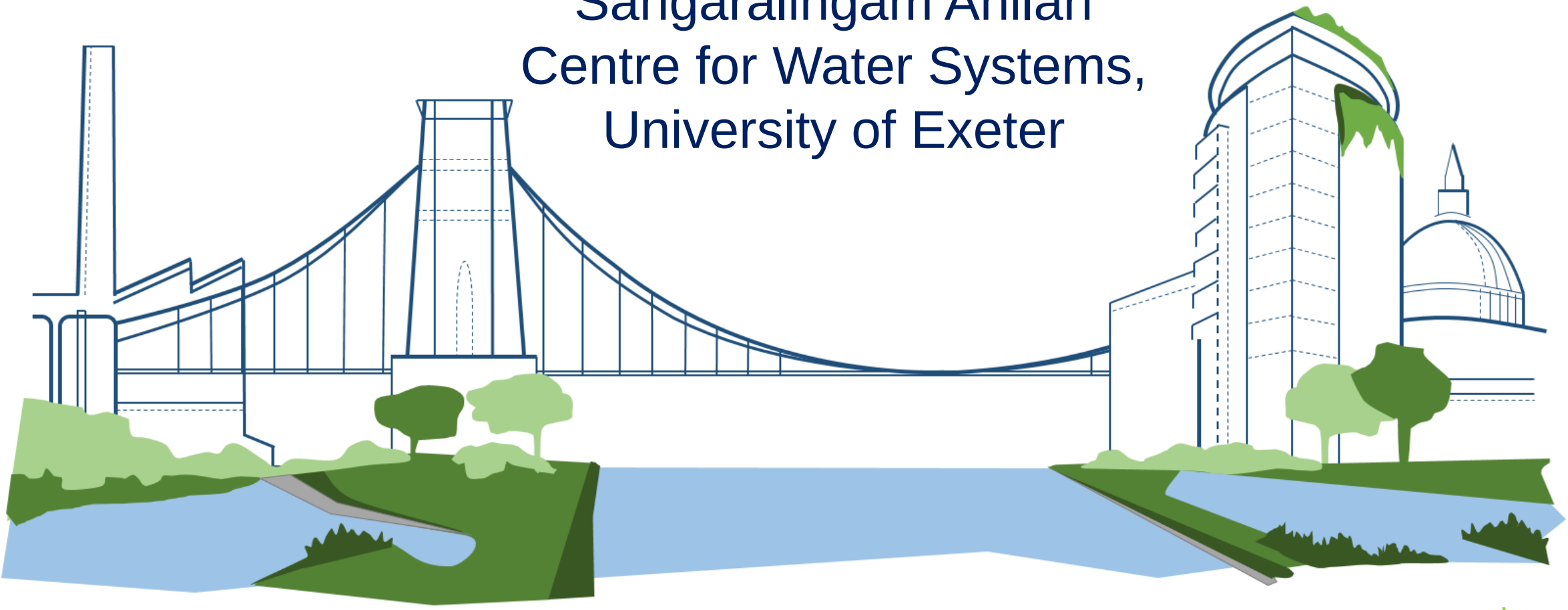
Managing Water at the Building Level

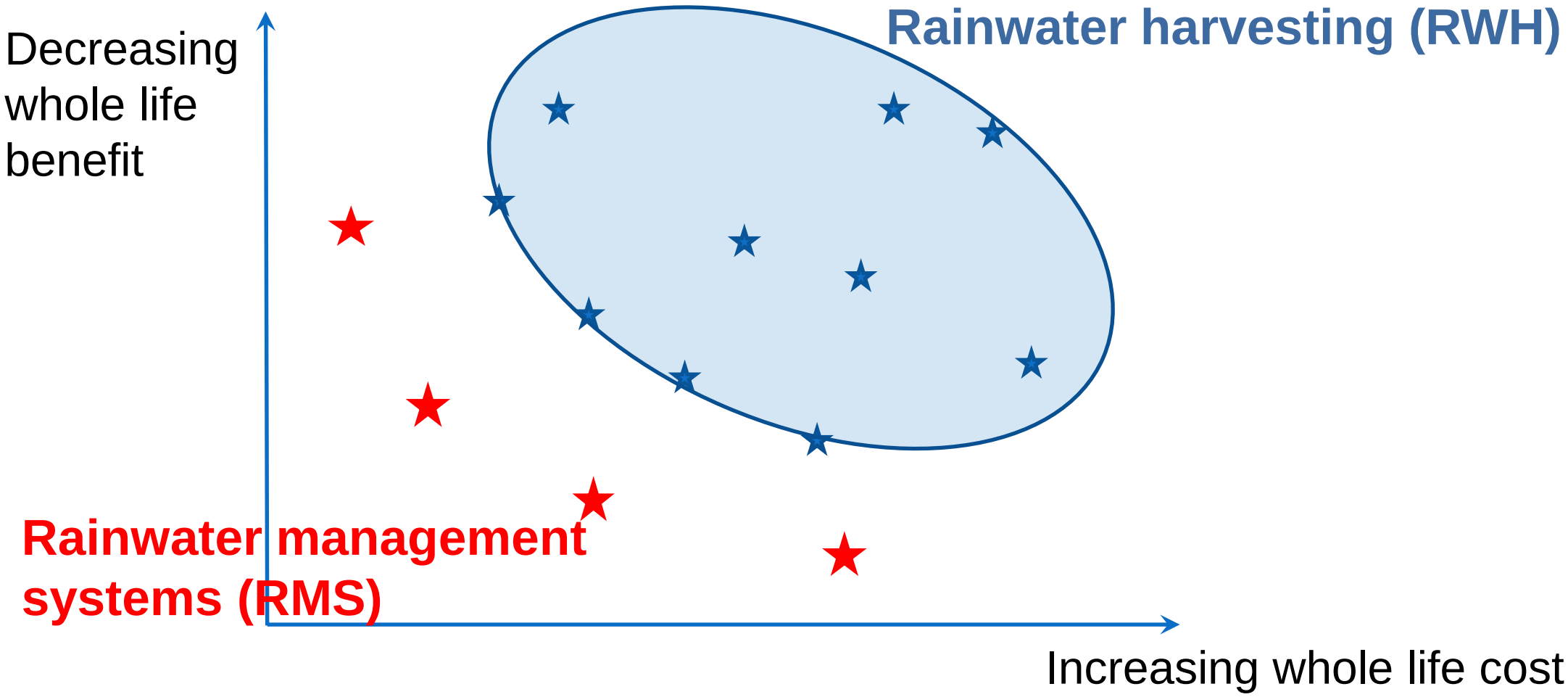
Sangaralingam Ahilan
Centre for Water Systems,
University of Exeter



