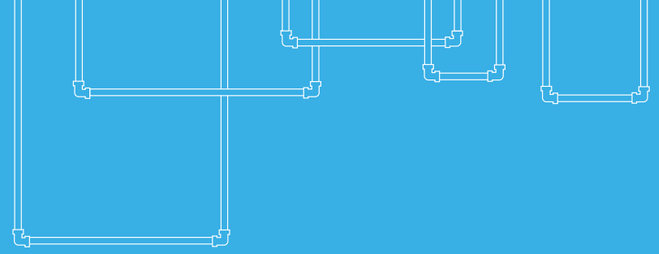
niwater

Delivering what matters

TAPPING INTO QUALITY WATER

IN NORTHERN IRELAND



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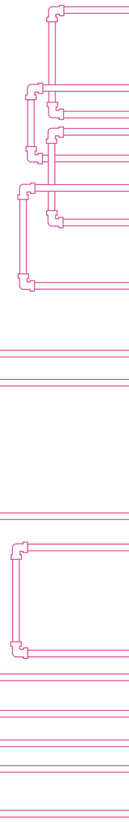


About NI Water

NI Water is a Government Owned Company (GoCo) set up in 2007 to provide the water and sewerage services in Northern Ireland. It is a Non-Departmental Public Body (NDPB) sponsored by the Department of Infrastructure who are the sole shareholder.

Domestic customers don't pay water charges instead NI Water receives a subsidy from Department of Infrastructure. Non-domestic customers have paid water charges since 2008.

We deliver clean, safe drinking water to approximately 900,000 households and businesses. To deliver this service we have a workforce of around 1300 people and require a huge system of pipes, pumping stations, water and wastewater treatment works and reservoirs.

Households and businesses
Our customers rely on the services we provide
910k

Water treatment works
We clean the water, making it safe to drink
24

Water mains length
We distribute the drinking water to our customers through water mains
27,000 km

Pumping stations
We use pumping stations to get the drinking water to our customers
351

Service reservoirs
We store the drinking water in service reservoirs
286*

Households and businesses
We collect wastewater from our customers
743k

Length of sewers
We collect wastewater from our customers using a network of sewers
16,500 km

Pumping stations
We use pumping stations to get the wastewater to our treatment works
1,350

Wastewater treatment works
We treat wastewater and return it safely to the environment
1,027

Sludge management centres
Sludge is de-watered before being incinerated
66

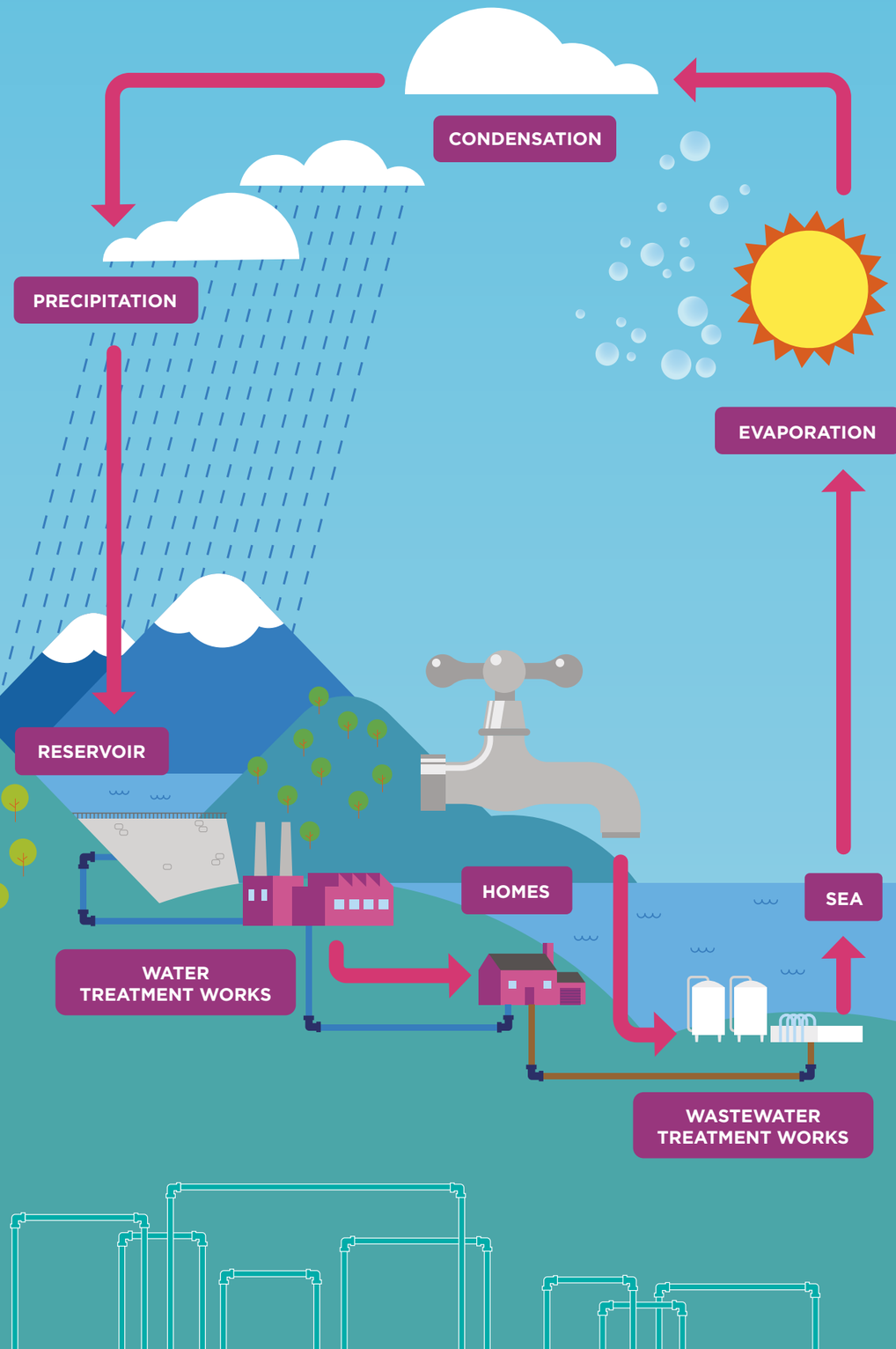
Water Resources

The earth has a finite amount of water, naturally circulated in the 'Water Cycle'. NI Water are custodians of this water cycle as we rely on this for our water supply.

