Sydney WATER

Research & Innovation Highlights 2021
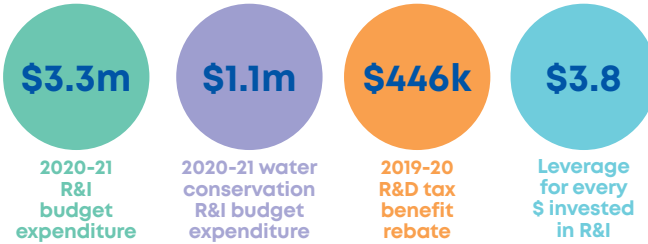
Contents

2021 at a glance

Sydney WATER

R&I investment and revenue

$3.3m
2020-21 R&I budget expenditure

$1.1m
2020-21 water conservation R&I budget expenditure

$446k
2019-20 R&D tax benefit rebate

$3.8
Leverage for every $ invested in R&I

Industry leader

NSW AWA R&D Excellence Award Winner
Development of wastewater epidemiology for NSW – Collaboration on SARS-CoV-2 monitoring in wastewater

Australian Financial Review Most Innovative Company
Shortlisted for work on SARS-CoV-2 monitoring in wastewater

Our R&I portfolio

First choice of customers & partners
High performance culture
Successful & innovative business
Thriving, liveable & sustainable cities

- Open innovation & capability building
- Pilots & technology trials
- Healthy waterways & environment
- Smart cities
- Assets & operations
- Reliable & resilient water supply
- Circular economy & resource recovery

200+
R&I projects currently underway (enterprise wide)

A culture of innovation

Measuring innovation
6.2 out of 10 Innovation Effectiveness Index score 2021

Sydney Water Science Week
400+ online participants

Wave innovation challenge
three sessions held over 2020-21 with 49 ideas pitched

OzWater 2021
26 presentations and eight posters presented

Innovation Festival
4,900 viewers over three days

Innovation, Research & Deployment Plan

In 2021, Sydney Water launched our Innovation, Research & Deployment Plan. The plan supports Sydney Water's Strategy, outlining our key research priorities and approach to innovation, from idea through to deployment.

Through the Plan, our goal is to foster a culture of innovation to advance the delivery of world-class water services.

Some key features of the plan include a stronger focus on development in Western Sydney, water conservation, and higher priority for deployment of R&I outcomes to fully realise business benefits.

The Innovation, Research & Deployment Plan is available on our website.

Innovation effectiveness

As Sydney Water is constantly evolving and enhancing its innovative capability, we needed a more advanced measurement of our effectiveness to take it to the next level. As a result, we completed an international best practice review to revise our Innovation Effectiveness Index.

The revised index includes not only internal and external perception measures, but the collaboration, impact and pace of innovations adopted across the organisation to enable innovation agility. We'll be reporting using the revised index from 2022 and are aiming for continuous improvement.

