



Research and Innovation is changing the way we do business

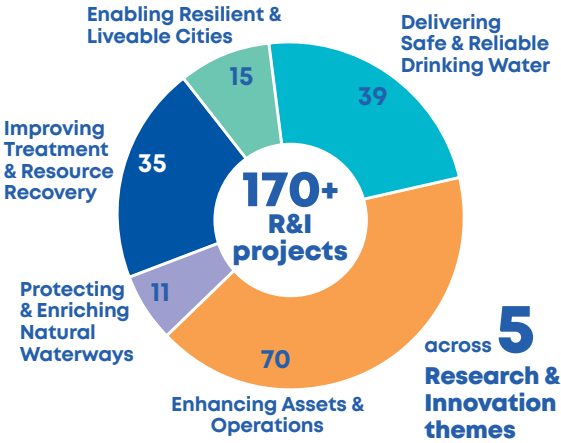
Annual Highlights 2018–2019



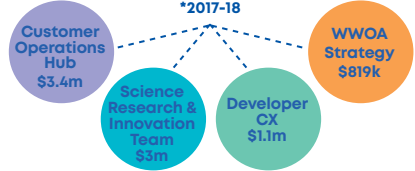
Sydney
WATER



Our achievements at a glance



\$10.4 MILLION invested in R&I *2017-18



\$883,000 R&D Tax Benefit Rebate *2017-18



\$1,000,000 worth of royalties raised from commercialisation of the Monoclonal Antibody test kit *over the past decade

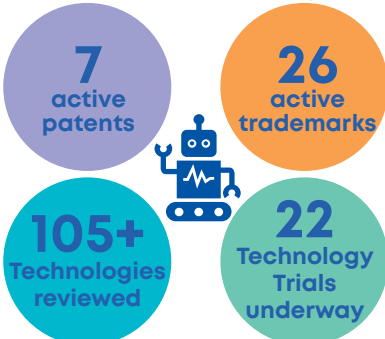
Smart Water Project of the Year – Customer Hub
 Australian Museum Eureka Award Winner – Data 61
 Smart Cities Award Winner – UOW SMART Infrastructure Facility
 Better Together Award – XDI Sydney
 AWA NSW Research Innovation Award Winner – R2T2 Rapid Response Robot
 Digital Utility of the Year – Digital Utilities Awards
 Best NSW Government Initiative Award Winner – IOT Pilot
 13 OzWater'19 Posters & Presentations



Building an Innovation Culture

3 events & over 100 Digital Disruption & Wave Challenge participants
 53 Innovation Insights Survey stories shared
 250 National Science Week attendees

WaterAid 2018 Global Winnovators Winners – Team Praan
Best Innovation & Solve – Team #LiveDifferently
Highly Commended Asia Pacific Region – Team Avasar



83 CX Lab workshops and activities with over **726 participants**

In July 2018 our R&I strategy was approved



We're collaborating with over

50 research partners

including
 Universities
 Government departments
 Industry partners
 Utilities
 Consultants

Sydney WATER



Our condition assessment robots are being used on the ground during maintenance to assess the condition of our critical water mains.

What an amazing year!

This year has been one of achievements and solid progress in building our innovation ecosystem across the business. The focus has been on bringing people and ideas together and looking at how we can do things differently.

A few of our 2018-19 highlights include:

- Our new Research & Innovation (R&I) Strategy, setting out our vision and roadmap to support Sydney Water's journey "to 2020 and beyond".
- For the first time ever, we've developed an Enterprise-wide R&I Plan to give visibility of all innovation across our business.
- Our Innovation and Culture Program is helping to promote, connect and share innovation stories across Sydney Water, driving a 'can do' culture that lifts the lid on innovation!

Across the business, we're working on over 170 projects from customer journey mapping and design thinking to emerging contaminants and waterway health.

We've delivered some major initiatives this year in response to the drought, including exploring emerging sensing technologies to better predict leaks and breaks with the support of the NSW Chief Scientist and NSW Smart Sensing Network (NSSN).

Our Digital and IoT teams have been busy rolling out smart meters and sensors to support a reduction in water consumption, network leakage and detecting sewer blockages to avoid high impact sewer overflows.

