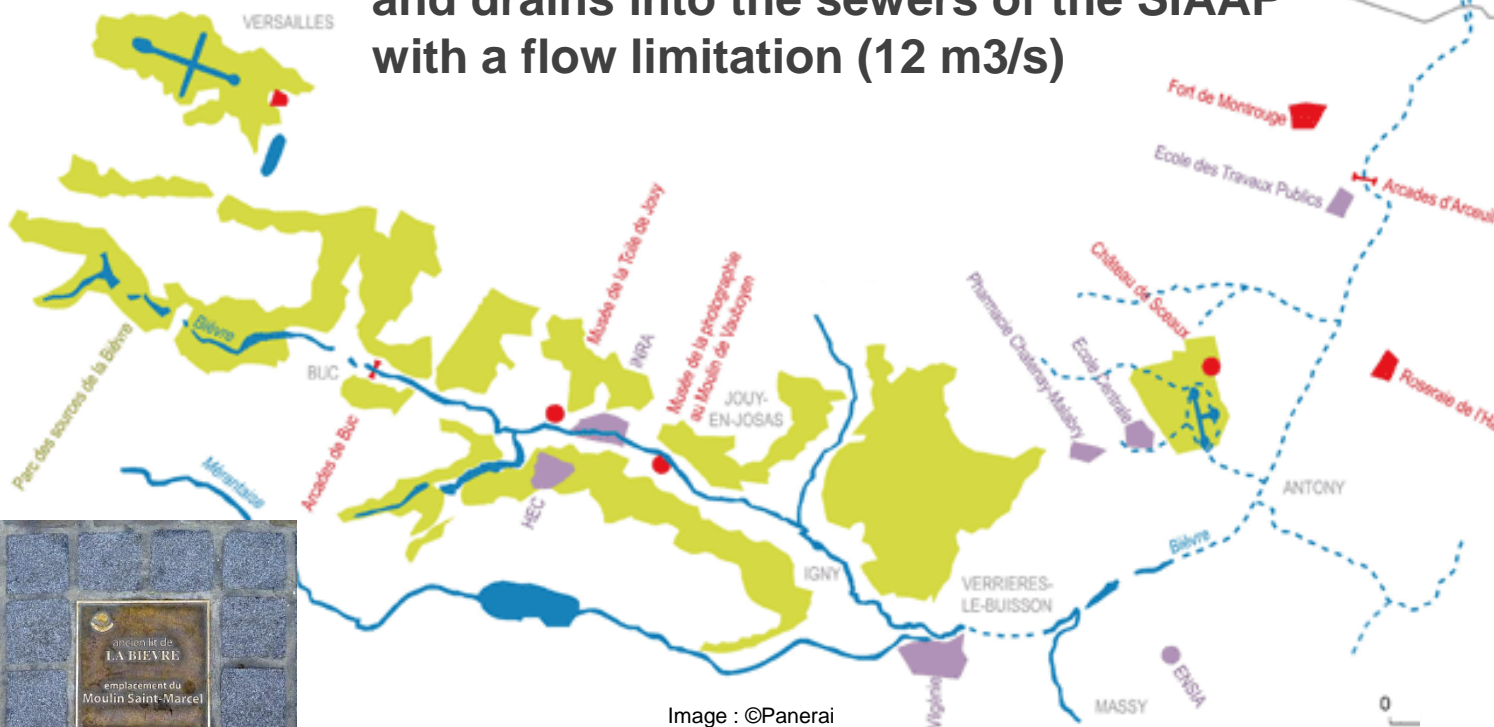
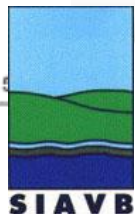


