D2.1 Report describing implementation and results of the “Model for NBS suitability” in the form of decision maps.
Part 2

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Lyon case

Explanation of how the decision of NBS implementation was made (France, Lyon)

- To keep in mind

Decision-making process is organized around an analysis of the ecological status of the rivers in the Yzeron watershed. Degradation factors are identified in areas of fair or poor condition. Possible solutions are listed. Improving ecological status can be coupled with actions to prevent flooding and severe low-water conditions. NBS are non-structural solutions, as opposed to grey solutions. Depending on the context, they can act in synergy.
The choice of NBS and its location depends on a number of criteria (type of, cost of building, cost of maintenance, novelty (= maintenance uncertainty and possibly additional cost for decision makers). The NBS can be built with available space as the only constraint, to handle known incoming and outgoing flows. The NBS can also be inserted into an uncontrolled inlet flow (river, wetland). In this case, its design is based on the principles of ecohydrological engineering, which take into account the feedback between the flows and the biota, under naturally variable conditions, and which must be integrated into the design phase.

- The decision consortium

It is made up of managers of water bodies (in the WFD sense), managers of infrastructures that interact with water resources (sanitation, irrigation), financiers linked to regional planning, and regulatory controllers. One of the mandatory missions of the Yzeron river contract is to achieve the objective of good ecological status for the watercourses in the watershed. The river contract makes use of summary studies of physico-chemical and biological indicators carried out by the Agence de l'Eau, the fishing association and by researchers under research contracts. These studies have identified frequent overflows from combined sewer systems during rainy weather as a major source of organic pollution. The increase in the frequency and volume of overflows is linked to urban expansion. Indeed, the connection of new urbanized areas, located on the outskirts of older networks, tends to rapidly saturate the capacity of combined sewer systems. Added to this is the ageing of networks built in the 70s, whose watertightness is no longer guaranteed. As a result, the drainage of groundwater by older networks contributes to reducing flows into the river during low-water periods. And this excess of clear water in combined sewer systems represents a loss of water resources, increases the volume to be treated at the wastewater treatment plant, and can lead to malfunctions at the plant. Any operation on the sewer network requires close collaboration with the sewerage authority. This is made easy by the fact that the sanitation association aims to reduce the operating costs of its network, which means reducing the amount of runoff it sends to the Lyon metropolitan wastewater treatment plant.

- Where the core of problem is located ?

Faced with these facts, the river syndicate must implement solutions. To this end, it has identified the main causes of the poor ecological status of the Yzeron basin's watercourses. These causes are: the scale and frequency of overflows from the combined sewer system, the low dilution capacity of small watercourses, morphological degradation linked to bank rectification and the intensity of discharges. These causes all contribute to reducing the natural capacity for self-purification.

- Where to act?
    - At source, upstream of the sewer system?

The aim is to reduce the amount of runoff reaching the combined sewer system.
For new buildings, the obligation to manage runoff created by waterproofing at plot level is a step in the right direction. At best, this will avoid increasing the frequency and volume of overflows into older combined sewer systems.
The creation of stormwater networks at the level of existing combined sewers is an effective way of reducing overflows, but at the cost of costly and disruptive works (traffic cuts) that not all municipalities can afford. These actions are planned over 10-year cycles and concern only part of the combined networks.

- In the sewage system, before the river?
  - A system for pre-treating overflow water before discharge into the river is possible. The technique is already being tested in an area of the Yzeron basin where there is sufficient space to develop a planted filter (Fig. 2.1)

Figure 2.1. Biofilter to improve combined sewer overflows water quality, before rejection to small water courses[1].

  - In the case of a small municipality, wastewater can be treated using a reed filter. This water can be infiltrated into a wetland, returned to the watercourse or reused for agricultural irrigation. Setting up this type of NBS requires knowledge of runoff zones (Fig. 2.2).

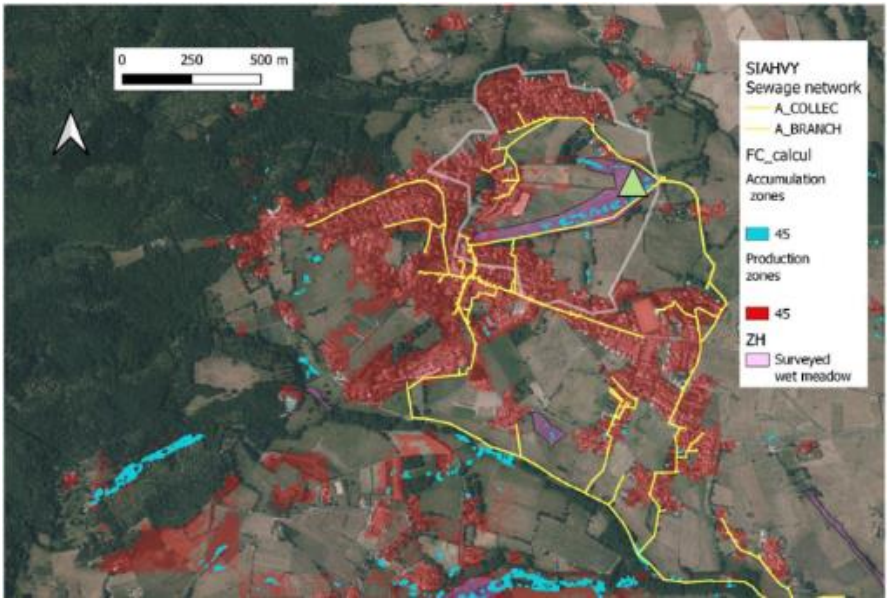

Figure 2.2. Detection of wetlands by the runoff model with accumulation scores of 4&5. Production areas 4&5 are urban but also rural depending on soil type and land use.

