Water utilities and services:

Priority actions towards a nature-positive future

September 2023

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Executive summary

The water utilities and services sector is critical to securing the availability and sustainability of water and sanitation for all - a basic human right[1] and core to United Nations Sustainable Development Goal (SDG) 6. However, the sector's impacts and dependencies on nature in providing this public service are increasing, driven by growing demand and accelerating changes in our climate.

This places the water utilities and services at the heart of the world's response to the interconnected nature and climate crises. If not transformed urgently and conscientiously, the sector will continue to have significant impacts on nature, with unsustainable freshwater use and competition for water resources resulting in a global water crisis[i]. The natural ecosystems and biodiversity that the sector interacts with are already in peril, particularly freshwater species which have seen an 83% decline globally since 1970.[2] Water quality is also deteriorating and 2 billion people do not currently have access to safe drinking water.[3]

To complement ongoing sustainability initiatives, all businesses need to **A**ssess, **C**ommit, **T**ransform and **D**isclose (ACT-D high-level business actions on nature). They should acknowledge the value of nature to their business; assess and measure their impacts and dependencies on nature; set transparent, time-bound, science-based targets; take actions to address their key impacts and dependencies; and publicly disclose performance and other relevant nature-related information.

Water utilities and services businesses vary globally, influenced by their geography, policies and regulation, and different operational models and infrastructure. The analysis presented in this report recognizes these differences and provides a sector-level summary of potential key impacts and dependencies on nature. Importantly, this report sets out the priority actions that all businesses should take now to **transform** and ensure the water utilities and services sector plays its role in halting and reversing nature loss by 2030 - the mission at the heart of the Kunming-Montreal Global Biodiversity Framework.

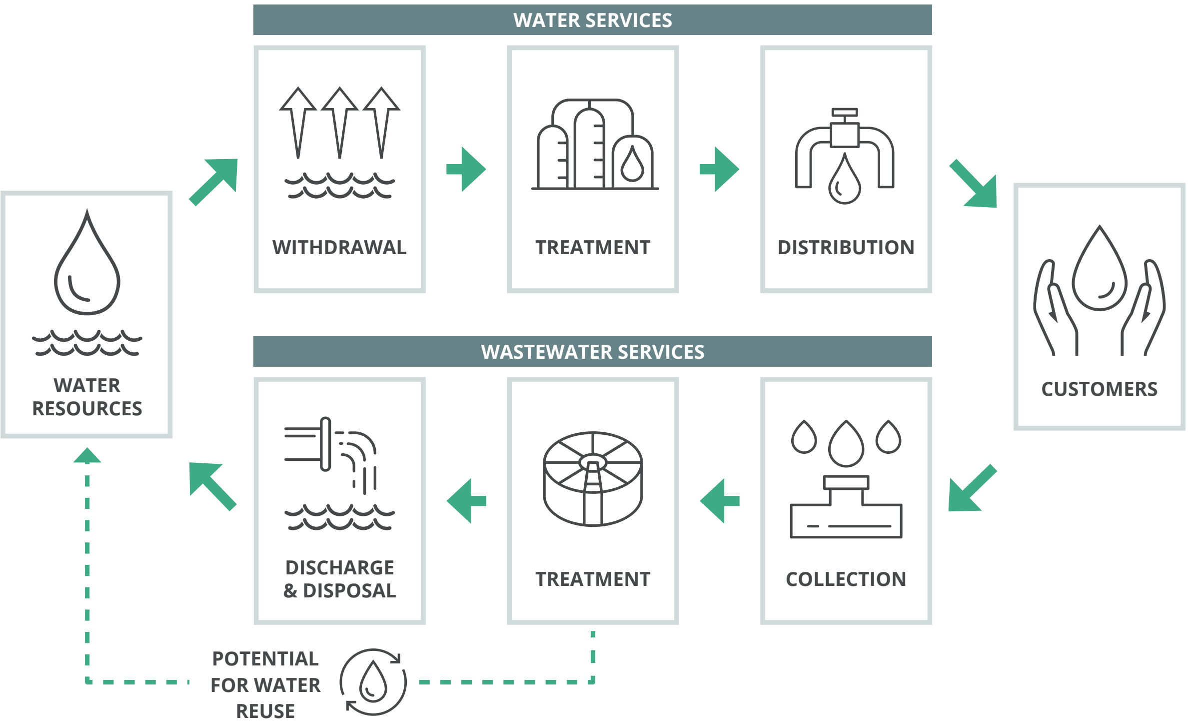
Scope of this report

Water utilities and services (SICS code: IF-WU) businesses are structured differently across the world. For this report, water utilities and services businesses are taken to include:

- Businesses that own or operate water supply and wastewater treatment systems and are generally structured as regulated utility businesses.
- Water services businesses that provide operational and other specialized water services to system owners and are generally market-based operations.

Out of scope are businesses in the food sector, including manufacturers and suppliers of bottled water.

Figure 1. Water utilities and services value chain



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[i] *Although the water crisis is global, its effects tend to manifest locally*

Nature-related impacts

To protect and enhance the ecosystems on which they depend, water services and utilities businesses should direct their efforts towards addressing the most significant impacts on nature in their operations and value chains, namely:

- **Freshwater use |** While playing a crucial role in providing drinking water, the sector contributes to the global water crisis through unsustainable freshwater withdrawal (or abstraction) and water loss. This is exacerbated by high consumption rates, population growth and climate change impacts.
- **Pollution |** Water utilities and services businesses contribute in varying degrees to the pollution of rivers, lakes and coastal waters through undertreated and/or untreated wastewater discharges as well as ageing, leaky infrastructure.
- **Land and water use change and degradation |** The sector can damage terrestrial and freshwater ecosystems (and in some cases, coastal ecosystems) from activities across the whole value chain. The most notable impacts tend to arise in direct operations through water withdrawal (or abstraction) and flow alteration, and wastewater treatment and disposal.
- **Greenhouse gas (GHG) emissions |** The sector emits GHGs across the entire value chain, raising the concentration in the atmosphere and amplifying global warming. The main sources of GHGs are energy consumption from fossil fuels, process emissions from sewers or biological wastewater treatment and untreated wastewater discharge, and emissions from wastewater disposal and sludge management.

Nature-related dependencies

Like many sectors, water utilities and services are dependent on a number of ecosystem assets, flows and services to function and grow. In particular, water utilities and services businesses rely heavily on:

- **Water flow maintenance |** The provision of clean water to meet human needs relies on the hydrologic cycle to recharge groundwater sources and maintain surface water flows.
- **Freshwater quantity (surface and ground water) |** As a direct physical input to the value chain, the sector is dependent on sufficient freshwater from both surface waters (natural or artificial waterways containing freshwater, including lakes, rivers, streams and canals) and ground water (freshwater located in the subsurface pore space of soil and highly permeable rocks called aquifers).
- **Freshwater quality (surface and ground water) |** Water filtration and purification is essential to meet human needs while underpinning ecosystems on which the whole environment relies. The quality of water determines the extent of treatment required.
- **Soil quality |** Healthy soils form a key component of the hydrologic cycle and are critical to sustaining the sector as they store, accept, transmit and purify water.

These dependencies strengthen the business case for investing in protecting and restoring nature.

Priority actions and opportunities

As a business in the water utilities and services sector, you can reduce your company's negative impacts on nature, mitigate risks to your operations and unlock commercial by prioritizing five key actions:

1. **Avoid sourcing freshwater in water-stressed regions and areas important to biodiversity; and reduce unsustainable freshwater use |** Take a watershed approach to water management to ensure sustainable freshwater withdrawal. Locate suitable long-term water resources with full consideration of societal, climate and nature impacts, particularly in water-stressed regions and areas important to biodiversity (see Net Positive Water Impact (NPWI) journey for example). Utilize water reuse as a reliable alternative source of potable water. Develop data-driven smart water management systems to improve water allocation, support efficient water usage and increase water security. Educate and incentivize customers to reduce water use (see 50L Home global platform to encourage water efficiency and boost awareness).

2. **Avoid and reduce water pollution |** Implement a range of solutions to help minimize your impacts on water pollution, including to modernize and/or rehabilitate facilities; utilize wastewater and sludge as a circular resource for energy, nutrients and other recoverable materials; leverage technologies for a smart wastewater network; and educate customers to reduce pollution from blockages.

3. **Avoid and reduce greenhouse gas emissions |** Take action across the whole value chain, focusing not only on energy-intensive treatment and distribution processes in direct operations, but also accounting for and managing embodied carbon. Undertake full life cycle carbon accounting, harness technologies to reduce nitrous oxide (N_2O) and methane (CH_4), and source and generate renewable or low-carbon energy to achieve an energy-neutral water cycle. Utilize tools such as IWA Climate Smart Water Utilities, WBCSD Wastewater Impact Assessment Tool (WIAT) and Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) Tool.

4. **Restore and regenerate habitats and ecosystems |** Work in partnership across catchments to conserve intact habitats and restore and regenerate degraded or converted ecosystems, for example by investing in natural infrastructure and implementing Nature-based Solutions (see IWA Nature-Based Solutions for Wastewater Treatment, the TNC Resilient Watersheds initiative, and IWA Nature for Water: A Series of Utility Spotlights for case studies). Where possible, locate interventions near your activities or the activities of your suppliers. Utilize the UN Decade on Ecosystem Restoration principles to identify best practices for restoring degraded land, freshwater and marine ecosystems.

5. **Transform the sector through circularity, partnerships and policy |** Work with policymakers to ensure the local, national and even international regulatory landscape supports effective implementation and scaling of actions for nature. Refer to the International Water Stewardship Standard 2.0 to develop collaborative approaches across business, sector, government, community and civil society organizations, and utilize IWA Water Utility Pathways in a Circular Economy, the World Bank's Water in Circular Economy and Resilience (WICER) framework and WBCSD's Circular Transition Indicators to adopt and support circularity.

Importantly, efforts to deliver these priority actions and transform the sector must be delivered in line with a just and equitable transition, including meaningful dialogue with affected groups, such as employees, local communities, Indigenous Peoples and marginalized communities.

Introduction

Nature underpins our collective wellbeing and is critical to our survival as a species. The services it provides promote human and economic development, health, security and equality. Nature is also our best ally in building resilience to climate change.

