

Project area: Ebbsfleet Garden City, Kent, UK
Intended audience: Practitioners, researchers, urban planners, water industry professionals

Summary

Urban metabolism can be defined as ‘the sum total of the technical and socio-economical processes that occur in cities, resulting in growth, production of energy, and elimination of waste’. Urban metabolism modelling seeks to quantify the inputs, outputs and storage in the urban system, including water, energy, food and waste. It also allows consideration of the interconnection of flows and recycling of resources. This factsheet briefly presents the urban metabolism modelling framework we will use to quantify the stocks and flows including their interconnections and interdependencies, our case study area and research questions.

Practical application of this research:

- The metabolism-based modelling approach overcomes issues commonly encountered by independent modelling of the components of urban water systems (water supply, wastewater and surface water collection) by providing an integrated approach that considers the interconnection and interdependencies of the urban water sub-systems
- This integrated modelling approach enables the urban water system to be modelled over long-term planning horizons for both businesses as usual and future intervention strategies
- This modelling approach enables the integration of sustainable urban water management strategies, e.g. rainwater harvesting, grey water recycling, at a sub-catchment scale to investigate their impact on urban water metabolism
- This is the first study of its kind in the UK and first introduction of urban metabolism modelling to urban water system planning and management in the Ebbsfleet Garden City

Quantitative urban water system performance modelling:

This study uses WaterMet², a mass-balance-based conceptual urban metabolism modelling tool developed by Behzadian and Kapelan (2015) to evaluate the sustainability performance of the urban water system in Ebbsfleet over a pre-defined long-term planning horizon for both businesses as usual and future intervention strategies. The WaterMet² model quantifies various basic flows and fluxes of water, energy and other environmental impact categories and calculates key performance indicators in the urban water system. The principal mass fluxes modelled in WaterMet² shown in Figure 1.

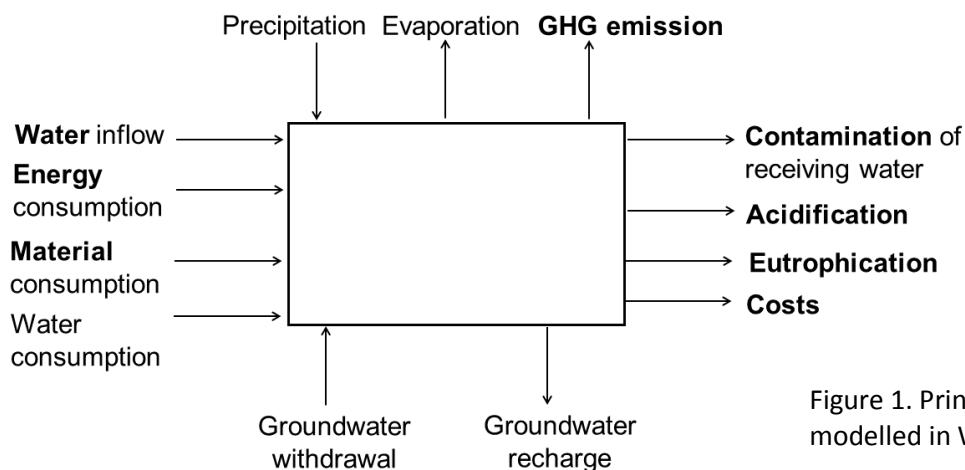


Figure 1. Principal mass fluxes modelled in WaterMet²

Ebbsfleet Garden City:

Ebbsfleet Garden City (shown by the red line boundary) is situated in an area supplied by both Thames Water (green) and Southern Water (orange). The locations of the water supply infrastructure (bore holes – circle, water treatment – triangle and rectangle – reservoir) of the both water companies are shown in Figure 2. The entire wastewater system in the Garden City is managed by Southern Water through three separate wastewater treatment works (red dots).

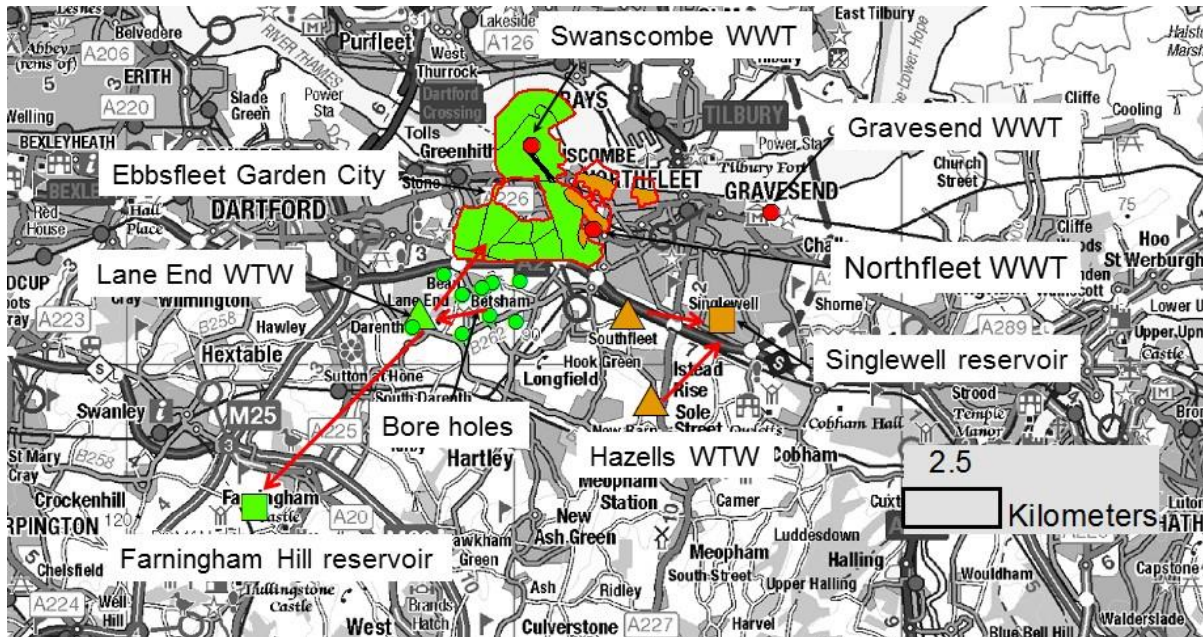


Figure 2: Urban Water System in Ebbsfleet Garden City

Research Questions:

- To understand the urban water metabolism of Ebbsfleet by systematically compiling data from development plans and water company records for use in WaterMet²
- To assess the urban water system performance through (social, environmental, economic, governance and asset) key performance indicators over the planning horizon (30-year)
- To explore sustainable urban water management strategies such as rainwater harvesting, grey water recycling, etc. and evaluate their potential impact on the urban water system
- To evaluate integrated urban water and wastewater management masterplans of the water companies (Thames and Southern Water) through WaterMet² simulations and feedback to Ebbsfleet Development Corporation for long-term decision making
- To couple or compare the urban water metabolism modelling with the semi-quantitative system dynamics modelling (water supply)

Reference: Behzadian, K., and Z. Kapelan. *Modelling metabolism based performance of an urban water system using WaterMet2, Resources, Conservation and Recycling* 99 (2015): 84-99.

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