Quantification of wastewater treatment resilience metrics

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WATER INFRASTRUCTURE AND RESILIENCE
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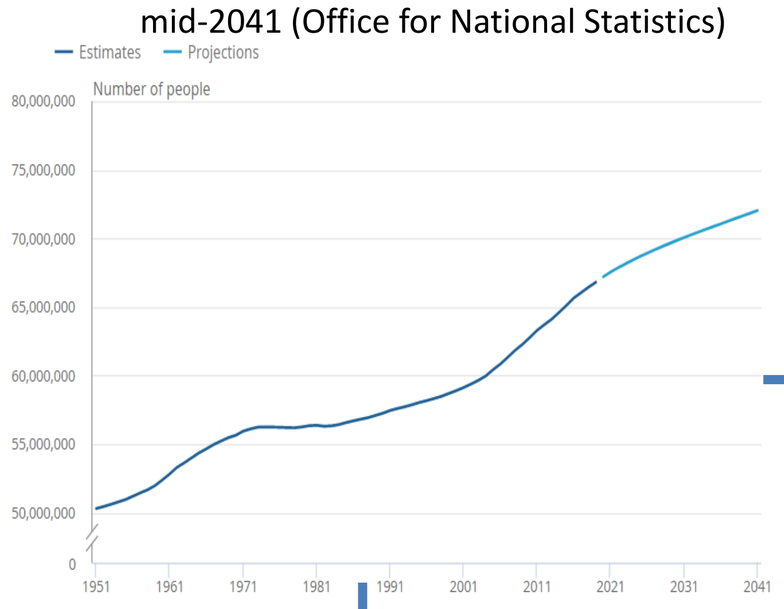
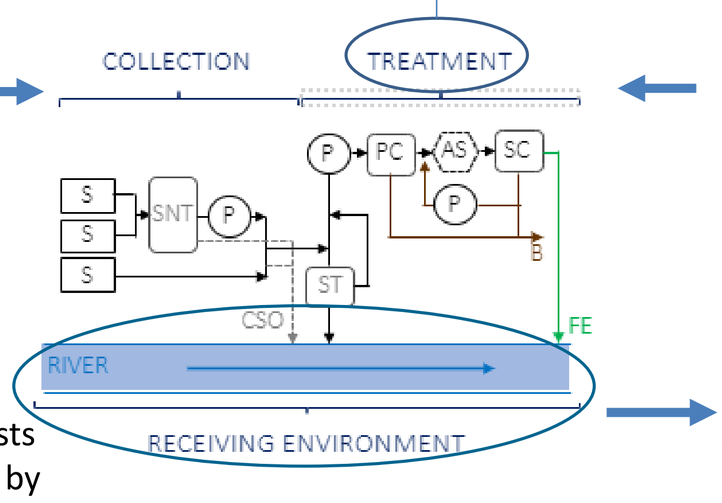
Project Overview

Stressors to the system → Population growth & Climate change

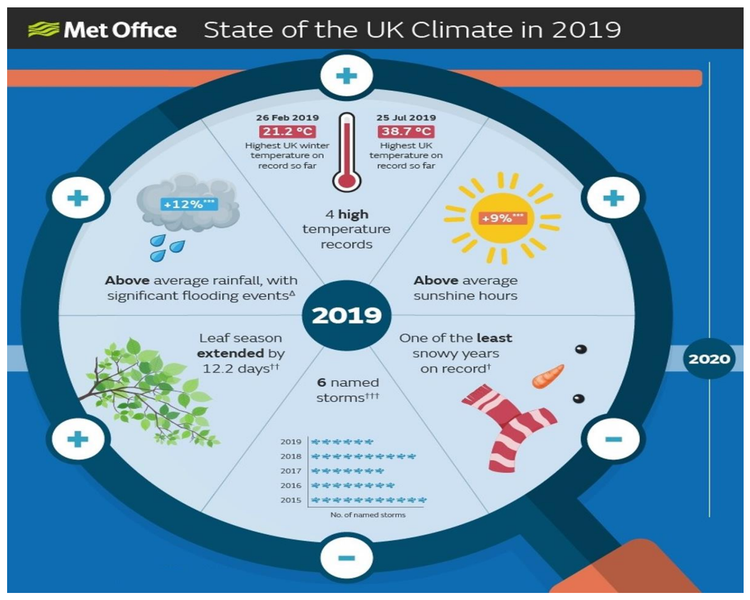
UK population growth estimates and projections, mid-1951 to mid-2041 (Office for National Statistics)



