Mykolaiv Water Hub

Water Leaders Course

National University of Water and Environmental Engineering

Newcastle University

University of Maryland

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European Bank
for Reconstruction and Development

Module 2 – Wastewater

Wastewater Infrastructure

Wastewater infrastructure forms the network that collects and transports wastewater from homes, businesses and industry to treatment facilities

Understanding how sewer systems operate is essential for managing flows, maintaining assets, preventing flooding, and protecting the environment

This presentation provides an overview of key concepts involved in wastewater infrastructure

Overview:

- Sewer systems and pipe networks
- Combined and separate sewer systems
- Asset management and maintenance
- Flow capacity and varying flow patterns
- Sewer overflows

Professor Claire Walsh
Newcastle University
Centre for Water

Ana Amezaga-Kutija
Newcastle University
Centre for Water

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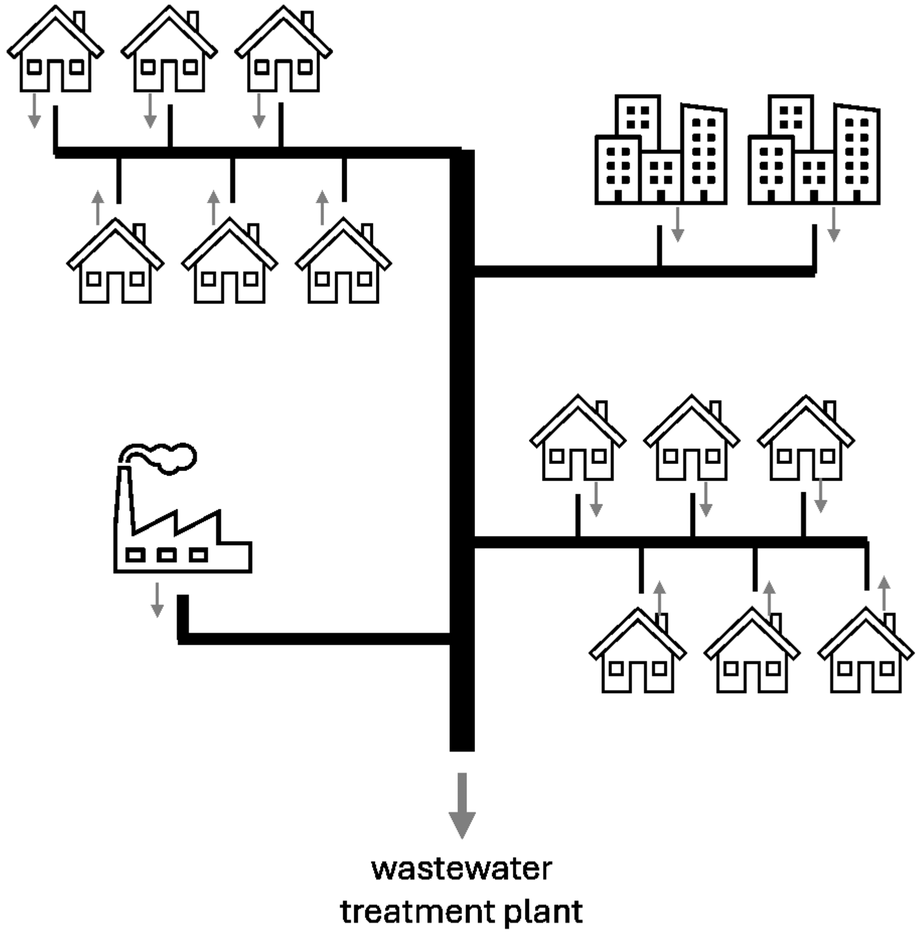
Wastewater Infrastructure

Sewer System

Sewer systems are networks of underground pipes that collect and transport wastewater away from communities to wastewater treatment plants

Wastewater from homes, businesses, and industry enters the sewer network through building drains

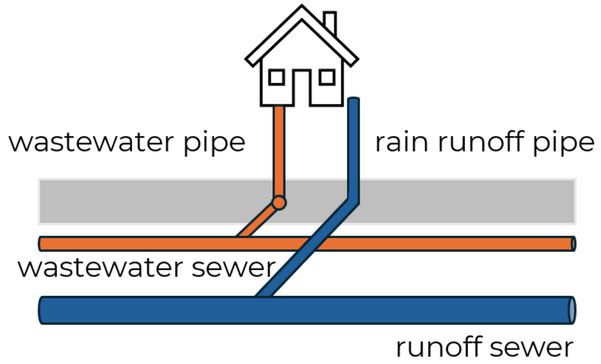
As wastewater moves through the network, flows combine from smaller local sewers into progressively larger pipes