Image : ©Panerai



Image : ©Mbzt



# Context: the Bièvre river upstream

LA  
BIEVRE

VUE GENERALE SYNDICAT

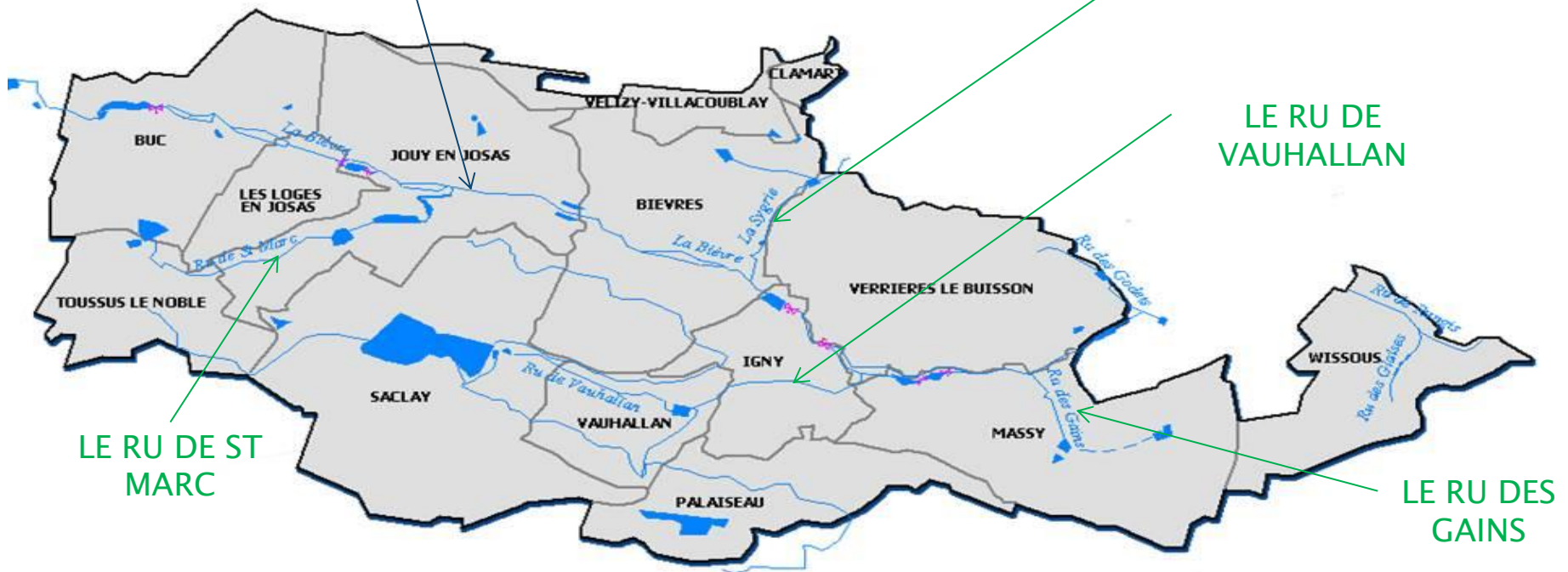


LA SYGRIE

LE RU DE  
VAUHALLAN

LE RU DE ST  
MARC

LE RU DES  
GAINS



- The SIAVB is responsible for the management of the upstream part of the river (18km) and 15km of tributaries
- 110km<sup>2</sup> for 130 000 inhabitants and 10 storage basins (~ 550 000 m<sup>3</sup>)



# Context: the floods of the Bièvre river

1. Context

2. Investment plan and challenges  
3. The automated regulation system



# Context: the 1982 flood



1. Context

2. Investment plan and challenges

3. The automated regulation system

In 1982, the Valley experienced catastrophic flooding

Ignny-Verrière was blocked



Ignny, impasse du Moulin,  
6 hours after the disaster



**Storm in the night of 21 to 22 July 1982,  
110 liters of water per m<sup>2</sup>**



Petit Bièvre car park, 3 hours earlier  
vehicles were completely covered in water



In Massy, roads and houses  
were completely flooded

The rain of 21 and 22  
July 1982 (**110 mm in 3  
hours**)  
generated

10 million m<sup>3</sup> of run-off  
water

for a:  
2 million m<sup>3</sup>  
disposal capacity  
over the period

and 500,000 m<sup>3</sup>  
retention capacity  
i.e.

**7.5 million m<sup>3</sup> of  
water flooded the  
valley.**



- In response to this event, the SIAVB first decided to launch an investment program aimed at preventing risks by implementing:
  - Two additional 64000 m<sup>3</sup> retention basins, i.e. a 30% increase in the volume stored on the Bièvre stream



- Following the construction of two additional retention basins, the valley now has four retention basins with an overall capacity of 274,000 m<sup>3</sup>





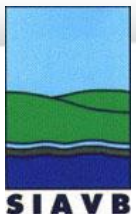
# The storage basins: La Geneste

1. Context

2. Investment plan and challenges

3. The automated regulation system

**La Geneste basin (Buc municipality)**  
**Capacity: 155,000 m<sup>3</sup>**





# The storage basins: Les Bas-Près

1. Context

2. Investment plan and challenges

3. The automated regulation system



**Bas-Près basin (Jouy municipality)**

**Capacity: 27,000 m<sup>3</sup>**





# The storage basins: Les Damoiseaux

1. Context

2. Investment plan and challenges

3. The automated regulation system

**Damoiseaux basin (Igny municipality)**

**Capacity: 37,000 m<sup>3</sup>**





# The storage basins: Vilgénis

1. Context

2. Investment plan and challenges

3. The automated regulation system



Vilgénis basin (Massy municipality)

