Mykolaiv Water Hub

Water Leaders Course

National University of Water and Environmental Engineering

Newcastle University

University of Maryland

FUNDED BY

European Bank
for Reconstruction and Development

Module 1 – Water

Drinking Water Treatment Systems

Drinking water treatment is a vital part of water infrastructure systems

It protects public health by treating raw water ensuring that water supplied to customers is safe for consumption and meets regulatory standards

This presentation provides an overview of key concepts and processes involved in drinking water treatment

Overview:

- Water sources
- Stages of drinking water treatment
- Water quality testing
- Waste management

Professor Claire Walsh
Newcastle University
Centre for Water

Ana Amezaga-Kutija
Newcastle University
Centre for Water

Mykolaiv Water Hub
National University of Water and Environmental Engineering
Newcastle University
University of Maryland
FUNDED BY
Europäische Bank für Wiederaufbau und Entwicklung

Drinking Water Treatment Systems

Water Sources

Drinking water comes from a variety of natural sources, which can be broadly classified as either **surface water** and **groundwater**

RESERVOIR



LAKE



Surface Water:

- includes river, lakes and reservoirs
- Water quality can vary significantly due to weather, seasonal changes and human activities, often requiring more treatment

BOREHOLE



BoreHole.jpg, Wikimedia Commons, by Amuzujoe , [CC BY-SA-4.0]

Groundwater:

- found in underground aquifers, accessed through wells or boreholes
- Typically, more consistent water quality with little contamination and may require less treatment

Regardless of the source, all water must be treated and monitored to ensure it meets drinking water quality standards and is safe for human consumption

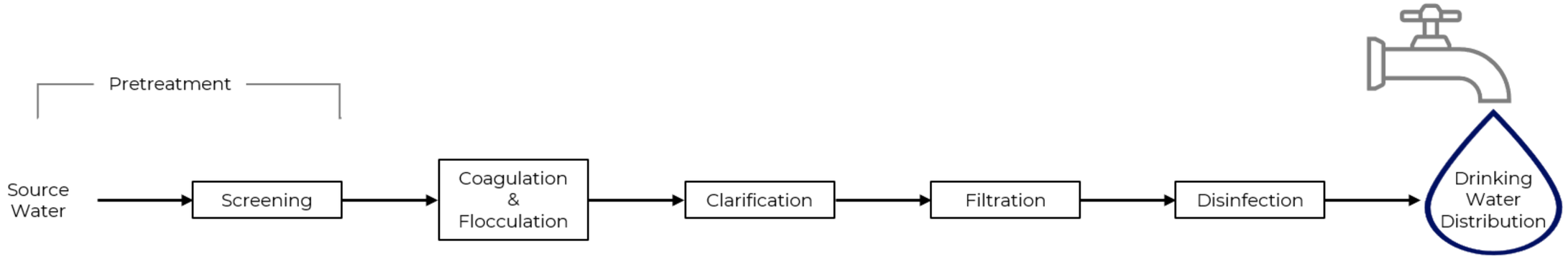
Drinking Water Treatment Systems

Stages of Wastewater Treatment

Drinking water treatment systems are designed according to the quality of the source water

Most drinking water treatment plants have multiple treatment stages, although some sources such as groundwater, may require only limited treatment as they naturally contain less impurities

The exact treatment requirements will depend upon local regulations, but the overall purpose is to produce safe and reliable drinking water for customers



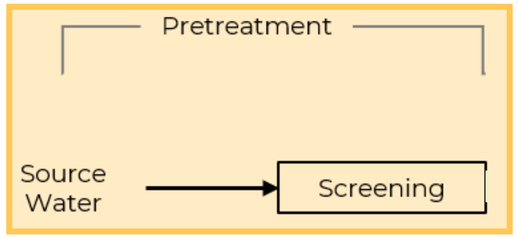
Drinking Water Treatment Systems

Pretreatment

Purpose: Removal of large debris and coarse suspended matter, to prepare water for treatment and to protect treatment equipment

Typical Units:

- Coarse Screens
- Fine screens or strainers
- Flow equaliser (occasionally required, when in influent conditions are not constant)

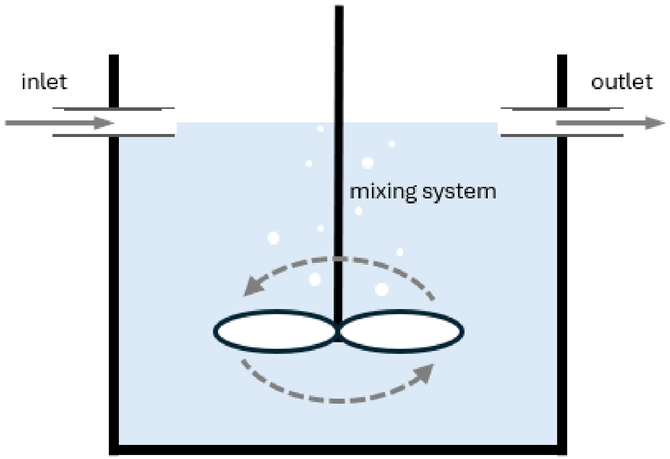


SEDIMENT SCREEN



LadderEnd.jpg, Wikimedia Commons, by David Grundler, Wes Hardaker and Evan Edwards, [CC BY-SA-3.0]

FLOW EQUALISER



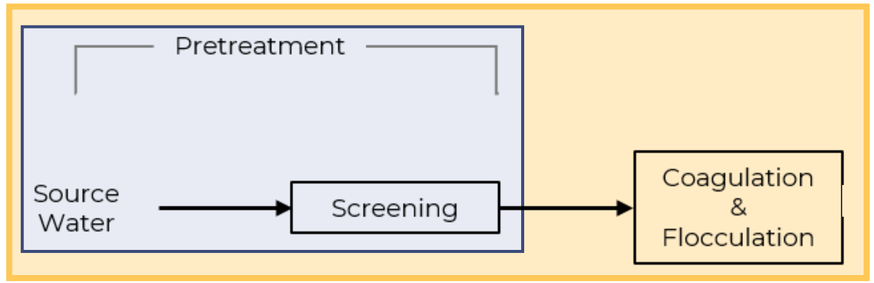
Drinking Water Treatment Systems

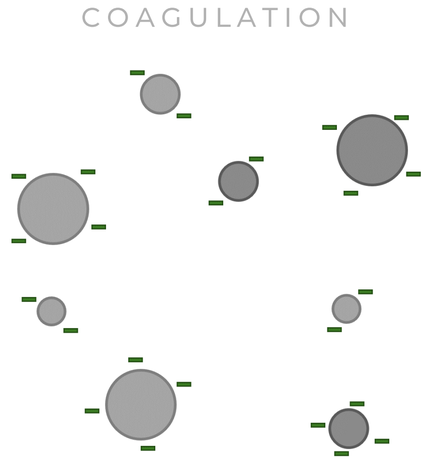
Coagulation and Flocculation

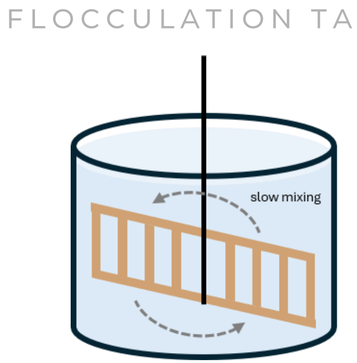
Purpose: Chemical addition to help fine suspended particles stick together to form larger flocs that can be more easily removed in further treatment stages

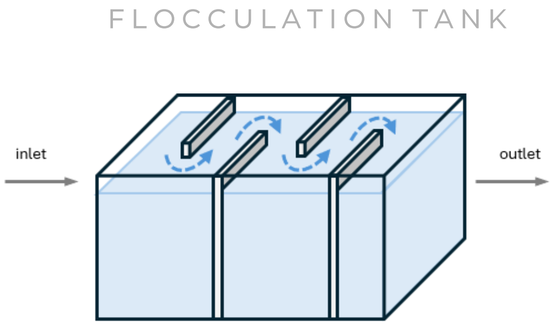
Typical Units:

- Coagulant dosing system
- Rapid mix tank
- Flocculation tank (slow moving)









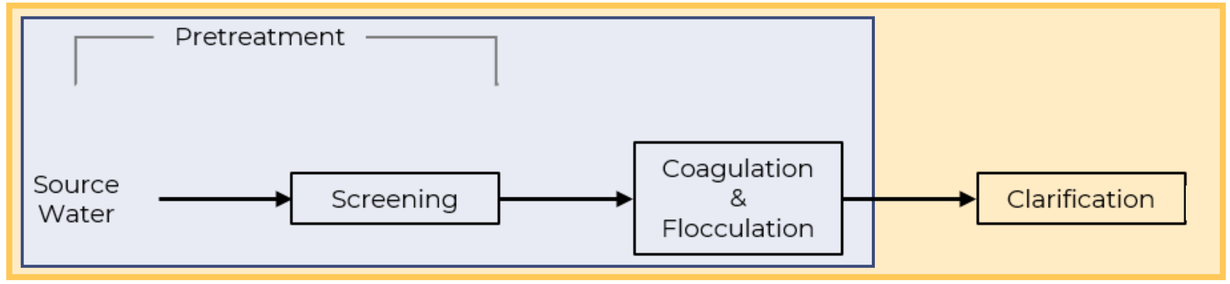
Drinking Water Treatment

Clarification

Purpose: Removal of suspended and flocculated matter, through physical processes

Typical Units:

- Settlement tank
- Clarifier
- Dissolved Air Floatation (DAF)



SETTLING TANK



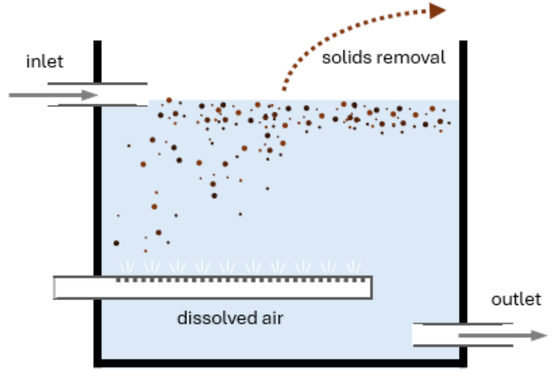
BecktonSTP,PrimarySettlingTank-geography.org.uk-148190.jpg, Wikimedia Commons, by John Roston. [CC-BY-SA-2.0]

CLARIFIER



SiloamSpringsWWTP003.jpg, Wikimedia Commons, by Brandonrush [CC-BY-SA-3.0]

DIFFUSED AIR FLOTATION (DAF)



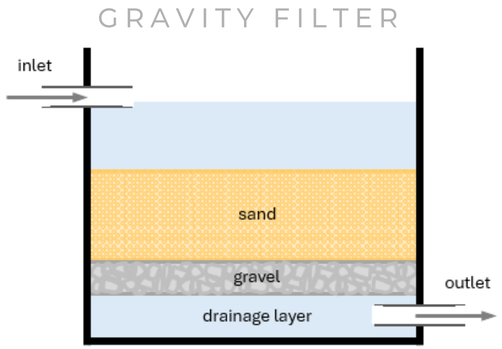
Drinking Water Treatment Systems

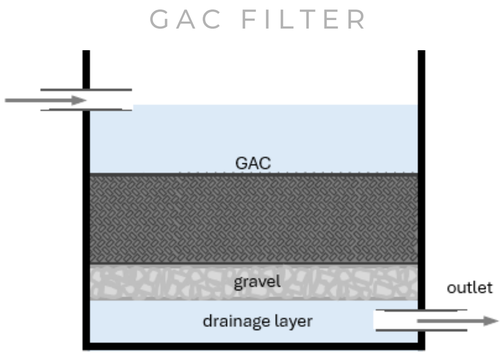
Filtration

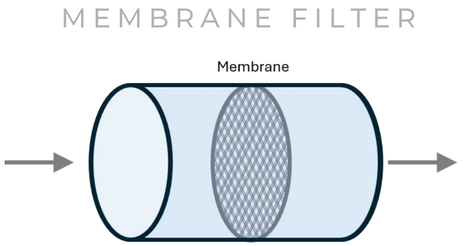
Purpose: Removal of remaining suspended solids, fine particles though physical filtration processes

