Practical investigation – Wastewater treatment flow diagram

Flow diagram

A flow diagram visually represents the steps and orders that must be made to complete a process. To improve students' Working Scientifically skills, flow charting skills are required for students to sequence steps in an explanation, correctly organise steps in a process, and obtain information from a flow diagram.

This activity aims to show students how to create a flow diagram and develop their flow-charting skills. They will also learn about how we treat our wastewater using different separation techniques. Rather than just describe the process in plain text, students can identify the steps by representing them visually.

The flow diagram cards include all the necessary process in wastewater treatment based on Penrith Water Recycling Plant. See how we treat wastewater into recycled water to protect the environment.

Syllabus links

- **SC4-9WS** – presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations.
- **SC5-9WS** – presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations.

We monitor and manage wastewater at water recycling plants like this one at Penrith

Instructions

1. Print off the cards attached.
2. Cut out the arrows and key with dashed lines for your flow diagram.
3. Rearrange the order of the slides to create a flow diagram of how you think we treat wastewater and recycle the solid waste in water treatment.
4. Cut out the items in the sorting game.
5. Place items where you think they are added or removed in water treatment.
6. Check your answers or visit Penrith Water Recycling Plant page.

Flow diagram cards

Penrith Water Recycling Plant

One of 30 wastewater treatment and water recycling plants in greater Sydney.

Here, we treat 24 million litres wastewater for ~100,000 people. We recycle water for onsite re-use, environmental flows and local sporting fields.

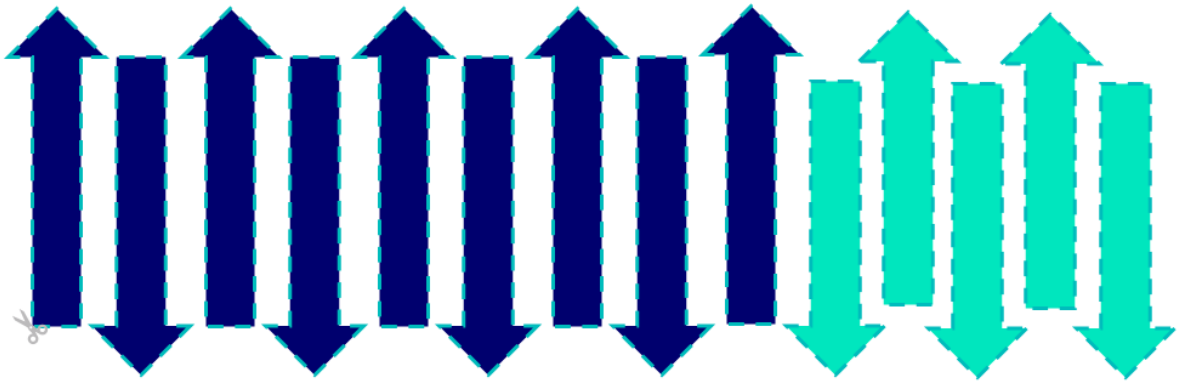
Primary treatment

Secondary treatment

Tertiary treatment

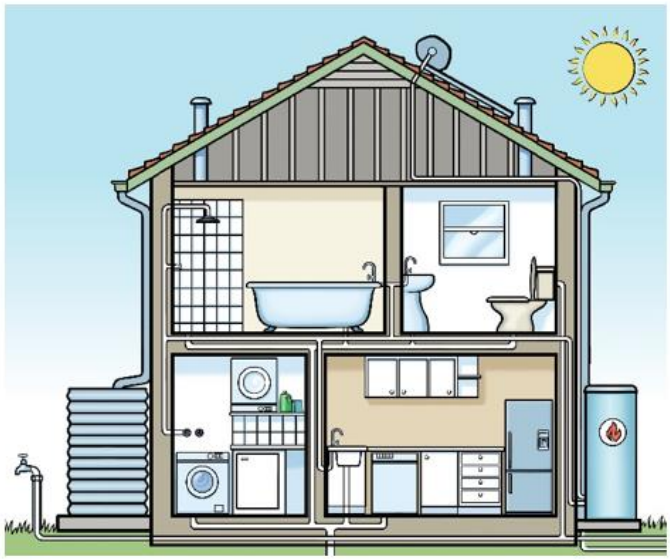
Water treatment

Solids handling



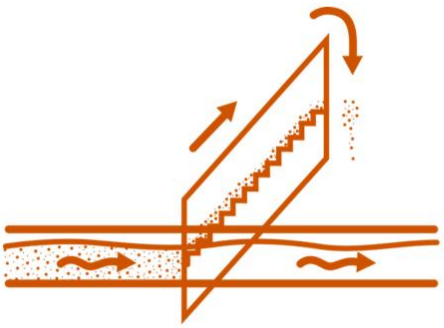
Wastewater

Wastewater is the water you've used in your homes, schools, businesses and industries. It goes down drains from sinks, baths, showers, laundries and toilets and other drains inside buildings. Wastewater is 99% water.



Step screen

We use a large and rapid mixing paddle to spin the water and mix solutions we add.



Biosolids transport

Trucks take our biosolids off-site to further process with compost or soils.