6.2
2021 Innovation Effectiveness Index (out of 10)
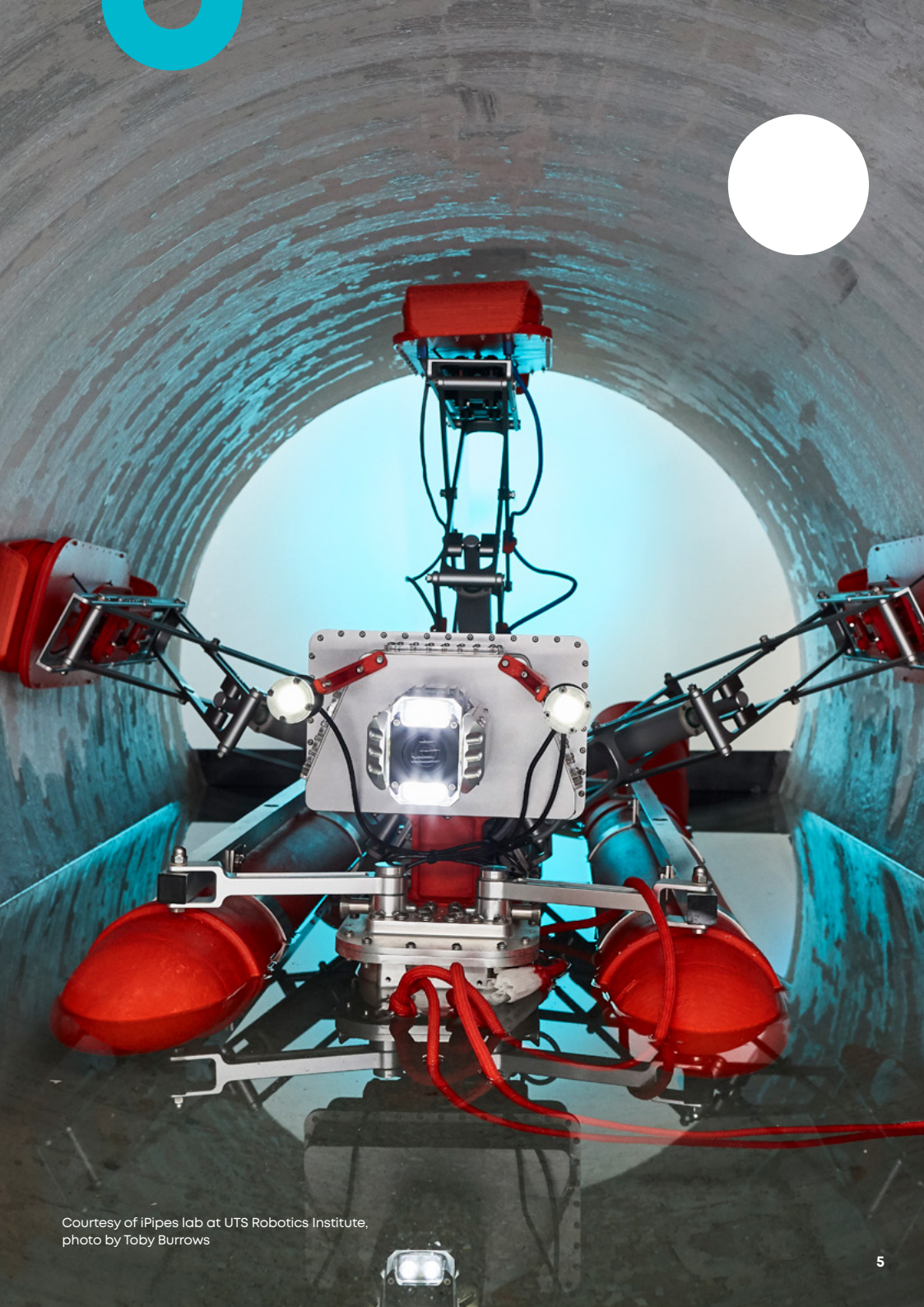
Courtesy of iPipes lab at UTS Robotics Institute,
photo by Toby Burrows

Sydney Water Innovation Festival

Held between 18-20 October, the inaugural Sydney Water Innovation Festival connected customers, community, academia, government, industry partners and key stakeholders in an interactive online environment.

A twin event with England's Northumbrian Water Group – who have been running their successful Festival since 2017 – the Innovation Festival was truly global, attracting visitors from 24 different countries!

The Innovation Festival was a chance for the water industry to step outside of their comfort zone, approach key challenges and generate new ideas in a creative and innovative way.

Festival highlights included;

• Keynote speeches from Craig Reucassel, Dr Karl Kruszelnicki, Corey Tutt and Catherine Caruana-McManus

• Panel sessions on regulation, driving innovation and Indigenous engagement

• 'The Splashes' debate – who is better at innovation: Australia or the UK? Featuring Shane Jacobson

• Technology 'shark tank' pitches with prizes

• Fun entertainment breaks

Five design sprints and a data hack were held during the festival, producing novel concepts and ideas. We're excited to explore how these can be progressed over the coming year.