Finally, we would like to thank our outgoing Managing Director Kevin Young for all his support of our R&I program over the last eight years. R&I needs strong leadership from the top down and bottom up if it is going to thrive and become "the way we do things around here".

As an organisation, we should be proud of our achievements and the innovative momentum across our business, supported by a Blue Bus culture that is growing every day.

We have an exciting future, with innovation holding our keys to success.

Dr Nicola Nelson,
Manager Science,
Research and
Innovation

Science
Week
2018



Innovation is in our culture

We've had a busy year engaging with the business through our innovation and culture program. We held a number of events to promote and connect the great innovation that is happening across Sydney Water.

Celebrating World Creativity and Innovation Week

On 15 April, we held a panel discussion facilitated by Professor Ian Snape, on how we can 'lift the lid on innovation', with guest speakers including:

- Dr Kathryn Mumford, Associate Professor at University of Melbourne
- Dr Steve Brodie, Executive Manager Innovation at CSIRO
- George Fonua, Founder Locomotive Consulting and Blue Bus Leader
- Professor Ian Snape, Director of The Coaching Space, Antarctic Expedition Leader - facilitating the discussion, drawing on his insights coaching and mentoring organisations.

Our inaugural Wave challenge – How can Sydney Water create a thriving circular economy?



Working with the Blue Bus Program to enable innovation

We will continue to work with our Blue Bus cultural change program to promote the 'can do' behaviours that will support new ways of working and enable innovation across the business and through collaboration with our external stakeholders.

Our inaugural Wave Session

The Wave program is building on the success of Digital Disruptors, to continue to foster innovation, creativity and collaboration across the business – for our customers and our community. The first Wave Session rolled in on May 23, 2019 at Potts Hill.

The event was a great success thanks to all the participants and volunteers on the day. We challenged teams to use their creativity and skills to create unique ideas for our Long Term Strategy theme:

'How can Sydney Water create a thriving circular economy?'

Moving towards an open innovation culture

We held an Open Innovation workshop at our CxLab to explore how Sydney Water can move towards an open innovation approach with our external partners. We used design thinking tools to consider how we can better engage and collaborate with our supply chain partners, share ideas, data and learnings and to look for opportunities in areas such as the Circular Economy to develop new value-added products and services.



Research and Innovation, from catchment to customer

Enhancing assets and operations



Page
12-13

- Quantum sensing for pipe leaks
- Pipe failure prediction model
- Internet of things (IoT) trials
- Smart metering
- CCTV machine learning for pipe condition assessment
- + many more!

Delivering safe and reliable drinking water



Page
10-11

- Graphene and novel polyelectrolytes for natural organic matter (NOM) treatment
- Microbial risk monitoring
- Environmental *E.coli*
- Monitoring nitrification in drinking water
- + many more!

Protecting and enriching natural waterways



Page
14-15

- PFAS risk assessments
- Cyanobacteria gene testing
- Microplastics
- Hawkesbury Nepean and South Creek studies
- Pilot wetland projects
- + many more!



Working with our partners from our water catchments, throughout our networks, and all the way to our customers!

Improving treatment and resource recovery



Page
16-17

- Co-digestion to produce energy
- Renewable power using sodium ion batteries
- Activated sludge microbiology to optimise biosolid production
- Optimising treatment technologies
- + many more!

Enabling resilient and liveable cities



Page
18-19

- Climate change interdependencies for critical infrastructure
- Customer Hub
- Save Water Alliance
- Partnerships with councils
- + many more!





Delivering safe and reliable drinking water

We are constantly improving our water quality management and monitoring systems to ensure we continue to provide high quality, safe and reliable water to today's 4.9 million customers now and in the future. Our key objectives include:

- Understand the long-term impacts on raw water quality to ensure treatment capacity
- Optimise treatment and disinfection practices to minimise disinfection by-products and ensure protection of public health
- Identify and understand emerging contaminants of concern in drinking water
- Optimise and identify laboratory techniques for microbial source tracking
- Develop alternative water supplies.

Chlorine Tablet Dosing Kiosk

As a result of collaboration between the Networks, Production and Technical Services teams, we've developed a small automated chlorine dosing kiosk. This kiosk eliminates manual handling issues and the need to climb to the top of reservoirs, improving safety for our staff as well as ensuring consistency of chlorine dosing across the network.