Outline

- Rainwater Management Systems (RMS)
- Performance of the RMS
- Impact of RMS on urban water system

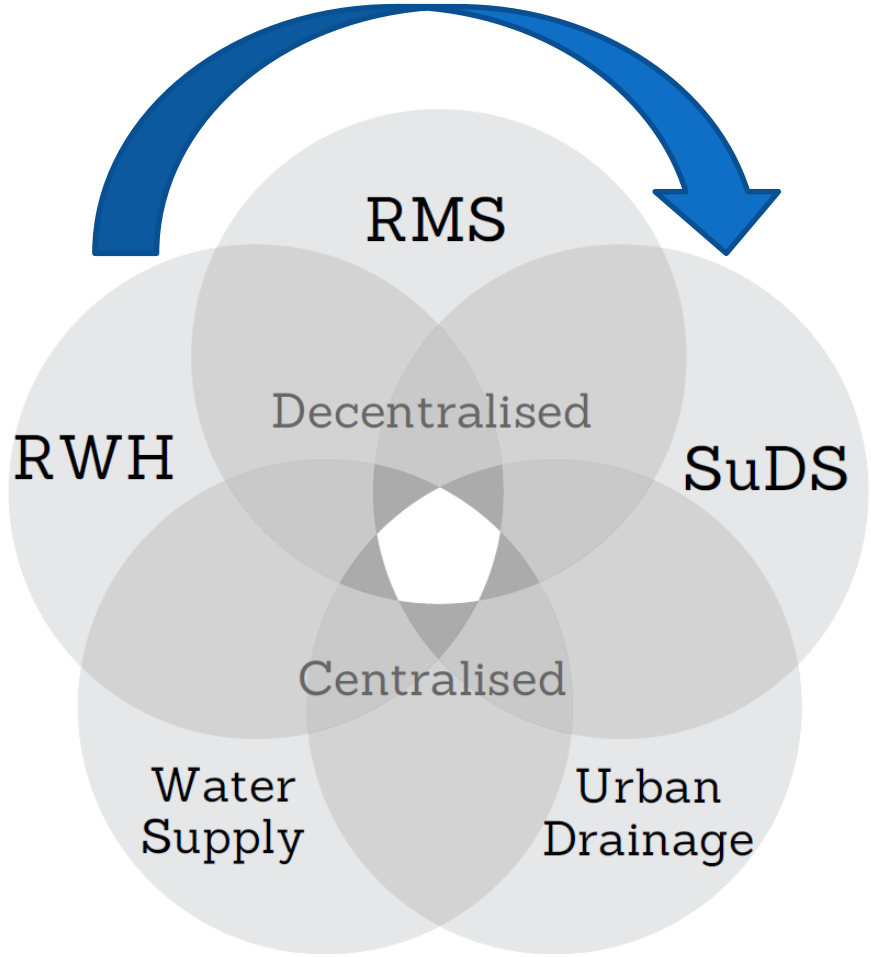
RWH to RMS?



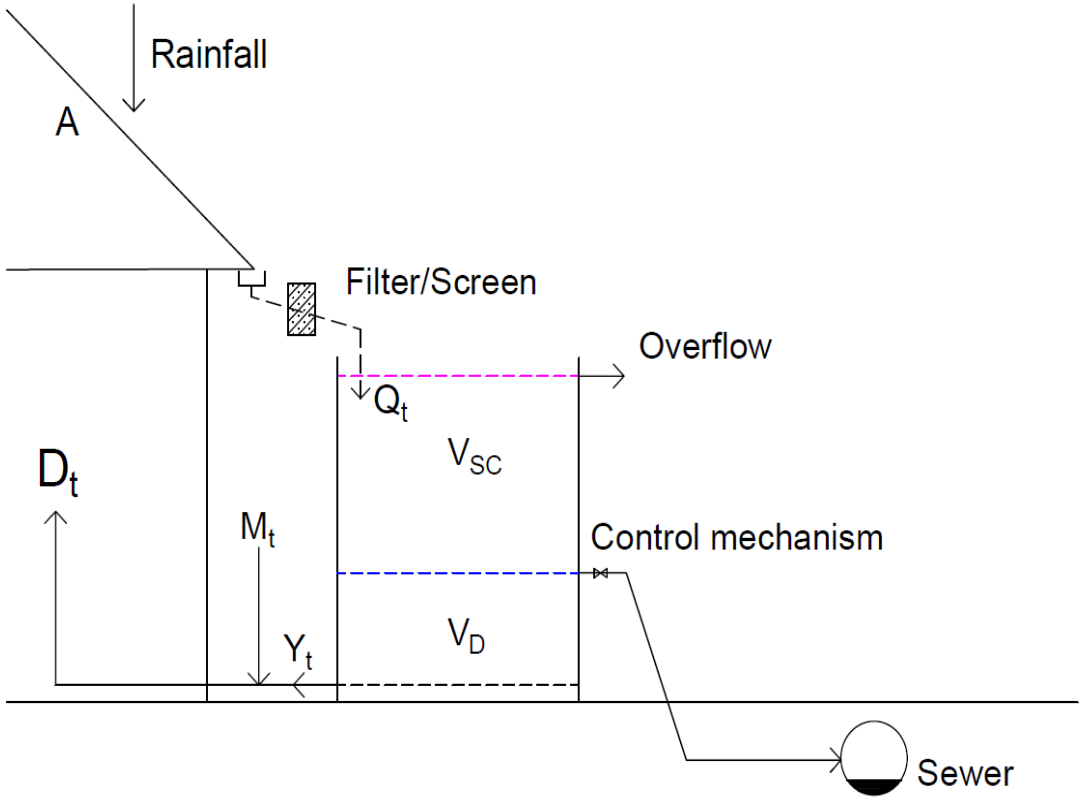
Melville-Shreeve, P., Ward, S., and Butler, D. 2017. Dual-purpose rainwater harvesting system design. In S.,Charlesworth and C., Booth. Sustainable Surface Water Management: A Handbook for SUDS.