The earth is approximately 75% water but 99% of this is unavailable for us to use. 97% is saltwater in the seas and oceans, 2% is frozen in the polar ice caps leaving only 1% as fresh water for us all to use. Global Warming, Climate Change and pollution are all having an effect on our Water Cycle impacting the quality of the water as well as where and when water is available.

* Number of service reservoirs in service and scheduled for regulatory sampling in line with the drinking water regulations.

The water cycle in action

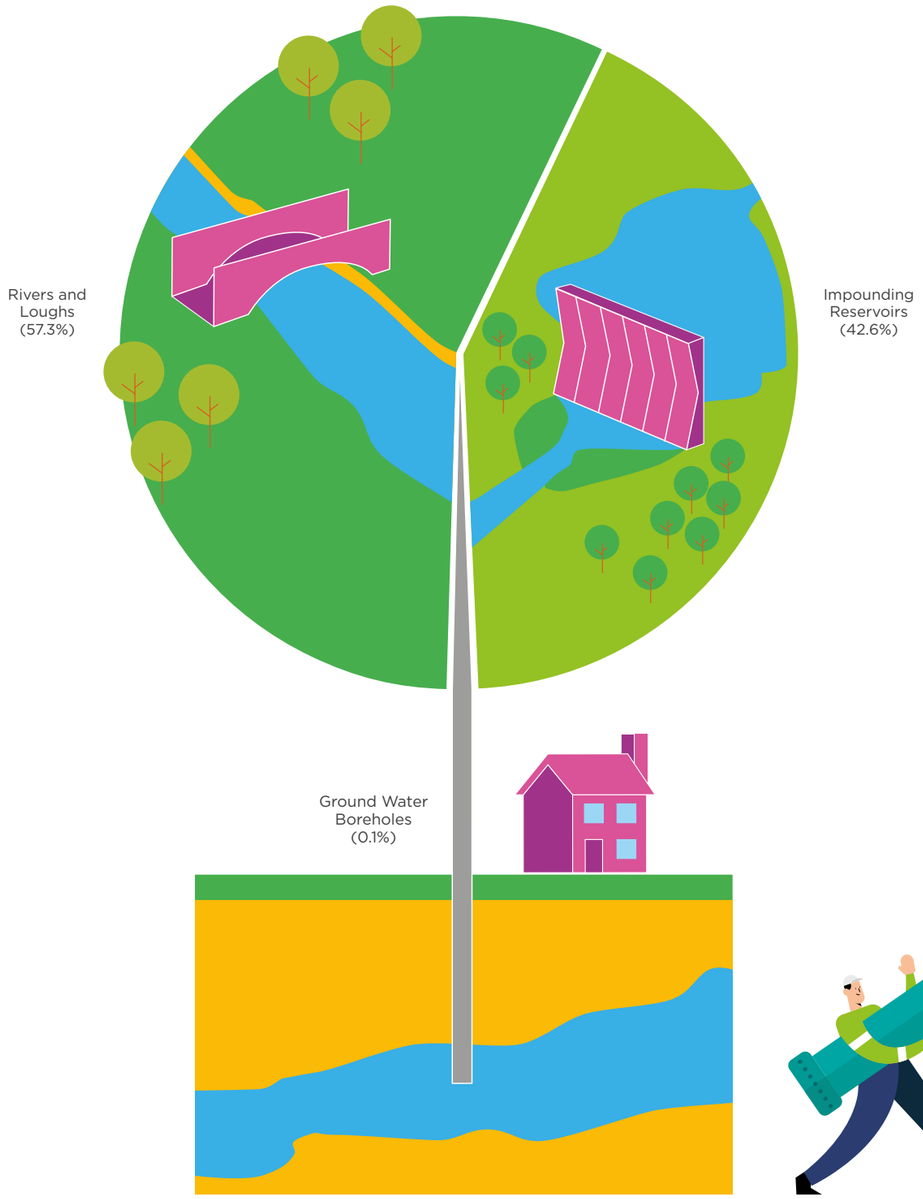


Where our water comes from

99.9% **of our water comes from surface water with the remaining water from groundwater via boreholes.**

NI Water utilise 39 sources of water including upland impounding reservoirs, boreholes, rivers and loughs.

Raw Water Sources



How water is treated and distributed

Raw Water

The natural water we see around us often appears to be clean but despite looking clean and safe to drink, water has the ability to contain a huge range of substances without changing its appearance making it unsafe to drink. A mixture of chemicals, micro-organisms and suspended solids are present in the raw water within rivers, loughs and reservoirs from a variety of sources and therefore the water must be treated before we can drink it.

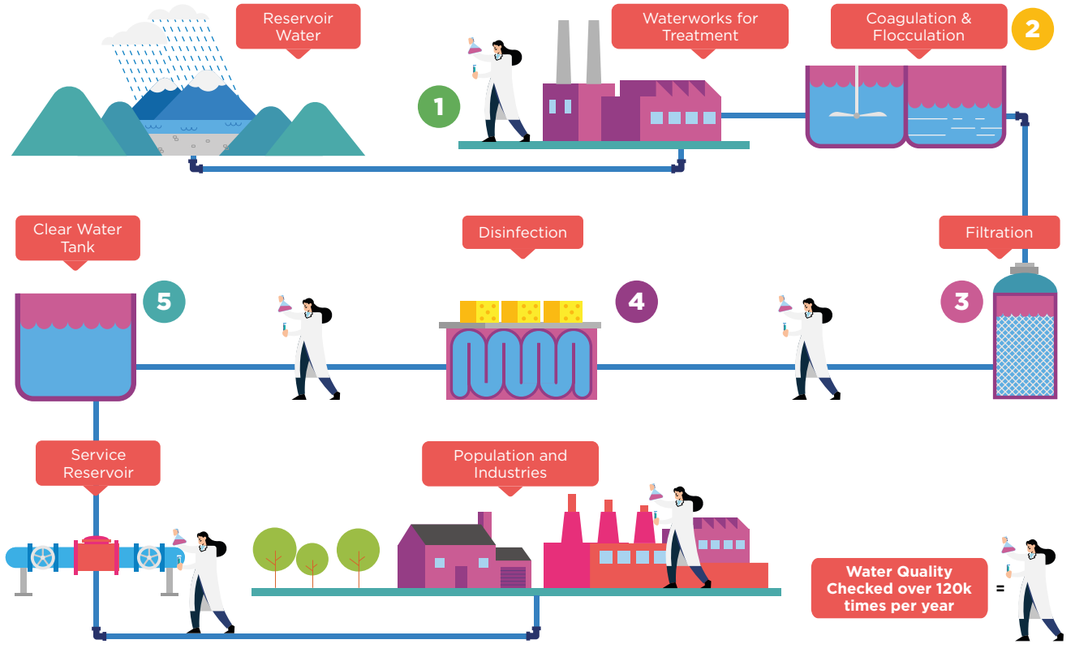
The raw water from each water source will differ in terms of the substances within the water but the water treatment process will take into account local factors and will always ensure the final water is cleaned and treated to a high-quality and complies with strict drinking water directives.