Nature's critical role is being increasingly recognized within the business and finance community – with some companies starting to embed natural capital in their decision-making to transform value chains and respond to shifting expectations from consumers, policymakers and regulators. However, corporate action on nature is lagging far behind climate action. Research shows that 83% of Fortune Global 500 companies have targets to address climate change, versus only 5% for biodiversity loss.[4]

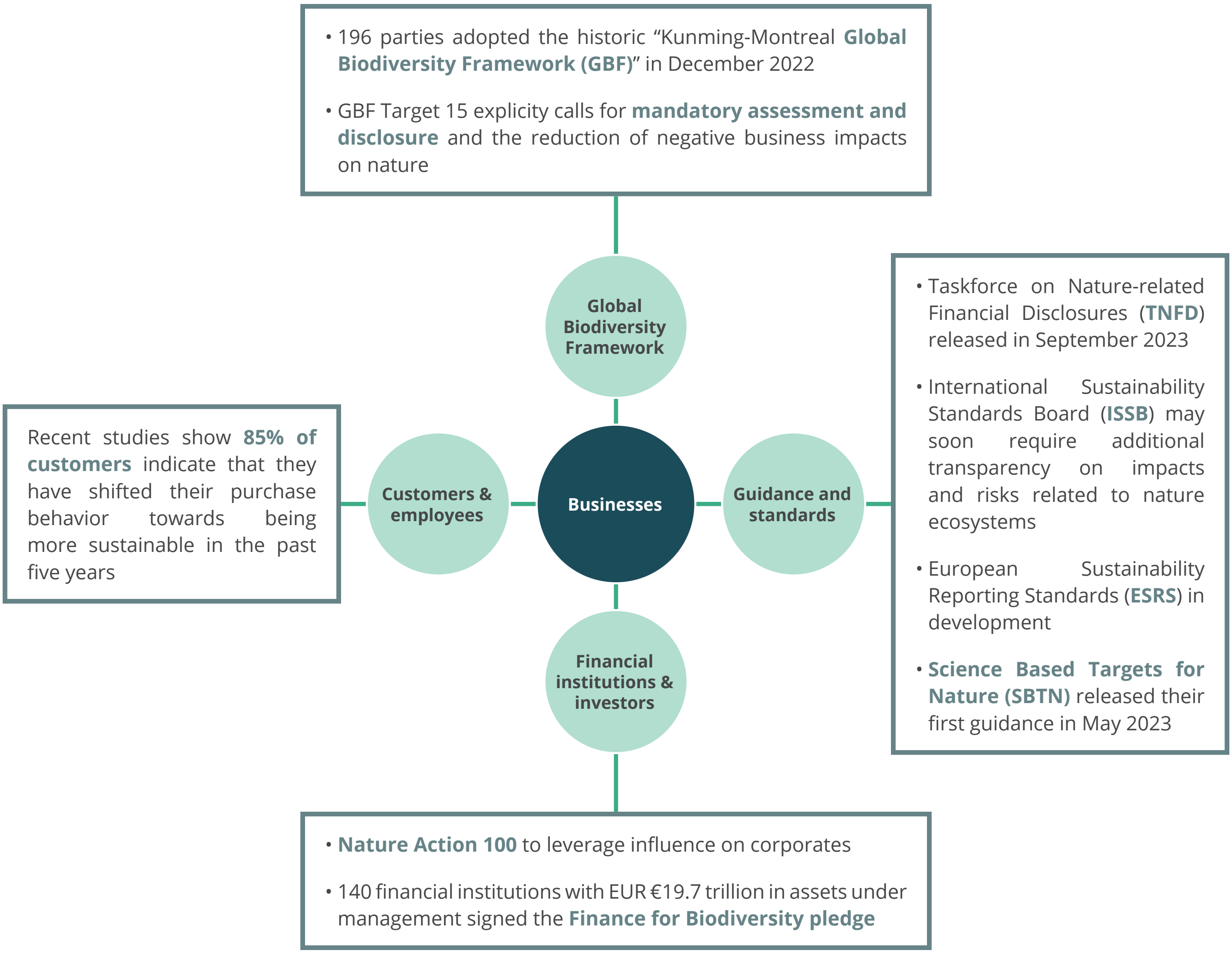
All parts of our economy are dependent on nature and its ecosystem services to continue functioning. Yet, each sector has unique dependencies and impacts on nature along its value chain. To take nature-positive action at the scale and speed required, it is therefore crucial for businesses to understand their specific interactions with nature within their sector context.

This report examines water utilities and services' specific impacts and dependencies on nature and biodiversity and sets out the priority actions that businesses in the sector should take now to credibly contribute to a nature-positive future.

Why nature matters for business

The importance of nature is swiftly rising for businesses in the real economy, as well as for the financial services industry and investors. A growing number of corporate leaders recognize the need to step up corporate action on nature, with four key dynamics shaping this imperative, as set out in figure 2.

Figure 2. Key nature-related dynamics impacting action on nature[4]



- 196 parties adopted the historic "Kunming-Montreal **Global Biodiversity Framework (GBF)**" in December 2022
- GBF Target 15 explicity calls for **mandatory assessment and disclosure** and the reduction of negative business impacts on nature

Recent studies show **85% of customers** indicate that they have shifted their purchase behavior towards being more sustainable in the past five years

- Taskforce on Nature-related Financial Disclosures (**TNFD**) released in September 2023
- International Sustainability Standards Board (**ISSB**) may soon require additional transparency on impacts and risks related to nature ecosystems
- European Sustainability Reporting Standards (**ESRS**) in development
- **Science Based Targets for Nature (SBTN)** released their first guidance in May 2023

- **Nature Action 100** to leverage influence on corporates
- 140 financial institutions with EUR €19.7 trillion in assets under management signed the **Finance for Biodiversity pledge**

The Kunming-Montreal Global Biodiversity Framework (GBF), adopted in December 2022 by 196 parties, commits governments to adopt policies to halt and reverse nature loss by 2030. The framework's 23 targets call for the collective effort of all actors of society: governments, business and civil society. Target 15 in particular explicitly calls for the mandatory assessment and disclosure of businesses' risks, impacts and dependencies on nature – sending a strong signal that businesses will need to step up their efforts to protect and restore biodiversity.

Business action on nature is also driven by the recent introduction of **voluntary guidance and mandatory standards**. For example, the European Sustainability Reporting Standards (ESRS) under the Corporate Sustainability Reporting Directive (CSRD) will mandate companies to disclose specific metrics regarding their impacts on nature and biodiversity, as well as their exposure to nature and biodiversity loss. Voluntary initiatives include the Science Based Target Network's (SBTN) initial set of science-based targets for nature and the Taskforce on Nature-related Financial Disclosures (TNFD) recommendations for nature-related financial disclosures, both designed to guide and support businesses in taking action on nature and meeting upcoming regulatory requirements.

Initiatives by **financial institutions and investors** are also ramping up, with over 140 financial institutions representing EUR €19.7 trillion in assets under management signing the Finance for Biodiversity Pledge. In addition, investors are coming together through the Nature Action 100 initiative to engage corporates on the importance of taking action on nature. The finance sector has a crucial role to play in allocating capital that will enable the transition towards a just, resilient and nature-positive economy.

Finally, **customers and employees** are increasingly expecting business to shift to models and products that protect nature and biodiversity rather than harm it. In UEBT's 2022 Biodiversity Barometer,[6] the loss of biodiversity was the second most urgent environmental concern for consumers after climate change. A company's approach on nature is therefore likely to increasingly influence consumer choices going forward. Indeed, research shows that there are significant commercial opportunities to be unlocked by companies willing to embrace nature-positive business models.[7]

How business can take action on nature

The concept of “nature positive” is widely acknowledged as a global goal to halt and reverse nature loss by 2030 and achieve full recovery by 2050, as captured in the mission statement of the GBF. A nature-positive world is a world where nature – species and ecosystems – is being restored and regenerated rather than declining. Individual companies, financial institutions and investors can contribute to this shared goal by adopting nature strategies across their spheres of control and influence. This includes modifying their direct operations (specifically at sites in locations of biodiversity significance) and helping drive change along their value chains.

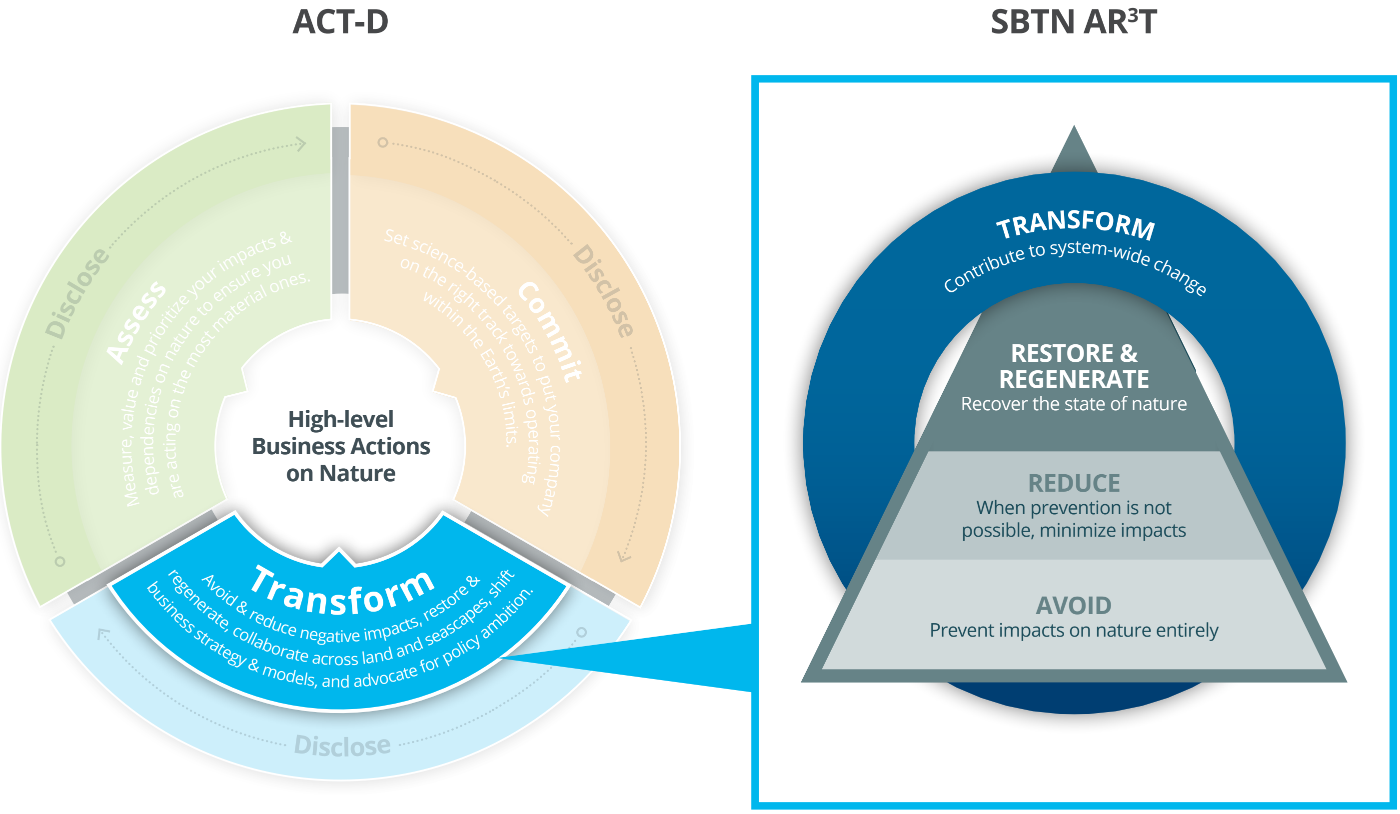
Nature is inherently complex and hence cannot be measured with a single metric or methodology. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and SBTN define nature as “all non-human living entities and their interaction with other living or non-living physical entities and processes”. TNFD defines it as encompassing four realms – freshwater, ocean, land and atmosphere – with biodiversity as an essential characteristic of nature that enables ecosystem assets to be productive, resilient and able to adapt to change.