Innovation Festival key themes:
• Customer experience
• Smart cities
• Water security
• Liveability
• Amplifying the voices of Aboriginal people
• Circular economy

24 Countries

Australia
Brazil
Canada
Chile
Fiji
Germany
Guadeloupe
Hong Kong
India
Israel
Italy
Netherlands
New Zealand
Philippines
Poland
Scotland
Singapore
Spain
Sri Lanka
Thailand
Ukraine
United Arab Emirates
United Kingdom
United States

Rated 4.2/5 by attendees

★★★★☆

SYDNEY WATER'S INNOVATION FESTIVAL
THE BRILLIANT GET TOGETHER

Viewers

1,400+ Day 1
1,700+ Day 2
1,800+ Day 3

62 Hackers & Sprinters

over 60 hours of innovation

Visitor
Sydney Water
Suppliers
Sponsor/ Guest

19 Sponsors

1,309 Registrations

35 Technology Shark tank pitches

8 Entertainers, instructors & performers

Innovation culture

Sydney Water's innovative culture means our people are continuously exploring new ways of improving services. We're harnessing the ideas of our people and encouraging a collaborative multi-disciplinary approach across the business.

Science Week

More than 250 people tuned in to our Science Week event to learn about all the interesting things we can detect from our wastewater. We heard from Professor Jochen Mueller from the SewAus Census program, along with Sudhi Payyappat, Todd Wightman, Tiffany Chen and Megan Dreyer from our COVID wastewater surveillance team.

"So interesting and surprised by how much information we can get out from wastewater samples by using science. Cool!"
Thang

"This is a shining example of public service. The team should be highly commended for their effort. You all really have customer at heart. We are all proud of you and grateful for your services. Thanks again."
Karu

wave
CREATE + INNOVATE

Merran Griffith, Nathan Harrison and Emma James from our Wastewater and Environment Custodian team, winners of Wave 2020

Open innovation

Most great ideas start from a ripple and build to a Wave.

Sydney Water's premier ideas festival, Wave, fosters innovation, creativity and collaboration across the business.

In 2020 and 2021, we trialled a new digital ideas platform, Hype, for open innovation and collaboration within Sydney Water, and with our various stakeholders. All of our people are welcome to submit their innovative ideas at any time. Hype is interactive and allows people to like, comment and vote on their favourite ideas.

We're committed to taking these ideas and bringing them to life. Let's check in with some of our previous winning Wave ideas.

Mobile environmental overflow treatment unit

A Mobile environmental overflow treatment unit that reduces the amount of potable water needed to restore waterways impacted by sewage was the winning idea from Wave 2019 'Responding to drought', presented by Greig Priestley, Steve Stojkovski, Greg DuPlessis, Terry Mahony, Leo Varela, Stuart Gardner from the Network Innovations team.

In 2020, we brought a UNSW undergraduate student into the team to turn this idea into a detailed concept. We received in-principle support from NSW Health and the EPA, and this project has now moved into the detailed design phase. We're hoping to see one of the mobile environmental overflow treatment units out in the field in the near future!
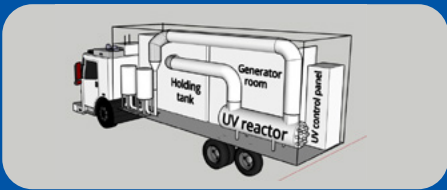
Community microgrids

The winner of the inaugural 2021 'P4S Innovation Running Race', microgrids improve system resilience by encouraging interlinked communities to capture renewable power and share stored energy to other householders during power outages. Watch this space!

Storm canal traction cleats

Emma Holman was the winner of Wave 2021 'Falls prevention', held in conjunction with the Health, Safety and Wellbeing team. Emma's idea to use traction cleats, a rubber device workers can slip over their work boots to give them better traction in stormwater canals, which can often be dangerously slippery with algae.

Emma was given the opportunity to pitch her winning idea to a panel of 'sharks' as part of the Sydney Water Innovation Festival, and the idea was voted the People's Choice winner! We're currently compiling feedback from our field crews before trialling the solution in our canals. This is shaping up to be such a simple yet effective way to improve safety in the field – thank you Emma!

Catchment Bots

The winner of Wave 2020 'Robotics, enabling a future-ready workforce' was Catchment Bots. A collaborative catchment computing tool to improve waterway health, this idea uses AI to monitor fish, frogs and vegetation, informing catchment health.

We've helped the team build a prototype monitoring device using GoPro cameras, and it's almost ready to be deployed in the Hawkesbury and Nepean Rivers and Stonequarry Creek. We're excited to start collecting data, testing the AI capability and seeing how many fish and invertebrates we can identify.