Sustainable Catchment Management

Sustainable catchment management is about improving the quality of the raw water in our drinking water catchments using nature-based solutions prior to treatment, so that we can save resources, protect habitats, and extend the life of our assets. Our team work to develop and implement on-the-ground catchment interventions with the help of a wide range of partners, from RSPB Northern Ireland to the National Trust, to reduce run off and pollution getting to the waterways we use to provide our customers with drinking water.

The Water Treatment Process

Everyday 24 water treatment works across Northern Ireland clean over 605 million litres of water ensuring customers receive a high quality product 24 hours a day, 7 days a week, 365 days a year.



The science behind water treatment

Treatment works may use one or more of the following chemical processes:

1. Coagulation and Flocculation before Coagulants such as aluminium sulphate may be added to the water to remove colour.

River and reservoir-stored waters usually contain dissolved (true) colour and finely divided material, often colloidal, which will not readily settle out and cannot be filtered out.

Coagulants, usually salts of iron or aluminium, can be added to form solid precipitates termed **floc**, containing these impurities. The **floc** can then be separated out using a conventional solid-liquid separation process. The process of flocculation, in which floc growth is encouraged by gentle mixing, is sometimes carried out depending on the requirements of the solid-liquid separation process.

The mechanisms of coagulation are:

a. Charge neutralisation and mutual adsorption

This requires a coagulant with ions of opposite charge to those of the colloidal particles to neutralise the repulsive charges. The colloids will then adhere to one another by adsorption. This is sometimes referred to as charge destabilisation. The trivalent ions **Al^{3+}** or **Fe^{3+}**, which form when aluminium or iron salts are added to water, hydrate to form aquometal complexes **$Al(H_2O)_6^{3+}$ or $Fe(H_2O)_6^{3+}$**. These then undergo hydrolytic reactions in which H_2O molecules are replaced by OH^- ions to produce hydroxometal complexes which are involved in charge destabilisation.

The formula for the reaction is simplified as: **$Al_2(SO_4)_3 + 3Ca(HCO_3)_2 = 2Al(OH)_3 + 3CaSO_4 + 6CO_2$**

b. Precipitation and entrapment

When the coagulant is added hydroxide precipitates form. These precipitates trap colloidal particles within their structure. In waters with a high colloidal content, the particles act as seed on which the precipitates easily form. This is known as sweep-coagulation.

c. Adsorption onto floc surface

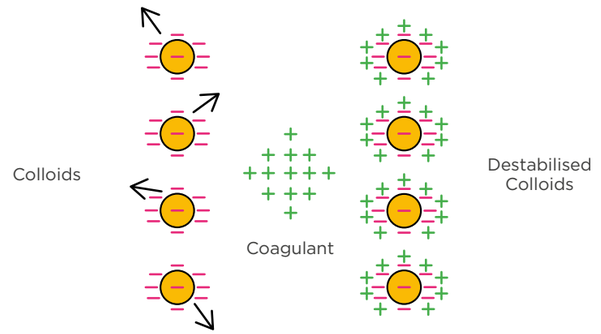
Once **flocs** have been formed colloidal particles and dissolved material will be adsorbed on their surface.

d. Co-precipitation

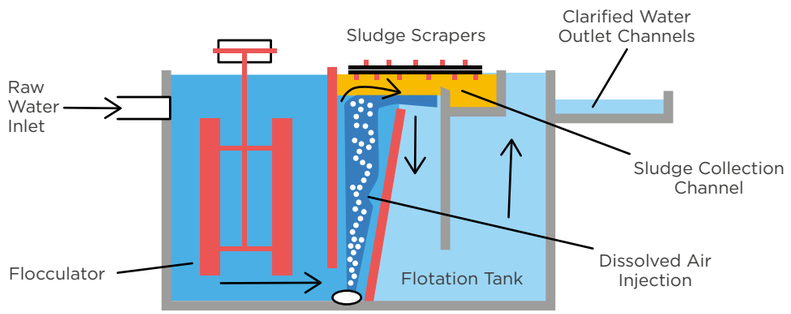
Where the coagulant forms precipitates it will incorporate the humid colour compounds as iron or aluminium humates. Separation of floc from treated water can be improved by the addition of flocculent aids, such as high molecular weight polyelectrolytes, normally anionic, which help bind the floc together. The next stage is to physically separate the floc particles from the water and this is done by sedimentation or flotation (Dissolved Air Flotation; DAF) followed by rapid gravity filtration.

Coagulation

How does Coagulation work?



2. Clarification

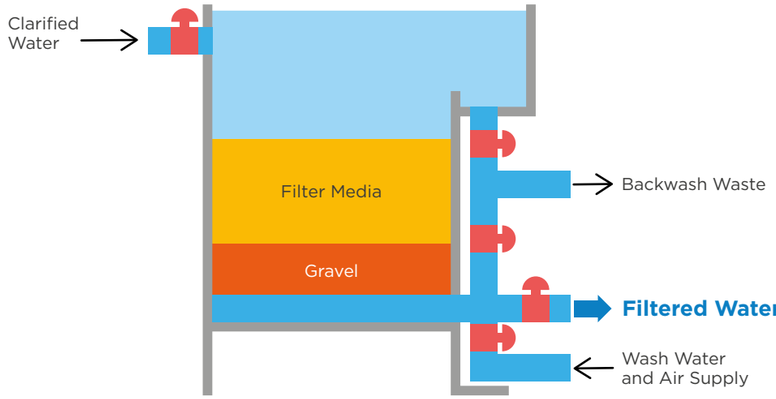


Dissolved Air Flotation Plant

3. Filtration

After coagulation and flocculation the water makes it way to slow gravity sand filters which take out any further particles in the water. A second filter completes the process.

