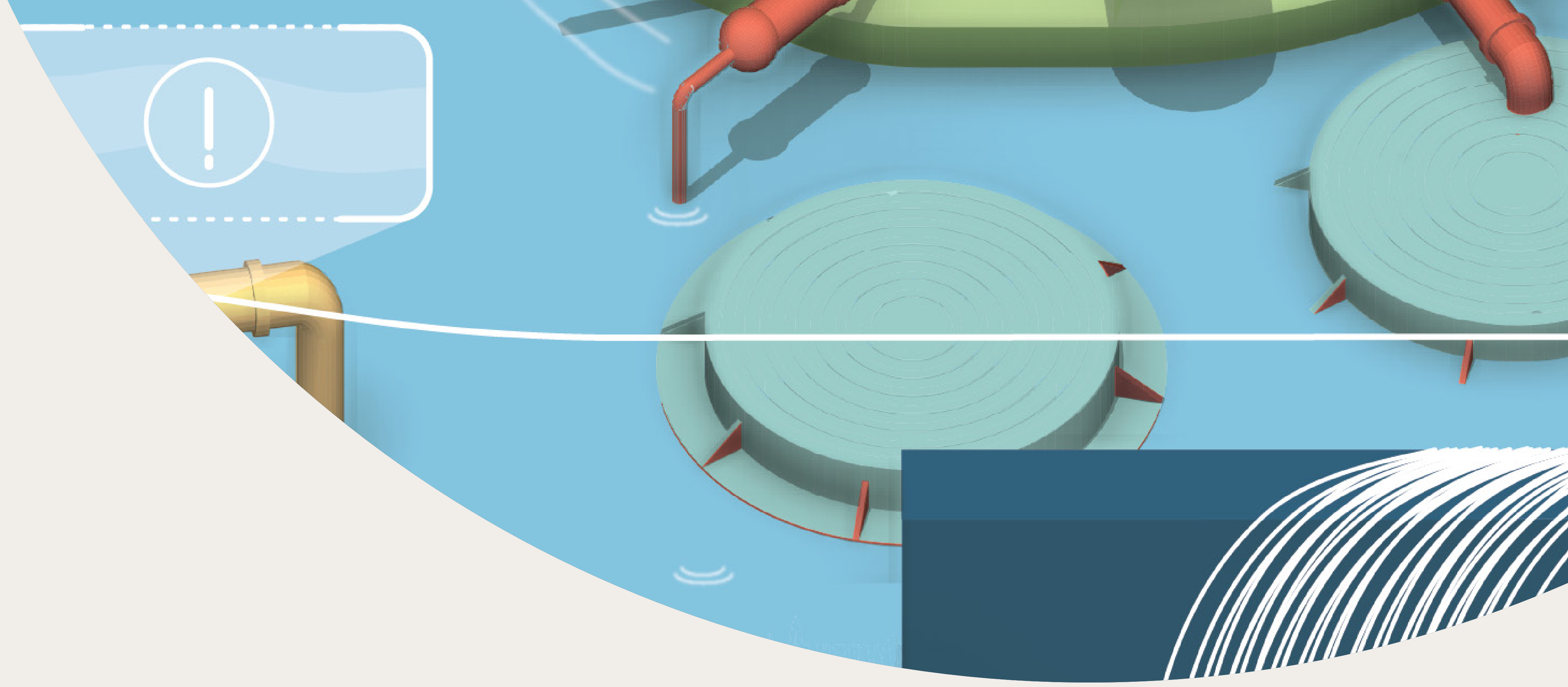
Issue 03

ARUP

AI for Future Cities

Water

Arup
July 2025



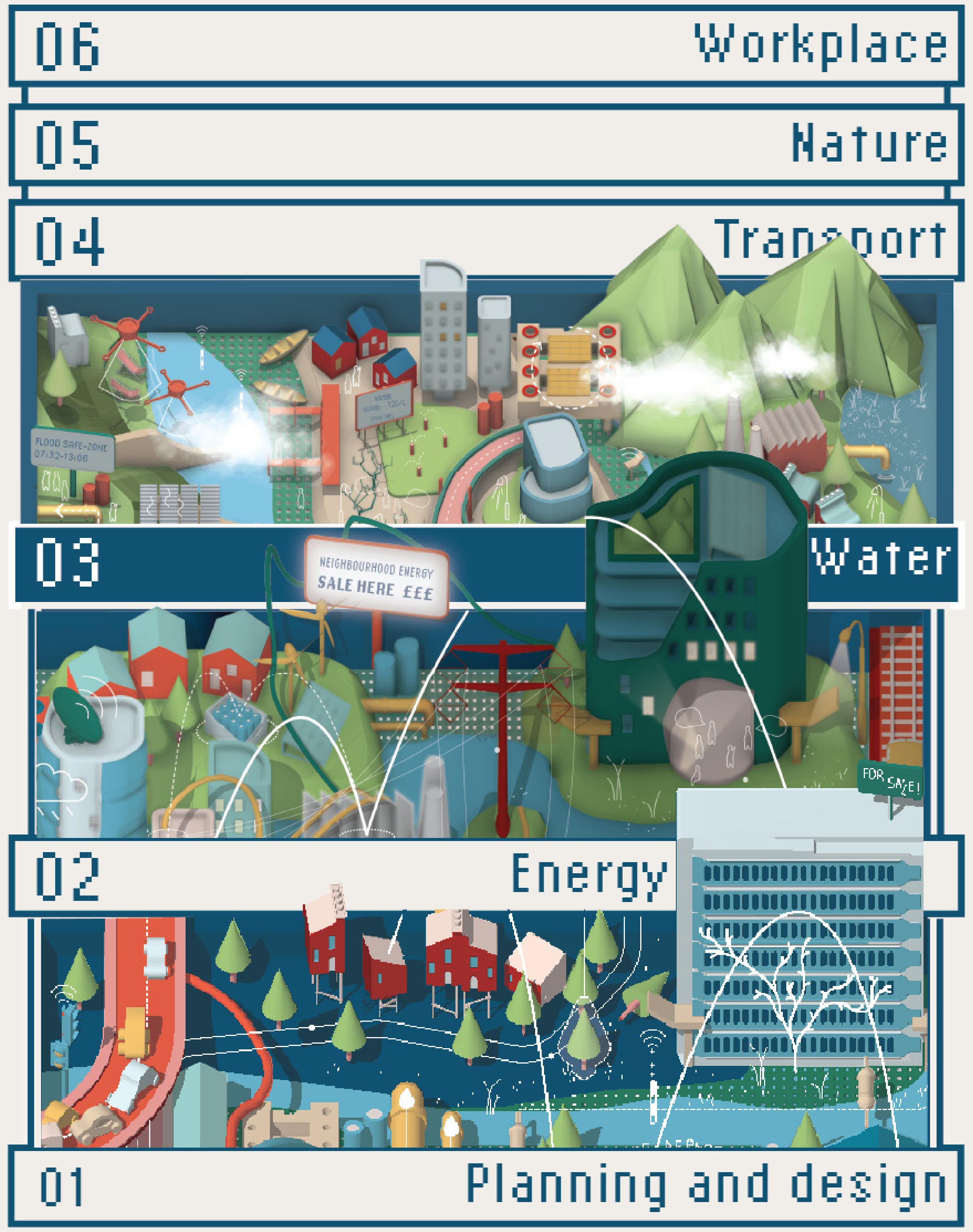
AI for Future Cities Series

The rapid evolution of artificial intelligence (AI) promises to enhance efficiency, speed and innovation. But what does this mean for cities: for how they are planned, designed, built and managed? What are the opportunities and what are the risks? Amongst the hype and speculation, how do we ensure that these technologies support us in achieving our shared goal of creating cities that are better for people and the planet?

Compiled by Arup's Foresight team, **AI for Future Cities is a series of critical reflections and expert insights on the uses and impacts of artificial intelligence across all aspects of our cities** – from planning them through to running them, from infrastructure through to resource flows. It will give you a rich understanding of how AI already operates in urban contexts today, what trends are shaping its use tomorrow, and informed speculation on the long-term possibilities.

This is issue 03 of ***a series*** on AI for Future Cities. Upcoming publications will focus on Transport, Nature and Workplace. Explore other issues here.

At Arup, we use the OECD definition[1] of AI: "*AI refers to systems that make predictions, recommendations, or decisions based on data to achieve human-defined objectives.*" Click here to view Arup's AI Policy.



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Contents

This third issue in the series focuses on **urban water**. How is AI changing the way we collect, manage and distribute water in our cities? How might new, AI-enabled water systems change the physical fabric of our cities and the lived experience of their residents? What new competencies may future practitioners require for creating and working with water systems that have been augmented by AI? And how do we ensure that AI remains a tool we use intelligently?