- Downstream of the sewer system, in the river?
  - As part of the ATENAS project, we plan to enhance the natural self-purification capacity of the riverbed. The NBS has been placed downstream of the longest stretch of river in poor ecological status (poor = magenta color; location: blue arrow;

[1] https://hal.inrae.fr/hal-02599141/document

CSOs = red dots) (Fig. 2.3). The design of this type of NBS is based on the principles developed in ecohydrological engineering, in particular that of double regulation between the flows of water and substances and the microbial biota, which changes with seasons (Fig.2.4). The cost of construction is 2.5 k€, including earthworks and pebbles to build the porous barrier.

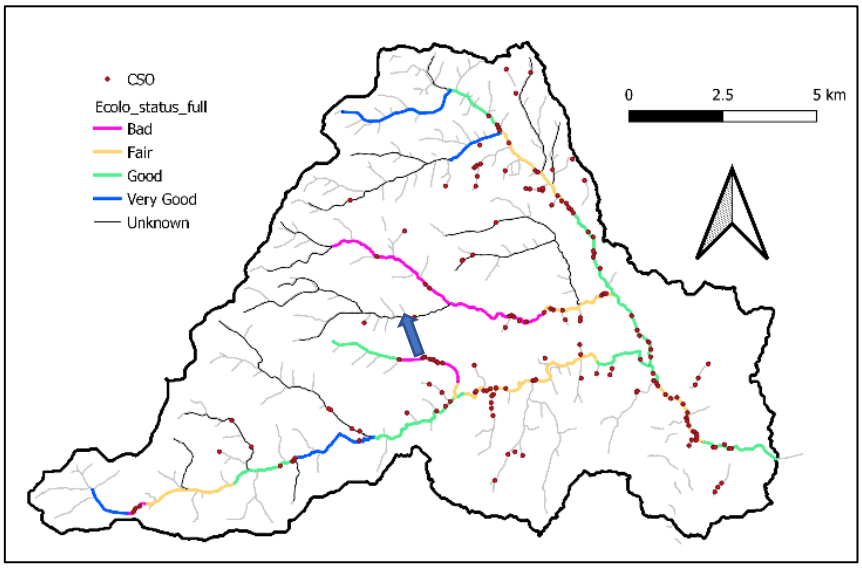

Figure 2.3. Define location of in river NBS location.

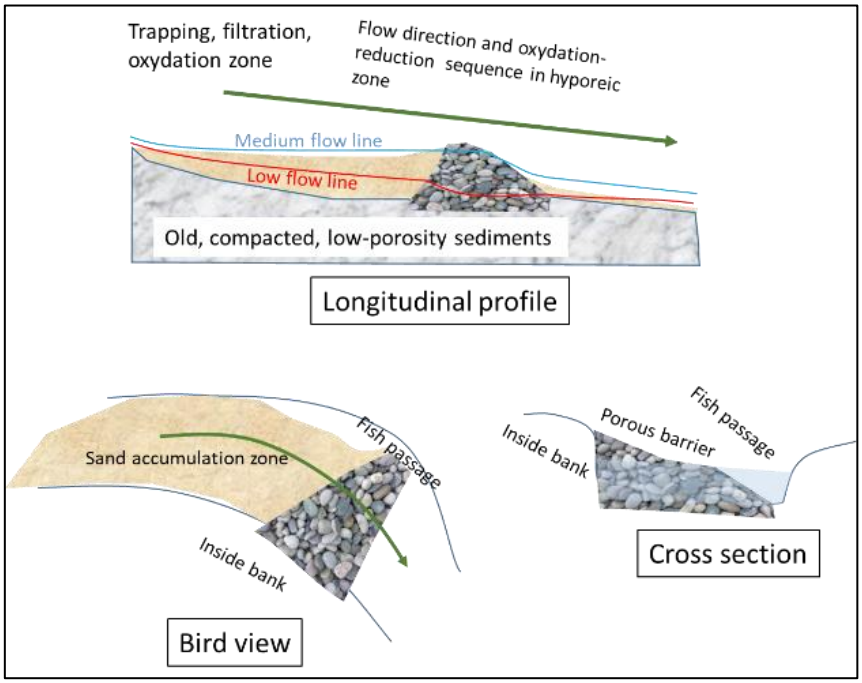

Figure 2.4. Ecohydrological operating principle of a porous ramp.