Carbon medium.



The Rapid Gravity Filter

4. Disinfection

It is essential that the final treated water should be safe to drink and contain no bacteria that could produce disease. One way to do this is by using chemicals.

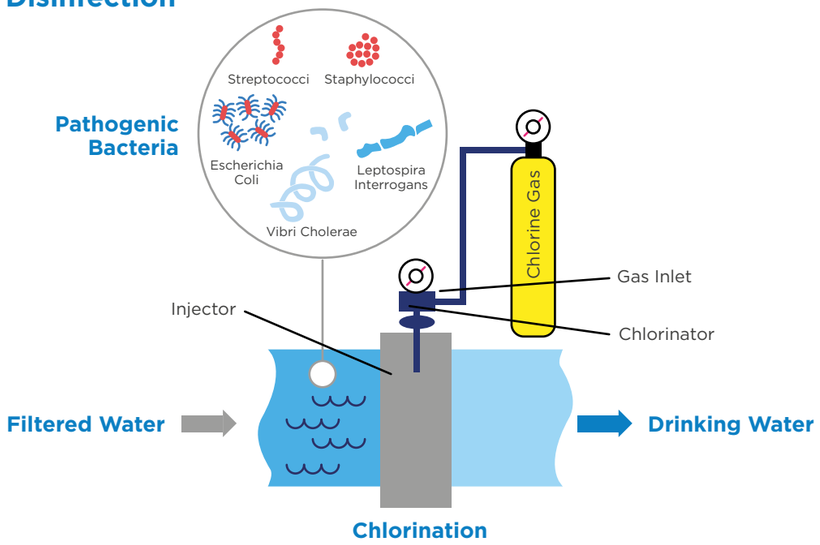
Chemicals that can be used are:

a. Chlorine - the most common. When **Cl_2** is added to water free from organic matter and ammonia, hypochlorous acid is formed. **$Cl_2 + H_2O = HOCl + HCl$** The very weak **HOCl** is further dissociated to **H^+** and **OCl^-**; the hypochorous acid **HOCl** and hypochlorite ion **OCl^-** are together known as the 'free available chlorine'.

b. Ozone

c. Sodium Hypochlorite

Disinfection



5. pH Adjustment

pH is a measure of the alkalinity or acidity of water. If water is too acidic it will corrode metal pipes. If it is too alkaline, it will cause a deposit to form. Natural waters seldom have a pH value below pH 5.5. Soft waters from moorland areas have pH values in the range of 6.0 to 7.0 (sometimes lower, in peaty areas). Waters containing carbonate hardness and little free carbon dioxide have a pH of about 7.5 to 8.0 or over. Waters in the range of 7.0 to 7.3 pH may be regarded as neutral. The Water Supply (Water Quality) Regulations (Northern Ireland) 2017 require that water in the distribution lies within the pH range of 6.5 to 9.5. pH adjustment is carried out using calcium hydroxide (**calcium oxide (CaO); lime**).

6. Manganese Removal

If manganese is not removed it can lead to staining or discoloured water in the distribution system. The removal of dissolved manganese (Mn^{2+}) from water requires a combination of high pH (through addition of lime) and an oxidant such as chlorine. Under these conditions, the manganese is converted into an insoluble form (Mn^{4+}) and removed from solution by an adsorption-precipitation mechanism onto the sand grains in the filter media. The reaction taking place in the chemical process is: **$Mn^{2+} + 2CaO + Cl_2 \rightarrow MnO_2 + 2CaCl$**

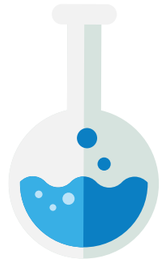
Quality Control

Before water reaches our taps every drop is cleaned to a high standard. To make sure it is safe water quality it is tested at various different points in the water supply system, including customer taps, by our team of highly skilled and experienced scientists at one of our dedicated laboratories in Belfast and Derry/Londonderry.

The quality of treated water is constantly monitored, and we analyse over

120,000

samples every year.



Drinking water quality compliance is assessed against the "Water Supply (Water Quality) Regulations (Northern Ireland) 2017". Currently overall compliance with drinking water regulations is 99.91%.

For further information on your drinking water quality visit: www.niwater.com/drinking-water

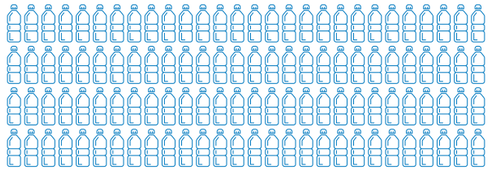
Join the Refillution

Our water quality testing shows that we are continuing to supply high quality water to all our customers across Northern Ireland with tap water not only being good for you but also good for the environment!

Northern Ireland uses around

145 million

single use plastic bottles every year.



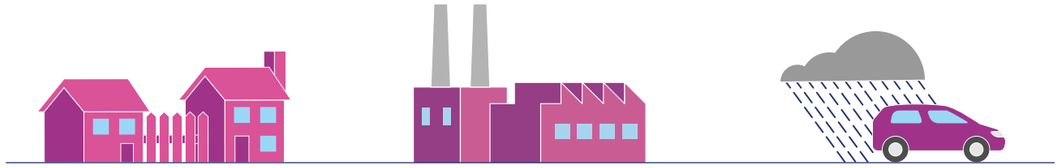
Many are discarded, ending up polluting our rivers and seas. By switching to a reusable bottle, we can help turn the tide in helping to reduce plastic waste. If just 1 in 10 refilled just once a week, we would save around 340 million plastic bottles a year!!

With our top quality tap water we can stay hydrated and reduce our plastic waste - a win-win for everyone.

The wastewater treatment process

NI Water cleans over 373 million litres of wastewater everyday. Wastewater includes all domestic wastewater from the kitchen, bathroom, factories and rainwater from roads and outdoor surfaces. Whilst the popular idea of sewage may be a thick lumpy sludge, in fact 99% of sewage is water.

Wastewater Sources - Where does sewage come from?