The UK population is projected to increase further. The Office for National Statistics forecasts an increase of 69.6 million by mid-2019 reaching 72 million by mid-2041

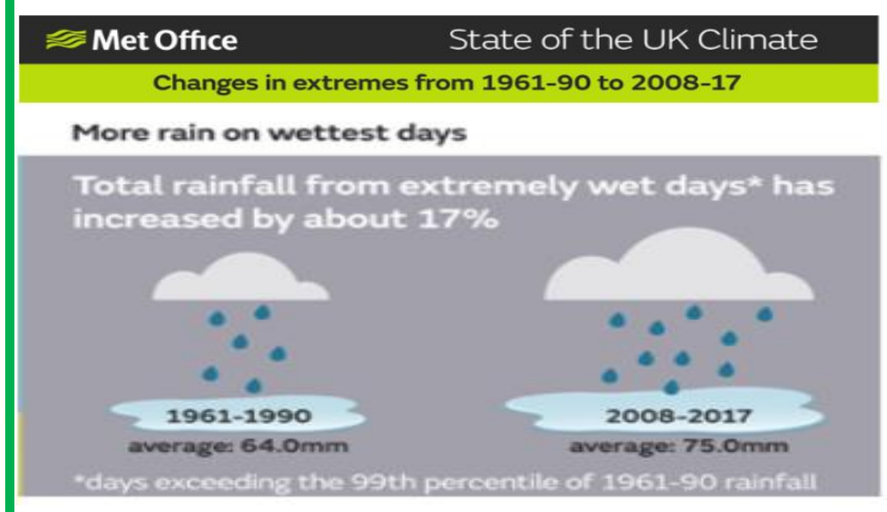


In a series from 1884, 2019 was the 12th warmest year (Met Office)

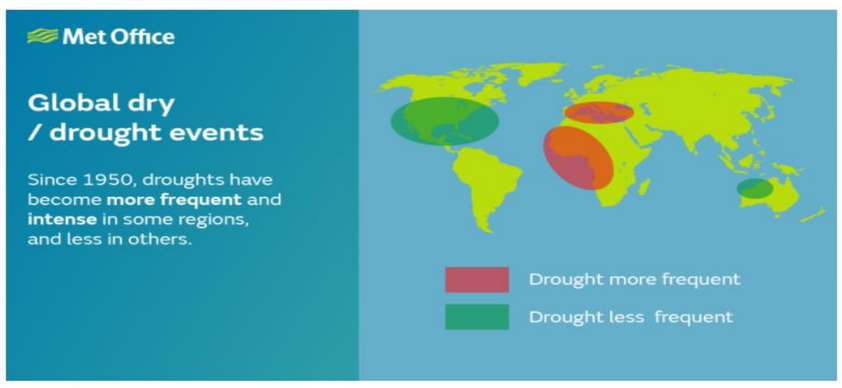


A longer period of low river flow, in addition to increasing water temperatures, will reduce dilution capacity and so water quality

Climate Change



What does climate change mean for WWTPs?



Droughts: reduced flows to sewers can increase costs of collection and treatment, and in some cases damage infrastructure (California Urban Water Agencies 2017)

WWTPs will have a higher concentration of pollutants during dry weather and be more dilute during heavy precipitation, with the addition of population growth. The *future generations* can suffer serious **pollution incidents** and lack of compliance with treatment standards. Thereafter, understanding how the different processes in wastewater treatment respond to these stresses will play a fundamental role in adapting to climate change and population growth

Threats: "Any event with the potential to reduce the degree to which the system delivers a defined level of service" (Butler et al. 2017)

Climate change might affect the urban water systems, and the wastewater treatment plants could be affected in various ways. For example, a higher number of pathogens could be convoyed to the wastewater treatment plant with storms. The flows through the water collection system could be increased by higher level of rainfall. These two events can impact the reliability and operating costs. It is important to consider that WWTPs under any changes to the determined values may experience performance or conduct failures, because they are designed for assumed flows and sewage characteristics, as well as climate conditions

Extreme events → *Return Period (occurrence)* → *Metrics to quantify resilience*

CHALLENGE

Objectives of the project

- **Understanding** possible **metrics** currently used and their characteristics
- **Developing** appropriate **comprehensive** resilience metrics
- **Developing** appropriate **algorithmic methods** for computing the **newly-defined metric**
- **Using** that algorithms to compare and identify the **least resilience treatment process**
- **Finding** ways to **quantify the stressors** and **their probability of occurrence**
- **Quantifying** the **impacts** on the wastewater treatment processes
- **Investigating** which **models** and **tools** best link impacts on the wastewater processes

Bibliography
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