‘SMART CITIES: SYNERGIES BETWEEN SUDS AND RAINFALL HARVESTING SYSTEMS’

A novel solution for future sustainable Cities

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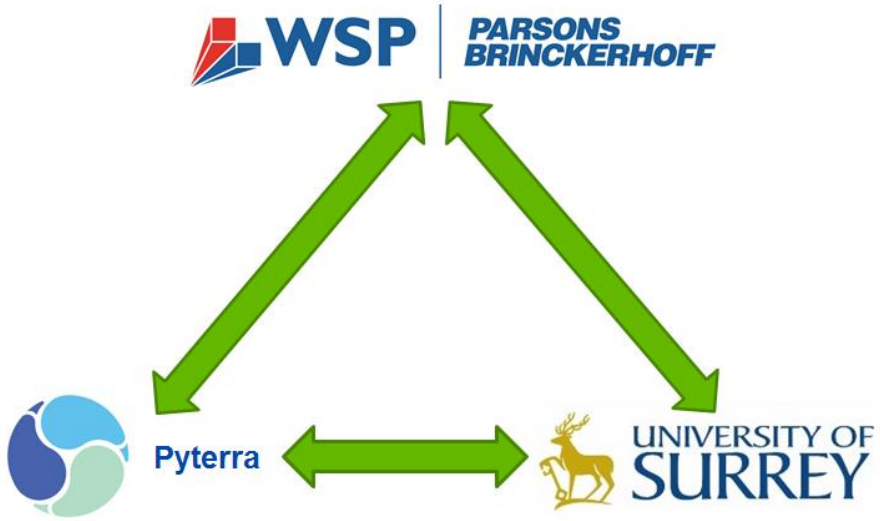
SUMMARY

- **Overview of our KTP project with the University of Surrey**
- **SUDS systems at local and wider scale**
- **Rainfall Harvesting Systems**
- **Combined systems**
- **A new approach for combined systems based on our KTP research**

OVERVIEW OF OUR KTP PROJECT

- **The new technology (Internet of Things, Big Data Smart Monitoring, Earth Observation, Unmanned Aerial Vehicles, etc) is slowly being applied to water engineering projects**
- **Engaged the University of Surrey - KTP**
- **A PHD Associate specialised in Machine Learning Technologies**
- **Working with us developing optimisation engines and applications**
- **Not just for water but for other parts of the business**



SUDS Systems at local scale (key concepts 1)

- **Sustainable drainage systems aim at counteracting the effect of development**
- **Increased impermeable surfaces (roofs and roads) and fast response of runoff from rainfall**
- **This is achieved by keeping runoff as near as possible to the source or in its vicinity**
- **Infiltration is in general the best solution unless constraints do not allow this to occur**

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SUDS Systems at local scale (key concepts 2)

- **Then we look at attenuation storage**
- **where possible we use natural systems such as swales and EMPTY PONDS**
- **New development needs to comply with National Planning Policy to reduce development runoff**
- **When discharging to watercourses large attenuation volumes are in general required**