All businesses need to acknowledge the value of nature to their business; **assess** and measure impacts and dependencies on nature; **commit** to setting science-based targets; **transform** their business models, operations and advocate for policy ambition and **disclose** material nature-related information. This is also known as the **ACT-D framework** which sets out the high-level business actions on nature.

To **transform**, businesses should follow the SBTN’s Action Framework (AR3T), which encourages businesses to:

- **Avoid and reduce** pressures on nature;
- **Restore and regenerate** to recover the state of nature;
- **Transform** underlying systems to address the drivers of nature loss.

Figure 3. High-level business actions on nature and the SBTN’s AR^{3}T framework



SBTN’s Action Framework (AR3T) defines the hierarchy of actions that companies can put in place as part of the “Transform” stage of ACT-D.

About this report

Business for Nature, along with the World Economic Forum (WEF) and World Business Council for Sustainable Development (WBCSD) have developed sectoral guidance to support businesses in **transforming** their business activities and contribute to a nature-positive future. The collection of sector-specific actions is available here.

Business for Nature and Accenture have conducted in-depth analyses of three sectors: fashion and apparel, fashion and water utilities and services. Building on the high-level business actions on nature, this report provides an overview of the typical impacts and dependencies of businesses in the fashion sector and sets out the **priority transformative actions** that businesses in the sector can take to help halt and reverse nature loss along the full value chain. Using the SBTN framework, the report distinguishes actions that contribute to halting nature loss (actions to avoid and reduce nature loss) and those that contribute to enhancing nature (actions to restore and regenerate nature).

Ultimately, this report aims to provide a strong foundation for fashion business to contribute to building a nature-positive world by 2030.

Understanding water utilities and services' impacts and dependencies on nature

This section summarizes the key impacts and dependencies on nature of companies within the water utilities and services sector, based on a **sector-average, global analysis and not ranked in order**. Company-specific impacts and dependencies will vary according to their specific activities, supply chains and operational locations. Companies will need to conduct assessment to locate their interface with nature and evaluate the impacts and dependencies using company-specific operation and supply chain information (TNFD's LEAP approach and SBTN's step 1 (screen and assess) and step 2 (prioritize) are useful frameworks to guide companies through their own assessment.

The impacts and dependencies have been developed predominantly using the online ENCORE tool (Exploring Natural Capital Opportunities, Risks and Exposure) and the SBTN sector materiality tool (which only covers upstream and direct operations), considering impacts and dependencies with high and very high materiality. The content was developed in consultation with nature experts and key players in the fashion sector, listed in the acknowledgements. Other sources are referenced throughout the document and include extensive desk research and academic reviews.

Water utilities and services | Impacts on nature

Water utilities and services businesses provide a critical public service, by providing clean and safe water and sanitation (SDG 6), and by managing the inevitable nature-related impacts of people and companies' use of water and production of wastewater, through for example treating and reusing wastewater. It is crucial however for businesses in the sector to better understand, quantify and manage their impacts on nature to maximize nature-positive outcomes.

The potential negative impacts of the sector span the whole value chain - from abstraction upstream to treatment and disposal downstream, and through all stages in between. The key nature-related impacts globally are freshwater use, water pollution, land and water use change and degradation, and greenhouse gas emissions. The scale and materiality of these impacts however are influenced by geography; the local and national regulation in which a business operates; the needs of communities located downstream of water intake sites; and the interrelation with other sectors which influence the water environment.

1. Freshwater use

Freshwater use to meet demands | The water utilities and services sector abstracts and distributes freshwater to end users (domestic, commercial and industrial), removing water directly from freshwater sources – both groundwater aquifers and surface water bodies. This impacts sensitive habitats and ecosystems if abstraction levels exceed a sustainable threshold, which is location dependent. On a local basis, water abstraction for distribution may compete with other industries including agriculture and aquaculture.

Only about 3% of Earth's water is freshwater. Of that, around 1.2% can be used as drinking water, with the rest locked up in glaciers, ice caps and permafrost, or buried deep in the ground.[8] Concern about global water availability is growing as freshwater use continues at unsustainable levels, further exacerbating the global water crisis. At current consumption rates, the situation is expected to worsen: by 2025, two thirds of the world population could face water shortages and natural ecosystems may be further compromised.[9] The crisis is exacerbated by high population growth rates and inefficient use (for example from water use in industry and agriculture), as well as increasingly widespread impacts of climate change such as floods and droughts.

Although the sector's relative contribution to the global water crisis varies by geography[ii], the water utilities and services sector is typically a key player in impacting freshwater use through extraction. The sector therefore has a crucial role in helping address the crisis by minimizing the impact of water demand on nature - for example by developing sustainable water strategies and implementing demand reduction initiatives - and by providing alternative water sources in some regions.

Leakage | More than 45 million m^3 of water per day are lost through leakage[10], which strains precious water resources and can result in large costs to businesses. Leakage is a primary cause of Non-Revenue Water (NRW) - the difference between the amount of water pumped through the distribution system to customers and the amount billed. The total cost to water utilities caused by NRW worldwide is conservatively estimated at $141 billion per year, with a third of it occurring in lower income countries.[11]

The IPBES defines five key threats to biodiversity. This impact of the water utilities and services sector on nature directly contributes to:

Pollution

Overexploitation ✓

Land use change

Climate Change

Invasive Species

[ii] *72% of all water withdrawals are used by agriculture, 16% by municipalities for households and services (that of the water utilities and services sector), and 12% by industries (UN-Water, 2021)*

2. Water pollution

The World Bank has identified water quality (which covers water pollution, nitrogen in water and water salinity) as an 'invisible crisis' which threatens societies and economies.[12] Water pollution is the most material type of pollution from the water utilities and services sector, with lasting and damaging impacts on nature. Other forms of pollution such as soil, solid and non-greenhouse gas air pollution also occur along the water utilities and services value chain. However, as these are less material nature-related impacts of the sector, they are not included in this review of priority impacts.

Water pollution is primarily a product of human activities and water utilities and services businesses contribute towards mitigating the direct impacts of these human activities on nature. However, businesses contribute in varying degrees - depending on the efficiency of the service they provide - to the pollution of rivers, lakes, urban streams and coastal waters through undertreated and/or untreated wastewater discharges and ageing, leaky infrastructure. These point sources of pollution can lead to negative impacts on nature and human health. The causes of pollution are described in detail below, while their impact on habitats and ecosystems is described in Impact 3 "Land and water use change and degradation".

Undertreated wastewater discharge | Wastewater treatment works take wastewater from the sewage system - which contains excess nutrients, heavy metals, pathogens, pharmaceuticals, microplastics, endocrine disruptors, antibiotics and many other compounds – treat it[iii], and in a perfect system, release it back into the water cycle in a state that does not impact nature.

Despite more ecologically acceptable alternatives (for example on-site systems), waterborne waste disposal remains the prevalent method for disposing of treated wastewater from domestic, commercial and industrial sources.[13] When not processed via tertiary treatment systems, wastewater discharges, although often legal, can have detrimental impacts on nature. Even with modern treatment supported by innovative technological developments and the use of Nature-based Solutions (NbS), nutrients are often not sufficiently removed, causing harm. For example, excessive nitrogen and phosphorus loading from undertreated wastewater can lead to eutrophication which reduces oxygen in the water and may cause harmful algal blooms and fish die offs. The severity of the impacts on nature depends on how wastewater is treated before reaching waterways (which varies by geography); which other sectors influence pollution in a catchment (for example diffuse pollution from agriculture and urban sources and physical modification of water bodies); and what the volume of the wastewater and its flow rates are (with high flows having a diluting effect).

Untreated wastewater | Globally, 44% of wastewater flows generated by households is discharged into nature without treatment.[14] The issue of untreated wastewater is not limited to countries where there is no wastewater public service, a lack of infrastructure or a tendency to discharge a large proportion of wastewater directly into the closest drainage channel or water body. In many countries, illicit discharge connections, leaking sewer systems and failing septic systems also result in discharges of untreated wastewater.

Infrastructure | Many sewer systems – which collect wastewater through a network of pipes and pumping stations and transport it to wastewater treatment works for treatment and disposal – are ageing, poorly maintained and/or unable to handle increasing pressure. The strain on infrastructure – which was typically designed or implemented without knowledge of current or future circumstances – arises from the accumulation of waste, increasing volumes of water stemming from high population growth and urbanization rates, and accelerating impacts of climate change (such as more frequent and heavy storms and rising sea levels). A notable issue in some regions is related to the increasingly frequent use of stormwater overflows or combined sewer overflows (CSOs), which are found at wastewater treatment works and elsewhere on the sewer networks. These release valves are used when sewage systems are at risk of being overwhelmed, during or following periods of high rainfall. This releases untreated wastewater (diluted with rainwater) into rivers and the sea to prevent damage to the sewage system that could cause flooding and sewage to back up into homes. Although CSOs are intended to be used in exceptional circumstances, in some regions they are now being used more routinely, increasing the pollutant load in receiving waters and causing harm to habitats and species.