Rainwater Management Systems (RMS)

- **RWH** – single function, single benefit.
- **RMS** – multi-function and/or multi-benefit:
  - Reduced water demand
  - Reduced energy (embodied and operational)
  - Reduced stormwater discharges
  - Increased resilience and sustainability



Model set-up



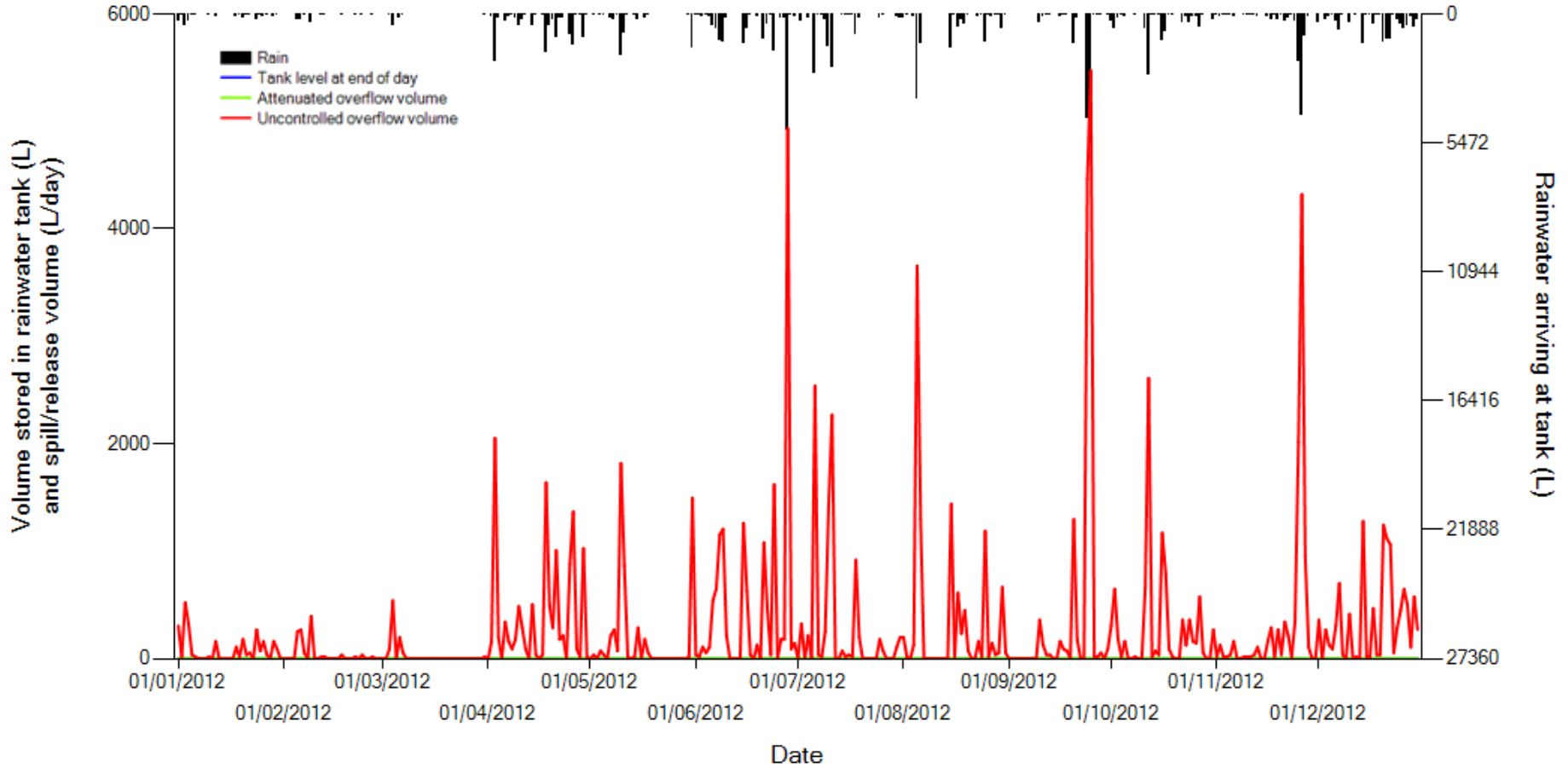
Three cases considered:

1. **Standard [1]:** water supply plus indirect stormwater management – single 'oversized' tank ($V= V_D+V_{SC}$)
2. **Passive [2]:** Water supply plus direct, passive stormwater management – two tanks (or tank compartments), 50/50 split ($V_D=V_{SC}$).
3. **Active [3]:** Water supply plus direct, active stormwater management – one tank designed to be operated actively (V).