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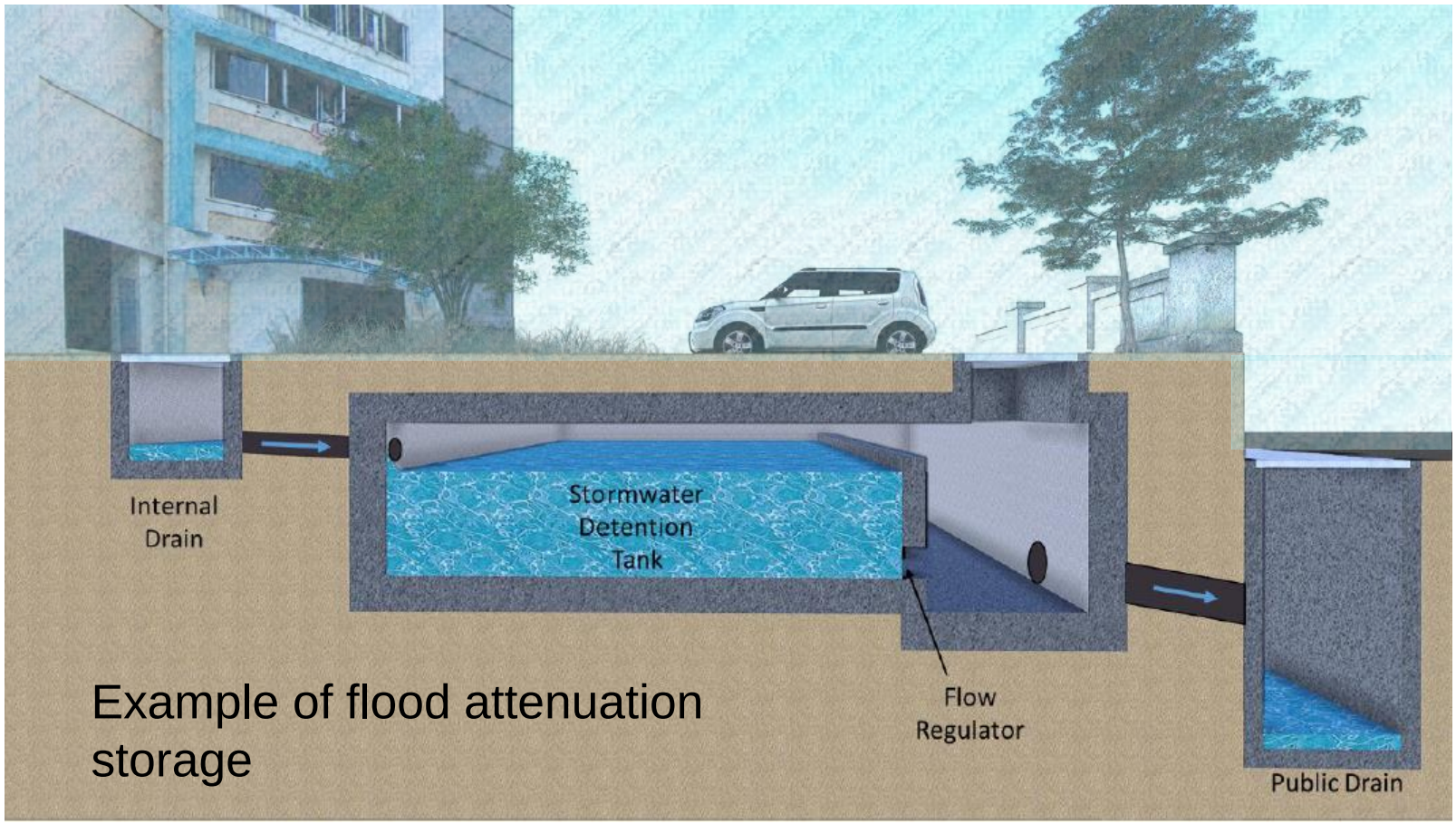
SUDS Systems at local scale (key concepts 3)

→ **Traditionally tanks or ponds are empty most of the time until it rains to receive rainfall up to the design storm (1 in 100 year rainfall taking account of climate change)**



Example of flood attenuation storage

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SUDS systems at a wider scale can alleviate flood risk

https://www.portsmouth.gov.uk/ext/documents-external/cou-policies-flood-swmp.pdf

- ✓ **Portsmouth Surface Water Management Plan**
- ✓ **Using modelling we demonstrated that if roof runoff was diverted to storage for community gardens and lawns it will solve the problem**
- ✓ **10,000 properties needed to be retrofitted**
- ✓ **It worked even for the climate change scenario with 30% increases of rainfall intensities over the next 100 years**

Flooding in Southsea in Portsmouth from combined sewers (October 2000 flood)