Capacity: 55,000 m<sup>3</sup>





**However,**  
**despite an increase in the storage**  
**capacity,**  
**the volume generated by a 2-hour**  
**decennial rainfall**  
**over the catchment area exceeds the**  
**existing retention capacity**



**As traditional solutions involving an increase in retention capacity could no longer be implemented (land restriction),**

**The SIAVB looked into a solution that would enable an optimal management of the flows into the river and the storage basins.**

**A decision was made with Veolia to create**

**An automated regulation system for the upstream part of the Bièvre river**

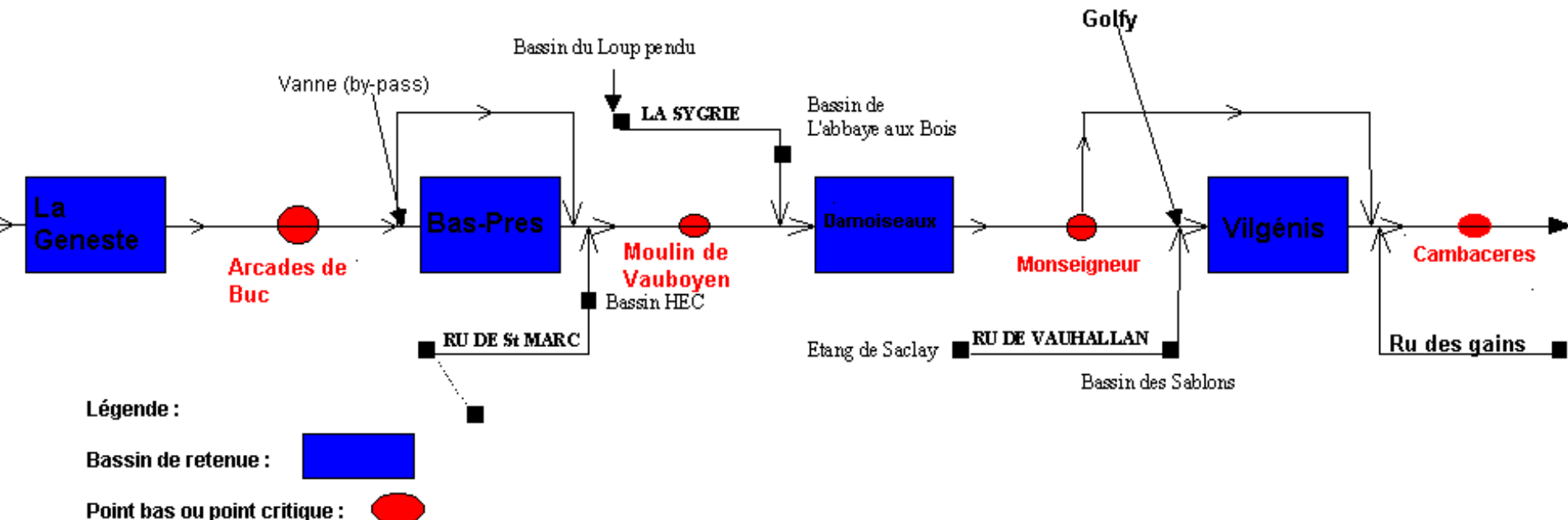




# The automated regulation system: the principles

1. Context  
2. Investment plan and challenges  
3. The automated regulation system

- Use the maximum hydraulic capacity of the reaches at all times:
  - to preserve the available storage capacity of the retention basins
  - while preventing river reaches from overflowing
- Adapt the basins' leakage rate:
  - to the river's downstream capacity
  - to the basins' filling rates



# The automated regulation system: the principles

1. Context  
2. Investment plan and challenges  
**3. The automated regulation system**

- **Two operating modes:**

- **Local regulation**

The leakage rate of each basin is regulated according to the downstream flow rate measured in the associated critical section.