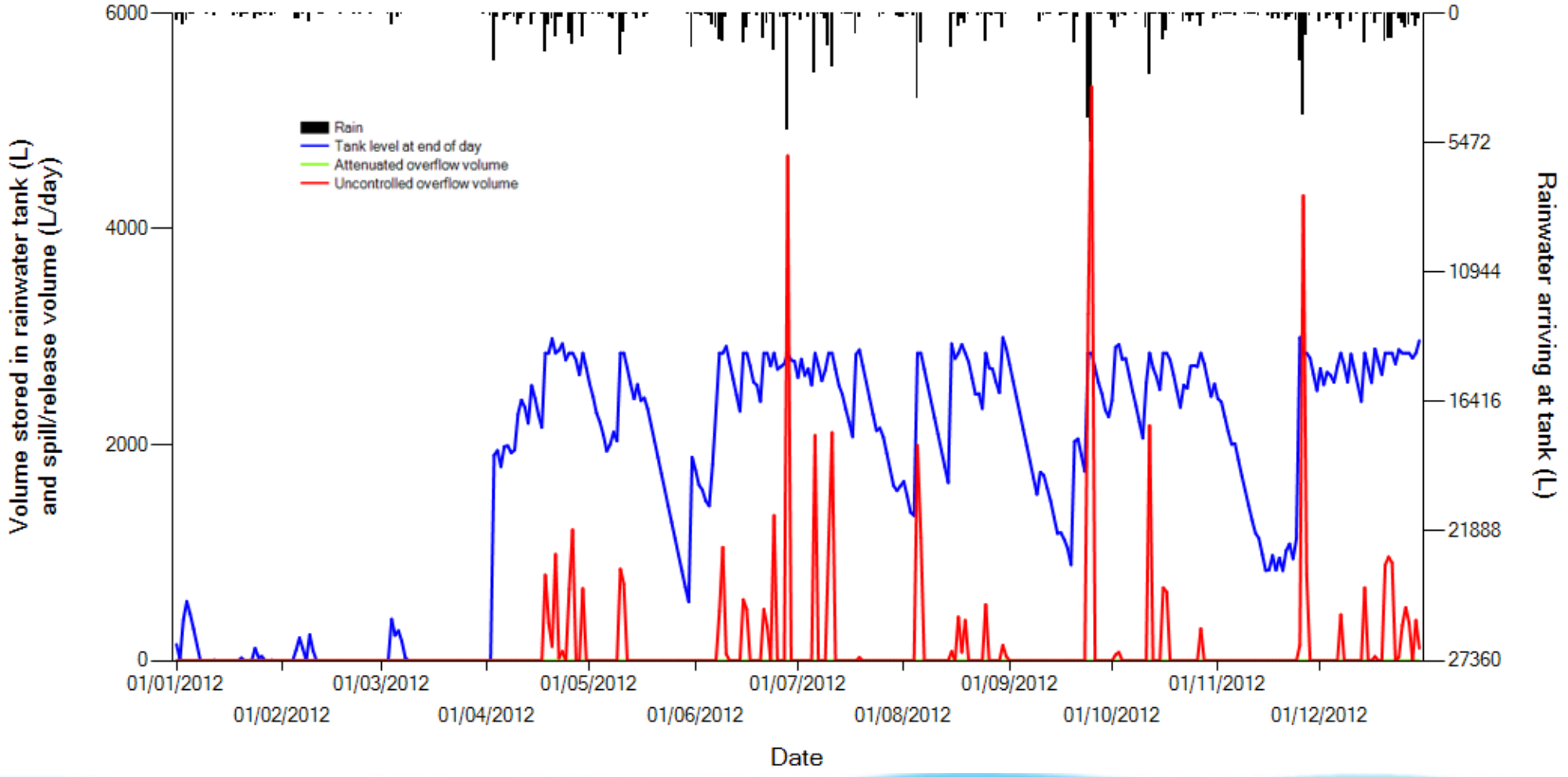
Rainwet model: daily supply-demand balance of rainfall, water demand and overflow discharges based on "yield after spillage" (Fewkes and Butler, 2000).

Fewkes, A & Butler, D., 2000. Simulating the performance of rainwater collection and reuse systems using behavioural models, Building Services Engineering Research & Technology, 21, 2, 99-106.