The IPBES defines five key threats to biodiversity. This impact of the water utilities and services sector on nature directly contributes to:

✓ Pollution

○ Overexploitation

○ Land use change

○ Climate Change

✓ Invasive Species

[iii] *Treatment varies globally: primary and secondary treatment (most common) reduces suspended solids, biological oxygen demand and ammonia; tertiary treatment (often at larger treatment works but has a more limited global application) reduces nutrient load; and experimental treatment to remove pharmaceuticals, metals, antibiotics etc.*

3. Land and water use change and degradation

The sector can damage terrestrial and freshwater ecosystems (and in some cases, coastal ecosystems) from activities across the whole value chain. The most notable impacts tend to arise in direct operations through water withdrawal (or abstraction) and flow alteration, and wastewater treatment and disposal.

Water abstraction | – Water abstraction primarily impacts freshwater and terrestrial ecosystems. Freshwater ecosystems include wetlands, rivers, lakes, mangroves and aquifers. Water utilities and services businesses are both dependent upon and exert impacts on these water systems, which are indispensable for sustaining life on our planet. They are home to at least 10% of the Earth's species[16] and form a critical part of the global water cycle – supplying, purifying and protecting freshwater resources. However, the global decline of freshwater habitats is staggering. Since 1970, freshwater species have seen an 83% decline globally, with an increasing number threatened with extinction.[17] Wetland habitats are acutely affected. As some of the most productive habitats on the planet – home to high concentrations of mammals, birds, fish and invertebrates and serving as nurseries for many of these species – action needs to be taken to reverse the damage caused to these ecosystems from overexploitation.

While other water-intensive sectors such as industry and agriculture also threaten these sensitive habitats, the water utilities and services sector causes damage through over-abstraction (where water abstraction exceeds location-dependent sustainable thresholds), which results in a lack of water and salinization, impacting healthy populations of species. Methods for abstracting water can also directly harm or kill freshwater species. For example, water intakes can enhance sedimentation, entrap fish and lead to the loss of riparian habitats. Indirect impacts also occur through land subsidence and damage to soil quality where large amounts of groundwater is extracted. Negative impacts on ecosystems are more prevalent in regions where there are competing demands for finite water resources - for example from water utilities, agriculture and the energy sector. Ecosystems also suffer as a result of the polluting impacts of the sector (see Impact 2: "Water pollution") which harm freshwater species and can exacerbate the impact of invasive non-native species (INNS).

Physical modification | Natural flows are critical to maintaining healthy ecosystems. However, the water utilities and services sector has contributed globally to flow alteration and physical modification to provide sufficient drinking water, although other sectors such as agriculture and energy also contribute to the issue. Modifications – weirs, dams, other man-made barriers, reservoirs, water withdrawals and diversions – have been linked to reductions in the abundance and diversity of flora and fauna, excessive growth of aquatic macrophytes and reduced growth of riparian vegetation.[18]

Wastewater treatment and disposal | The impacts of undertreated and/or untreated wastewater (as described in Impact 2: "Water pollution") affect freshwater, terrestrial, marine and coastal ecosystems with resulting harm to biodiversity and the functioning and richness of ecosystems. Impacts arise from ammonia, biological oxygen demand and suspended solids; excess nutrients causing algal overgrowth ('algal blooms') or dead zones due to dangerously low oxygen; increased susceptibility to disease; changes to species interactions and native species persistence; the accumulation of heavy metals, other contaminants and pathogens found in contaminated water and sewage; and elevated levels of endocrine disrupters (including steroids and other pharmaceuticals) which can impact sex ratios, reproduction and overall population.[19,20] Furthermore, wastewater treatment plants are increasingly recognized as a potentially significant conduit of microplastic pollution in aquatic environments, which not only impacts habitats but also disrupts food webs.[21]

Desalination | In addition, the water utilities and services sector can contribute to habitat and ecosystem degradation and greenhouse gas emissions (see Impact 4: "Greenhouse gas (GHG) emissions") through desalination (the process of making saltwater drinkable) when not properly designed or managed. Desalination plants are increasingly being used across the world – specifically in regions where freshwater resources are in crisis - as part of a portfolio of water supply options. In some countries, desalination plants are the only source of drinkable water - for example in The Bahamas, the Maldives and Malta[22]. However, these plants may lead to unintended consequences for nature through the accumulation of a byproduct – brine. Brine is a hyper-saline mixture comprised of extracted salts and other metal compounds present in the desalination mix. It raises salinity and introduces toxic chemicals used as anti-scalants and anti-foulants, such as copper and chlorine. This can cause pollution and increase the risk of cumulative ecological effects through food chains in marine ecosystems, surface waters, sewers and wells where it is typically discharged. Typically, regulation requires desalination plants to evaluate the potential environmental impact of brine discharge before providing a permit to businesses – with continuous monitoring requirements to reduce any negative impact on nature.

The IPBES defines five key threats to biodiversity. This impact of the water utilities and services sector on nature directly contributes to:

Pollution	Overexploitation	Land use change	Climate Change	Invasive Species
✓	✓	✓	✓	○

4. Greenhouse gas (GHG) emissions

The water utilities and services sector emits greenhouse gases (GHGs) across the entire value chain - contributing up to 5% of global GHG emissions, through carbon dioxide (CO_2) from energy consumption, plus emissions of methane (CH_4) and nitrous oxide (N_2O) from wastewater handling.[23] This estimate is higher for urban areas, where emissions from the sector may contribute up to 15% of a city's total GHG emissions.[24] The figures are expected to grow in the future as demand for ever more scarce water supplies drives reliance on energy-intensive sources of water supply such as desalination and large water transfers.[25]

Emissions are categorized as direct (scope 1) or indirect (scope 2 and scope 3). The International Water Association's Roadmap to a Low-Carbon Water Utility provides a detailed description and breakdown of these emissions at each stage of the value chain. Predominant sources of GHGs in the water utilities and services value chain are set out below.

Energy consumption using fossil fuels | Energy-intensive processes in the value chain include pumping (where gravity does not allow natural flows) and treatment (described in more detail below), which emit significant quantities of CO_2 where companies source fossil-based electricity over renewables. Emissions may be higher where there is ageing infrastructure (such as pumping stations) due to inefficient energy consumption. Fossil-based energy consumption also arises from truck transport at various stages of the value chain - including the transportation of water for distribution and discharge or reuse, of chemicals for treatment, and of sludge for off-site disposal. While the use of heated water by customers falls outside of a company's direct operations and control, it also considerably increases the sector's contribution to GHG emissions.

Wastewater treatment | Emissions from sewers and/or biological wastewater treatment form a large component of a water utilities and services company's carbon footprint. The electricity consumption needed to power electromechanical equipment (outlined above) makes up a large proportion of this. However, CH_4 and N_2O emissions produced during treatment are also concerning as they have a global warming potential (GWP) of, respectively, ~27 times and ~265 times that of CO_2. Globally, wastewater treatment, together with energy, agriculture and waste, are the four largest sources of human-induced CH_4 emissions. N_2O makes up around one quarter of a company's GHG emissions across the whole value chain - including drinking water supply, wastewater collection and treatment, effluent discharge, sludge processing and disposal.[26] Emissions are produced during biological wastewater treatment processes, but they are not well understood and monitored at present, varying between treatment plants and typically underestimated in emissions inventories. Therefore, water utilities and services companies need to take urgent action to better understand their N_2O and CH_4 emissions, and to focus their emissions reduction efforts accordingly in order to achieve net zero targets and reduce resulting impacts on nature.

Wastewater discharge and disposal | The direct discharge of untreated and/or undertreated wastewater can release CH_4 and N_2O emissions in receiving waters due to the anaerobic breakdown of organic material. In regions where informal wastewater disposal is common, these emissions can be significant. CH_4 and N_2O can also be emitted from sludge disposal off-site, with emission volumes depending on the method used and the type of sludge for example undigested or digested).

In addition to the emissions outlined above, water utilities and services businesses must also consider the following:

1. Embodied emissions - which can be significant where there are large capital maintenance of construction projects.
2. Water loss (as described in Impact 2: "Water pollution") – which not only leads to further exploitation of freshwater resources, but also emits 'unnecessary greenhouse gas emissions' estimated at 847 million tons of carbon due to additional carbon intensive extraction, treatment and distribution to make up for that which is lost.[27]
3. The interconnectedness between the impacts of climate change and the challenges of water and wastewater treatment – with the demand for energy-intensive water treatment processes increasing as the effects of climate change intensify. For example, changing precipitation patterns may alter the ecology of surface water bodies, reducing freshwater quality and increasing the need for treatment to meet drinking water standards. Also, reduced river flows may require discharges of water that have undergone more carbon-intensive wastewater treatment in order to protect river water resources and water quality due to a dampened dilution effect.

The IPBES defines five key threats to biodiversity. This impact of the water utilities and services sector on nature directly contributes to:

✓ Pollution
○ Overexploitation
○ Land use change
✓ Climate Change
○ Invasive Species

Water utilities and services | Dependencies on nature

The water utilities and services sector is heavily dependent on freshwater – a finite natural resource. Water is an essential provisioning ecosystem service provided by freshwater ecosystems, but these provide many other services across a variety of utilities, resources and functions including water purification, fisheries, erosion prevention, flood protection, wildlife habitat, climate regulation and cultural services.[28] Providing a safe and secure water supply to all end users – be it residences, businesses and other entities such as governments – is dependent on a healthy natural environment.

The use of freshwater in the water utilities and services sector leads to several **key dependencies** on nature and the services it provides.

Water flow maintenance | The provision of clean water to meet human needs relies on water flow maintenance, a regulating and maintaining ecosystem service. The hydrologic cycle is the system that enables circulation of water through the Earth's atmosphere, land and oceans. It is critical to the recharge of groundwater sources and maintenance of surface water flows, upon which the water utilities sector is dependent as a direct physical input to the value chain. Globally, water companies are intrinsically vulnerable to changes in patterns of the hydrologic cycle including those brought about by the impacts of climate change. Therefore, accelerating climate impacts (such as changing weather patterns, extreme floods and droughts, and warmer waters which affect water quantity and quality and the ability of water and wastewater assets to withstand extreme weather and natural disasters) all present significant risks to the sector.