Foreword
Meeting our water challenges with AI

Nearly three years have passed since the explosion of excitement around AI, sparked by the emergence of large language models and generative AI. Since then, surging investment has triggered a proliferation of different AI models that can improve how we work and what we deliver.

Applying AI to the real world is the opportunity

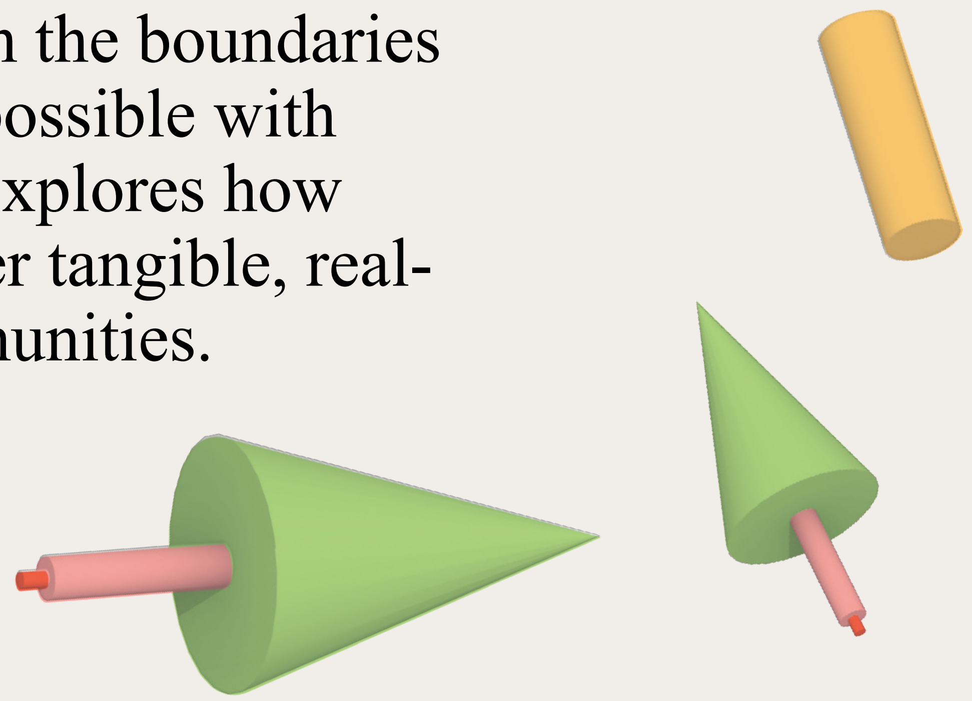
This series by Arup University’s Foresight team focuses on applications of AI that have tangible, real-world benefits in accelerating decarbonisation and supporting climate resilience.

This issue focuses on water, a resource that is central to basic human needs but one that is also undergoing unprecedented stress from trends shaping our future world. From the pressures of climate change and rapid urbanisation to rising geopolitical tensions over shared resources, water systems face mounting challenges that demand novel approaches and cutting-edge solutions.

AI has the potential to play a significant role in new approaches to how water is collected, treated, managed and distributed in our cities. At Arup, we are already using AI to support in the planning, optimisation and protection of water infrastructure. We have worked on masterplan studies that use machine learning to analyse the water need for different building types, allowing us to optimise the deployment of green (trees, parks, green walls) and blue (ponds, lakes, rivers) infrastructure which store and hold excess water. Our use of AI has also supported clients to develop real time responses to infrastructure stress from stormwater overload, helping to increase resilience during extreme weather events.