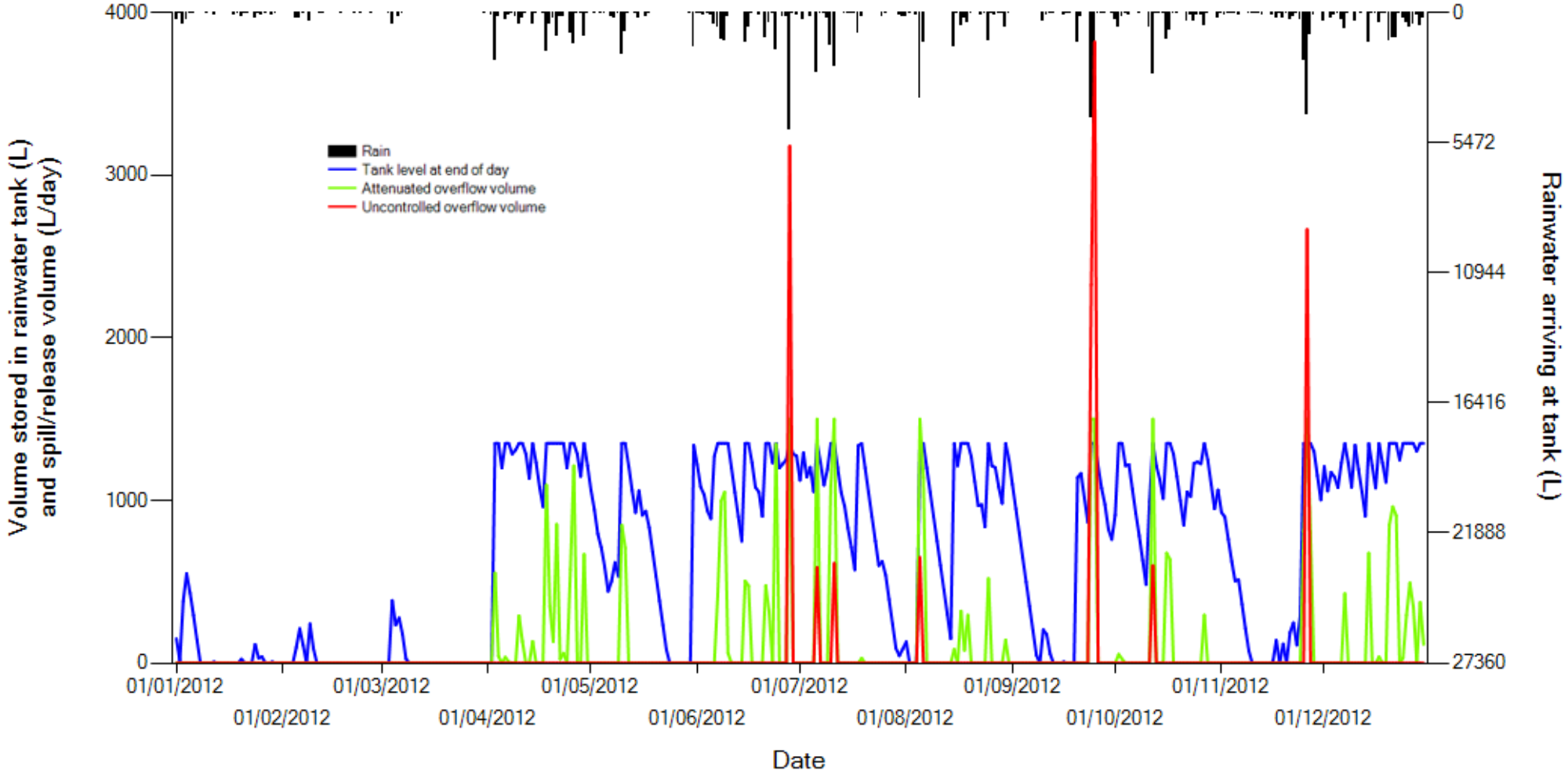
No water demand met, 100% discharge to sewer



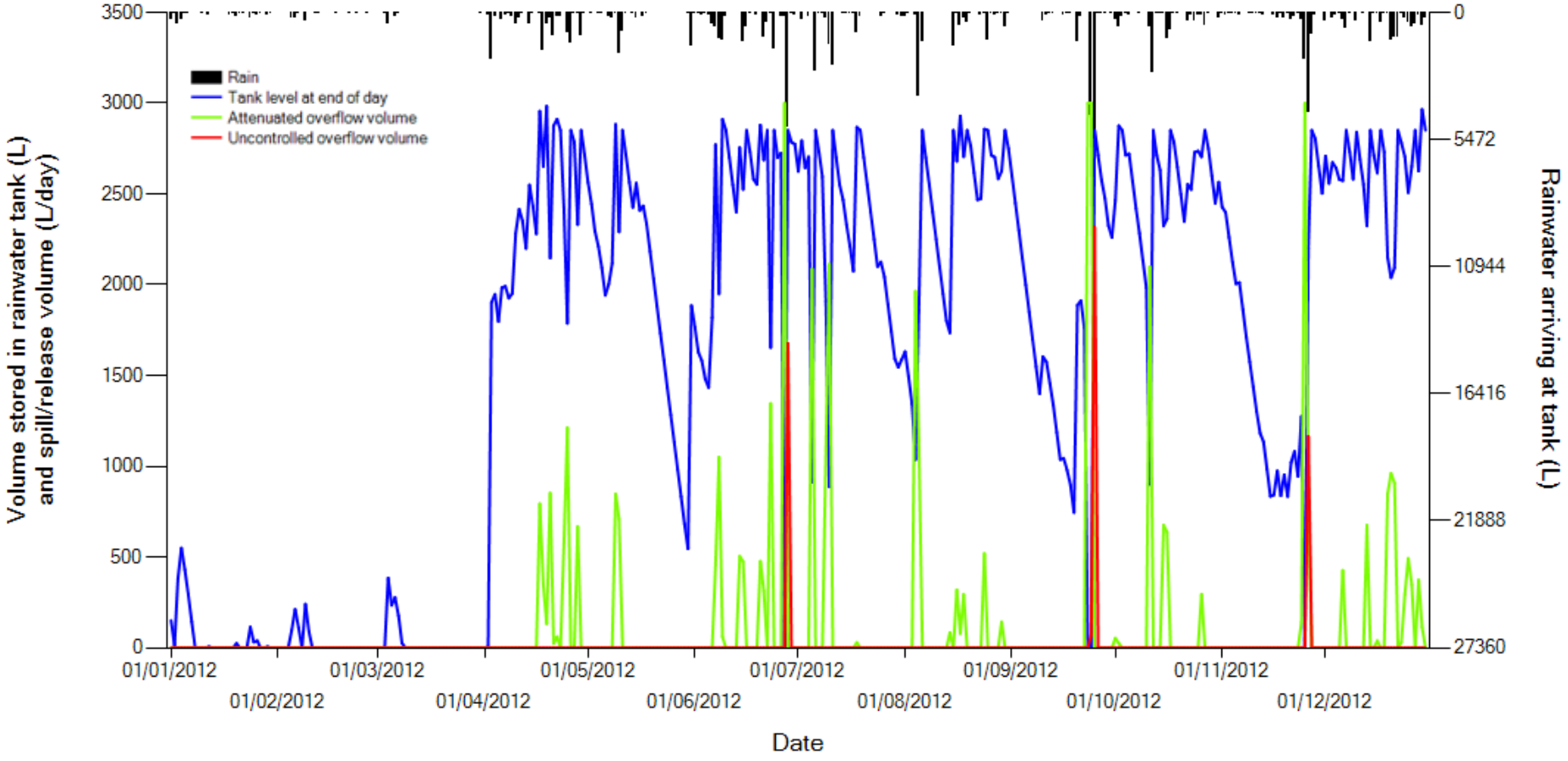
Water supply plus indirect stormwater management: Type 1