- **Global regulation**

The valley's hydraulic status as a whole is considered to help decide upon regulation actions





# The automated regulation system: the principles

1. Context  
2. Investment plan and challenges  
3. The automated regulation system

- Leakage rate settings are generated using three main criteria:
  - Basin filling ratio (available volumes),
  - Flow rate values in critical sections,
  - Flow rate variations (gradients) in critical sections.
- The regulation of the hydraulic system's flow leads to the updating at each time step of flow rate settings at the basins' outlet



- **Active components contribute to the regulation process:**

- In all the Bièvre retention basins
- In the four critical sections of the river
- +
- A supervision and control room



- **Passive components (information on the conditions in the catchment area):**

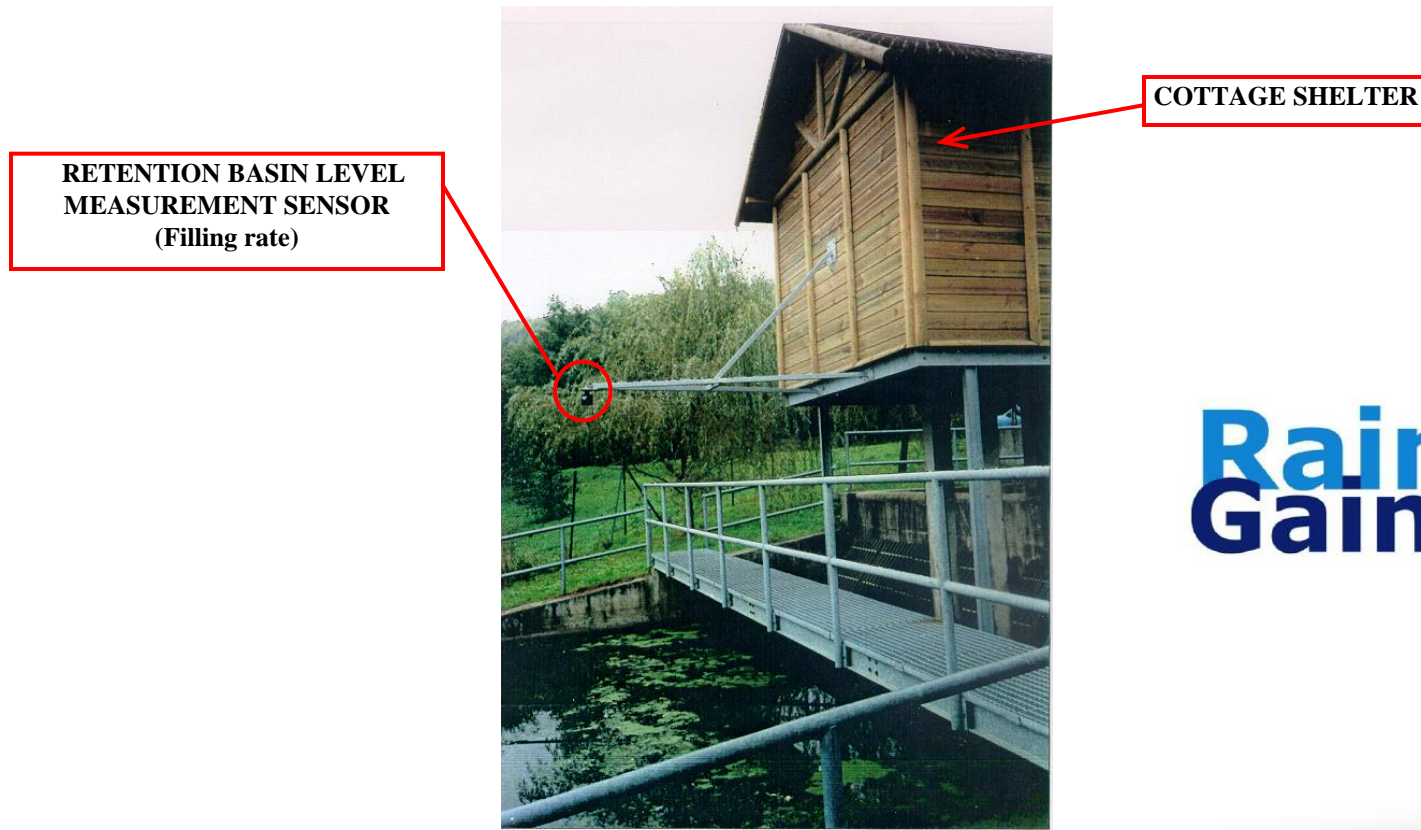
- Rain gauges
- Flow gauging on tributaries
- Level measurement in retention basins located on tributaries
- Short-term weather forecast (radar data)



# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Active component of retention basins:



Bas Près bassin



# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Active component of retention basins:

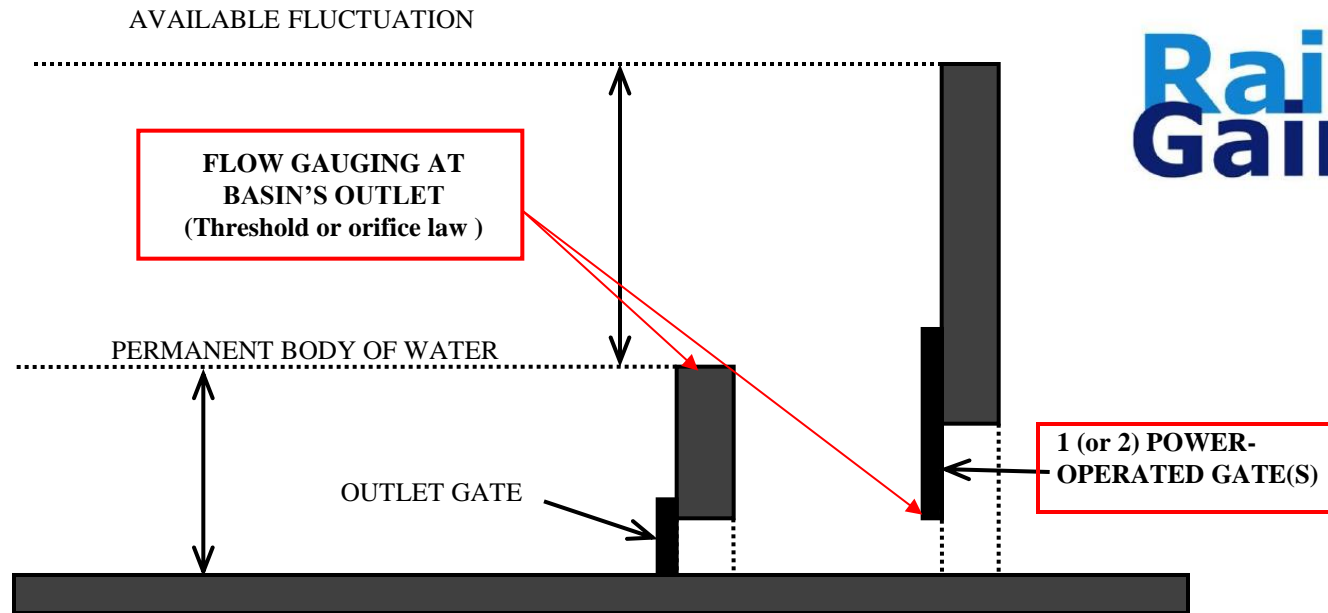


Diagram representing a retention basin regulating structure

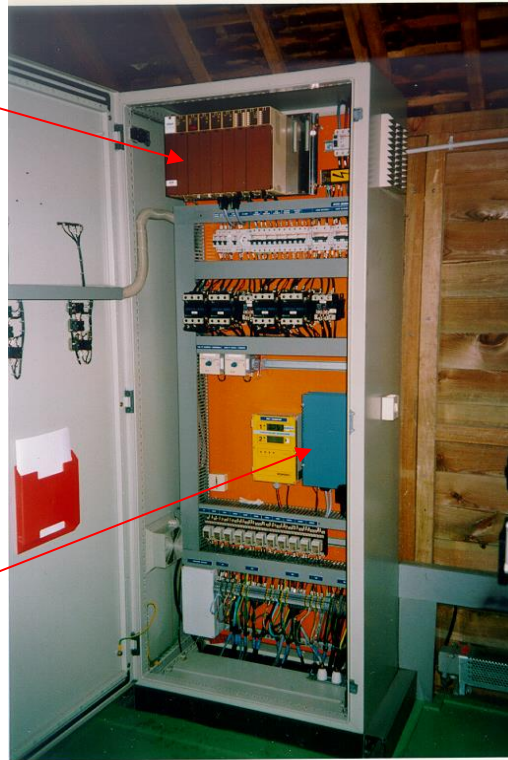
# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Active component of retention basins:

CONTROLLER

TRANSMISSION  
MEDIUM



ENGINE FOR THE VALVES

Cottage shelter equipment

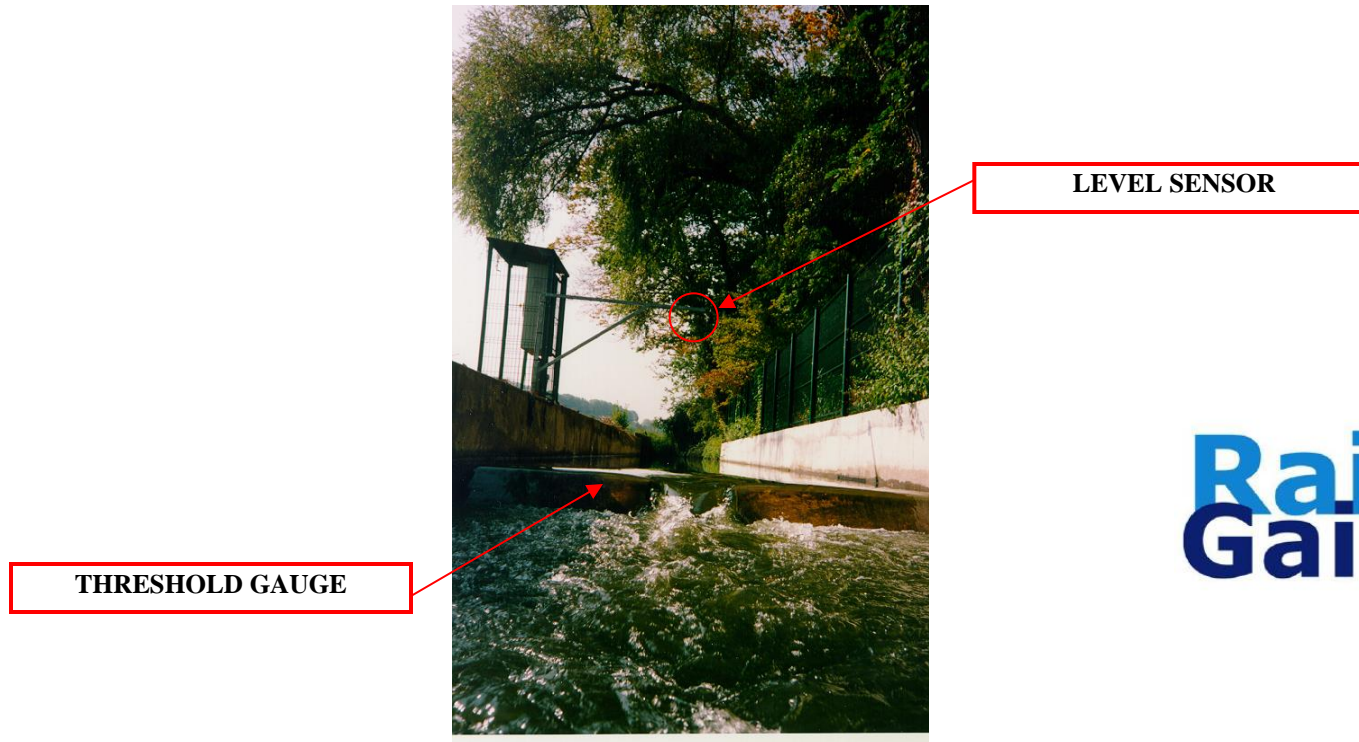




# The regulation system's components

1. Context
2. Investment plan and challenges
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## Active component in the critical sections:



Vauboyen critical section



# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system



## Active components: the control room

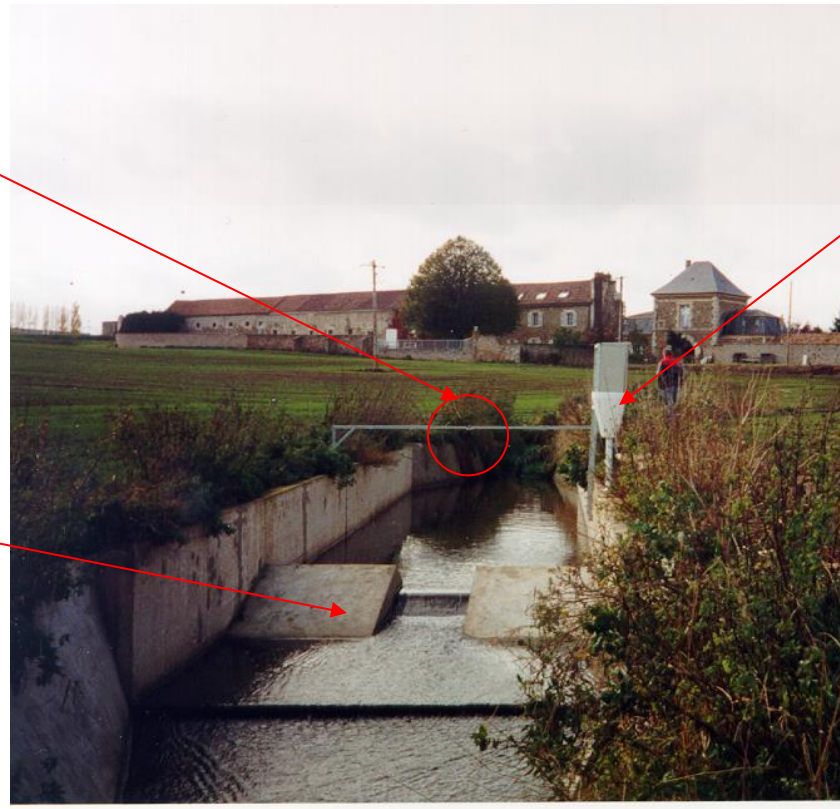




# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Passive components of a Bièvre tributary