These applications showcase the transformative potential of AI in strengthening urban water infrastructure. This report aims to push the boundaries of our imagination regarding what is possible with this rapidly evolving technology and explores how we can harness it responsibly to deliver tangible, real-world benefits for our cities and communities.

We face huge sustainability and resilience challenges alongside the ever-pressing need to deliver infrastructure and prosperity at pace for communities around the world. It’s difficult to imagine how we can meet these demands successfully without the power of AI to enhance human innovation, creativity, and productivity.



Will Cavendish
Global Digital Services Leader
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Foresight Perspective: How can AI help us manage the growing demands of our urban water systems?

For thousands of years, effectively managing limited water resources and urban demand has been crucial for the growth and survival of cities. Past generations have overcome water constraints with ingenuity and technology, and the same holds true for the present and future. However, novel elements differentiate our future constraints from the past; the rate and scale of urbanisation will continue to accelerate, with a growing concentration of demand for domestic, commercial, and agricultural uses in our river basins.

Meanwhile, climate change and biodiversity loss will push our water challenges to the extreme. These extremes will simultaneously give us too much water through extreme rainfall, result in greater instances of poor-quality water and mean we have too little water from growing demand and longer, more pronounced drought conditions.

Laying the foundations

Understanding the water context we operate in, will be crucial to fully realising the potential of AI in cities and the water industry. Data, and our ability to collect, store and share data across all stakeholders will be at the heart of this. Getting our data foundations correct will provide clarity on the quantity and quality of our water supplies to the demand and distribution of water[2]. Future cities that get the data foundations correct will be best able to leverage digital technologies and AI to respond to our most pressing challenges, enhancing both the resilience and efficiency of their water systems.

Dealing with "too much water "

For every degree of planetary warming, the moisture content in the air increases by 7%[3], which affects rainfall. In response, cities are already using AI-supported planning tools, such as Arup's NatureInsight® and Terrain, to better locate sustainable urban drainage systems (SuDS). These SuDS can enhance urban biodiversity and absorb excess water from extreme rainfall as well as the risks of fluvial, pluvial and coastal flooding that cities face. In the future, AI could assist in predicting the optimal moment to retain and release water in these SuDS – supporting 'urban sponginess' and helping to manage flood risk, water availability and the associated physical, social and economic costs of water-related disasters.

Sea levels are already 21-24 cm higher than pre-industrial times and set to continue rising[4]. We already have a good sense of how this will change the shape of cities, but how could AI help us in planning an appropriate response? AI could allow us to take a more granular lens alongside a systems view, bringing together a diverse range of previously discrete datasets to provide evidence for mitigation decisions that are hyper-specific to individual neighbourhoods or streets.

> "AI could integrate diverse historical datasets across whole catchments such as sea level rise, material usage and demographics. This would enable us to map the relationships and roles of water system components that were previously viewed in isolation and limited to political and infrastructural geographies."

Dealing with "too dirty water"

AI has the potential to significantly develop autonomous decision-making capabilities. When integrated with IoT sensors and smart meters, these technologies could scale on-site water and wastewater treatment and recycling[5]. This approach would promote increased circularity and decentralisation in parts of the water network. As a result, overall system pressure could be reduced and the most energy-intensive aspect - wastewater treatment - could be decarbonised[5]. However, this transition to a more distributed system could increase the number of points of failure across the system, introducing new vulnerabilities that may compromise water resilience.

Elsewhere we are seeing emergent practice of AI helping to develop lab-grown corals and using machine learning to transplant these into existing reef ecosystems[6], enhancing flood resilience, water quality and biodiversity. However, technological solutions alone will not solve our water quality challenges. For generations, indigenous communities have built deep knowledge about how people and nature can live in balance. This indigenous wisdom can be fed into large language models, supporting decision makers to develop solutions that are sensitive to the diversity of all beings in a water-based ecosystem. Using such approaches, we might see future cities use AI to embed indigenous ways of knowing into water infrastructure delivery that could perhaps adapt in real time, responding to ecological indicators observed in traditional knowledge such as blooming plants and animal migration.

Dealing with "too little water"

With the global population rapidly urbanising, and growing towards almost 10 billion by the mid-century, water scarcity is set to increase[7] and extreme droughts are expected to affect 30% more land area annually by the end of this century[8]. We are already seeing how AI can help forecast and monitor droughts, changing response times to predictable emergencies and developing our understanding of the causes of droughts[9]. What if future cities could combine seasonal climate predictions, satellite imagery and ground testing to begin to understand and better predict the probability and duration of future droughts and their long-term effects? Imagine a city where AI predictive modelling gives residents and communities advanced drought warnings and provides context specific information that gives time to prepare and suggests mitigating actions.

Considering new vulnerabilities

The deployment of AI solutions requires an acute awareness of the potential trade-offs and risks. We are already seeing how the deployment of AI is causing issues with water supply[10]. Data centres' demand for water increasingly competes with people, agriculture and other industries. Despite innovations of closed loop and zero water data centres, we need to make sure the deployment of AI solutions in this space is net positive for people and planet. Cyber-attacks are growing across all sectors, with critical infrastructure like water increasingly targeted as geopolitical tensions rise. The deployment of digital solutions and AI in the water sector might expand this vulnerability.

What new vulnerabilities may emerge through the deployment of these technologies in water? How can we ensure different parts of the water network are interoperable whilst also remaining secure to external threats? Given these emerging challenges, what new skills and responsibilities do stakeholders in our water network need to prepare for today?

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Horizon Scan Evidence: Trends shaping the future of AI in Water

This is just a small selection of key data we are tracking on how AI operates in the context of cities at present (now→), of emerging trends we are observing (near →), and of informed speculations we are making about long-term possibilities that stem from signals of change (next →).

Get in touch for access to our expanding database of trends and workshop exercises that explore the future role of AI in our cities.

Sponge cities
04

AI is being used to map and better locate sustainable urban drainage solutions and increased permeable absorptive surfaces helping to better manage stormwater and flood risks in cities.

Futures Today Institute, 2025

NOW

Improved leak and defect detection
05

AI data analysis of flow rates, system pressure, water use and quality is supporting faster leak and defect detection in water systems, enabling rapid response and reduced damage-related costs.