Water supply plus direct, passive stormwater management: Type 2



Water supply plus direct, active stormwater management: Type 3



No red = no spills

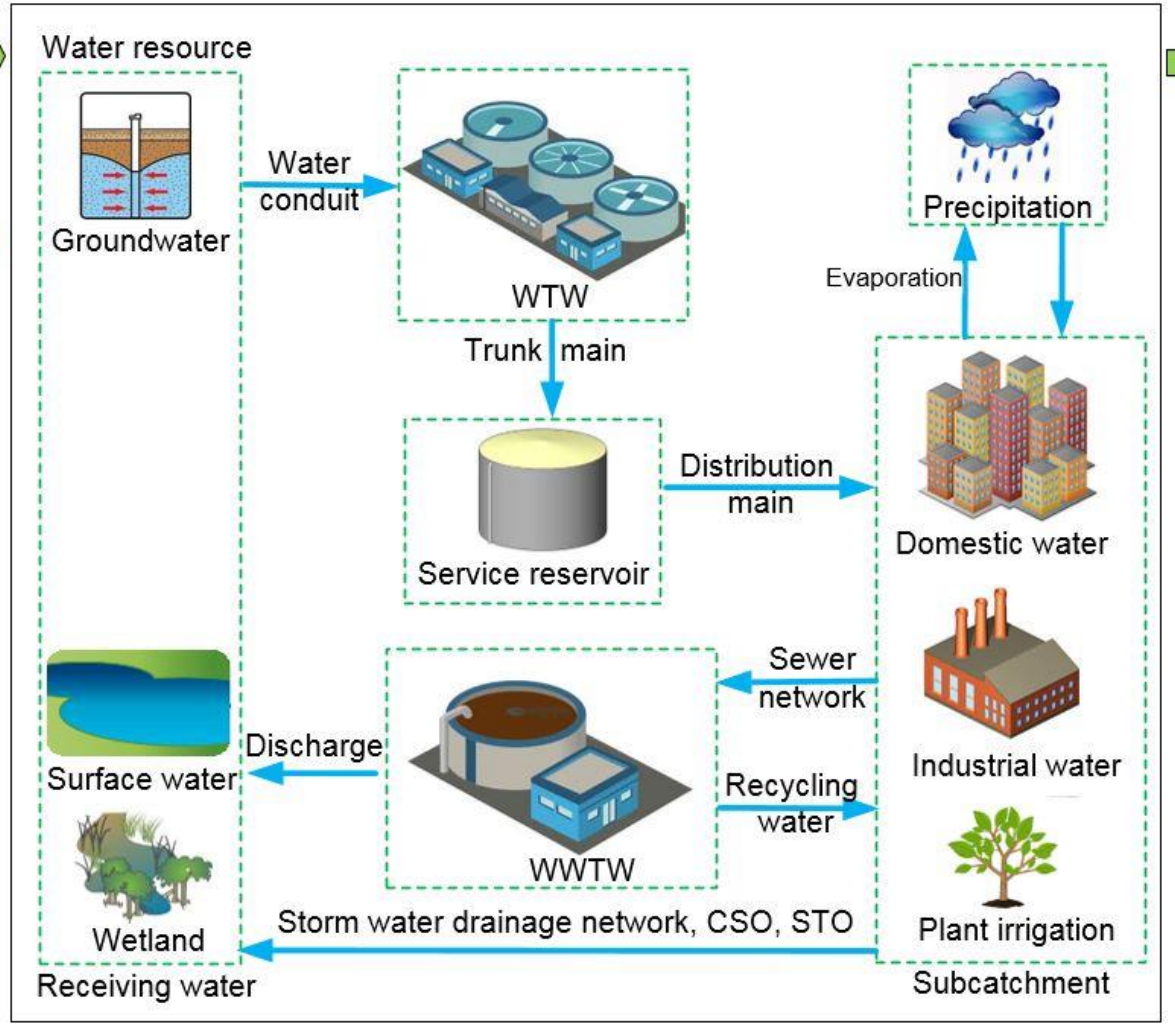
Urban Water System Modelling
Ebbsfleet Garden City

Model input:

- Weather data time series
- Inflow time series to water resources
- Database of pipeline characteristics

- Characteristics of Components Including:
- Transport/Storage capacity
- Consumption per unit volume of water for:
- Energy sources
- Chemicals
- Resource recovery
- Operational cost

- Water demand per capita/Daily water demand
- Demographic information
- Industrial development information
- Hydrologic characteristics
- Number of properties