Wastewater Infrastructure

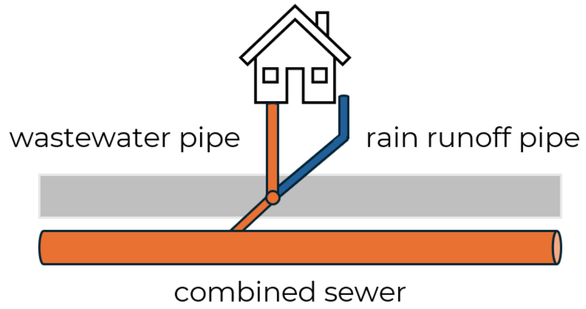
Sewer System

Separate Sewers



- 2 separate pipe networks one carrying wastewater and the other rainfall runoff
- More common in newer developments
- Wastewater sewer carries water to treatment and runoff sewer releases water to the environment
- Reduces the volume of water requiring treatment

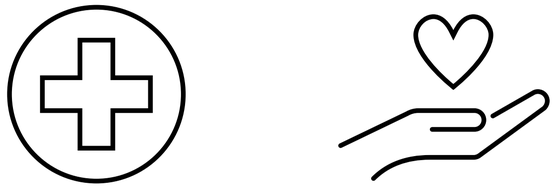
Combined Sewers



- 1 pipe network carrying both wastewater and rainfall runoff
- Common in older urban areas
- All water is transported to treatment
- During storm events and periods of sustained rainfall can experience high flows

Wastewater Infrastructure

Sewer System



The primary purpose of sewer systems is to help protect public health and the environment by safely removing sewage from populated areas



But combined sewer systems, which collect wastewater and rainwater in the network, can also help manage surface water and reduce local flood risk

Wastewater Infrastructure

Sewer System

Sewer networks include not only pipes, but also manholes and access chambers.

Manholes provide safe access for inspection, monitoring and maintenance activities

.Regular inspections of manholes and pipes help identify blockages, structural defects and other issues before they become serious problems.

Proactive maintenance helps prevent flooding, pollution incidents and service disruptions.



Sewagemanholevover.jpg, Wikimedia Commons, by BogTar201213, [CC-BY-SA-4.0]

Wastewater Infrastructure

Sewer System

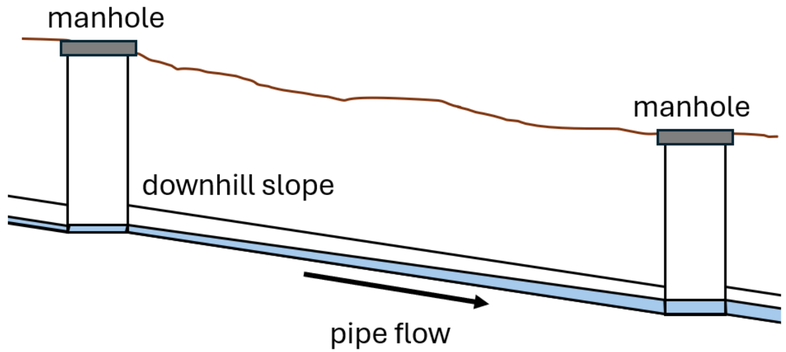
Most sewer networks rely on gravity, using the fact that wastewater naturally flows downhill

Pipes are typically installed with a gentle slope, allowing wastewater to move through the network without additional energy input

Therefore, sewer systems are generally not pressurised, making them simpler and more cost-effective to operate.