Research &
Innovation
Case Studies

Water conservation

Water storages are currently full, but that doesn't mean we can be complacent when it comes to saving water. We're investing in innovative and proactive water conservation initiatives that focus both on customer water savings, as well as operational improvements for the business. Here's some of our highlights.

One Stop One Story

Sydney Water is proud to be partnering with Thriving Communities and their One Stop One Story (OSOS) Hub Pilot Program. The OSOS Hub enables frontline workers in corporate and community organisations to connect and refer their clients to a range of support through a single access point.

This process aims to make it simpler for people to navigate support offerings, and reduces the burden and complexity involved in contacting each individual support program. This also means Sydney Water is able to offer water efficiency support programs such as WaterFix and PlumbAssist to the people who need it most.

SmartPipes

When cleaning up sewage overflows in the environment, our field crews use potable water to flush the waterways. Historically, we only estimated water usage, as we had no easy way of accurately measuring it. Enter the SmartPipes.

We're trialling an intelligent standpipe that remotely captures the water being extracted from a hydrant in real-time and transmits the information to a live portal. The benefits of using the SmartPipe technology include identifying and improving water conservation practices, and delivering greater transparency for improved water management, business efficiencies and customer engagement. The trial started with 23 SmartPipes, but we've already ordered 10 more to keep up with demand! We're predicting up to 252 million litres of water will be accounted for during this year-long trial.

Hydraloop

We're trialling Hydraloop, a household scale greywater recycling system that treats wastewater from baths and showers, which is then used for flushing toilets and watering gardens. By installing a Hydraloop unit, property owners could achieve average household tap water reductions of between 25-45 per cent – or the equivalent of around $180 a year on water bills!

We'll be installing the system in a variety of residential dwellings, as well as a multi-unit social housing redevelopment.

Water smart homes in Greater Sydney

A field guide for the future

Collaborating with UTS Institute for Sustainable Futures

'Water-smart homes in Greater Sydney – A field guide for the future' explores how smart technologies could transform water use practices in commercial buildings and homes in Greater Sydney, and particularly new areas in Western Sydney, over the next ten years.

A key feature of this study is the creation of a series of visual narratives, designed to aid in thinking through key questions, hurdles and opportunities likely to emerge in a transition towards smart water systems and fixtures in homes across Sydney. The vision narratives are based on different dwelling types that are likely to characterise new development in the Western Parkland City, including a mid-range apartment complex, a high-end eco-luxury dwelling, a social housing development, and an aged care retirement village.
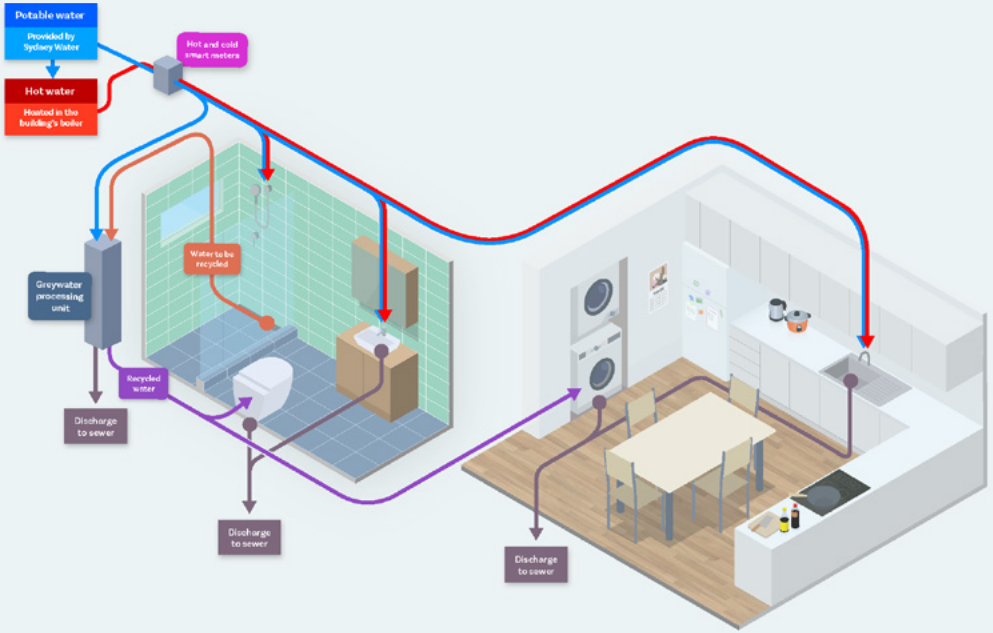
Want to find out more? Check out the full report on our website at Water smart homes in Greater Sydney – a field guide for the future.