Lead Flushing

NSW Health currently recommends flushing kitchen taps for 30 seconds every morning to reduce lead impacts from household plumbing fittings. A Sydney Water study demonstrated that a conservative 10 second flush was sufficient to reduce lead levels, with water saving implications of 800 megalitres per year!

Case Study

NOM and climate change – Adapting catchment monitoring



Natural Organic Matter (NOM)

Natural Organic Matter (NOM) in source water can have a significant impact on treatability. NOM impacts floc formation, increasing the probability of early filter breakthrough and formation of disinfection by-products.

In addition, **climate change** and **drought** impact our water supply catchments resulting in an increase of the amount and type of NOM present within source water.

Sydney Water is leading the way in NOM research. We're working with the University of NSW, City University London and WaterNSW on the ARC linkage project

“Adapting catchment monitoring and potable treatment to climate change.”

The aim is to understand the impacts of climate change on NOM and at the same time develop innovative sensors to detect targeted changes in NOM levels and provide an early warning system for potential water quality impacts.

Earlier work by UNSW and Sydney Water developed an in-situ and portable floc **strength instrument**, providing a rapid screening technology for optimisation of treatment technologies as NOM changes.

We're patenting a new **graphene oxide membrane** for NOM removal which we've invented with UNSW.



Enhancing assets and operations

To meet customer expectations, we're striving to improve the performance and extend the life cycle of our assets, as well as increase the efficiency of our operations using advanced analytics and intelligent technologies. Our key objectives include:

- Enhance current and future service standards to improve and extend asset life
- Improve workplace health and safety
- Optimise lifecycle investment decision making to enhance reliability of services
- Improve smart monitoring, sensing and proactive maintenance to improve customer service.

We're also trialling **drone** technologies for asset inspections, remote water sampling, remote monitoring and pipe CCTV, improving **safety** and reducing labour time.

Case Study

We're leading the way in IOT

80 digital / smart meters are currently being trialled in residential and commercial sites to support a reduction in water consumption and network leakage

Sydney Water's IOT Pilot won **Best NSW Government Initiative** at the Committee for Sydney's 2018 'Smart City Awards'

A trial of 280 smart sensors have been deployed in Liverpool, successfully detecting 20 sewer blockages and averting high impact sewage overflows to **4700 properties**



Reducing leaks and breaks to help us save water during drought

As the drought progresses, we're looking towards innovative technologies to help predict, prevent, assess and repair leaks and breaks in our pipes. We're collaborating with leading experts including University of Technology Sydney (UTS), CSIRO's Data 61, Water Services Association of Australia (WSSA), NSW Smart Sensing Network (NSSN), water utilities, universities, industry suppliers and international partners to investigate, develop and trial new smart science and engineering to reduce failures and save water.

By using these cutting-edge technologies for preventative asset maintenance for leaks and breaks, we're on track to save

\$70 MILLION

in efficient renewal costs over five years!



Predictive Analytics

Predicting and prioritising high risk pipes

Robotic Sensing

Developing smart sensing robots to improve pipe condition assessment techniques (2019 NSW AWA R&I Award Winner)

Advanced Sensing

Investigating, developing and testing advanced smart sensing technologies such as Quantum Sensing to detect leaks

Smart Linings

Pipes and Infrastructure Spray lining machine launched in April 2019 to line and coat poor condition pipes



2019 NSW AWA R&I Award Winner

Rapid response robot on 7 NEWS



Protecting and enriching our natural waterways

We will contribute to healthy waterways and clean beaches that our communities can continue to enjoy. To achieve this in a dynamic and rapidly growing city will require new and innovative ways of operating in a holistic catchment approach. Our key objectives include:

- Understand emerging contaminants of concern to protect the receiving environment
- Implement smarter monitoring processes to understand the impact of wastewater on the environment
- Incorporate a whole of catchment approach to protect our waterways and improve liveability for our customers
- Optimise decision support tools to predict environmental impacts from our operations.