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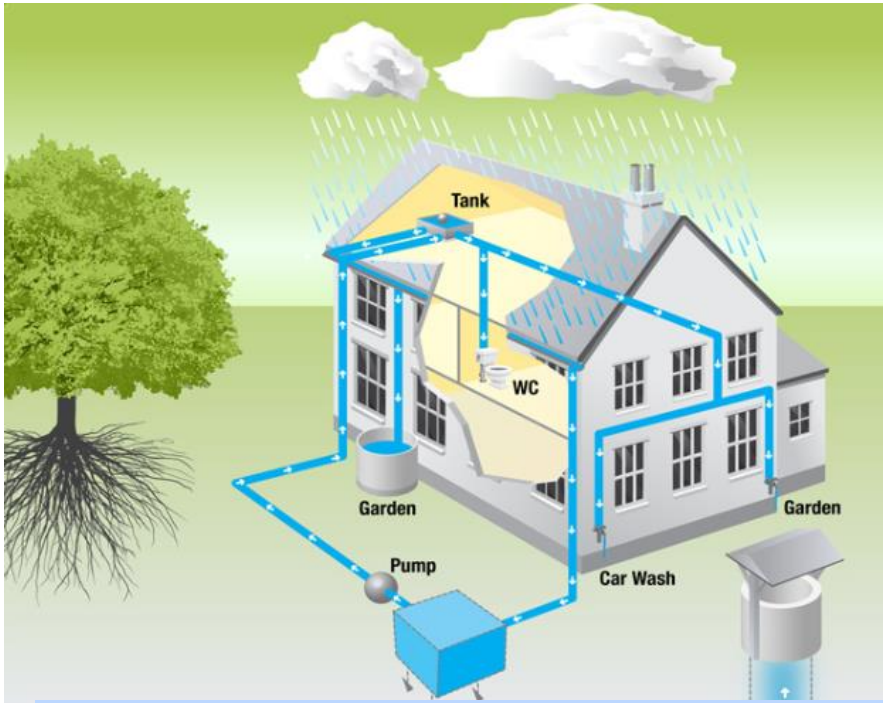
RAINFALL HARVESTING SYSTEMS

- **Rainfall harvesting systems collect roof runoff and store this volume for re-use**
- **For irrigation, car washing, flushing toilets and even for washing machines**
- **Greywater re-use is more complicated as it implies re-using water from showers, kitchen taps, etc (risks)**



Example of Rainwater Harvesting System

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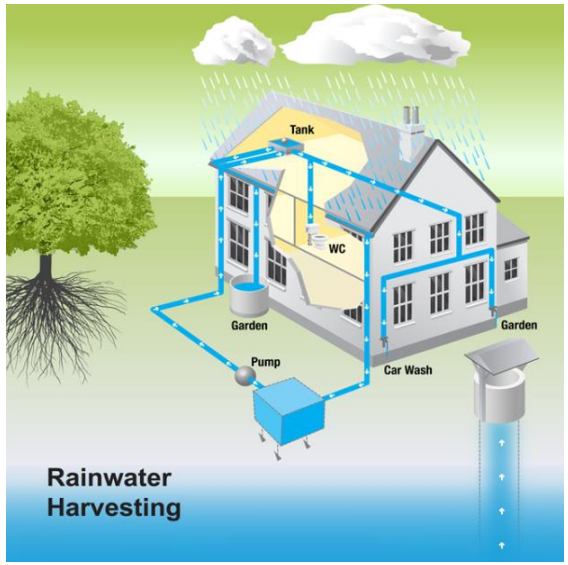
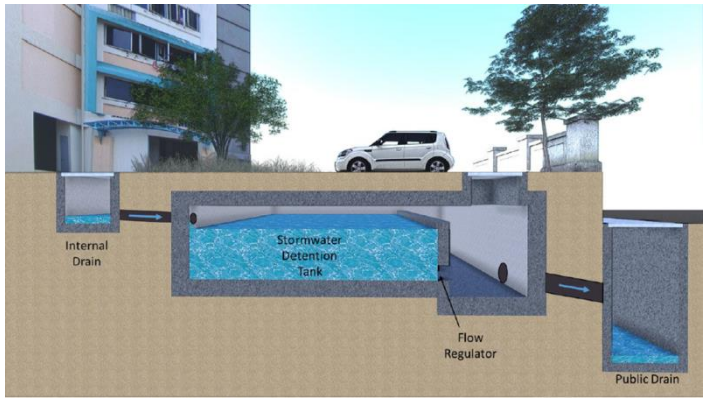
RAINFALL HARVESTING SYSTEMS