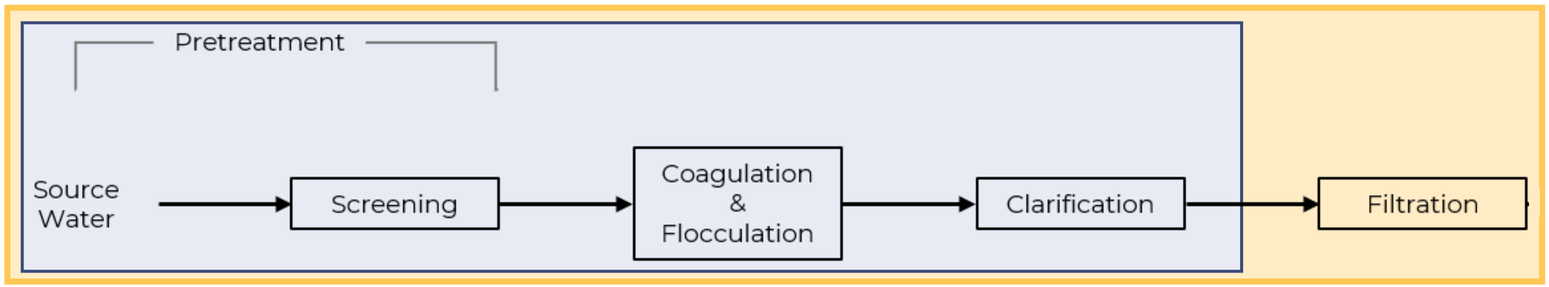
Typical Units:

- Rapid gravity filter
- Slow sand filters
- Granulated activated carbon (GAC) filters
- Membrane filters









Drinking Water Treatment Systems

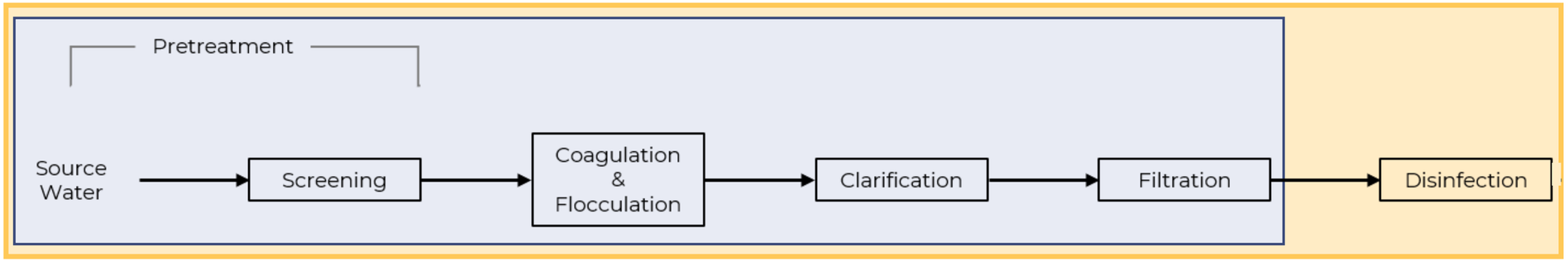
Disinfection

Disinfection is normally a required in drinking water treatment, although the specific requirements depend on local regulation

Purpose: Removal of Pathogens

Typical Units:

- Chlorination
- UV radiation



CHLORINE



UV RADIATION



VBlacklightUVLEDFlashlight.jpg, Wikimedia Commons, by DanceWithNyanko, [CC-BY-SA-4.0]