The findings from 'Water-smart homes in Greater Sydney' were used as part of our Customer Experience Design Sprint, which developed a solution for young people to share information on water and sustainability, called The Ripple Effect. Watch this space!

Water flows

Potable Water
Provided by Sydney Water

Discharge to Sewer
For treatment by Sydney Water

Eco-lux Wastewater Treatment

Discw treated water

Smart irrigation

Pond

Bioretention bed

Tank top-up

Reuse Storage Tank
Cleaned stormwater and recycled water is stored afor use in the precinct

Social Housing Rainwater tank

Daylighted Creek
An underground stormwater drain has been uncovered and restored as a more natural and open waterway, improving habitat, decreasing nutrient pollution and reducing downstream flooding.

● Water flow monitor

■ Water quality monitor

Chen Family Home: Water

Potable water
Provided by Sydney Water

Hot water
Heated in the building's boiler

Hot and cold smart meters

Greywater processing unit

Water to be recycled

Recycled water

Discharge to sewer

Discharge to sewer

Discharge to sewer

Avni and Rishit's home: Data

Leak detection and shutoff system

Smart Device Manufacturer

Smart taps

Smart control toilet

Smart command shower

Smart control dishwasher

Water use data
Rich information about how smart devices are using water in the home

Private Water Utility

Leak alerts
Notifications when leaks are detected and water is shut off

Targeted conservation messages
Such as water saving tips and competitions, & comparison of water use with local averages

Smart control washing machine

Smart control
Receives input to control connected smart technologies

Will Sydney Water receive any data on water use in Avni and Rishit's apartment?

Artificial intelligence to predict tree root intrusion

Collaborating with Macquarie University and the Bureau of Meteorology

Sydney Water responds to up to 13,000 sewer chokes each year, and the majority of these are due to tree root intrusion. This occurs when tree roots seek out water and find their way into our pipes, causing blockages. Tree root intrusion leads to approximately 1000 incidents each year.

We've already analysed data from more than 2,000 sewer blockages, which were attributed to more than 90,000 tree stems belonging to 651 tree species. We used this data to create an AI model that predicts which tree species are most at risk of intruding into wastewater pipes across Sydney. The Bureau of Meteorology is also developing a soil moisture model, which will be integrated with this research.

Up next, we'll be extracting root samples to identify tree species through forensic genetic identification. This will help us verify and validate the AI model to better identify which species cause the most chokes, and even pinpoint the individual trees that are causing issues!

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Assessing vibration using photonic sensors

Collaborating with City, University of London

Fibre-optic photonic sensors are a new and innovative tool – they're durable, cost-effective and can withstand harsh environments. We're trialling them in different settings to improve safety and ensure the resilience of our assets.

Following a 2018 pumping station failure and associated clean-up cost of around $23 million, we're seeking to better understand the structural health of our assets to prevent failure.

We're installing photonic sensors at two similar pumping stations to assess the impacts of vibration and strain on the unreinforced concrete walls found in many aging assets, and any effect on structural integrity when the pumps are running.

We'll also be producing a methodology to apply to our other pumping stations, improving safety and ensuring the resilience of pumping station assets at Sydney Water and around the world.

Moving towards proactive maintenance

Smart infrastructure management – realising the benefits

Sydney Water has developed a suite of intelligent tools and models to improve safety and monitor the condition of our assets. You've probably heard about our award-winning robotics, including our main break tool, planned maintenance tool and rising main tool, which are able to safely and accurately assess the condition of our water pipes.

We also have machine learning tools for predicting critical water mains breaks and sewer corrosion hotspots.