- **Traditionally rainfall harvesting systems and SUDS systems are kept separate**
- **This is because SUDS systems are kept in general empty and are designed to work by gravity**
- **Bring certainty and relatively low maintenance**





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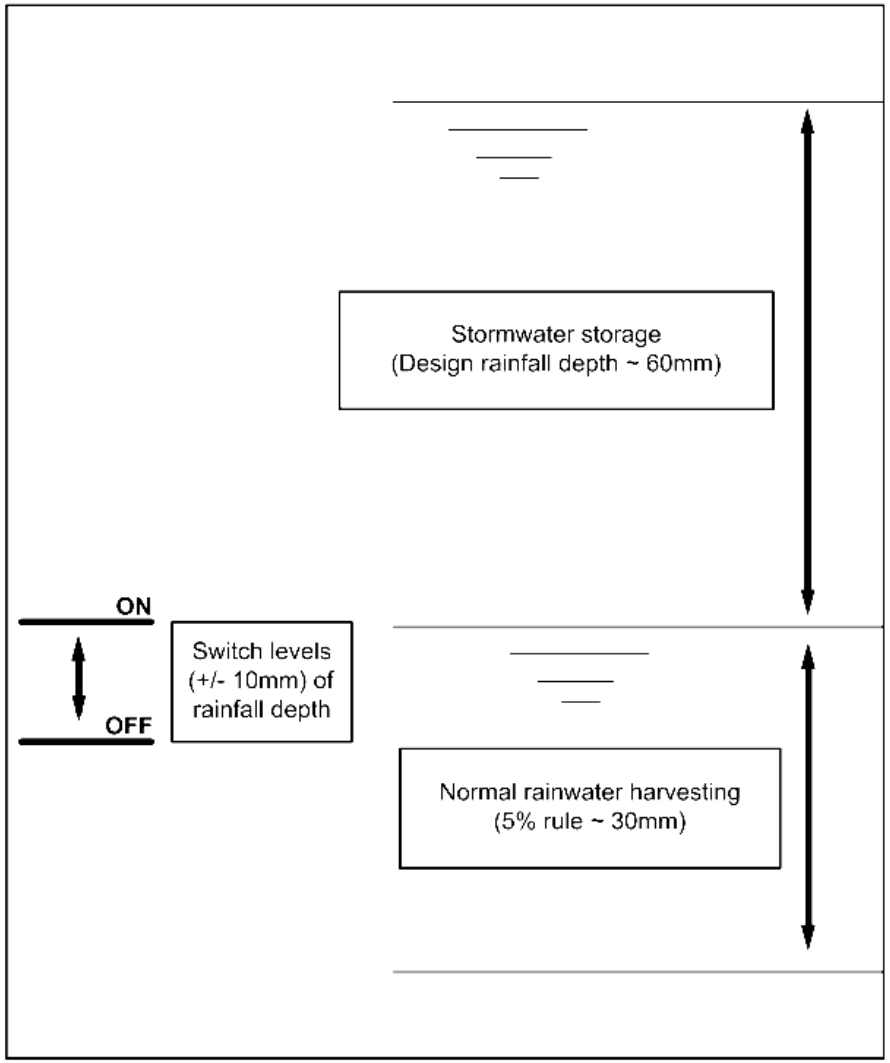
COMBINED SYSTEMS (PUMPED SYSTEM)

- **British Standards however offer the option of a combined system**
- **Even if storage for these two uses is located in the same tank, the space above for flood attenuation is kept empty until a rainfall event occurs**
- **Issues about removing the stormwater volume with caution as the outfall/discharge system could be at capacity**
- **Need to look at the weather forecast and gauging stations**