- Ecological restoration of a watercourse falls into this category. This is illustrated by the case of the Yzeron river in its downstream urban section (Fig. 2.5). The full length of concrete channel was demolished on 1.4km and replaced by a wider flow zone to better manage flooding. The reconnection of the river with groundwater and the creation of morphological diversity have resulted in significant ecological and functional gains. However, this is a very costly project (7.4 M€), 70% of which is co-

financed by the Regional Water Agency. This work is justified by the need to protect economic assets and people from flooding.

Figure 2.5 Before and after restoration of concreted watercourse in an urban area

- Processes to amplify in decision making process

Knowledge of the ecological (biological and chemical) status of the watercourses in a small catchment area (150 km2) is an important starting point for prioritizing actions to manage rural and urban runoff. It is then possible to identify the pressure factors on which to work effectively, taking into account the cost-benefit balance. Ecological gains are among the benefits to be assessed.
Runoff mapping is a tool for positioning NBSs, as we can choose to act on production zones, transfer zones or accumulation zones. These choices are driven by local constraints (public/private domain; cost; available space).

Context of the organizational and decision-making processes of the Yzeron basin (city of Lyon, France) for the adoption of NBS is presented in Fig. 2.6. This include structuring opportunities / stages in new knowledge, shared will, and main findings.

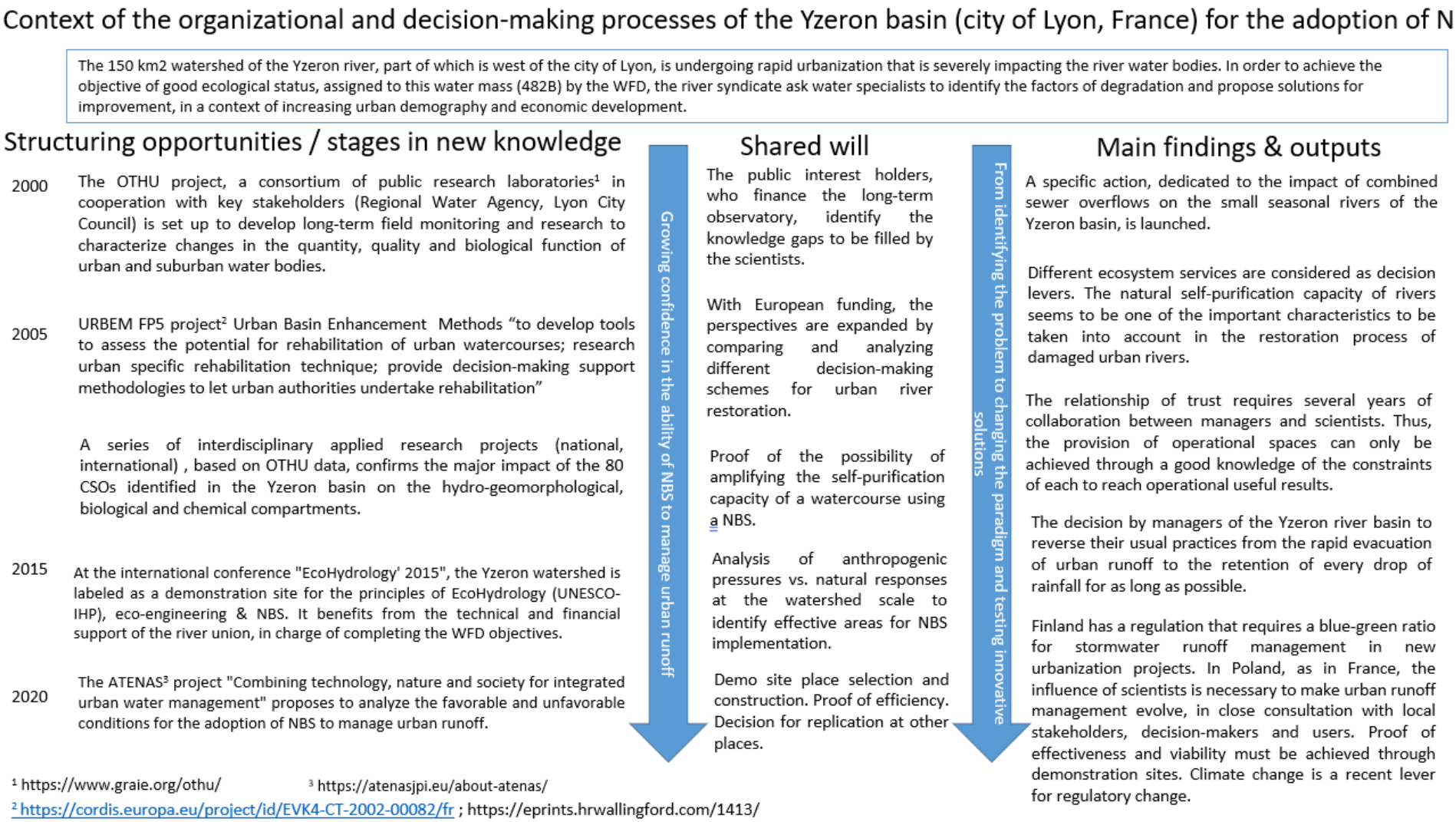

Figure 2.6. Context of the organizational and decision-making processes of the Yzeron basin (city of Lyon, France) for the adoption of NBS.