We're excited to be taking these innovations and making significant progress towards widescale use across our business, and potentially even commercial applications.

Acoustic sensing for leaks and breaks, **saving 5000ML water**, and **over $10 million per year**

Predictive models detect **80 per cent** of critical water and distribution main failures within **200m**

Innovation of critical water mains and sewer riser main tools to non-intrusively and continuously assess wall thickness, corrosion hotspots and CCTV **up to 1km**

Our crews will be better equipped to know where they need to repair the pipe to prevent main breaks

IoT sewer blockage detection

Our teams are deploying thousands of digital sensors across Sydney's wastewater network to detect and remove blockages before they cause a problem.

We've installed more than 3000 monitoring devices, which have already detected more than 220 blockages.

We're safely and efficiently installing innovative Internet of Things (IoT) monitoring devices in locations across our wastewater network. The sensors raise an alarm when they detect rising wastewater levels upstream of a blockage, notifying our field crews and allowing them to remove the blockage before it turns into an overflow.

So far, this project has deployed more than 3,000 IoT devices. Since commencement, 220 identified blockages at environmentally high-risk sites have been removed, representing avoided incident cost of $300,000 per month, reduced environmental harm and disruption to customers.

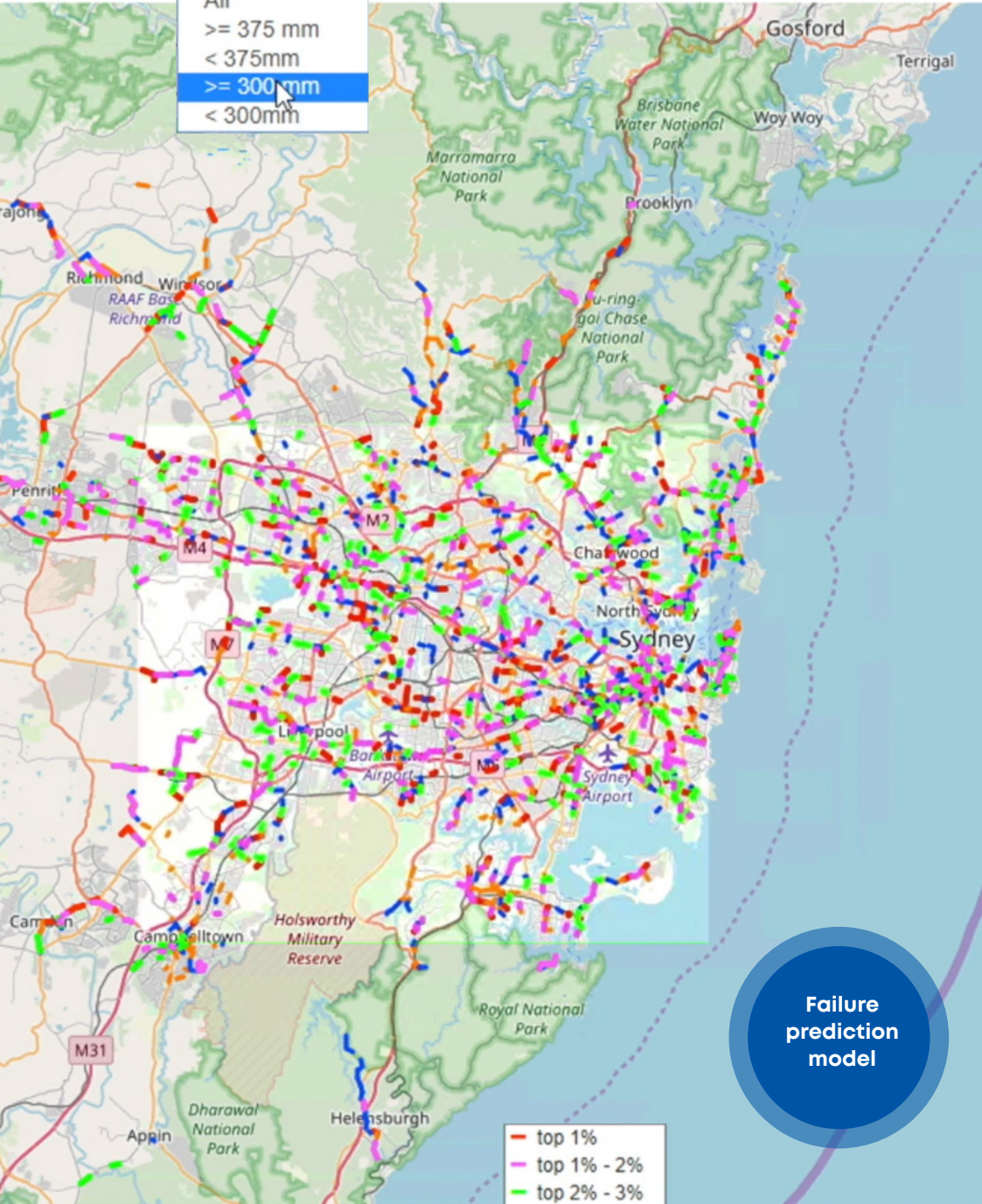This initiative also won the 2021 IoT Alliance of Australia's Water Award.