Alnaser, Maxi, Elmousalami, 2024

NOW

AI-enhanced pollution and epidemic detection
15

AI can scale solutions enabling early detection of water quality issues, emerging disease and infrastructure failures by analysing historical data, trends and real time data to forecast emergencies more accurately.

Ibrahim et al. 2025; Arup, 2021: Wastewater for Health

NEAR

AI-enhanced flood forecasting
17

Flood events can be forecast up to seven days in advance with the help of AI, allowing for early interventions that minimise social impacts and those on the wider built environment.

Kumar, V et al, 2025

NEAR

Indigenous knowledge integration
34

AI systems are emerging that capture and integrate indigenous knowledge alongside existing datasets, to develop solutions and insights that result in positive water outcomes.

WWF, 2023

NEXT

Enhanced water system operation
10

AI and digital twins are using water sensor data and virtual representations of real-world water systems to enhance forecasting and decision making in operational interventions, enhancing the efficiency of water management.

Ong, Tortajada, Arora, 2023

NOW

AI driven data centre water demand
12

Data centres which power growth in AI solutions are significantly increasing water demand for cooling systems, raising sustainability concerns, especially where they draw water from regions facing water stress.

Fortune, 2023

NOW

Advanced metering
24

AI is enabling smart meters and smart water systems to better monitor and manage water usage while helping minimise water volume lost (and the cost of damage) from leaking pipes through the use of sensors and monitoring.

Adedeji et al, 2022

NEAR

Aging Water Workforce
32

Large parts of the water industry are expected to retire in the coming years. AI is increasingly being considered to make up for this shortfall, as well as capturing tacit knowledge from the retiring workforce.

Arcadis, 2024

NEXT

Wave hazard early warning
47

A growing cutting-edge approach combining weather and wave data with the latest digital and AI technologies to develop a more accurate way of forecasting coastal flooding.

University of Plymouth, 2025

NEXT

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The City of 2035: How might AI in Water shape the city, and what new realities emerge?

Enhanced monitoring of assets

Images from CCTV, drones and satellites can flag potential drowning incidents. They can also monitor water assets, spotting any defects such as blockages in urban waterways, natural debris, litter or waste blocking trash screens mounted in culverts.

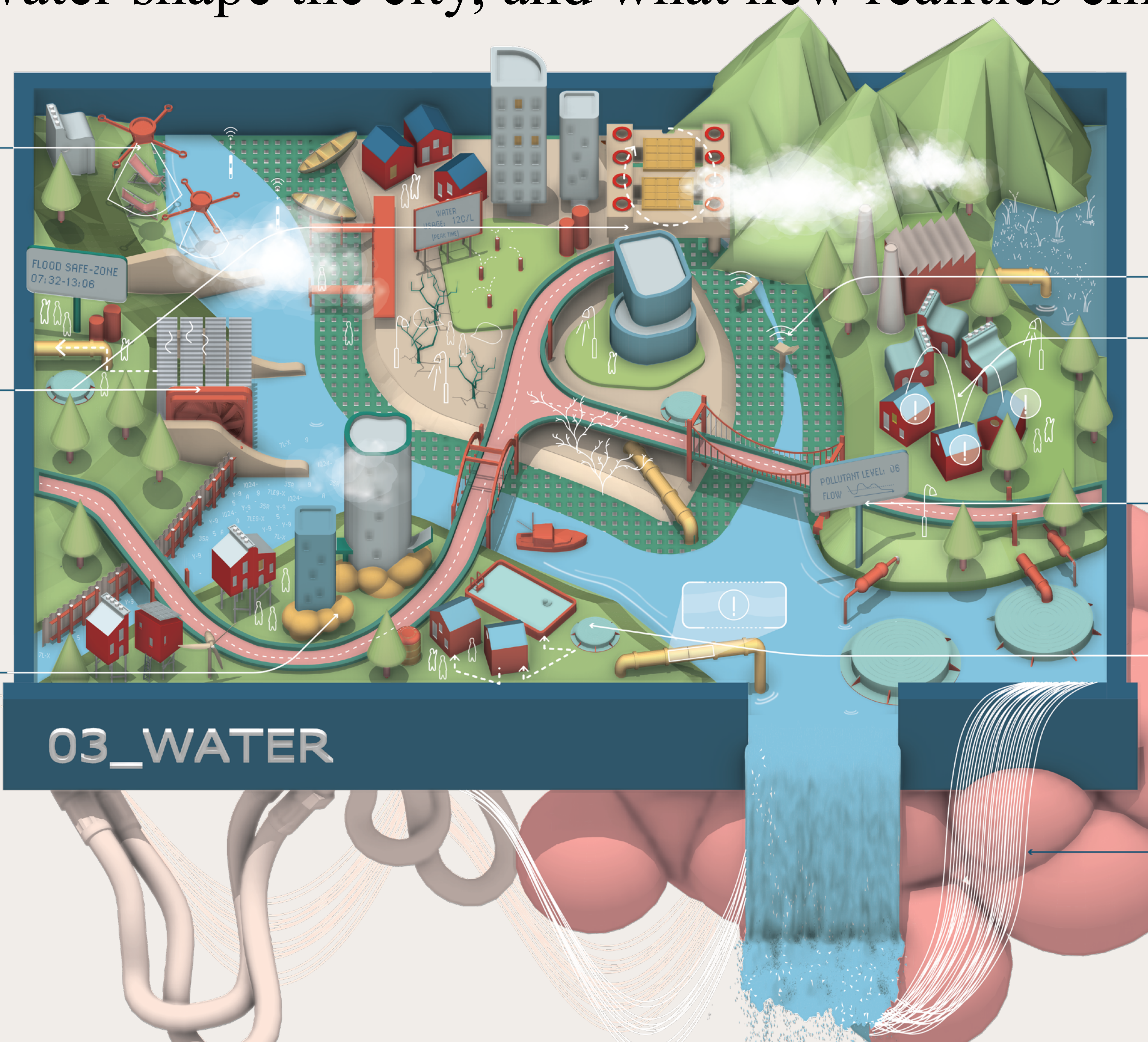
Watch this space for our forthcoming work on "The Future of Data Centres"

Closed loop & good neighbour data centres

Water demand growth remains limited as closed loop and zero water cooling systems for data centres become widespread. Excess heat produced by data centres is captured and converted into clean, usable hot water for use in urban district heating networks.