Drinking Water Treatment systems

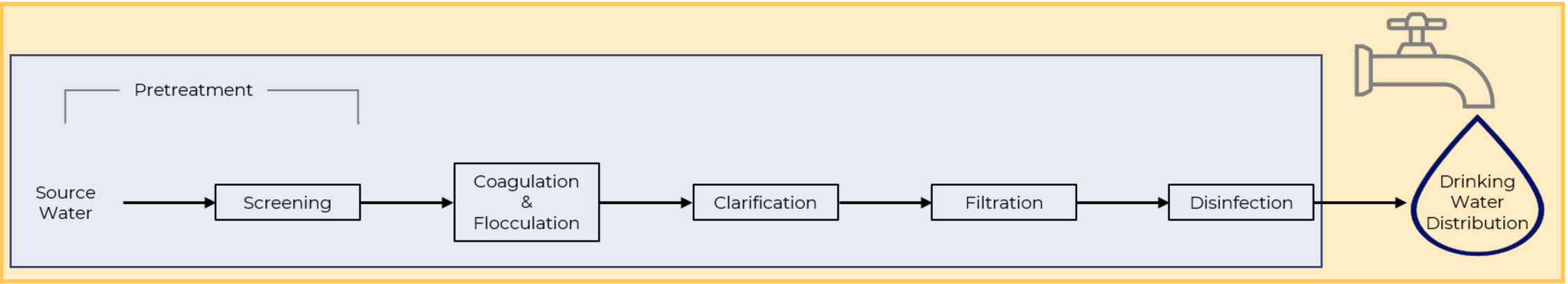
Drinking Water Distribution

Once treated, drinking water either enters the distribution network directly or is temporarily stored, before it is later supplied to homes businesses and other consumers

Before entering the distribution system, the treated water must meet local regulation drinking water quality standards and be safe for human consumption



Faucet2.jpg, Wikimedia Commons, by Nicole-Koehler, [CC-BY-SA-3.0]]



Drinking Water Treatment Systems

Water Quality Standards

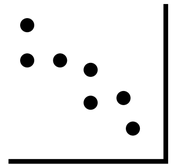


All drinking water treatment plants monitor water quality of incoming wastewater and treated water

Why is water quality monitored?

To assess treatment performance

- Determine the quality of incoming source water
- Check whether each treatment stage is effectively removing contaminants
- Support management of treatment process e.g managing chemical dosing



To ensure regulatory compliance

- Verify and demonstrate that treated water meets regulatory drinking water quality standards
- Protect public health and maintain customer confidence



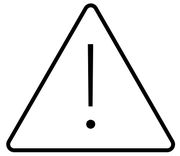
How is water quality measured?

- **Online monitoring**: continuous measurements using sensors and instruments
- **Offline monitoring**: samples are collected and analysed in a laboratory



Drinking Water Treatment Systems

Waste Management



As impurities are being removed during drinking water treatment, waste by-products are formed which must be managed separately

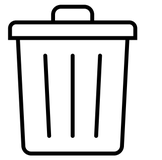
TREATMENT PLANT



SheikhHasinaWaterTreatmentPlantinRanguniaChattogram.jpg, Wikimedia Commons, by Zitu.madcap0901125, [CC-BY-SA-4.0]]

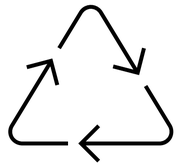
Key waste streams:

- **Screening:** debris such as leaves, twigs and weeds
- **Clarification:** Settled solids, **sludge**, organic matter and used treatment chemicals
- **Filtration:** filter back wash water, captured solids and spent media (GAC)



Why is waste management important?

- Waste materials must be handled and disposed of in accordance with local environmental regulations
- Poor waste management can pose risks for public health, worker safety and the environment



Some drinking water residuals can be recovered, recycled and reused, depending on their composition, local regulations and site-specific requirements

Mykolaiv Water Hub

Water Leaders Course

National University of Water and Environmental Engineering

Newcastle University

University of Maryland

FUNDED BY

European Bank for Reconstruction and Development

2026