

# Water Infrastructure Asset Management

## GPIE Research Group



Construction of water distribution networks in France first began towards the late 19th Century, peaking in the 1970s and 1980s. Today, water managers are tasked with finding the best way to secure and operate these networks. This process, commonly referred to as asset management, combines a number of considerations, including water resource management, pipe longevity, and protecting public health. Given the obvious importance of providing drinking water to the population, as well as the long periods of time for which pipes remain in place, asset management strategies need to be constructed on a long-term basis. They must take into account environmental and social changes affecting network infrastructure, as well as advances in technology. Managing water networks calls for skills from a variety of disciplines, including engineering, mathematics, economics, and the social sciences.



The GPIE Research Group (French : Gestion Patrimoniale des Infrastructures liées à l'Eau) develops tools and methods to aid in creating asset management strategies for water networks. The team has three main interests :

- Evaluating and managing performance and risk for drinking water networks
- Optimising long-term asset management strategies
- Developing tools and methods for water managers



### Disciplines

Engineering Sciences Hydraulics Applied Mathematics Statistics Information Technology Economics

### Keywords

Infrastructure Asset Management Water Network Modelling Risk and Performance Safety Leak Reduction Renewal Resilience Sustainability Subscribers Critical Infrastructures Reliability Hydraulics

### Head of Group

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## Evaluating and managing performance and risk for drinking water networks

The goal of asset management is to safely maintain a satisfactory level of service to subscribers, while also taking into account environmental issues. The key considerations when managing a network are ensuring good water quality, keeping service disruptions to a minimum, and limiting any adverse effects on the urban and natural environment.

To ensure water quality, it is essential to have a clear understanding of how networks work. To give water managers a clearer picture of their networks, the GPIE team carries out research into network and network element modelling. These models are used for hydraulic predictions (i.e. flow and pressure), water quality assessments (residence time and substance concentration/mixing), and network security (optimal sensor placement and contaminant source identification).

Most disruptions to service are caused by burst pipes, which, because they are mainly situated underground, are difficult to inspect visually. To help decision makers anticipate pipe renewal requirements, GPIE has developed a number of statistical models. Often combined with multi-criteria techniques, these models allow pipes to be ranked in order of impact on service quality, meaning that replacement work can be concentrated on areas where it is needed most.

In view of the stress on water resources, GPIE also develops methods and indicators to evaluate and build strategies to reduce losses.

### Optimising long-term asset management strategies

Water network asset management is a long-term exercise. Managers need to know how much work will be necessary to maintain a satisfactory level of service in the years to come. Potential future changes to network layout and capacity must also be examined. Alongside this, managers need to take into account social, economic, and financial issues.

In a departure from the common approach to long-term asset management strategies, which is generally based on fixed pipe lifetimes, GPIE is working to introduce the notion of “random service life distribution”, based on survival analysis.

To help decision makers take different malfunction risks and natural disasters into account, and to further

secure and sustain critical infrastructures, our research also focuses on the concepts of vulnerability, resilience, and robustness. The GPIE team also studies subjective risk analysis techniques.

Uncertainty surrounding the evolution of water shortages caused by climate change, debate over how best to define the notion of “service quality”, and the potential effects of network infrastructure on the environment all create a raft of issues for water managers to deal with.

By applying cost benefit analysis techniques, it is possible to take into account all non-market benefits as well as different time scales.

The team’s research also examines how funding can be used most efficiently, as well as comparing the costs and impacts of different approaches to construction, maintenance, and renewal work.

Because of the varying territorial and institutional make-up of the areas where they are installed, water networks can be subject to a wide variety of economic strategies and modes of governance. GPIE works with other teams from IRSTEA (French research body) to study the impact of these varying types of governance and the resulting effects on the way in which asset management strategies are constructed.

### Developing tools and methods for water managers

To ensure that our research is accessible to as many organisations as possible (local authorities, engineering contractors, etc.), we produce specialist guides and software solutions. This is made possible by our own in-house team of object-orientated programming specialists. Our two best-known applications available to the general public are “Porteau” and “Casses”.

Porteau is a tool to model pressurised hot and cold water distribution networks. Using this application, it is possible to calculate hydraulic and temperature-based parameters, as well as analysing the transport and kinetic behaviour of substances. This tool helps water managers to optimise the design, operation, and security of their networks.

<http://porteur.irstea.fr>

Casses is a decision support tool for water pipe renewal. Using Casses, it is possible to rank individual pipes within a network according to risk of future failure.

<http://casses.irstea.fr>