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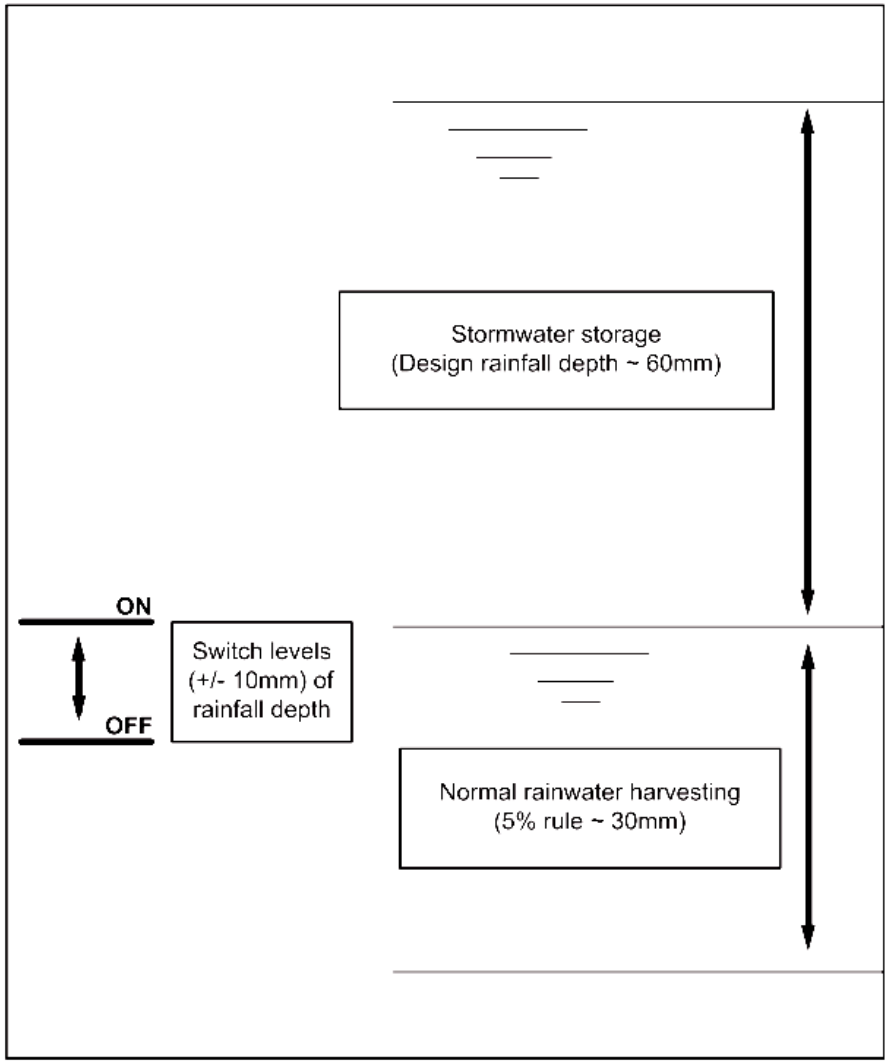
A NEW APPROACH TO ALLOW FOR UNCERTAINTIES IN CLIMATE CHANGE

- **The water optimisation engine that we have developed (KTP) uses the entire tank space for the two uses**
- **This is a Smart City concept where spaces can have multi-functional uses**
- **The system does not work only with tanks but on ponds, which means they can be full of water**