Failure prediction model

Legend:
- top 1%
- top 1% - 2%
- top 2% - 3%

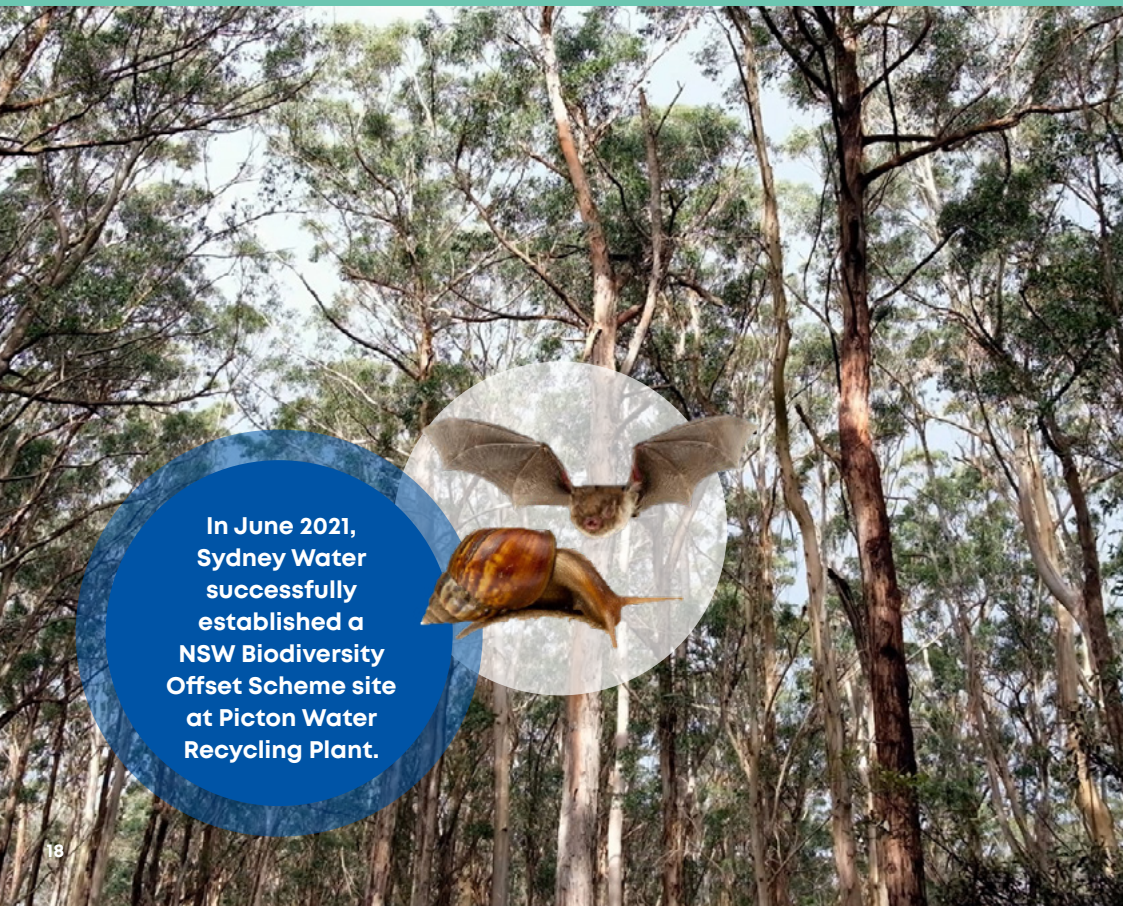# Biodiversity offsetting for conservation

In June 2021, Sydney Water successfully established a NSW Biodiversity Offset Scheme site at Picton Water Recycling Plant.