LEVEL SENSOR

RAIN GAUGE

THRESHOLD GAUGE



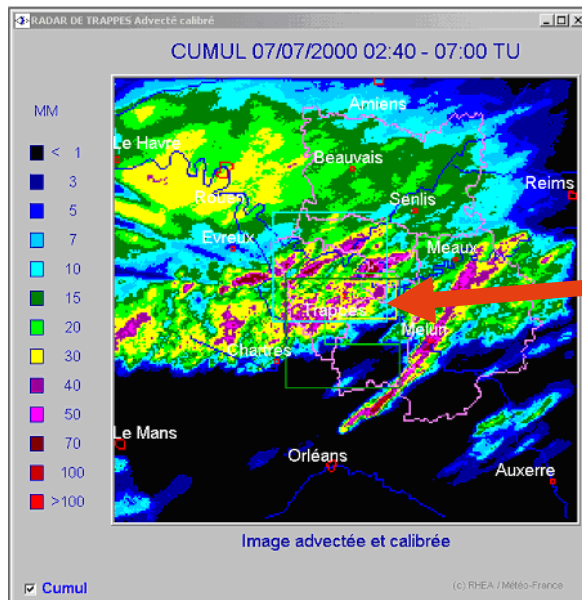
Trou Salé on the St Marc rivulet



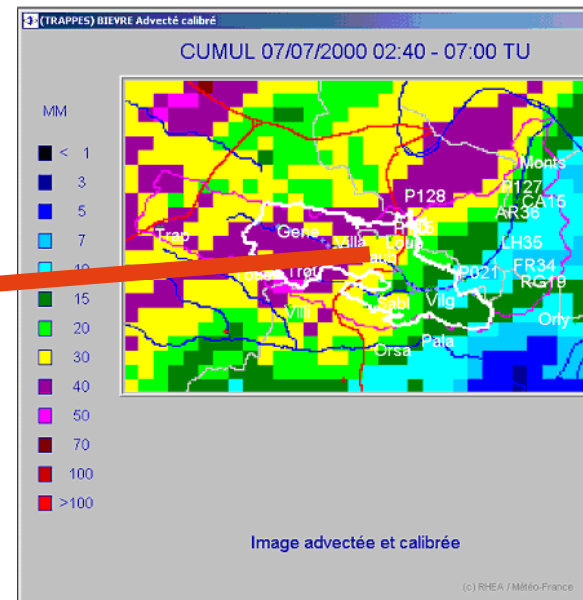
# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Passive components: short-term weather forecast



Cumulative precipitation data for the Paris region centered over the radar of MeteoFrance



Cumulative precipitation data for the upstream Bièvre valley catchment (zoom)