Freshwater quantity (surface and ground water) | Water is a provisioning service: a resource obtained from freshwater ecosystems to meet basic human needs. As a direct physical input to the water utilities and services value chain, the sector is dependent on sufficient freshwater from both surface waters (natural or artificial waterways containing freshwater, including lakes, reservoirs, rivers, streams and canals) and ground water (freshwater located in the subsurface pore space of soil and highly permeable rocks called aquifers). Furthermore, maintaining sufficient water quantity in rivers and other water bodies is important to ensure resilience against the impacts of water pollution from undertreated and/or untreated wastewater (see Impact 2: "Water Pollution").

Freshwater quality (surface and ground water) | Quality water is a regulating service, essential to meet human needs while underpinning ecosystems on which the whole environment relies. The quality of water determines the extent of treatment required and typically relates to the source of water. Ground water from aquifers, springs and boreholes is generally of higher quality and may only need basic treatment and disinfection (although it can contain heavy metals and pollutants, for example from agrochemicals), whereas surface water often requires more complex treatment as it contains impurities that must be removed to meet drinking water standards.

Soil quality | Soils are home to more than 25% of the Earth's total biodiversity. They support life on land, nutrient cycling and retention, food production, pollution remediation and climate regulation.[29] Healthy soils are a regulating and maintaining ecosystem service: they form a key component of the hydrologic cycle and sustain the water utilities and services sector by storing, accepting, transmitting and cleaning (purifying) water.[30] Soils act like a sponge to regulate both freshwater quantity and quality, supporting water purification and cycling through infiltration and percolation. With an estimated 74% of all freshwater used by humans deriving from soil,[31] the water utilities and services sector is heavily dependent upon healthy soils to provide quantity and quality freshwater. At the same time, the sector plays a role in maintaining good soil health through levels of groundwater use (groundwater depletion can reduce soil health) and regenerating soils (from the use of biosolids in agriculture, where regulation permits).

It is also important to recognize the interaction of invasive non-native species (INNS) with the above dependencies. INNS present a risk to the water utilities and services sector as they decrease water quality, damage infrastructure, impact water flow maintenance and endanger native habitats and species critical to healthy ecosystem functioning. INNS are one of several key causes of species extinction and loss of biodiversity in freshwater habitats worldwide. They overwhelm important vulnerable ecosystems, cause extinction of native flora and fauna (by out-competing them for space and resources), increase competition and predation among species, and spread disease. Water utilities and services businesses have an important role to play in supporting the ongoing management of INNS.

Water utilities and services' contribution to a nature-positive world by 2030

The operation and nature-related impacts of the water utilities and services sector differ across countries and globally. Yet, there are common, collective actions that companies can take to strengthen their contribution to a nature-positive world.

Some businesses in the water utilities and services sector have made progress in tackling their impacts on the climate. This progress indirectly benefits nature, with climate change forming one of the five direct drivers of biodiversity loss according to the IPBES. However, the sector now needs to move further and faster to address its impacts on biodiversity and nature more broadly; to help maintain the availability and quality of natural resources on which the sector depends to provide clean water and sanitation, whilst also reducing the impact of operational disruptions and increased business costs.

This report puts forward **five priority actions** that water utilities and services businesses can implement simultaneously to radically reduce their impacts and dependencies on nature. These high-level actions are based on the Science Based Target Network (SBTN)'s Action Framework (AR^{3}T – see "Introduction").

1. Avoid sourcing freshwater in water-stressed and areas important to biodiversity; and reduce unsustainable freshwater use

Notwithstanding the continued need to serve the population and to work with regulators, water utilities and services businesses need to take steps to promote the sustainable use of water and ensure water security. This requires efficiencies on both the supply and demand sides. For water supply, efforts are required to ensure abstraction is sustainable in the long term; to reduce water waste; and to implement water reuse where economically and environmentally viable. For water demand, businesses can influence consumer behaviors around water use and advocate for enabling policies.

Prioritizing sustainable abstraction | Long-term sustainable abstraction plans are important to avoid further harm to increasingly water-stressed areas and/or areas rich in biodiversity (such as Key Biodiversity Areas and Ramsar sites). Businesses should fully consider the impacts of climate change in water-stressed areas - drawing on available mapping tools such as the WRI Aqueduct Water Risk Atlas and utilizing this information to locate and plan for long-term sustainable abstraction. Platforms such as the NWPI (Net Positive Water Impact) journey are helpful for businesses operating in water-stressed areas and seeking to build resiliency in their own operations as well as in the communities and ecosystems in which they operate. The importance of utility-regulator relationships is critical in planning sustainable abstraction (see Action 5: "Transform the sector through circularity, partnerships and policy" for more detail). A key role for businesses is to take greater agency in communicating water carrying capacity.

Reducing water waste | Businesses should set out plans to reduce leakage to help reduce water waste and, consequently, delay the need for new resource and thus the pressure on nature's freshwater resource. Developing smart water management systems is a critical step. These systems capitalize on the application of technology – which collects, simulates and processes data – to optimize decision-making in order to improve water allocation, support efficient water usage and drive the overall sustainable management of water resources. Businesses may see additional benefits in reduced operating costs, improved energy usage efficiency, more sustainable customer behavior, and improved water quality (see Action 2: "Avoid and reduce pollution" for a summary of some available technologies).

Promoting water reuse | Water reuse – using treated wastewater as a source of water – is gaining momentum as a reliable alternative source of potable water in the face of growing water demand. There is a range of uses for water after advanced (tertiary) treatment, including agricultural irrigation, industrial uses, landscape irrigation, environmental enhancements, non-potable and potable reuse, recreational uses and groundwater recharge. Benefits for nature are achieved by reducing pressure on freshwater sources, by reducing pollution and by supporting habitats and ecosystems - for example through groundwater aquifer recharge, river flow restoration, water augmentation in lakes and ponds, and restoration of wetlands and biodiversity. Government incentives are important to deliver financially viable projects. There are guidelines for water reuse in some regions, for example in Europe and the US.

Water reuse – Singapore[32,33]

Singapore – an island state with little land – is one of the most water-stressed places in the world and once dependent on Malaysia for water. To boost self-sufficiency and resilience, the government has developed an advanced system for treating sewage involving a network of tunnels and high-tech purifying plants. Changi Water Reclamation Plant forms the core of the water reuse system, with capacity to treat up to 900 million litres of wastewater daily. Recycled wastewater now meets 40% of Singapore's water demand - a figure that is expected to rise to 55% by 2060. Much of the clean, safe, drinking water – referred to as "NEWater" – is primarily used for industry and cooling buildings, but is also used to top up drinking water reservoirs in the dry season.

Influencing consumer water use | To reduce consumer water use and thus decrease the demand on the abstraction of finite freshwater resources, businesses can leverage their position to: 1) influence policymakers to develop effective regulations for improved water efficiency at home, and 2) work with customers and educate employees to improve water efficiency in homes, workplaces and major industry. Tools such as the 50L Home global action-oriented platform can be used to encourage water (and energy) efficiency and generate awareness around sustainable water use.

Implementing this action could address the following impacts and dependencies of the sector on nature:

Impacts

Freshwater use	✓
Greenhouse gas emissions	○
Land and water use change and degradation	✓
Water Pollution	○

Dependencies

Water flow maintenance	✓
Freshwater quantity	✓
Freshwater quality	○
Soil quality	○

2. Avoid and reduce water pollution

Businesses in the water utilities and services sector need to adopt strategic approaches to address water pollution, differentiating between global and local impact.

Investing in improving facilities | Upgrading, modernizing and rehabilitating treatment plants and sewer networks is essential in reducing the strain on sewage systems and ensuring that treated effluent or unplanned untreated sewage no longer impact the environment. This will benefit nature primarily though reducing excess nutrient in receiving waters, which in turn reduces eutrophication. Managing the health of the distribution network together with improving monitoring is also crucial in reducing water leakage. This in turn will alleviate the pressure on freshwater resources and indirectly reduce GHG emissions as more of the water abstracted, treated and distributed is used to meet demand. In making facility upgrades, businesses should also consider the impacts of a changing climate - for example managing higher water temperatures in cooling plants and the associated impacts in terms of pollution.

Reusing energy, nutrients and other recoverable materials from wastewater | Businesses should explore ways to recover energy (see “Renewable energy sourcing and on-site generation” under Action 3), nutrients and other materials by utilizing wastewater as a circular resource. In doing so, businesses can realize commercial opportunities and indirectly reduce water pollution due to lower volumes of wastewater requiring treatment and discharge into the natural environment. A number of countries and companies are leading the way in reusing wastewater and its associated materials as demonstrated by the case studies.

Sewage sludge is the residual, semi-solid material that is produced as a by-product of wastewater treatment. A range of treatments can be implemented to allow the safe disposal of sludge, but companies need to focus on improved management and circularity to reduce pollution at the end of the value chain (disposal stage). Sludge management can take many forms - recovery, disposal, recycling, or treatment- depending on geography[38]. Sludge disposal routes vary in individual countries, affected by many factors such as population density, land area, cost, and social acceptance, as well as regulation. Some countries have extensive legislation systems where minimization of waste production is preferred, followed by recycling. In other countries, more sludge is landfilled or disposed on lands not subjected to control. Sludge can have many circular uses – for example in agriculture, in building products or as a fuel. Its use in agriculture is generally considered a viable, circular option although some countries restrict use due to concerns of high concentrations of metals, pathogens and persistent trace organic pollutants which can accumulate in the environment.

Treating wastewater - Denmark[34,35]

Since 1987, the pollution caused by wastewater in Denmark has been reduced by 80-90% depending on the type of pollutant. 95% of all wastewater is now treated – often to a higher standard than the legal requirements. This has been made possible by upgrading the wastewater treatment system with a number of new and innovative Danish technologies, as well as by educating staff, improving legislation and promoting cooperation between stakeholders in the value chain. Having set this standard, Danish water companies are now engaged in international partnerships through which they sell water technology products and solutions from Danish manufacturers to public authorities and utility companies all over the world.