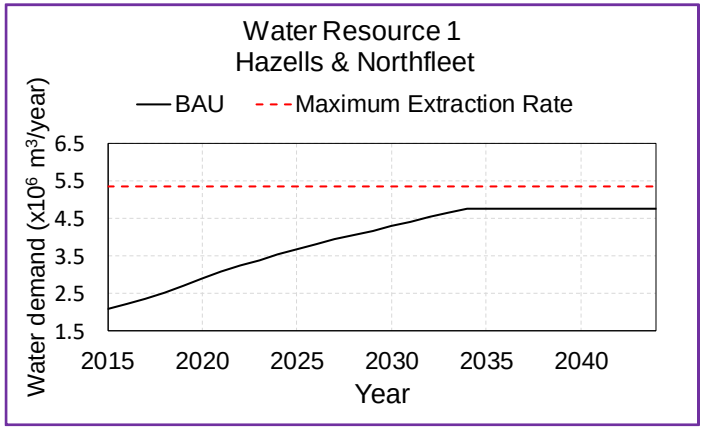


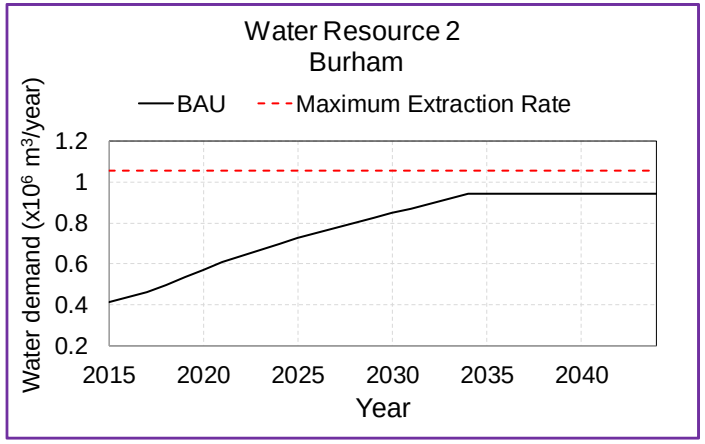
Model output:

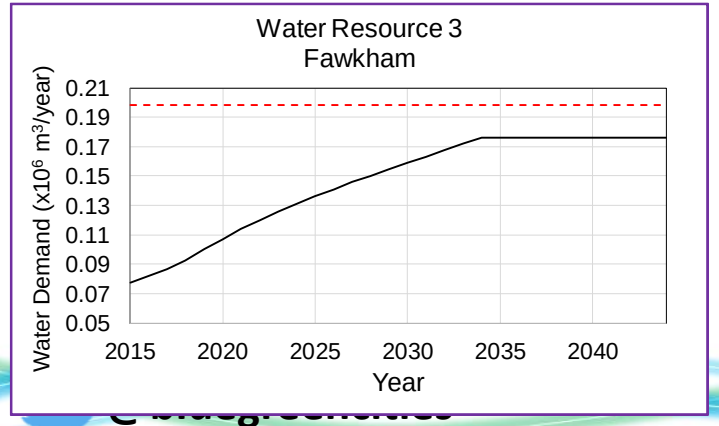
- Water flow
- Energy flow
- GHG flow
- Acidification flow
- Eutrophication flow
- Material flux
- Chemical flux
- Pollutant flux
- Cost flux