AI enabled sponge cities

SuDS are strategically located to maximise drainage. AI enabled forecasting and automated decision making optimises the release of absorbed water, which is timed to supply water during times of drought and not overwhelm sewage systems during periods of overflow.



Sensitive sensor deployment

Sensors are strategically positioned across the urban water network, based on the net-benefit they provide across the full product lifecycle. This enhances data collection and ability for AI assisted analysis on the quality, distribution and quantity of water.

Improved customer engagement

Water customer experiences are automated and more widely available due to AI. Conversations with AI chatbots are used as early warning indicators for companies highlighting the first signs of a failure in the network.

AI water pollution detection

Water pollution is actively monitored by AI systems from floating water detection devices in waterways and satellite imagery, allowing for advance notice of unsafe water pollution levels.

Decentralised water networks

Through sensors, enhanced prediction and autonomous decision making, AI enables the uptake of on-site water and wastewater treatment and recycling, contributing to decentralisation of assets in the water system.

Marine acoustics

AI utilises undersea telecoms cables to detect sounds and monitor marine and reef life and biodiversity as part of coastline regeneration efforts.

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Expert Insight: Augmenting our abilities in urban water systems through AI

AI is reshaping water management just as profoundly as it is shaking up the rest of our lives

On the surface, the data boom is adding stress: hyperscale data centres now withdraw millions of litres a day for cooling, often in drought-prone regions, while climate change throws cities between frequent states of too much and too little water. At the same time, ageing distribution systems, treatment plants and storm sewers are being made to deliver against higher expectation for service levels, carbon and equity goals than ever before. The traditional approach - moving water from source to tap and then away as quickly as possible - is inadequate. Yet the very AI revolution that is driving some of this new demand also offers the tools to manage that complexity.

A new paradigm: data-centric water engineering

Researchers at the Centre for Water Systems at the University of Exeter describe this moment as the birth of a fourth engineering paradigm, data-centric water engineering, where continuously streamed data becomes the organising principle for planning, operating and financing in urban water management. The new paradigm rests on three interconnecting principles: treat data as first-class infrastructure; fuse physics-based and machine-learning models; and automate decisions wherever possible.

Enter AI

Water utilities across the world have applied machine-learning for more than a decade to predict short-term demand, identify leaks and schedule pump maintenance. What changes now is the ability to scale these implementations. Foundation models, like those developed by OpenAI, Google and others, along with advanced machine learning approaches like graph neural networks can digest everything from SCADA time-series to drone imagery, learning relationships that would overwhelm an engineer, in seconds.

This promise already shows up in practice. Urban water problems are complex, involving many inter-connected systems, AI can help analyse large quantities of data and find solutions. Arup's Terrain platform, for example, couples machine-learning with satellite imagery and embeds Arup's engineering expertise to enable city-scale automation of design. Shanghai and Mansfield have used it to target some of the world's largest green-infrastructure retrofits. Another of Arup's tools, WeatherShift, downscales future climate scenarios so designers can stress-test infrastructure decades ahead of time.

From automation to intelligence

The next boundary to cross is from automation and forecasting to AI systems that can act with some autonomy. Deep-reinforcement-learning is emerging as a practical tool to enable stormwater systems to do this.

In the United States, Arup is already using AI-powered tools to help enhance environmental benefits. In Florida, Arup and The Nature Conservancy are applying AI and machine learning to develop and test a watershed approach that integrates monitoring, forecasting, and automated controls to pilot a 'smart' watershed that continuously learns and adapts to changing conditions. This collaboration will establish an innovative framework for using AI and machine learning technology in water management. Moreover, it will demonstrate how emerging technologies can be applied to existing stormwater infrastructure to improve environmental outcomes.

Looking toward 2050...

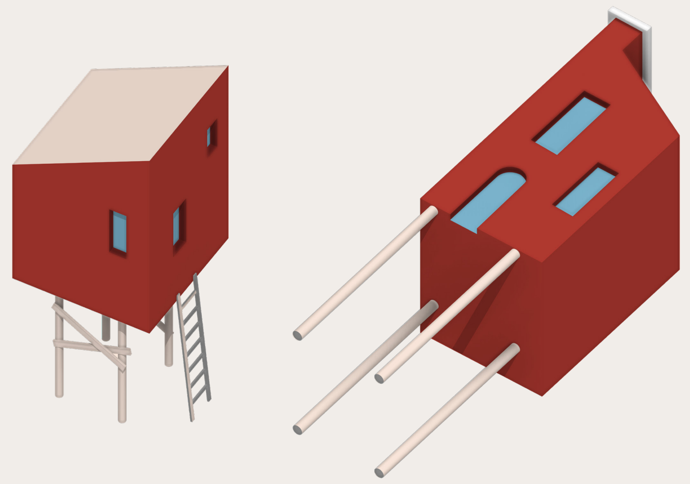
We envisage how a truly digital, climate-adaptive, and water-resilient city might operate. Amongst thousands of possible outcomes, three different plausible futures emerge.

- **Every parcel of a city as a distributed micro water utility.** Roofs, cisterns, parking spaces and parks switch between storage, reuse and controlled release according to conditions forecast minutes ahead. Water is treated as a circulating resource, not a once-through commodity.

- **Efficient, resilient, AI driven urban infrastructure.** Intelligent controllers dynamically configure pump and valve operations across entire catchments, squeezing the existing network so efficiently that most cities postpone new reservoirs, tunnels or treatment trains.

- **Neighbourhoods that design their own urban sponge.** Platforms let communities re-imagine "green-blue corridors" that reduce flood peaks, filter runoff and cool streets, and show, in real numbers, who benefits and when.

Reaching these futures is no certainty. It will take capital and collaboration for sensors and cloud pipelines, open data standards that all vendors support, and governance that keeps engineers firmly in the loop. Yet the prize, a water-secure, low-carbon, socially just, water equitable city, is within reach if we use AI to enhance, not replace, human judgment.



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Case Studies: What is Arup currently doing to improve water in cities through AI?

Arup has worked with partners and clients around the world on AI-driven solutions for real-world application that deliver better outcomes for cities.