Biofactories: A circular wastewater treatment approach

Biofactories are innovative wastewater treatment plants based on circularity. In contrast to traditional sewage treatment plants, biofactories prioritize advanced and sustainable waste management through the recovery and transformation of resources from waste, turning waste into valuable bioproducts such as regenerated water, biofertilizer, bioplastics and biomethane for use in vehicles. See for example Aguas Andinas in Chile[36] and Guijuelo in Salamanca, Spain[37].

TreaTech treatment technology

TreaTech is developing a treatment technology that will enable ever-increasing quantities of wastewater to be treated in a sustainable way while recycling its valuable by-products. Through its catalytic hydrothermal gasification (HTG) system, different types of liquid wastes that are usually incinerated or landfilled (such as sewage sludge) will be turned into by-products such as methane-rich renewable gas, clean water and mineral salts that can further be upgraded into phosphorus products including fertilizers.

The extraction of resources such as cellulose, biopolymers and struvite present additional potential circular opportunities from reusing wastewater. Struvite is a resource obtained from phosphorus recovery – a method for recovering nutrients from wastewater.[39] Phosphorus is a scarce resource with great value for the agricultural sector. It is accumulated in wastewater sludge and in internal side streams and, if treated properly, can be converted into a pure fertilizer such as struvite through controlled harvesting.[40] This relatively new and innovate method should be explored by water companies seeking to build circularity, considering its nature-related benefits including fewer heavy metals accumulating in the food chain and a reduced risk of groundwater contamination and dissolution into surface waters. Other benefits include flexibility in terms of use and storage as well as economic benefits stemming from struvite's higher value over sludge.

Leveraging technology to reduce freshwater use and pollution | While technology is increasingly being used to promote wastewater circularity (as described above), new and emerging technologies and artificial intelligence (AI) can also be harnessed to locate leakage and blockages and to help businesses reduce freshwater use and water pollution. For example, smart networks that use sensors, automation and technological processes have great potential in improving water management.

Technologies for smart water management

An increasing range of technologies are available to support water utilities and services companies reduce their impacts and dependencies on nature. For example:

- Distributed acoustic sensing (DAS) - to enable companies to undertake pre-emptive maintenance, pipeline integrity management and leak detection.
- AI-based solutions - such as the 'Automated Asset Condition Assessment using AI and Computer Vision' that inspects sewer pipes and identifies faults such as displaced joints and cracks. The technology automates the process of analysing CCTV videos using computer vision and machine learning methods. It has been validated by several water utilities companies in the UK, Finland and Australia and is now being commercialized by companies around the world. See IWA's Digital Water Programme including A strategic digital transformation for the water industry to learn more about digital and AI solutions.
- Earth observation systems including:
  1. ASTERRA – which provides intelligence to identify leaks and assess pipes.
  2. Space-O (Space Assisted Water Quality Forecasting Platform for Optimized Decision Making in Water Supply Services) - which generates real-time, short- to medium-term forecasting of water flows and quality data in reservoirs.
  3. Rezatec – which uses geospatial AI to remotely monitor and dynamically manage dams, water pipeline networks and water quality.

Supporting customer education | Water utilities and services businesses should support behavior change campaigns that can influence and incentivize customers to reduce wastewater pollution. This includes for example educational campaigns to encourage people not to dispose of cooking fats and wet wipes in drains – which are key cause of blockages and waterways pollution.

Implementing this action could address the following impacts and dependencies of the sector on nature:

Impacts

Freshwater use ○

Greenhouse gas emissions ○

Land and water use change and degradation ✓

Water Pollution ✓

Dependencies

Water flow maintenance ○

Freshwater quantity ○

Freshwater quality ○

Soil quality ○

3. Avoid and reduce greenhouse gas emissions

The water utilities and services sector must reduce the release of harmful GHG emissions throughout the whole life cycle, focusing not only on energy intensive treatment and distribution processes in direct operations, but also accounting for and managing embodied carbon. Implementing Nature-based Solutions can also help businesses capture and store carbon (see Action 3: "Restore and regenerate habitats and ecosystems"). Taking these steps is critical to ensure the sector plays its part in the pathway to global and national decarbonization and net zero targets. A range of practical measures can be taken by businesses to reduce emissions and achieve an energy neutral water cycle. For further support on decarbonization, businesses should utilize the strategies set out in Net Zero The Race we all win: Mapping the route to water utility decarbonization.

Implementing full lifecycle carbon accounting | Water utilities and services businesses must ensure carbon accounting methodologies include hard-to-measure emissions such as methane (CH_4) and nitrous oxide (N_2O) - which may be significantly underestimated in current inventories but are critical to achieving global emissions reduction targets. For example, reducing discharges of untreated wastewater could reduce global methane emissions by up to 5 to 10%.[41] Inventories must also include embodied carbon emissions – emissions associated with initial construction of an asset, coupled with those from asset maintenance and renewal. These emissions are often significant for businesses due to large capital maintenance and construction programmes. Full lifecycle carbon accounting ensures businesses can manage and reduce embodied carbon emissions, for example by prioritizing embodied carbon reduction in the design stage of new schemes together with active supply chain engagement. CIWEM's Blueprint for carbon emissions reduction in the UK water industry provides globally applicable information on opportunities for reducing both operational and embodied carbon.

Harnessing technology to monitor and reduce emissions | Businesses should deploy affordable, high-efficiency technologies to make meaningful progress in monitoring and cutting emissions. Digital technologies can simplify capital planning, accurately find criticalities and pinpoint investments for the greatest impact. Examples include "smart" pumps, leak detection sensors (for example free-swimming acoustic sensors), digital twin technologies (a digital representation of a physical object, person, or process, contextualized in a digital version of its environment) and other digitally powered solutions that dramatically reduce the amount of energy used in the treatment and distribution of water.[42] Other solutions include equipment renewals in energy intensive areas of operation such as blowers for process treatment, pumps capable of higher efficiencies operating in smarter networks, and new biogas boilers providing low-carbon heat for treatment.

Using technology - as well as supporting research and development - is vital in enabling the sector to understand the source of hard-to-measure emissions (CH_4 and N_2O) from operations and take targeted action to reduce these emissions. The Unisense Environment technology is an operationally stable and commercially available device for monitoring N_2O emissions, but only 500 devices are deployed globally at present.[43] Monitoring data can be used in software to predict and model emissions, which in turn can optimize performance to minimize emissions and reduce energy use, as well as provide cost saving opportunities. Where treatment processes are changed, businesses should monitor and model any changes in emissions in order to make adjustments that will improve operational efficiencies and reduce emissions.

World's first 'Net zero Hub' - United Kingdom[44]

Severn Trent is building the world's first carbon-neutral waste treatment plant in Staffordshire, backed by UK and Irish water companies and by Aarhus Vand in Denmark and Melbourne Water in Australia through the Net Zero Partnership. The project will transform a large, carbon-intensive wastewater treatment plant into the world's first retro-fit carbon-neutral site. Promising technologies will be integrated on one site to reduce and remove carbon. The new hub, which is already home to advanced digestion (THP) and 'gas to grid' technology, has the potential to change wastewater management globally. Among the new processes and technologies are:

- **'Actilayer' technology** - a novel cover for sludge plants which reduces levels of N_2O through the use of catalytic material and sunlight.
- Cellulose Recovery from **Dutch company** Cirtec - enables recovery of used toilet paper from sewage and recycles it into a valuable, sustainable material that can be used for other purposes such as insulation or construction products.
- **Digital Twin technology** - a virtual representation of the whole treatment plant to optimize low carbon technologies, see how they interact and automatically apply learnings to the treatment plant.

Tackling N2O and CH4 emissions - Denmark and the Nordic region[45]

The Danish water sector is a global leader in tackling N2O and CH4 emissions. Several of Denmark's large treatment plants are actively working towards decreasing their emissions by monitoring N2O activity. Critically, Danish legislation supports this ambition with a Water Sector Act adopted in 2010 to ensure that water utilities have high environmental quality, consider nature and security of supply, and are run in an efficient and transparent way. There are three types of benchmarking utilized in the Danish water sector today to support efforts: voluntary, performance and economic. While progress can still be made, other countries and businesses can learn lessons from Denmark as one of the countries involved in the Cooperation of the Nordic water associations working on A Road Towards a Nordic Climate Neutral Water Sector. See also the IWA & DANVA 2023 joint webinar series focusing on the Nordic region for inspiration.

Renewable energy generation - Victoria, Australia[46]

Portland: Considered to be 'an Australian first', an 800-kilowatt wind turbine has been built at Wannon Water's Portland Sewage Treatment Plant in the state of Victoria. The turbine produces more than two gigawatt hours of renewable energy each year - powering Portland's energy-intensive water and sewage treatment facilities and helping to reduce the company's carbon emissions by an average of 2,500 tonnes annually.

Melbourne: Melbourne Water's Eastern Treatment Plant (ETP) is set to become one of the largest 'behind-the-meter' solar installations in Australia. The 19 megawatt solar farm, housing 39,000 solar panels, will create significant amounts of renewable electricity to help power the plant – approximately 36% of ETP's total energy needs. The plant will reduce the amount of energy required from the electricity grid and reduce emissions by more than 30,000 tonnes annually, contributing to the company's targets to halve emissions by 2025 and reach net zero by 2030.

Adopting an energy-neutral water cycle | By introducing new technologies to reduce energy consumption and increase renewable energy production, businesses should aim to have an energy-neutral water cycle whereby the energy recovered from wastewater treatment plants is able to cover the energy consumption related to the business' groundwater extraction and water and wastewater transport and treatment. Companies must evaluate trade-offs however, as biogas production can lead to increased production of N_2O due to the low carbon and high ammonium levels present in wastewater from biogas production.[47] A balance is therefore needed between securing energy efficiency and renewable energy generation on the one hand, and reducing N_2O and CH_4 emissions on the other. This is crucial to ensure that the benefits of energy efficiency are not reduced by large-scale emissions of N_2O and CH_4 from energy recovery.[48]

Sector-specific tools are available to support businesses in measuring, monitoring and reducing their GHG emissions, for example:

- IWA Climate Smart Water Utilities contains many resources to support businesses, including the Climate Smart Utilities Roadmap which spans five steps required to identify opportunities for increasing efficiencies and reducing costs, while reducing GHG emissions.
- The Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) Tool is a free, open source resource to help companies assess their GHG emissions and energy consumption.
- Water New Zealand's Carbon Accounting Guidelines for Wastewater Treatment: CH_4 and N_2O can also be leveraged to guide the accounting process.
- Applicable to small and medium sized water and wastewater systems, the US EPA Energy Use Assessment Tool can help businesses quantify energy usage and highlight areas of inefficiency to identify and prioritize energy improvement projects.
- WBCSD's Wastewater Impact Assessment Tool (WIAT) is publicly available, free and does not store or collect any data. It uses site-level data to calculate GHG emissions from wastewater treatment and provides users with a visualization of the impact of wastewater at a site level and prioritizes where action can have the greatest positive impact.