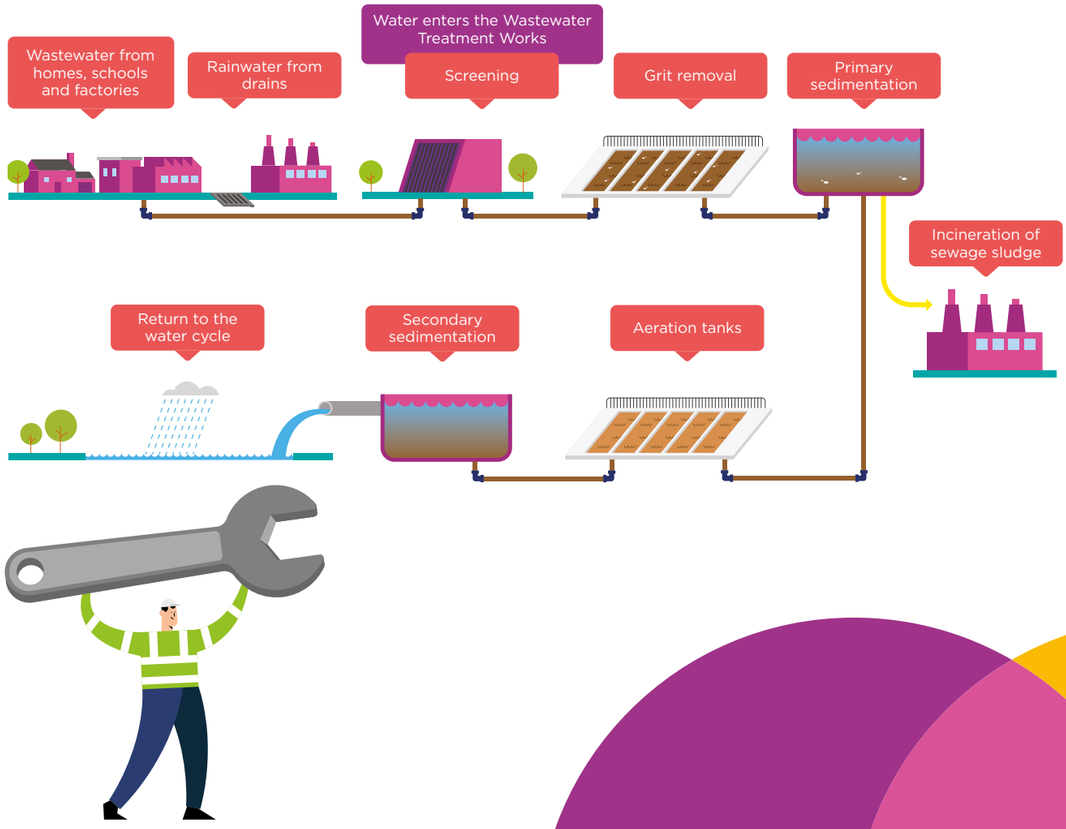
Residential
Sinks, Toilets, Baths, Waste

Industrial
Chemicals, Grease, Waste Solids & Liquids e.g. Food Wastes, Milk, Metal Finishing

Surface Water
(in combined systems only)

The treatment process relies on the combination of physical separation of solids from the sewage and the use of biochemical processes to reduce harmful organic and chemical substances.

Wastewater Treatment Process: Over 373 million litres per day



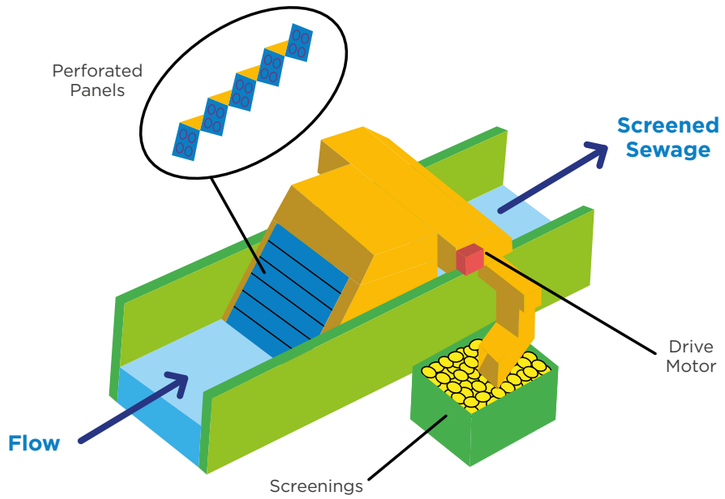
1. Screening the Wastewater

Wastewater can contain a lot of rubbish and objects that may block or damage equipment or pollute our water courses.

Many items that should never have been put down the sewers/drains in the first place such as wet wipes, nappies, sanitary items and cotton buds all need to be removed via screening before treatment can begin.

Special machines called Detritors also filter out the grit that often washes into the sewers with the wastewater.

Screening - Removal of Plastics and Rags



2. Primary Settlement

The wastewater will still contain organic solid matter - human waste. In our primary settlement tanks we separate the waste from the water, the solids will sink to the bottom and settle to form ‘sludge’ – scrapers help push the sludge towards the centre of the tanks, where it is then taken away for further treatment.

The cleaner water passes over the tank wall ready for the next stage of treatment.

3. Biochemical Processes

Although the larger bits of sludge have been removed we now need to take out the smaller and sometimes invisible micro-organisms which are often harmful. At our larger wastewater treatment works we put the wastewater into ‘aeration lanes’ which pump air into the water which encourages useful microbes to break down and eat the harmful microbes To do this wastewater treatment works may use one or more of the following biochemical processes.

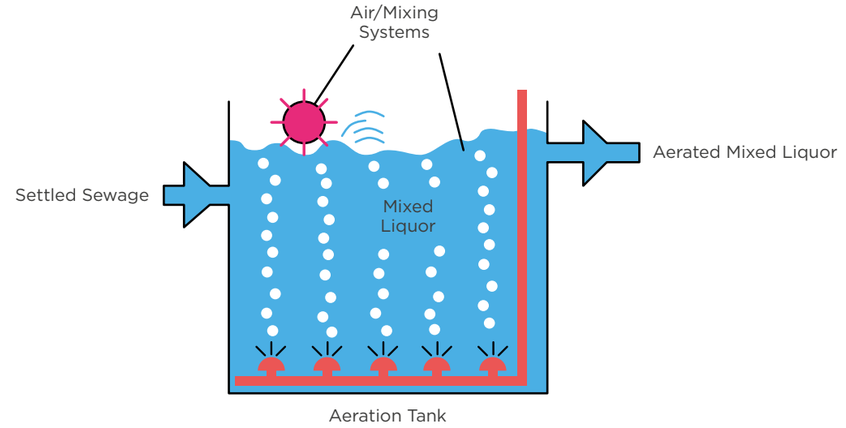
a. Biological activated sludge

Activated sludge may be defined as ‘the flocculent microbial mass of bacteria, protozoa, and other microbes with a significant proportion of inert debris, produced when sewage is continuously aerated’. It consists mainly of organisms which are able to metabolize and break down the principal contaminants of wastewater. The activated-sludge process is a method of treating sewage and other biodegradable wastewaters, by aerating and agitating the liquid in a mixture with activated sludge, and subsequently separating it from the treated effluent by settlement. Most of the separated sludge is then returned for re-use with the excess being removed for disposal as surplus activated sludge.

b. Biological filtration

Settled sewage is passed through a 2 metre deep bed of small stones or other materials (media) using distributor arms. Bacteria, fungi and other organisms living on the media surface breakdown the sewage as it passes through the bed.