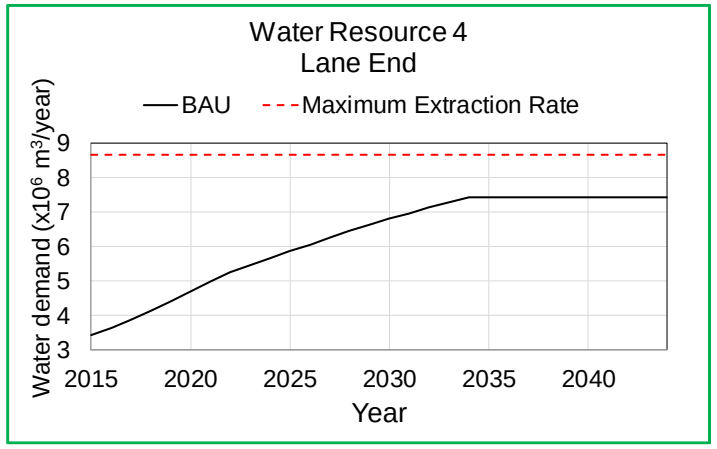
urban flood resilience

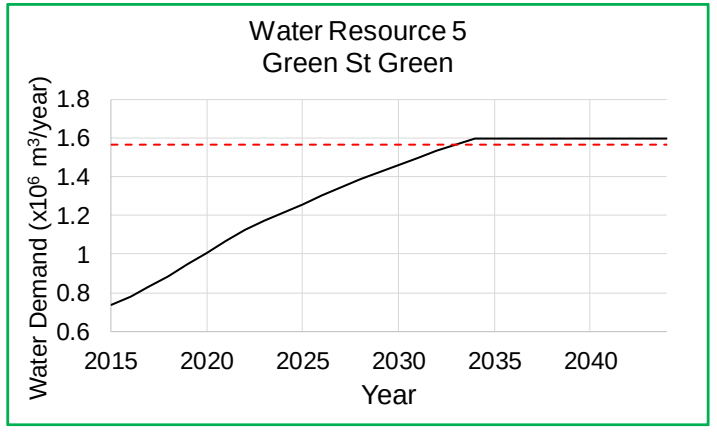
Water supply demand







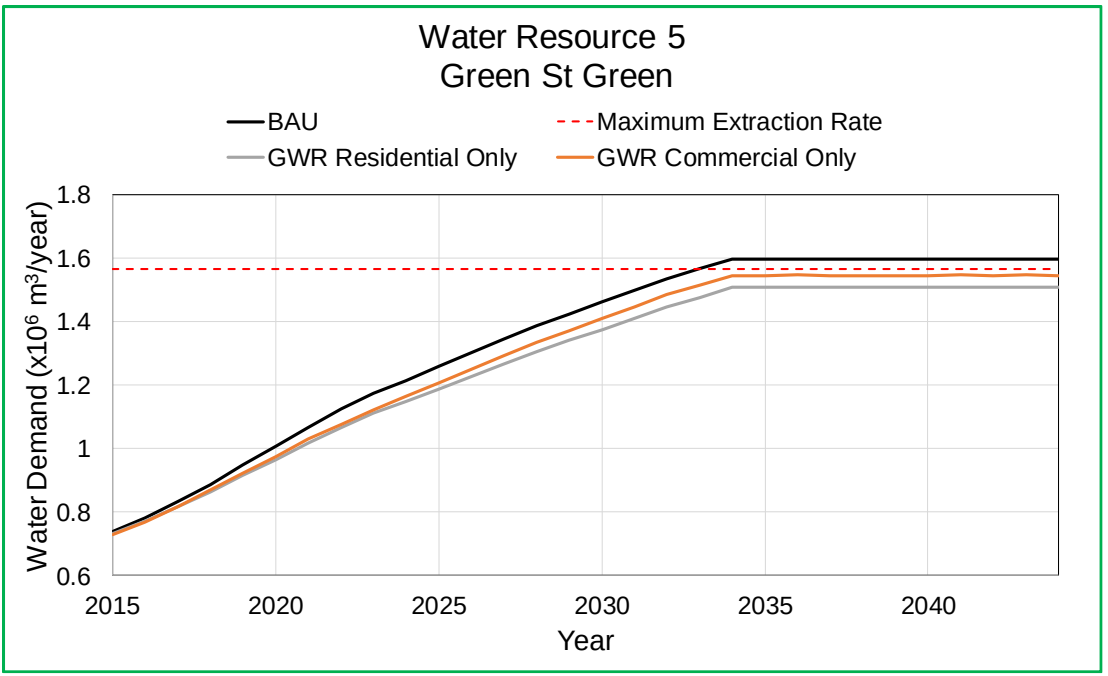


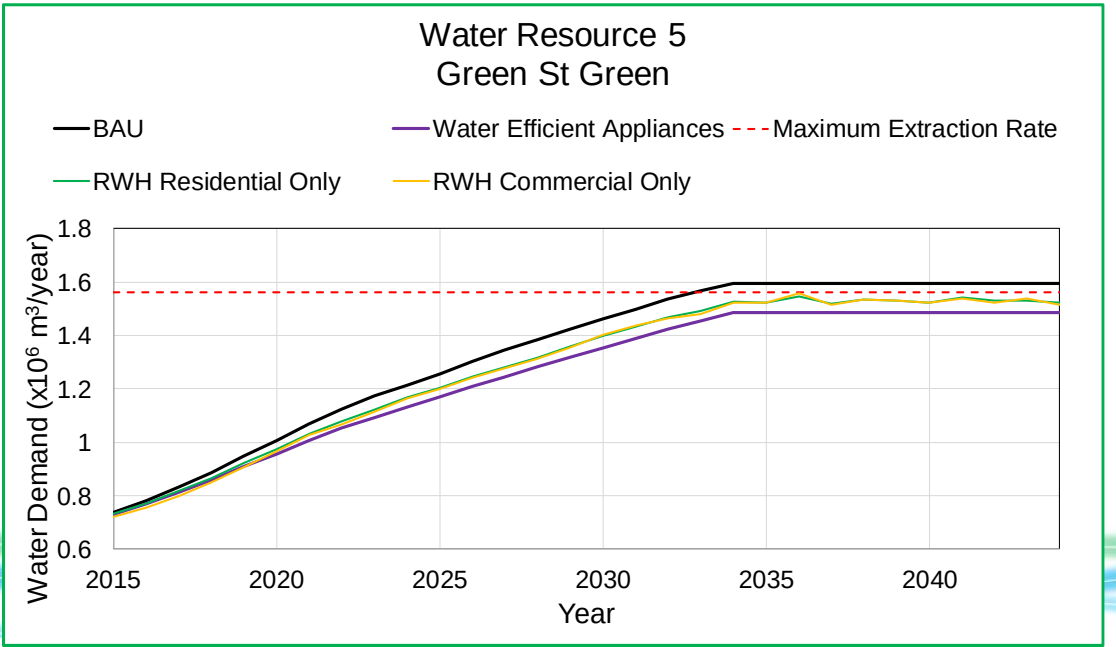


Sustainable Water Management Strategies

- Rainwater Harvesting
- Grey Water Recycling
- Water efficient appliances
- Leakage reduction

Water management Interventions





urban flood resilience

Conclusions

- **All** RMS systems deliver water saving benefits **AND** stormwater benefits to varying degrees.

- Where **supply is low relative to demand (e.g. Ebbsfleet)**, tanks are likely to be emptied more frequently so water supply **yield is lower**, but this provides greater potential for **stormwater control**.

- **Passive** and particularly **active** control provides improved performance, w.r.t. **stormwater** management, especially **peak flows.**

- Other benefits can be achieved by design & operation optimisation: **pollution control** (CSO reduction), **climate change adaptation** (variable tank splits), **resilience enhancement** (supply failure) and reduction in **urban heat island** effects.

- **Multi-functional, multi-benefit systems** are the future as exemplified by rainwater management systems.