Using gravity reduces both energy consumption and operating costs

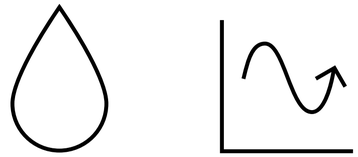
In some locations, wastewater must be transported uphill. In these cases, pumping stations and pressurised pipes can be used. However, these systems are typically avoided where possible



Wastewater Infrastructure

Wastewater Flows

Wastewater flow is not constant and varies thought a day and across the seasons



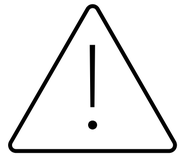
Sewer networks and treatment plants must be designed to manage these changing flow rates

The amount of variation depends on the type of sewer system:

- **Separate sewers** mainly experience flow changes caused by human activity
- **Combined sewers** experience both human activity and rain-fall related flow changes



Wastewater infrastructure must operate effectively during both normal and peak flow conditions



If system capacity is exceeded, flooding, pollution incidents and public health risks can occur

Wastewater Infrastructure

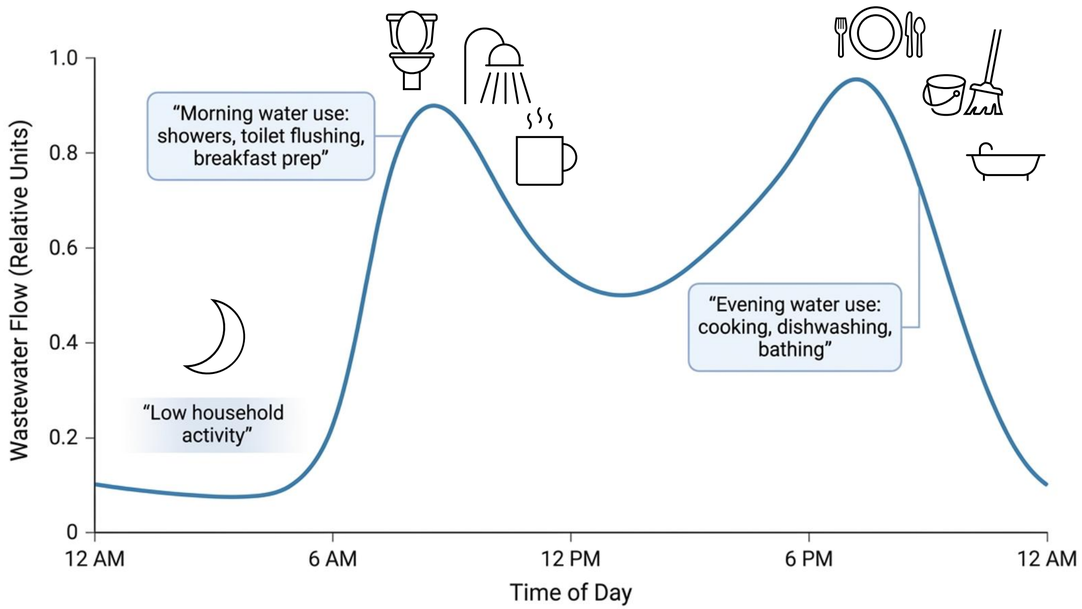
Wastewater Flows

Daily Flow Variation

Often referred to as the **diurnal wastewater flow pattern**

Primarily driven by domestic water use.

- Flows typically **peak** in the **morning** and **evening** due to activities such as toilet use, showering, cooking, and cleaning.
- Flows often reduce during the day when many people are away from home.
- **Lowest flows** usually occur **overnight** when most people are asleep.



Wastewater Infrastructure

Wastewater Flows

Seasonal Flow Variation

Rainfall and storm events can significantly increase flows in combined sewer systems

Depending on local climate the volume of rainwater entering a sewer can often exceed the volume of wastewater

During prolonged wet periods, soils become saturated, reducing infiltration and increasing the amount of water entering sewer systems.

Wet weather creates the most challenging operating conditions for wastewater networks, increasing the risk of flooding, sewer overflows and pollution incidents



Drivingthroughflashflood.jpg, Wikimedia Commons, by Shootthedevgru at English Wikipedia, [CC-BY-SA-3.0]

Wastewater Infrastructure

Overflows

Sewer networks have overflow structures which are designed to release wastewater to the environment during extremely high flows as a relief mechanism

Most commonly associate with combined sewers systems, where wastewater and rainwater share the same network

Overflows are necessary to protect the piped network from critical infrastructure damage that can have significant public health and safety risks

In theory overflows should only operate during periods of heavy rainfall when wastewater is highly diluted by large volumes of rainwater, but this is not always the case

Sewer overflows are often debated as they help prevent flooding and network damage but can also harm the environment when discharges occur



Dischargepipe.jpg, Wikimedia Commons, by US Department of Agriculture, Public Domain

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