Biological Treatment



Biochemical Action on Organic Matter

4. Phosphate Removal

Phosphate is removed from wastewaters in order to prevent the eutrophication (nutrient enrichment) of the receiving waters. This is particularly important for inland waterways such as the Lough Neagh or Lough Erne/systems. Phosphorous is present in wastewaters in three forms: orthophosphate ion, polyphosphates and organic phosphorous compounds. Polyphosphates can be looked upon as polymers of phosphoric acid from which water has been removed, complete hydrolysis results in formation of orthophosphate.

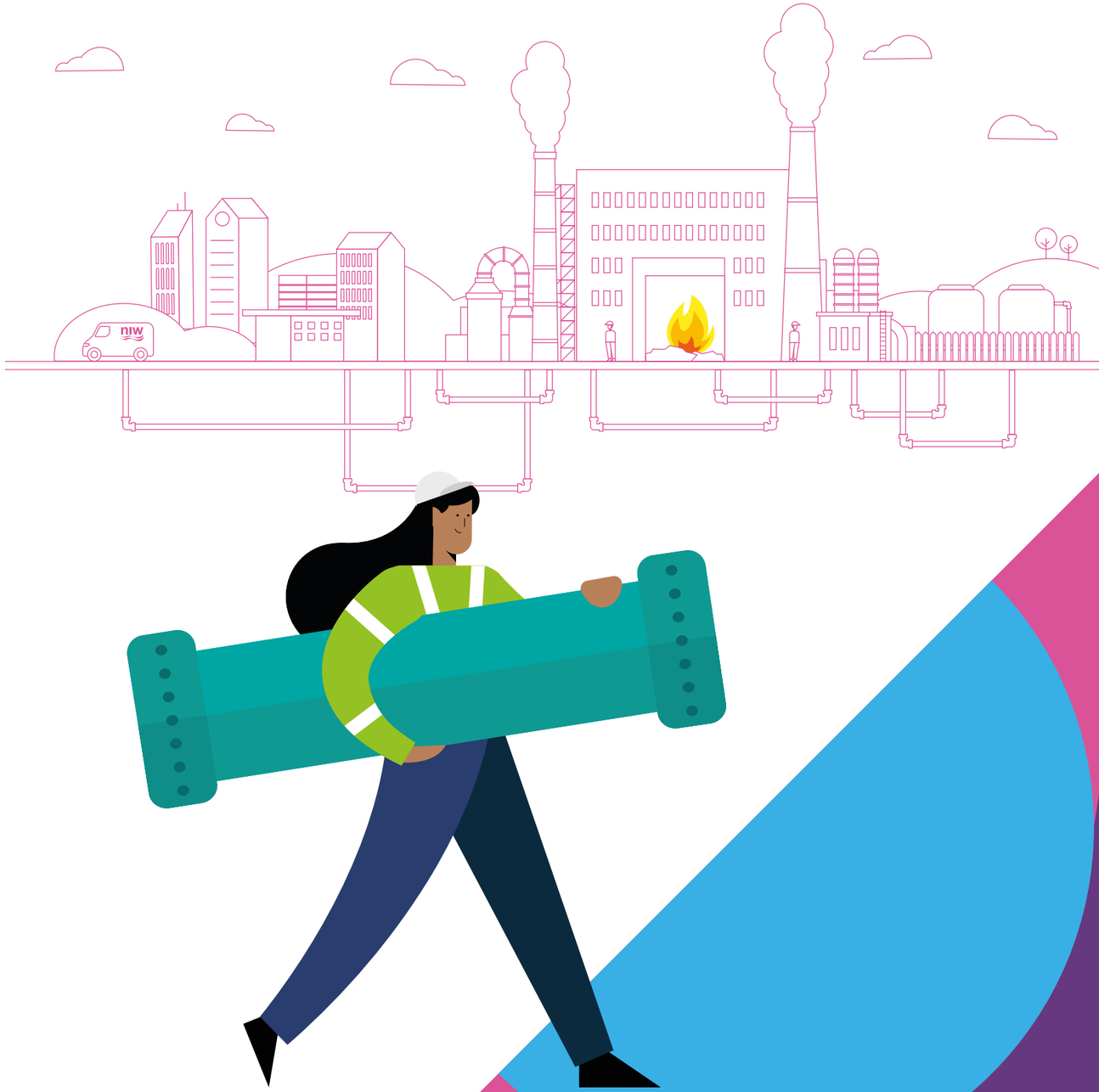
The chemistry of organic phosphates is complicated but their decomposition also leads to orthophosphate. In raw sewage, all three forms are present in significant amounts. After biological treatment the main form of phosphorous in the effluent is orthophosphate. The standard form of orthophosphorous in wastewater is $PO_4\ 3^-$. When a metal salt (M^{3+}) is added to the wastewater, the precipitation of phosphorous can be expressed as follows: $M^{3+} + PO_4\ 3^- MPO_4$. This precipitate is then removed. The normal metal salt added is Ferric Aluminium Sulphate.

5. Final Settlement

As the water enters the final settlement tank, any remaining solids including the useful microbes sink to the bottom forming more sludge which is recycled back to the aeration lanes and the clean water spills over the top of the tank and is channelled back to the nearest water course.