These cutting-edge projects give us powerful insight into how AI may shape the future expectations of practitioners and how these may be transferable to other domains across the city.

***What if** all parts of the water system could model and optimise design decisions based on input data from a diverse range of contexts?*

Keeping Victoria's waterways healthy with optimised stormwater management

Melbourne, Australia, 2024

Read more

The state of Victoria's Department of Energy, Environment and Climate Action (DEECA) needed an informed analysis of the most effective solutions for meeting stormwater harvesting targets across different development types and scenarios.

Arup, in collaboration with Frontier Economics, used the stormwater management modelling tool (MUSICX) to assess the economic and financial feasibility of the interventions required to meet stormwater flow reduction, and identify and evaluate a range of options for achieving flow reduction targets for different development types.

Machine learning was used to identify the most effective and efficient combination of interventions which achieved harvesting targets. The algorithm adhered to the potential stormwater measures and constraints set by our integrated water management experts for each of the 460 possible development scenarios.

A total of 13,000 model runs were automated and presented in a PowerBI dashboard, a user-friendly format which allowed data to be clearly interpreted and inform better decision-making around stormwater management.

***Imagine if** all at-risk communities had access to an advanced flood prediction system which alerts residents to potential flood events and initiates a community-wide response.*

FloodAI: Next Generation of Flood Forecasting

Northumberland, UK, 2025

Read more

Arup, alongside Northumberland County Council and the UK's Department for Environment, Food & Rural Affairs (Defra) have developed FloodAI, as part of Defra's wider Flood & Coastal Resilience Innovation Programme to enable greater flood resilience in vulnerable communities.

FloodAI is a flood forecasting service utilising AI and 'smart' sensor technology to evolve the way we communicate flood warnings to enable an effective operational flood response. FloodAI is being piloted in areas that are particularly exposed to flooding due to the fast-responding nature of their catchment, isolating them from existing flood warning services. These areas tend to be rural and lack density, meaning they struggle to obtain flood defence investment.

The use of AI provides greater computational speeds for forecasting flooding over traditional hydraulic models. The model is also using rainfall forecasts as well as historical rainfall data as part of its forecasting. While there is uncertainty in future forecasts, accelerating the time it takes to forecast floods and therefore increasing lead times in flood warnings allows for better preparation and response, reducing potential damage and aiding faster recovery.

Expert Insight: From Water Risk to Readiness: AI's Role in Climate Adaption

Climate change is reshaping our water future from a quality to quantity perspective. Flash floods overwhelm stormwater systems, prolonged and extreme droughts threaten supply, invasive species impact property values - it is clear that ensuring resilient water resources is becoming a defining challenge across the built environment. Looking ahead to 2035 and beyond, traditional static planning will no longer suffice.

> We need smart, adaptive systems that can prepare for, adjust to, and ultimately deal with water risk. AI, when thoughtfully used, can allow us to realise these benefits and deliver urban resilience at speed and at scale.

Observing, Understanding and Addressing Water Risks: What Is AI's Role?

Digital solutions powered by AI-driven decision support tools and advanced analytics will equip stakeholders across the 'water sector' at a range of scales across the city, from water utilities to coastal hotels. These tools will provide them with greater insights to better address flooding, sea level rise, scarcity, algal blooms and a long-list of climate-change-induced water-related risks.

A future-proof strategy requires prioritising observations, comprehension and near/real-time response. AI can augment our current approach and has a role to play across all three pillars:

1. Observing: Leveraging Internet of Things (IoT), earth observation satellites, and drones to generate real-time, high-resolution water-risk data on floods, droughts, and contamination, enabling democratisation of water data across the public realm. Here, synthetic data can be leveraged where there are gaps. We are already seeing cutting edge practice in this space, including AI enhancing our ability to detect and reduce water leakage in Maricopa County, Arizona and deploying smart buoys to measure water quality in Lake Winnebago, Wisconsin.

2. Comprehending: AI-driven modelling and digital twins can integrate elements of hydrology, climate projections, land use, and asset performance to forecast scenarios and model potential failures/ unexpected outcomes. Our comprehension improves significantly through AI solutions, the benefits of which we are realising today, such as visualising pipeline repair data in augmented reality in Hue City, Vietnam.

3. Addressing: Through automated controls, adaptive systems, and decision-support platforms, AI can enable near/real-time response, from dynamic pump operation to climate-informed investment planning. Translating raw data into actionable insights and decision-making is key. For instance, Townsville City Council, Australia has leveraged AI to undertake a rapid detailed condition assessment of their vast wastewater network, rapidly generating a list of repair recommendations and where to prioritise engineering work.

The result is a shift from reactive repair to anticipatory adaptation - making infrastructure resilient not just for today's risks, but for those unfolding decades ahead.

AI-powered digital twins

True foresight goes beyond projecting current trends - it requires exploring deeply uncertain futures. AI-powered digital twins can simulate multiple climate change scenarios such as sea-level rise, compound heat-and-drought stress, and extreme storm events. This information can be layered, enabling planners to identify peaks and shifts, such as new flood-frequency thresholds or aquifer depletion timelines - enabling phased investments designed to scale and pivot according to emerging conditions. This is all part of a water-centric lens on climate-informed decision-making, reimagining design as an iterative strategy, not a one-off masterplan.

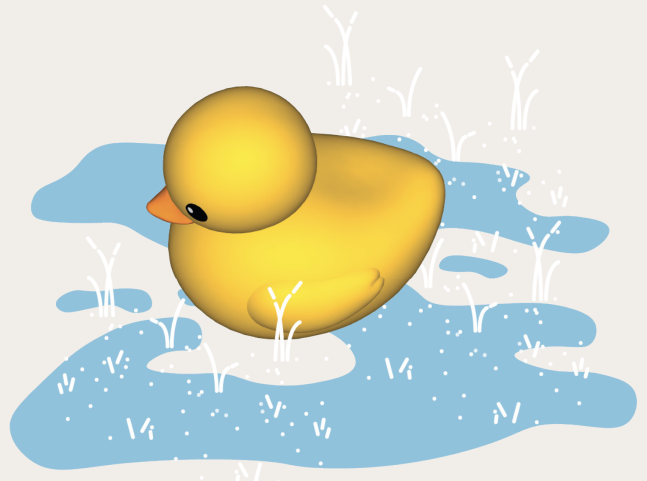
Using AI effectively to overcome such challenges will require navigating fragmented data and limits to water infrastructure. Bias reduction and respecting effective guardrails will lead to a more equitable adaptation by enabling transparency and improving access for underserved communities facing the risk of water disasters.