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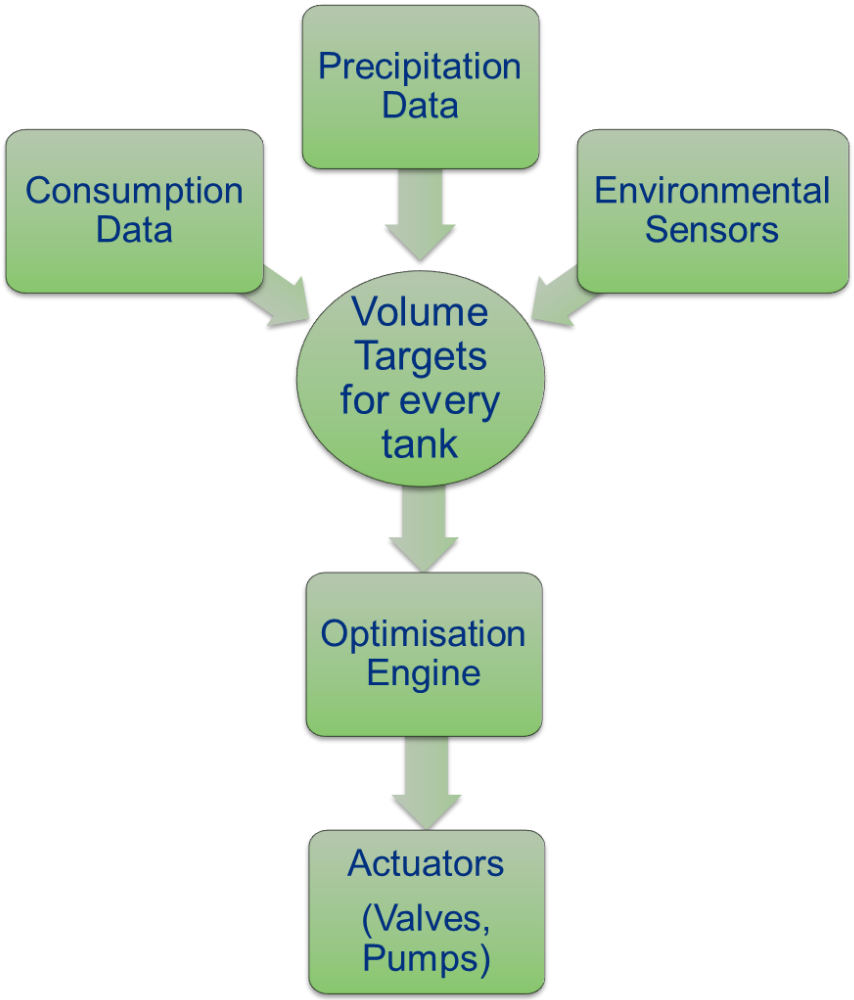
A NEW APPROACH

- **The optimisation system will be able to automatically empty partly or fully the stored water (from previous rainfall events), in time prior to a major storm**

- **or will fill it fully, if a long period of draught is forecast**

- **It will automatically set the optimum storage needed daily at each house/building, depending on real time rainfall, water consumption, weather forecast, river and groundwater level data**



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BENEFITS AT LOCAL SCALE

- ✓ **This system results in two-fold savings, with 60% and 30% storage volume reduced costs for rainwater harvesting and SUDS**
- ✓ **Rainwater harvesting becomes a more attractive proposition (not only is terms of water footprint but capital costs)**
- ✓ **Environmental benefit of having wet ponds**
- ✓ **It is future proof as long periods of droughts and storms are anticipated to continue to occur around he world**

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BENEFITS AT WIDER SCALE

https://www.portsmouth.gov.uk/ext/documents-external/cou-policies-flood-swmp.pdf

- ✓ **At a wider scale water can be held in within green infrastructure**
- ✓ **Which can be partly or fully emptied in time prior to a large storm occurring**
- ✓ **It brings a synergy between maximising the use of water most of the time and using for flood attenuation on rare occasions**

Flooding in Southsea in Portsmouth from combined sewers!