Implementing this action could address the following impacts and dependencies of the sector on nature:

Impacts

Freshwater use	○	Greenhouse gas emissions	✓	Land and water use change and degradation	○	Water Pollution	○

Dependencies

Water flow maintenance	○	Freshwater quantity	○	Freshwater quality	○	Soil quality	○

4. Restore and regenerate habitats and ecosystems

To meaningfully contribute to a nature-positive future, it is crucial for water utilities and services businesses to restore and regenerate the habitats and ecosystems degraded or destroyed through their operations and value chain activities. For restoration and regeneration efforts to be impactful, it is essential for businesses to work with the communities who have in-depth knowledge of local ecosystems, and to support Nature-based Solutions.

Prioritizing Nature-based Solutions (NbS) | NbS are actions that involve working with nature to protect, sustainably manage, and restore natural and modified ecosystems whilst delivering other co-benefits, including to address societal challenges effectively and adaptively and provide human well-being and biodiversity benefits.[49] NbS are one of the 14 adopted resolutions of the UN Environment Assembly, created to strengthen actions for nature and achieve the Sustainable Development Goals (SDGs). NbS interventions are diverse. They have the potential to address many of the sector's nature-related impacts, including increasing freshwater quantity, reducing pollution, enhancing habitats and ecosystems, reducing or storing carbon and building climate resilience (as demonstrated by the Pacific Institute's review of case studies, 2020).

NbS can also offer multi-functional benefits across wider society and the economy. The types of interventions businesses have already implemented globally are wide ranging, as demonstrated by the case studies (see right). Interventions include:

- **Restoring, sustaining or planting native vegetation –** this includes reforestation, tree planting, the creation of buffer zones, forest conservation, successional planting and restoring habitats and degraded lands.
- **Planting vegetation buffers –** this includes cover crops, grass strips, hedge rows, riparian buffers and trees in croplands.
- **Developing natural treatment systems –** this includes wetland construction, restoration and conservation (see The Dragonfly Concept and Anglian Water case studies). Wetlands can act as an alternative or supplement to conventional water treatment systems - filtering and purifying wastewater before it enters rivers or lakes.
- **Re-establishing hydrologic connection and recharging aquifers –** this includes re-wetting historical wetlands; building retention, detention and infiltration ponds; and undertaking floodplain inundation and channel reconnection.
- **Installing flood bypasses and green infrastructure for flow regulation –** this includes vegetation, roadside plantings and rain gardens that capture, filter and reduce stormwater.
- **Implementing urban green infrastructure –** this includes green roofs, green spaces and rainwater harvesting.
- **Undertaking targeted land protection and soil improvement –** this includes working with farmers and land managers to implement catchment management programmes (see Silver Creek Pilot Project case study below) and improving soil health and monitoring to increase organic matter, carbon content, earthworm populations and microbial activity.
- **Removing invasive species –** i.e. non-native flora and fauna.

'Zone Libellule' (the Dragonfly Zone) - SUEZ Group, France and China[50,51]

SUEZ's Dragonfly Zone concept complements the conventional treatment provided by wastewater plants with the purification capacity of nature. It is an artificial wetland that can be established downstream from a wastewater treatment plant, in which the development of biodiversity intensifies the fight against micropollutants and limits their spread in freshwater or seawater. The Dragonfly Zone consists of a series of basins of varying shapes and sizes, planted with local species selected specifically for each project. The treated wastewater circulating through these basins is purified by a combination of biological actions and physical effects. The succession of varying wetland environments, with different flow speeds and depths of water, mobilizes these different mechanisms for pollutant degradation or absorption, adapting the treatment to each site's objectives. The Dragonfly Zone concept has been deployed at sites in France and exported to a 29.4 km^2 site in Shanghai, China.

Silver Creek Pilot Project – New Water, Wisconsin[52]

New Water, a brand of the Green Bay Metropolitan Sewerage District, implemented a five-year pilot project in the 4,800-acre Silver Creek watershed, working with farmers and agronomists to demonstrate phosphorus reductions resulting from agricultural best practices. The project included cropland evaluation of all fields, an inventory of stream bank erosion and in-stream sediment deposition, soil testing, stream water quality monitoring, landowner interviews, field walks and data analysis.

Ingoldisthorpe Project - Anglian Water, United Kingdom[53]

Anglian Water's wetland treatment site at Ingoldisthorpe in Norfolk was created in 2018 in partnership with the Norfolk River's Trust. The company installed a Nitrifying Sand Filter at the works to achieve an ammonia level of 3mg/l, and constructed a wetland to further improve water quality of the water being discharged into the River Ingol. The wetland is around one hectare in size and consists of four interconnected shallow ponds through which water from the Water Recycling Centre flows. The ponds are planted with species suitable for the location and habitat such as water mint, water avens, marsh marigold and flag iris. The wetland has enhanced biodiversity by providing new wildlife habitat of value for invertebrates, mammals and birds. The project highlights how NbS can meet human needs and improve biodiversity, whilst reducing cost and carbon.

NbS research and tools

A wide range of resources are available to support businesses in keeping pace with the evolving landscape on scaling NbS and to support widescale implementation. These include:

- IUCN Global Standard for NbS – A user-friendly framework for the verification, design and scaling up of NbS – a standard which can help the sector design restorative NbS.
- Benefit Accounting of Nature-Based Solutions for Watersheds Landscape Assessment 2020 – a report which provides case studies and interviews and outlines the opportunities and challenges of NbS for businesses.
- Benefit Accounting of Nature-Based Solutions for Watersheds 2021 – a report which outlines which specific NbS can be implemented in various habitats and suggests methods for measuring the benefits.
- WaterProof platform – an online too which provides a rapid and indicative NbS investment portfolio and pre-feasibility return on investment.
- NBS Benefits Explorer - a prefeasibility platform to help businesses identify, account for and value NbS benefits

NbS case studies

A growing set of case studies provide inspiration and insights for water utilities and services businesses seeking to support NbS, including:

- The UN Global Compact Water Action Hub (search for 'Nature-Based Solutions') - global
- The Nature Conservancy's Water Funds - global
- The IWA Nature-Based Solutions for Wastewater Treatment - global
- IWA Nature for Water: A Series of Utility Spotlights - global
- The University of Oxford case study platform - global (rural)
- The Urban Nature Atlas - global (urban)
- UNEP HDI's Nature-based Solutions to Emerging Water Management Challenges in the Asia-Pacific Region - Asia Pacific
- Resilient by Nature: Increasing Private Sector Uptake of Nature-based Solutions for Climate-resilient Infrastructure - Latin America and the Caribbean

Implementing sustainable drainage systems | The sector needs to advocate for sustainable drainage systems (note: terminology varies globally) that put nature at their heart, as a complement to existing piped and channeled drainage systems ('grey infrastructure') and bigger sewers needed to accommodate increasing stress from stormwater and risk of pollution. Sustainable drainage systems aim to replicate natural physical, chemical and biological processes in a catchment. Businesses should ensure they are site-specific and designed with full consideration of the underlying hydrology, functional purposes of the area being developed and the local communities.

Implementing restoration and regeneration projects | There are important considerations for water utilities and services companies when developing and scaling projects to achieve intended benefits for nature, climate and people in a given geography. First and foremost, projects should be located near an organization's activities, or the activities of its suppliers, to rehabilitate degraded ecosystems and restore converted ecosystems when negative impacts cannot be avoided or minimized. The UN Decade on Ecosystem Restoration principles detail best practices for restoring degraded land, freshwater and marine ecosystems. The International Union for the Conservation of Nature (IUCN) also sets out eight key criteria for successful regeneration projects in its Global Standard for NbS:

- Address social challenges – involve all stakeholders in the decision-making process around priority challenge(s).
- Designs informed by scale – not only to the biophysical or geographic perspective but also to the influence of economic systems, policy frameworks and cultural perspectives.
- Net gain to biodiversity and ecosystem integrity - undertake evidence-based assessments, benchmarking and monitoring.
- Economic viability – a full cost effectiveness assessment including understanding of resourcing options and any associated externalities.
- Inclusive, transparent and empowering governance processes - acknowledge, involve and respond to the concern of a variety of stakeholders, especially rights holders; and adhere to and align with the prevailing legal and regulatory provisions.
- Equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits.
- Manage adaptively, based on evidence – implementation plans include adaptive management as a response to uncertainty and to effectively harness ecosystem resilience.
- Sustainable and mainstreamed within an appropriate jurisdictional context – take a view of long-term sustainability and align with sectoral, national and other policy frameworks.

Implementing this action could address the following impacts and dependencies of the sector on nature:

Impacts

Freshwater use ✓

Greenhouse gas emissions ✓

Land and water use change and degradation ✓

Water Pollution ✓

Dependencies

Water flow maintenance ✓

Freshwater quantity ✓

Freshwater quality ✓

Soil quality ✓

5. Transform the sector through circularity, partnerships and policy

Fundamental to the effective management of water resources – and to the longevity of the ecosystem services which water provides to nature and people – is the need to bring all watershed components, water resource users, managers and respective interests together for a holistic transformation water utilities and services. The sector must collaborate to implement integrated catchment management, and work in partnership with policymakers to ensure that policy environments support ambitious nature-positive action.