The Picton Water Recycling Plant site is home to four threatened ecosystems; grey myrtle, Cumberland shale plains woodland, turpentine and Cumberland shale ironbark woodlands. There are also three threatened species at the site; the southern myotis bat, large-eared pied bat and the Cumberland land snail.

Covering an area of 144ha, the flora and fauna at the site is now protected in perpetuity.

We've committed to active land management, such as weeding, fire management and revegetation, which will increase the quality of the ecosystems and attract threatened species, improving the overall ecological quality and diversity of the area.

As a biodiversity offset site, offset credits will be generated, which will be sold to developers to offset the environmental impact of new development. We're expecting revenue of up to $13 million, which will be used to fund all management costs for the site and generate additional unregulated revenue.

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Purple roofs for stormwater management

A collaboration between Sydney Water, Western Sydney University, Knauf Insulation, Green Roof Diagnostics and Evolvement Pty Ltd

'Purple roofs' combine two technologies – green roofs and blue roofs – to improve stormwater detention and retention effectiveness. We're comparing the performance of a steel roof, green roof and purple roof to assess their ability to survive and to reduce peak flow in storm events in Western Sydney.

Analysis of the last seven months of rainfall and runoff data indicates that the purple roof performs better in regard to retention, runoff volume and reaching peak runoff compared to a green roof or traditional roof.

Green roofs add plant material and a growing membrane. They can hold some water, but when saturated, water runs straight through.

Purple roofs have both a void layer for stormwater detention, as well as plant material, mineral wool and soil. They passively release water through a layer that slows outflow.

Traditional roof where the water runs straight off.

Towards a net-zero carbon future

As part of our plan to achieve internal net-zero carbon emissions by 2030, Sydney Water and Jemena have signed an agreement to generate biomethane at our Malabar Wastewater Treatment Plant in South Sydney.

Biogas is a by-product of anaerobic digestion, which is part of the wastewater treatment process. At our treatment plants, it's normally used for on-site electricity generation, with any excess combusted through waste gas burners. This project will involve upgrading the biogas to biomethane, which can be injected back into the gas distribution network

As Australia's first biomethane-to-gas project, it will see thousands of Sydney homes and businesses using renewable green gas for cooking, heating and hot water. The zero-carbon emission, high-quality biomethane gas will be injected into Jemena's New South Wales gas distribution network – the largest in Australia with 1.4 million customers.

Just one of the innovative ways Sydney Water is world class in our use and generation of energy.

What's coming up in the pipeline?

Parkland city arboretum

We're planting 600 trees in Western Sydney to determine the effect of irrigating with recycled water versus potable water

Technology trial centre

We're investigating innovation hubs and technology trial centres around Western Sydney

Green infrastructure for WWTP polishing

We've completed a proof of concept and will soon be trialling innovative green solutions for wastewater polishing

Harnessing digital metering for water conservation

We're expanding our use of digital metering and looking at further applications for saving water

Hydrogen

We're conducting experimental research to assess the suitability of using tertiary treated wastewater for hydrogen production

Better life at home trial

We're including our people in a trial to maximise the benefits of outdoor water use, reduce heat island impacts, backyard temperatures and electricity bills through misting systems

Innovation Festival 2022

We'll be back again in 2022 for an even better Sydney Water Innovation Festival

Water conservation

We're trialling new water efficiency technologies, including smart shower timers and outdoor smart irrigation systems

Deploying advanced sensing for leaks and breaks

We're focusing on the deployment of our new sensing technology, to better identify potential leaks and breaks before they impact the customer.

Joey, our water leak detection sniffer dog.

**For more information on
Research & Innovation
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