Incinerator

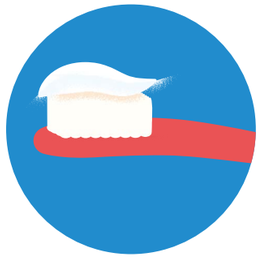
Up to the end of 1998 disposal of sewage sludge was traditionally concentrated on agricultural land and dumping at sea. Disposal at sea became prohibited and from 1999 sewage sludge from across Northern Ireland has been incinerated in Belfast at one of two incinerators. The incinerators are operated by an external company under a Public Private Partnership contract on behalf on NI Water. The ash from the incinerator is disposed at landfill.



Protecting our water – What can you do to help?

Water Efficiency

There are lots of easy ways to save water around your home. Try making the little changes you see here and you will make a big difference.



Turn off the tap while brushing your teeth to save over 6 litres of water per minute.

Take shorter showers. Reducing your shower time by just 1 minute can save up to 7 litres of water!

Keep a jug of water in the fridge for drinking. There'll be no need to run the tap until it goes cold every time.

Wash the car with a bucket instead of a hose. You'll save up to 1,000 litres of water an hour!

Use your toilet's half-flush function (if it has one). That'll save 3 litres every flush.

Save water in the garden. Water plants when it's cooler and use a watering can instead of a hose.

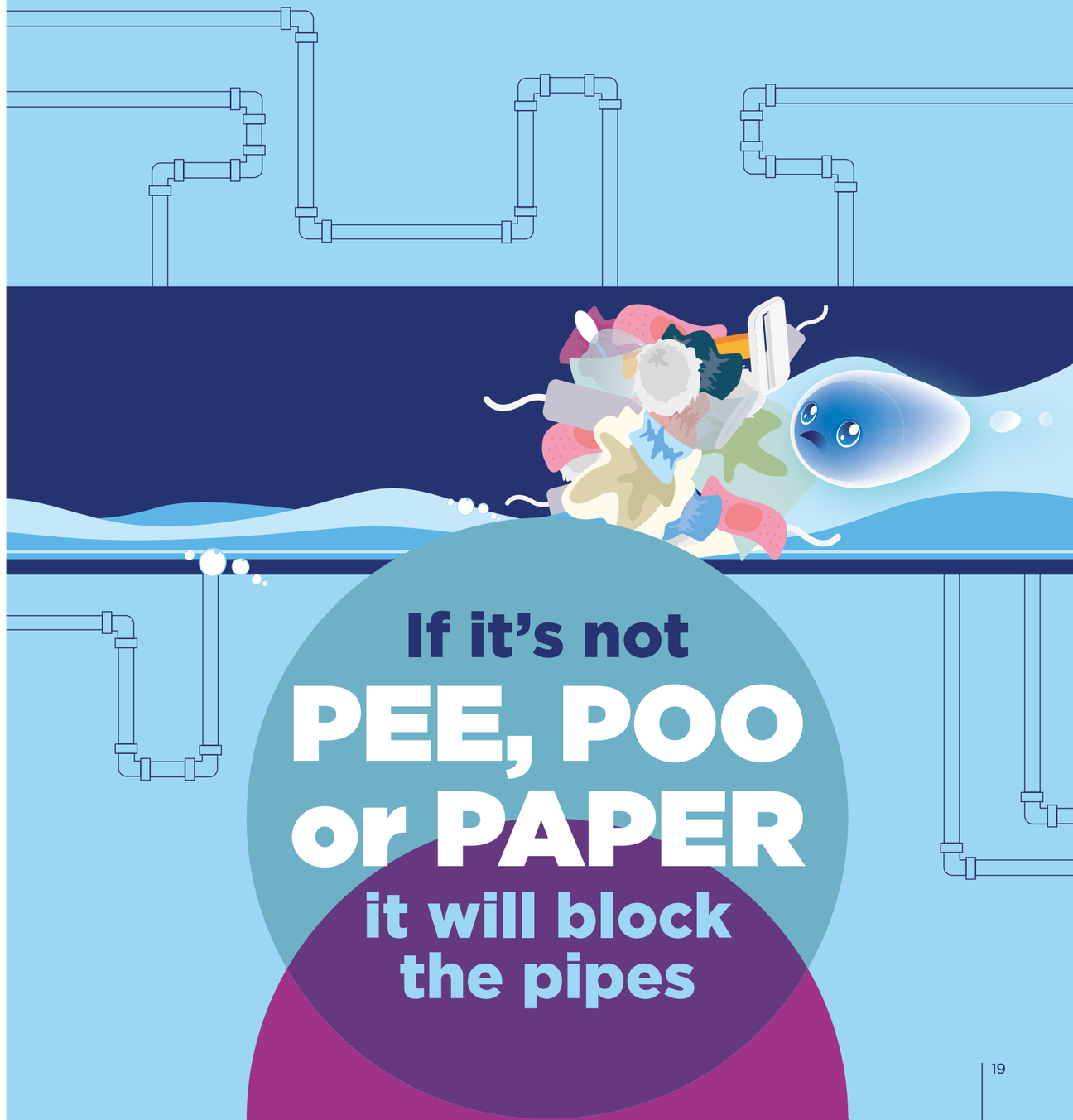
Only fill the kettle to the amount of water you need. If you're only making two cups of tea, don't fill it to the brim!

For more water saving tips visit: www.niwater.com

Bag it and bin it

Did you know?

Every year, people putting the wrong things down the toilet and drains cause hundreds of blockages, which floods homes and gardens and can even end up in our water courses. Remember -The only things that **should** be flushed down the toilet are the 3'ps – poo, pee and paper.



NI Water - Sustainability

Climate Change

As the largest user of electricity in Northern Ireland, NI Water has an important role to play in helping to tackle climate change. We have ambitious targets to achieve net zero for the energy we use by 2030 and reach net zero for all our emissions by 2040. We are doing this in several ways and we have highlighted some examples below:

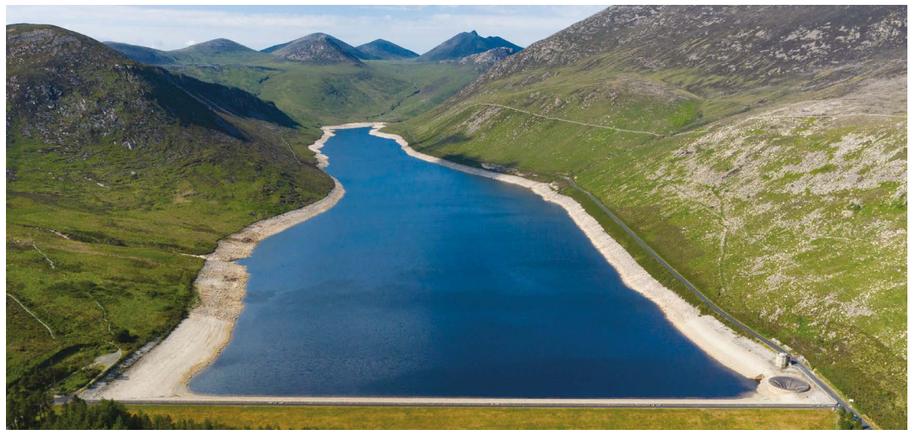
- Reduce our energy demand by becoming more water and energy efficient;
- Shift to 100% renewable electricity through investment in solar power, battery energy storage, green hydrogen, hydro and wind power;
- Switch to electric vehicles and zero carbon fuels for heating our buildings, homes, and businesses;
- Restore and protect peatlands;
- Plant the right trees in the right places;
- Recover energy from waste sludge;
- Protect raw water sources; and
- Remove carbon from construction.

For further information about NI Water's climate initiatives visit: www.niwater.com/climatechange

Keeping the water flowing – planning for the future

Planning for the Future

Although we have a generous supply of rain in Northern Ireland, the demand for water from customers is increasing and although there is currently a sufficient supply of raw water to NI customers an increase in the number of dry periods with higher than normal temperatures over recent years has lead to 'high demand' events during which customer usage increases dramatically. This can cause localised issues when water cannot be supplied quick enough to meet demand, this is because of hydraulic constraints within the water network rather than an issue with the availability of raw water.



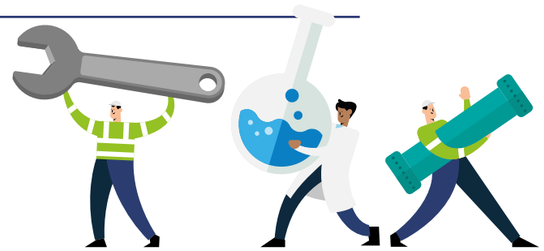
As part of its on-going long term forward planning process NI Water produces a Water Resource & Supply Resilience Plan (WR & SR Plan) approximately every 6 years. The WR & SR Plan is an important document for NI Water, as it shows how the company will manage and develop water resources to make sure there is enough water to meet future supply needs. The WR & SR Plan takes into account changes in population, housing, water usage and incorporates any predicted changes to our climate. This includes how water supplies would be maintained during critical periods such as severe winters, drought and also includes a drought plan.

The last plan was published in June 2020 and can be accessed here: www.niwater.com/managing-northern-irelands-water-resources/

Any strategic changes to the supply of water will be informed by the WR & SR plan. In addition to that plan smaller local changes may take place to optimise how water is supplied locally in our distribution network. The network is configured into Supply Zones (linked to the supply WTW's), and then incrementally into smaller areas defined as District Metered Areas and Pressure managed areas. The boundaries of these areas are continually being reviewed and refined as necessary to provide resilience to the network and ensure customer service is achieved. An example of why change is necessary is due to new properties being added to the network.

Careers

NI Water provides a great place to work powered by talent. Join us and help to **“Deliver what matters”**.



Where can I make a difference?

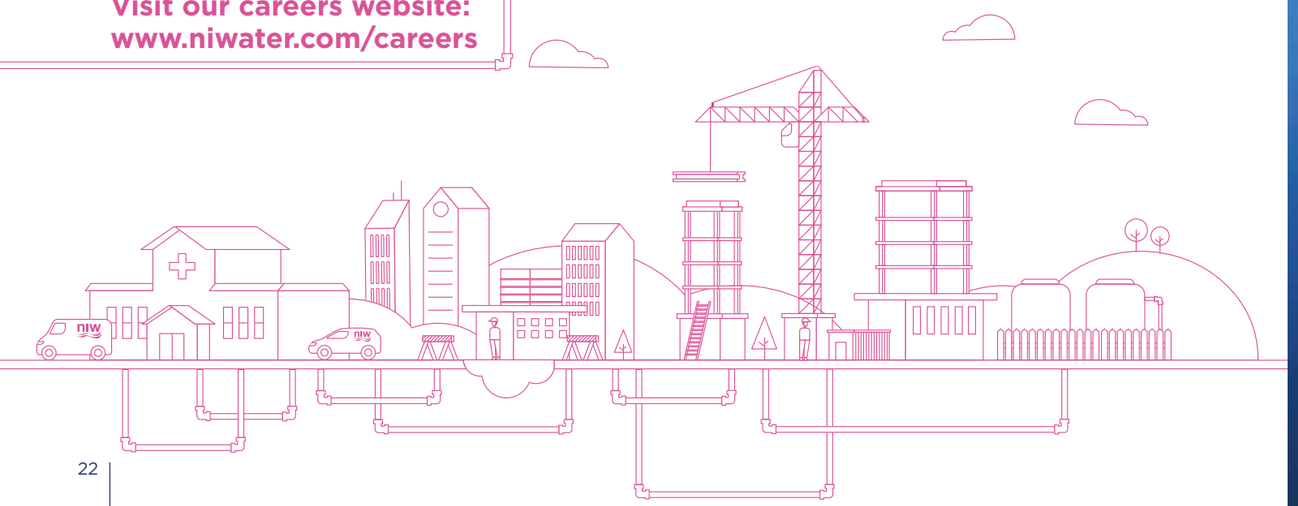
The task of bringing water to the people of Northern Ireland is huge and there’s lots to learn, with lots of experiences on offer, we have career opportunities in:

- Data Analytics
- Customer Service
- Analytical Sciences
- Engineering
- Information Technology
- Human Resources
- Legal Services
- Finance
- Energy
- Operations
- Communications
- Internal Audit

The support staff underpin all the work that NI Water do and are crucial to our day-to-day operations.

Our frontline staff are at the heart of delivering what matters, they carry out a range of hands-on roles from operating our Water & Wastewater Treatment Works to detecting and fixing interruptions to our supply network. Sign up to our Entry Level Academy which provides a wide range of apprenticeships and graduate opportunities.

Visit our careers website:
www.niwater.com/careers



NI Water are guardians of the infrastructure, the networks and assets, but every one of us uses the service. Only together can we continue to protect our most valuable and precious asset – **water**.

Image courtesy of Edna Teggarty

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Feb 2024

niwater

Delivering what matters