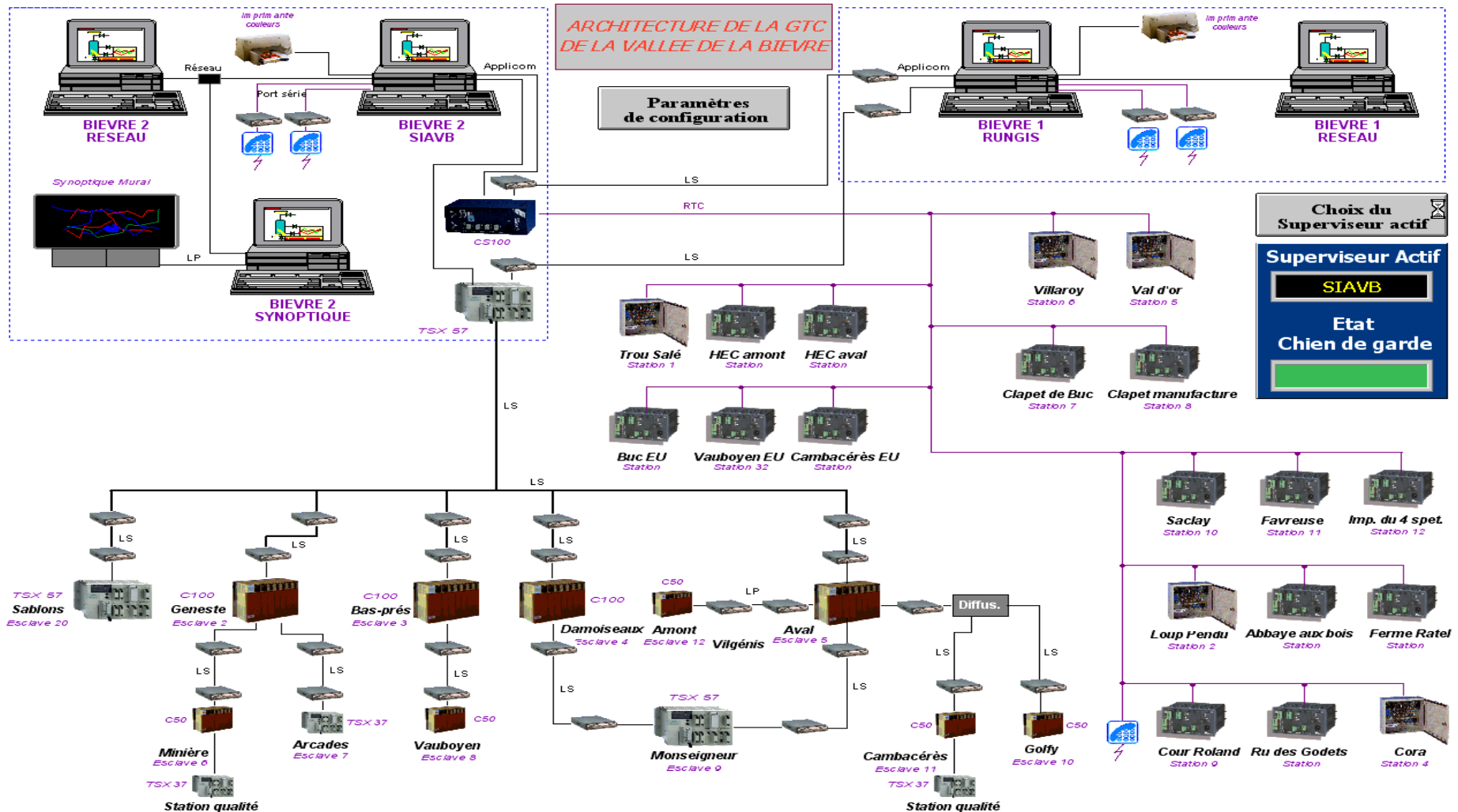


# The regulation system's components

1. Context
2. Investment plan and challenges
3. The automated regulation system

## Architecture of the regulation system: redundancies and fall-back strategies

Vue générale Pluviomètre	Vue générale hydraulique	Vue générale Qualité	Synthèse hydraulique	Vue générale RTC	Vue générale régulation		Alarme	Geneste	Bas Prés	Récamier	Déconnexion
Autres vues	Sauvegarde	CS 100	Minitel	Vue fonct. sites	Param. hydr.		Courbe	Damoiseaux	Monseigneur	Vilgénis	<b>bw</b>
							Architecture	Saclay	Sablons	Autres sites	



# The automated regulation system: the complete solution

1. Context  
2. Investment plan and challenges  
3. The automated regulation system

- An automated regulation system for the management of the Bièvre river and its storage basins
- An operator on-call available 24/24 7j/7 and crisis management procedures for the critical events
- A data acquisition and treatment system (database/archiving) enabling:
  - A real-time evaluation of the hydraulic performance of the Bièvre river and its automated regulation system
  - A post-analysis diagnostic of the regulation system during significant rainfall events
- An evolving system making it possible to incorporate new technologies and new Client's requirements





# Performance of the regulation system

1. Context

2. Investment plan and challenges

3. The automated regulation system



**In practice,**

**these two regulation modes have made it possible to manage without major flooding**

**6 significant rain events since 1995**

**including 2 major ones in 2001**

**On 6 July 2001 the rainfall level was estimated at 55 mm in 2 hours.**



# Performance of the regulation system

1. Context
2. Investment plan and challenges
3. The automated regulation system

Rainfall of 22 January 1995



**DOWNSTREAM SECTION  
DEMOISEAUX BASIN**



**VAUBOYEN CRITICAL SECTION**



# Bièvre valley/RainGain: pilot site

1. Context
2. Investment plan and challenges
3. The automated regulation system

The shared experience between Veolia and the SIAVB, since many years, makes this Valley an ideal site for the management of the river in high resolution



*X band dual-polarized radar (© Selex)*



- A SPECIAL THANKS TO
- **BERNARD WILLINGER (Veolia)**
  - **Mr CARINI and Mr CARDINAL (SIAVB)**

**ANY QUESTIONS?**



*X band dual-polarized radar (© Selex)*