Beneficial reuse

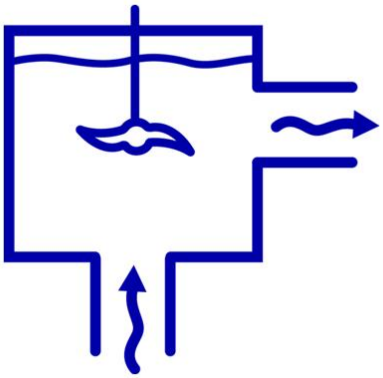
Our biosolids are safe and used to help improve soil, mainly in broad-acre farms. These large farms grow canola, wheat, oats, barley and pastures.

Vortex grit chamber

We stir the wastewater rapidly, forcing the water to spiral and create a vortex to collect and remove grit in the centre of the tank, separating it from the water.

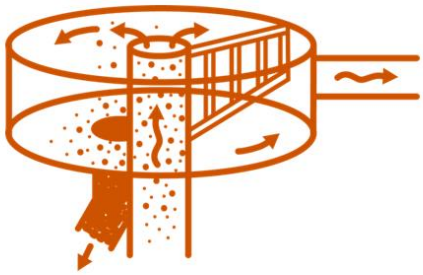
Mixing chamber

We use a large and rapid mixing paddle to spin the water and mix solutions we add to stick small particles together into 'flocs' and remove remaining nutrients .



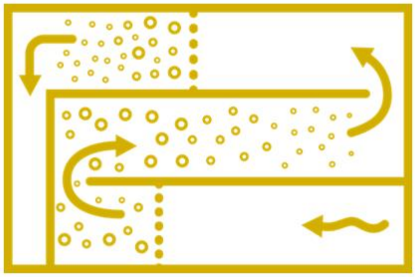
Sedimentation tank

We slow the flow of wastewater and allow solids to settle to the bottom of the tank (sludge), while oil and grease (scum) float to the top. Scrapers at both the top and bottom remove these for solids handling. The water in middle continues to be treated.



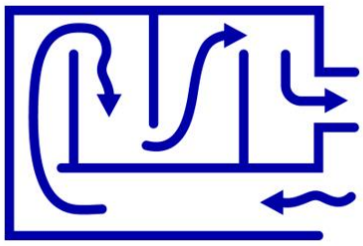
Bioreactor

We add micro-organisms (activated sludge) to the wastewater, to break down nutrients (like nitrogen and phosphorous).



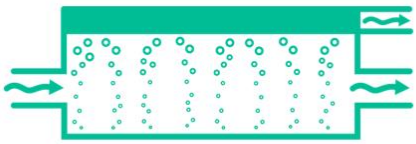
Disinfection

We add chlorine to remove pathogens to protect public health. If the water is for immediate discharge into the environment, we follow this stage with dechlorination



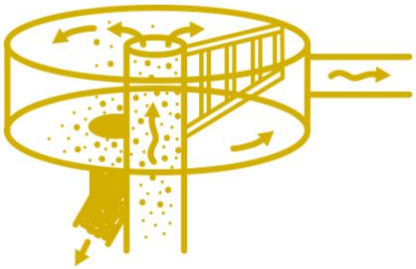
Dissolved air flotation

Sludge and scum we collected is thickened by pass tiny air bubbles through the mixture. Solids cling to the bubbles and are concentrated at the top and removed for further solids handling.



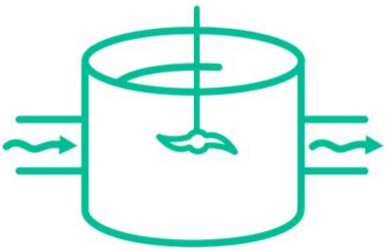
Clarifier

We slow the flow of water so microbes (activated sludge) settles to the bottom of the clarifier where scrapers remove it. The clear water on top is collected for further treatment.



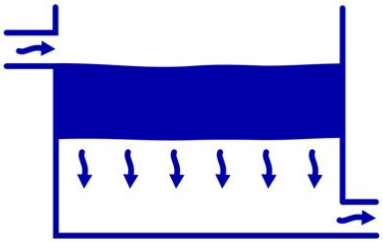
Aerobic digester

Thickened sludge is digested by microbes with air that break down and stabilise the sludge. This makes nutrients available to plants and reduces pathogens and odours.



Sand filters

Filters made of sand trap remove any remaining floc and fine solids



Centrifuge

We use high speed centrifuges spin sludge to remove water from the final biosolids. This helps make it lighter for easy transport in trucks.

Recycled water

We treat 24 million litres for onsite reuse, local sports fields, environmental flow and for further treatment using membrane technology at St Marys Advanced Recycling Plant.

Sorting game

Cut these cards out of items we find in wastewater and place where you think these items are removed in the flow diagram.

Discuss why you think it's important to remove these items, what should and shouldn't be in wastewater. Add other items you think people put down drains.

 wipes	 toys	 fine suspended particles	 poo
 razors & sharps	 pathogens	 condoms	 cotton balls

Sydney WATER

 money & jewellery	 pee	 cotton tips	 bleach
 sanitary products	 phones & electronics	 milk	 tissues
 paints	 washing powder & liquid detergent	 large food scraps	 small food scraps

 tea & coffee grounds	 toilet paper	 sand & gravel	 toothpaste
 soap	 cigarette butts	 fats, oil & grease	 nappies
 floss	 drugs and medicine		