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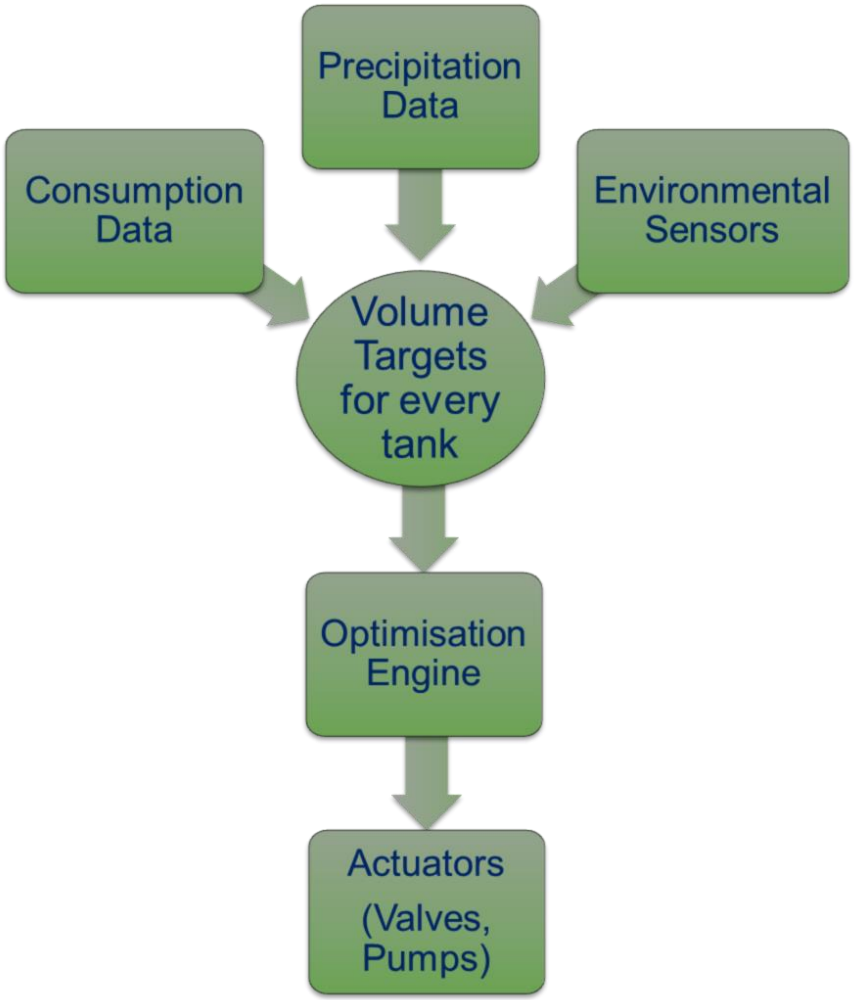
Conclusions

- **An optimisation system that has full control of the storage of water in a system, brings the benefit of using the same space for more than one use**
- **By being able to use the space more efficiently, it can be designed to allow for climate change uncertainty**
- **Key issue is to have a certain degree of certainty of the storm arriving, as early as possible**



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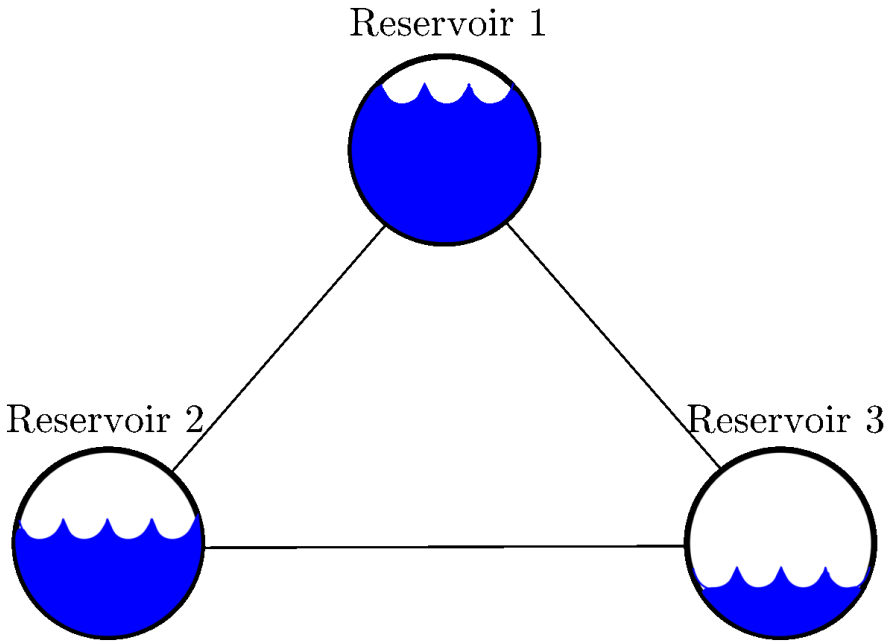
WHAT IS THE WATER OPTIMISATION ENGINE

- **We have developed a novel software tool that provides a robust and adaptive solution to water management projects.**
- **The core of the tool is an optimisation algorithm that estimates the transferred volumes of water in order to reach the target volumes on each node.**
- **The main advantage is that it works automatically and adaptively, constantly tracking the best solution on the system.**
- **The optimisation has been tested already for different scenarios and use-cases and it has achieved excellent performance.**



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