

# **OPERATIONAL CONSIDERATIONS FOR THE LONG-TERM DESIGN**

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# Design

decision variables: , , , ...



# Operation

decision variables: , , ...

Uncertainty **description**. 

Uncertainty **realisation**. 

Staged design and  
deep uncertainties.

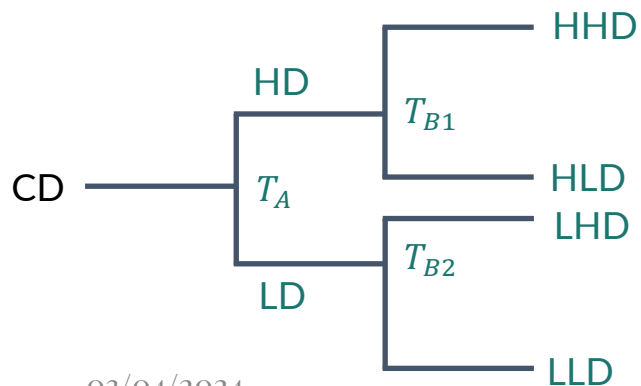
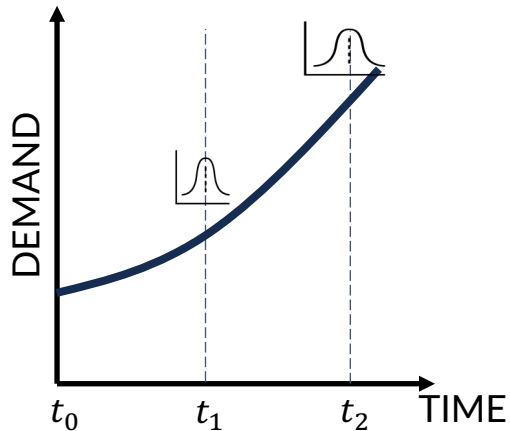
Energy costs reduction and  
water quality improvement.

# Flexible WDS Design

under future demand  
uncertainty

I. Basupi, Z. Kapelan

J. Water Resour. Plann. Manage., 2015, 141(4)



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Flexible  Deterministic 



Cost vs Insurance



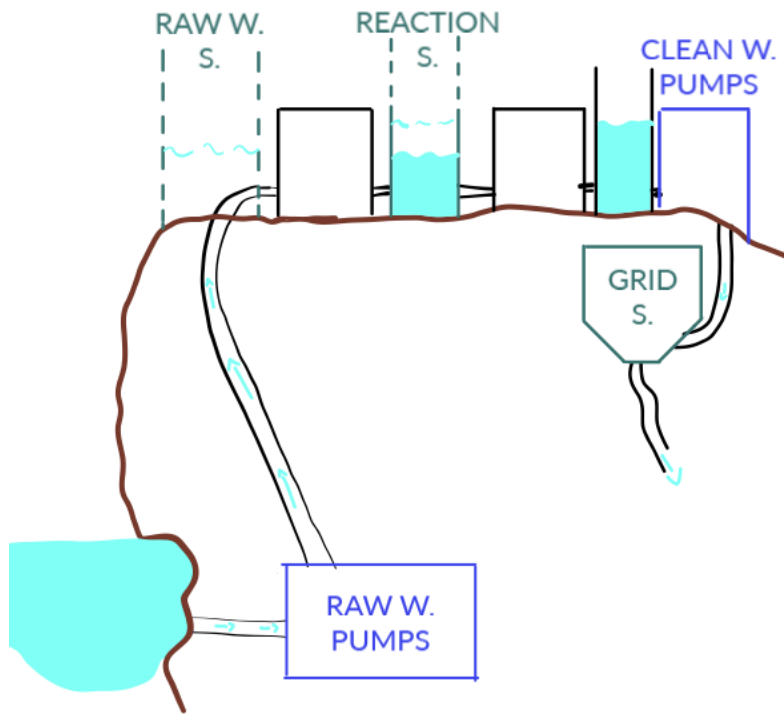
?  Design decision variables.

Should we fix operational decisions at the beginning of the planning horizon or optimise as we go?

# Cost-Optimal Flexibilization

of drinking water pumping  
and treatment plant

B. Zimmermann, H. Gardian, K. Rohrig  
Water, 2018, 10



Flexible   Fixed

 Buffer storage  Opportunity

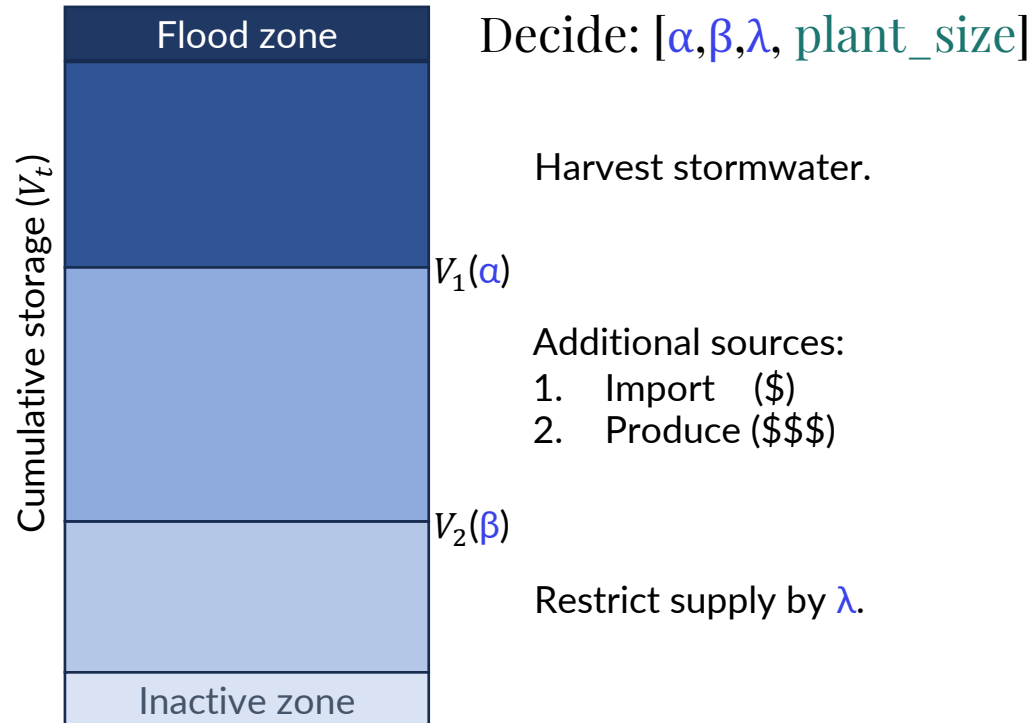
 Effects of the uncertainty.

Should we design the plant for  
operational flexibility too?

# Impact of Operating Rules on Planning

capacity expansion of urban water supply systems

X. Tian, S. Galelli, R. de Neufville  
Urban Water Journal, 2018, 15(7)



03/04/2024

Operations  $\xrightarrow{\alpha, \beta, \lambda}$  Design  $\text{plant\_size}$

With an effect comparable to hydrological uncertainty.

? Simulation-based analysis.

How can we handle this source of uncertainty during optimisation?

## Design

decision variables: , , , ...

## Operation

decision variables: , , ...

Uncertainty description. 

sources: , , , 

Uncertainty realisation. 

## Operational

adjust its operations  
is the ability of a system to implement interventions  
efficiently to cope with a changing environment.  
without the need to modify the design.

# Takeaways

Thank you!



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Design influences operations, and operations are a source of uncertainty that affects design.



Quantifying operational flexibility can help us understand this uncertainty and implement new strategies.