Looking Ahead: Water and Autonomous Resilience Agents

By 2035, AI systems embedded in water and infrastructure could operate as autonomous resilience agents. Picture integrated platforms that continuously monitor performance of stormwater assets, trigger adaptive interventions such as temporary storage or flow diversions as thresholds are breached. The built environment will be better positioned to adjust long-term investment plans based on updated climate projections and asset stress signals.

This future will require cross-sector collaboration from everyone across utilities, urban planners, insurers, financiers, to co-design AI-solutions to address water risks.

AI has the potential to transform water adaptation from reactive avoidance to proactive resilience. To realise this promise, AI must be grounded in foresight thinking, robust governance, and equity. AI is no silver bullet, but rather a powerful amplifier of human planning that needs training, context and relevant resources. Planners, engineers, communities, and AI systems will need to work in concert to shape a future where the built environment can withstand and adapt to the water realities of our new climate.



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***Imagine** a future city where rainfall is captured and stored in a network of natural assets and AI autonomously decides the optimal moment for water storage and release.*

Global Sponge Cities Snapshot – Arup Terrain

Global, 2022

Read more

Arup's Global Sponge Cities Snapshot explored the natural infrastructure of "spongy" cities and how they cope with increasingly heavy rainfall and other impacts of climate change. The Global Sponge Cities Snapshot analysed urban centres of ten global cities; Auckland, London, Montreal, Mumbai, Nairobi, New York, Shanghai, Singapore, Sydney and Toronto.

Arup's Terrain AI-enabled tool compared the urban centres of these cities quantifying their natural assets, identifying opportunities for the cities to value and utilise their existing natural infrastructure. Natural assets like grass, trees, leaves, lakes and ponds retain rainfall and slow down surface water, reducing flood risk.

Terrain calculated the percentage of green and blue areas of city centres through AI and satellite imagery. Soil types and vegetation variance imputed into rainfall runoff calculations were analysed and combined with land use data, generating a natural "sponginess" snapshot of each city.

The sponge cities soak up heavy rainfall and create areas of shade and cooling. The snapshot encourages cities to rethink their approach to impermeable surfaces and increase adoption of permeable, nature-based infrastructure. In addition to the flood prevention benefits, these nature-based responses also introduce biodiversity, reduce carbon-intensive infrastructure, improve public spaces and occupant wellbeing, and increase resilience to extreme heat and droughts. The Global Sponge Cities Snapshot aimed to reframe the narrative around cities as concrete jungles, instead thinking more about nature as an asset or an infrastructure that needs to be protected and enhanced.

What new roles and responsibilities may emerge for practitioners working in a smart watershed context, where AI independently takes decisions to learn, adapt and evolve?

Nature Conservancy: Optimising stormwater systems in urban areas

Florida, USA, 2024

In Florida, Arup is partnering with The Nature Conservancy, OptiRTC, Jones Edmunds, Amazon, and the National Stormwater Trust to pilot an innovative, AI-enabled watershed management approach. This collaboration aims to demonstrate how existing stormwater infrastructure can be enhanced through a combination of real-time monitoring, forecasting, and automated controls. Arup is leading the digital and data analytics aspects of the project, including the development of physics-based models, AI/ML algorithms, and open-source tools in collaboration with Amazon. By enabling the infrastructure to adapt dynamically to changing weather and runoff conditions, the project seeks to reduce flooding and pollution while improving water quality and resilience across the watershed. At its core, this is a proof-of-concept for how AI and machine learning can transform conventional infrastructure into smart, adaptive systems that benefit people, ecosystems, and local economies. The longer-term ambition is to scale this approach globally, supporting the broader uptake of climate-resilient, nature-positive infrastructure.

Additional examples of where Arup have leveraged AI and digital technologies to achieve remarkable outcomes in water projects can be found here:

Urban Drainage Masterplan
Shanghai, China
Read more

Sustainable Flood Resilience
Mansfield, UK
Read more

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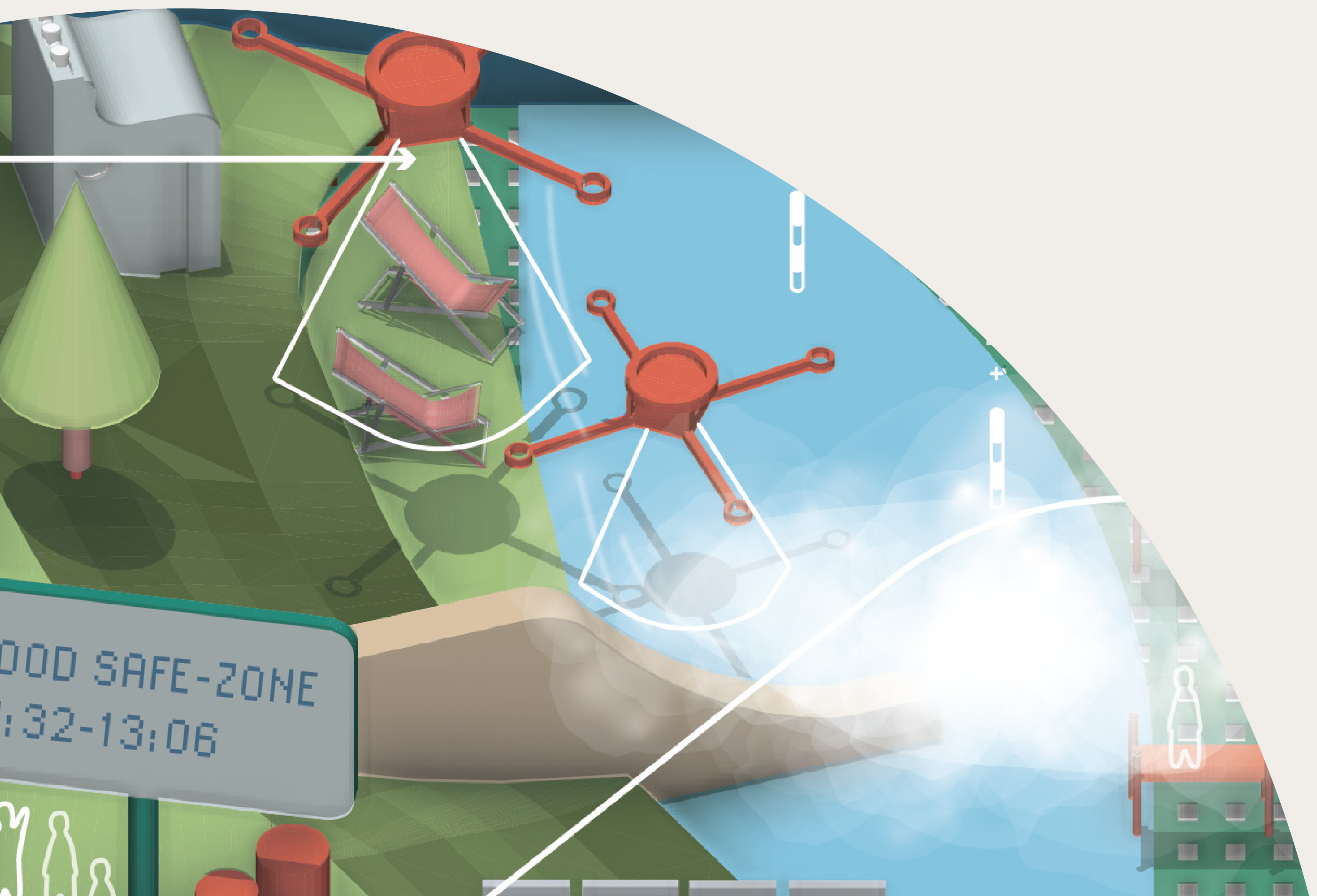
Recommendations:
Practical steps for today's practitioners

AI will impact water in cities in profound ways. Although we can't predict these impacts exactly, we can take anticipatory steps today to be better prepared for the future city.

These recommendations seek to provide the **foundational elements** and **enablers** that are required for AI fully to augment our water systems.



1 Deploy sensors strategically

AI needs data to function, which in turn needs sensors. Stakeholders should prioritise investing in sensor deployment across the water network in the "right" places. The focus should be on locations where sensors yield genuinely valuable insight and there is a net benefit relative to the carbon lifecycle of the sensor itself. This is vital for maximising the value of existing infrastructure and realising the impact of AI in the water system.

2 Data-driven decision making is key

The future of the water sector will be data-driven, with decisions increasingly based on more complex data. Insights from AI will be crucial for practitioners to translate data into useful knowledge to enhance decision making. AI will increasingly be responsible for making decisions autonomously in the network. Understanding the data that feeds into this and retaining a human in the loop is critical.

3 Create a data sharing ecosystem & framework

Data in the water industry is often fragmented and siloed. This acts as a barrier to achieving the interoperability required for AI to have benefits at scale across the whole water system. To overcome this, it will be crucial to develop sufficient data sharing infrastructure, protocols and agreements between associated parties and stakeholders.

4 Ensure you are secure digitally

Digitalised water systems are set to become increasingly vulnerable to cyberattacks and digital threats. Cybersecurity needs to be high on the investment agenda to ensure critical water infrastructure and data is safe and systems are up to date.

5 Water futures will diverge from past trends

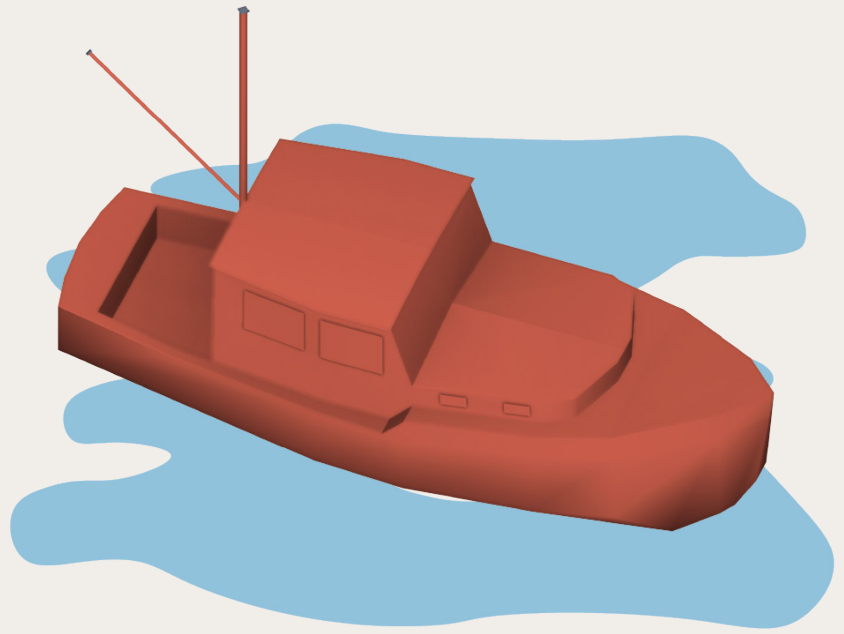
AI is valuable in forecasting and predictive modelling, but be wary that the past is not representative of the future, particularly a future of climate change and extreme water events. Keep models up to date to prevent model drift and work on developing adaptive pathways to explore varying future scenarios that inform decision-making.

6 Listen to water communities

AI can help in a lot of different ways in the water industry, but it does not directly engage with the communities served. Storytelling, communication and codesigning processes with communities are vital in developing AI in the water sector. Striking a balance between leveraging data and technology and empowering communities by addressing their social priorities is crucial.

7 Future generations of water specialists

Large parts of the water industry workforce are set to retire in the coming decade, with many fewer people in the pipeline. AI is expected to take up a lot of the slack, but not all of it. Ensure that tacit knowledge and the decades of experience that is about to retire is captured and passed on to future specialists.



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Get in touch with our experts to discuss further.

Arup University is our corporate university function that prepares our clients, collaborators, and global membership for the future. We are committed to raising technical standards across the natural and built environment sectors.

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