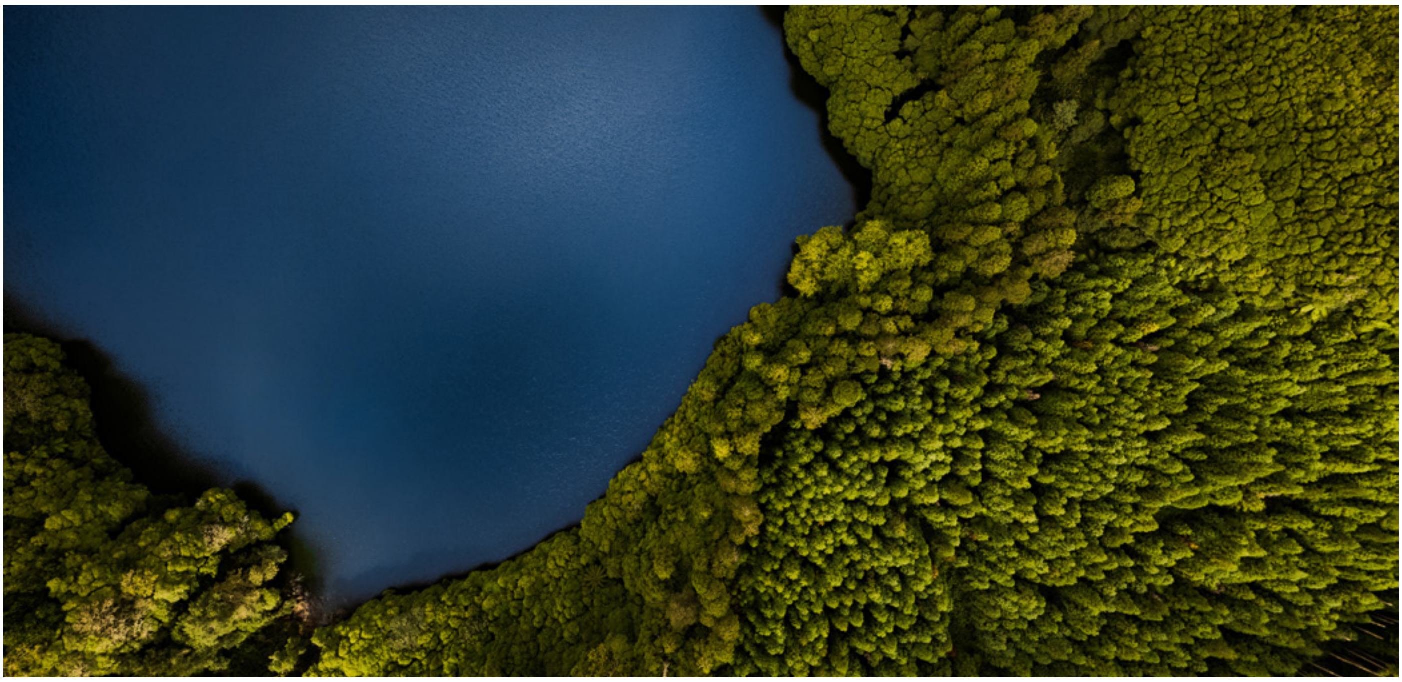
Embedding circularity | Shifting to a resource recovery mindset and applying the principles of the circular economy, the water utilities and services sector can maximize the use of resources and minimize waste generated for disposal, and leverage the full value of treated water through multiple uses: as a source of water (see Action 1: "Avoid sourcing freshwater in water-stressed and key biodiversity areas; and reduce unsustainable freshwater use"); as an input to processes; as a source of energy; and as a carrier of nutrients and other materials (see Action 2: "Avoid and reduce pollution"). While circular models can greatly enhance water sustainability and resilience, they are currently underutilized. Implemented appropriately, circularity can help tackle nature-related impacts of water quality and excessive use of water; help save energy thereby reducing GHG emissions and mitigating the impacts of climate change; and provide social and economic benefits through new business opportunities and jobs. Embedding circularity also supports the sector's role in achieving the UN SDGs, specifically SDG 6 'Clean Water and Sanitation', SDG 9 'Sector, Innovation and Infrastructure' and SDG 12 'Responsible Consumption and Production.'

In addition to effective management practices and enabling regulatory policies, the adoption of circular models can be greatly accelerated by technological innovation. However, no single technology can be applied in a one-size fits all approach: a combination of proven technologies and smart thinking is needed. Businesses should leverage available guidance, for example IWA Water Utility Pathways in a Circular Economy, the World Bank's Water in Circular Economy and Resilience (WICER) framework and WBCSD's Circular Transition Indicators to guide their actions in embedding circularity. This will ensure that natural systems are preserved and regenerated, whilst also building resilient and inclusive services and designing out waste and pollution.

Forming partnerships for integrated catchment management | Collaborative partnerships are essential to form between all stakeholders who depend on, and impact, water catchments and the natural ecosystems. This is reflected in SDG 6.5 to "implement integrated water resources management at all levels, including through transboundary cooperation as appropriate". Sustainable, integrated water resources management promotes the co-ordinated development and management of water (and land-based) resources. It is vital for long-term environmental, social and economic well-being, avoids compromising vital natural ecosystems, and helps balance competing water demands across society and the economy.[54]

The AWS standard 2.0 can be utilized to improve collaboration in terms of five outcomes: good water governance; sustainable water balance; good water quality status; important water-related areas; and safe water, sanitation and hygiene for all.

Partnering in multi-stakeholder initiatives is also important to scale up action across watersheds. For example, SIWI's Action Platform for Source-to-Sea Management has been developed to take into account that upstream activities from different sectors compound one upon another, leaving virtually no coastal or marine area unaffected. The approach coordinates sectors to ensure coherence in policies and practice which enable land, freshwater, coastal and marine resources to be managed holistically; and to balance the long-term benefits for nature, communities and the economy.



Advocating for, and influencing, ambitious policy | For the 'Transform' actions outlined in this report to be effective and result in nature-positive outcomes at scale, water utilities and services businesses, as a regulated sector, need to work with policymakers to secure supportive local, national and even international regulatory landscapes. Defining pragmatic actions that enable processes, policies and practices is an important way for water utilities and services businesses to influence the regulatory environment in which they operate; to create accountability; and to reduce the costs and risks of transitioning to a net zero, nature-positive world.[55] Joining other players in the sector in calling for action by governments is one way of achieving this: an example is the 2021 global call by international water industry trade bodies to tackle emissions associated with processing wastewater. By joining industry associations and trade groups water utilities and services businesses can also collectively voice their concerns and advocate for policies that align with their interests. These organizations often have established relationships with policymakers and can effectively represent the industry's perspectives. Industry associations can also support businesses in identifying how they can act on nature given local and national regulations.

Successful utility-regulator partnerships are critical to incorporate nature into sustainable water management at a catchment scale. Many global case studies of such partnerships[56] can be taken as inspiration for businesses working to roll out projects that address nature-related impacts (see Action 4: "Restore and regenerate habitats and ecosystems").

Water Funds - The Nature Conservancy (TNC)

Water Funds are one of TNC's signature watershed investment tools. They act as collective action mechanisms that bring together different water users – usually utilities, businesses, food producers and local governments – to invest in ecosystem protection and upstream communities within the watersheds they depend on. The funding and other resources generated help pay for conservation activities, such as replanting native trees, using cover crops or restoring wetlands. TNC uses its science and community engagement expertise to identify where and how NbS should be deployed based on local capacity and context.

Mobilizing the public and employees | Public and employee participation is essential to effective water use and management – with every end user being educated on the challenges and risks associated with water use and disposal in the context of the accelerating global water crisis. Businesses in the sector can support educational campaigns, partner with local communities and schools, and use their platforms to promote responsible water use and encourage behavioral change. Furthermore, there are opportunities in some regions (see India for example) to encourage positive competition amongst municipalities to generate win-wins.

Implementing this action could address the following impacts and dependencies of the sector on nature:

Impacts

Freshwater use ✓	Greenhouse gas emissions ✓	Land and water use change and degradation ✓	Water Pollution ✓

Dependencies

Water flow maintenance ✓	Freshwater quantity ✓	Freshwater quality ✓	Soil quality ✓

Conclusion

An increasing number of water utilities and services businesses have recognized their reliance and impact on nature in recent years, and taken steps to reduce both. However, mounting policy, regulatory and consumer pressures, and above all, the accelerating threats posed by nature loss, call for more rapid and deliberate transformative action by the sector. This action will not only promote the health of the planet, but also of corporate bottom lines - by minimizing risks and maximizing the commercial opportunities that come from protecting and restoring nature.

Taking into consideration the most material impacts and dependencies of the water utilities and services sector on nature, and drawing on this report as well as the growing body of sector-specific and -agnostic guidance and frameworks available to support them, it is time for businesses to embed nature in all levels of decision making. This will not only ensure they continue to function and thrive, but will also contribute to the essential transformation of the sector on the path to a resilient, fair and nature-positive economy.

Resources

In addition to the tools mentioned in the priority actions above, the following **sector-specific guidance and tools** are currently available to companies in the water utilities and services sector:

- Water and Biodiversity Risk Filters (WWF)
- Aqueduct risk evaluation tools (WRI)
- Utility of the Future program (World Bank and Global Water Security & Sanitation Partnership, 2021)
- Net Zero The Race we all win: Mapping the route to water utility decarbonization (Xylem, 2022)
- Setting Site Water Targets Informed by Catchment Context and Setting Enterprise Water Targets (CEO Water Mandate)

The following **organizations and coalitions** also provide useful information for the sector:

- CEO Water Mandate - The Water Resilience Coalition and WASH4Work.

For additional sector-agnostic resources, please refer to Business for Nature's High-level Business Actions on Nature.

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Acknowledgements:

This report was led by Business for Nature and Accenture, and builds on the Get Nature Positive Handbook, developed by Accenture, the Council for Sustainable Business and the UK Department for Environment, Food and Rural Affairs.

Thanks also go to the many leading academic, industry, NGO and government experts who provided invaluable perspectives, listed in alphabetical order: ANDI (National Center of Water and Biodiversity); Anglian Water Services Ltd; Anthesis; BSR; Capitals Coalition; Carbon Disclosure Project; Cranfield University; Fauna & Flora International; Global Reporting Initiative; International Water Association; Manila Water; McKinsey; the Pacific Institute; Stockholm International Water Institute; The Nature Conservancy; The Rivers Trust; United Nations Environment Programme World Conservation Monitoring Centre; United Utilities; We Mean Business Coalition; Wildlife Habitat Council; the World Business Council for Sustainable Development; the World Economic Forum; World Resources Institute; and World Wildlife Fund.

Citation:

"Water utilities and services: Priority actions towards a nature-positive future" Business for Nature et al., September 2023

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