PFAS

(per- and polyfluoroalkyl substances) are man-made chemicals that persist in the environment and can bioaccumulate in the food chain. An independent expert review of our PFAS monitoring data and risk assessments concluded **that there is a low likelihood of PFAS contamination** in Sydney Water's drinking water, wastewater, recycled water or biosolids. However, we will continue to collaborate with the EPA, water utilities and researchers as the science around PFAS develops.

Microplastics

Throughout 2018/19, we worked with the EPA and CSIRO to better understand the type and quantity of microplastics being released via wastewater treatment plants and the potential effects (based on a hazard assessment of five co-occurring chemicals) on the marine environment. The results from this study should be available in early 2020.



Case Study

Innovative approaches for managing nutrients in our waterways

We've installed



6000

wetland plants
over an area of

1000 m²

The Picton Water Recycling Plant uses treated effluent to irrigate our 119 ha farm, where fodder is grown and sold to dairy farms in the region. During wet weather, we need to discharge excess nutrient-rich water into nearby Stonequarry Creek and downstream into the Nepean River.

We've recently constructed **four wetland cells at the Picton Water Recycling Plant** to test the effectiveness of wetlands in reducing nitrogen loads in treated wastewater.

We'll test the performance of floating wetlands and shallow surface flow wetlands as **low energy, natural treatment systems** to better understand the variability, treatment time, land required and costs.

This study will provide a robust and impartial assessment of the different wetland configurations.

We can then begin to introduce low energy natural treatment systems, reducing nitrogen loads from wastewater where it makes sense.

Installing our pilot wetland at Picton





Improving treatment and resource recovery

We will look for sustainable treatment solutions, incorporating the recovery of valuable material from our wastewater, managing the impact of our waste products, and reducing our carbon footprint.

Our key objectives include:

- Identify energy generation and reuse opportunities to produce new value added products and services
- Identify and trial new emerging technologies, processes and novel chemicals to optimise water and wastewater treatment
- Identify resource recovery opportunities to contribute to the circular economy.

Working together with our stakeholders

In collaboration with the SUEZ Technical Team and Customer Delivery, we've used our pilot plants to stress test the water treatment process at Prospect Water Filtration Plant. This has allowed us to optimise filter capacity, offsetting significant capital investment and achieving savings of **\$100 million in avoided upgrade costs!**



With UoW, we've launched a solar energy generation and battery storage system at Bondi SPS

The Circular Economy - Generating energy from waste

We're working towards a circular economy, harnessing our 'waste' to create enough power to run our treatment plants.

Co-Digestion of Food Waste

In collaboration with the SMART Infrastructure Facility at the University of Wollongong, we've developed a biogas optimisation model that can help us use the spare capacity of our digesters to co-digest food waste and sludge. Not only are we efficiently generating biogas to power our wastewater treatment plants, we're also **saving organic food waste from landfill**.

Optimising biomethane production

In collaboration with the University of Sydney, the Science Research & Innovation team engaged an undergraduate student to investigate how to best optimise biomethane production from cogeneration. We can apply the findings from this study to significantly reduce our emissions as well as increase our electricity production.

We're optimising
biogas
production at
our wastewater
treatment
plants



Enabling resilient and liveable Cities

To build our resilience, we will need to understand the long-term challenges that face our growing city and the contribution of water to delivering improved liveability outcomes for our current and future customers.

Our key objectives include:

- Support the creation of climate resilient assets to meet future servicing and liveability
- Explore new technologies, materials and design to achieve urban cooling
- Test and evaluate scenarios to explore new approaches for future servicing
- Improve energy efficiency and investigate alternative energy sources
- Explore new technologies for water efficiency and water sources to conserve water.



Case Study

Low Carbon Living CRC

After 7 years, the Low Carbon Living CRC concluded in 2019. Sydney Water's **Cooling Western Sydney** study gained widespread praise and media attention and is currently being adopted as part of Infrastructure NSW's **South Creek Strategy**.



Case Study

Improving our understanding of community public health

We provide wastewater influent samples to a number of universities and researchers. Increasingly, researchers are turning to wastewater as a method of understanding public health in the community.

Our research partners use our wastewater to better understand:

- Drug use (UQ SewAus and National Wastewater Drug Monitoring Program)
- Pharmaceutical use (UQ)
- Antibiotic resistance in the community (UNSW)
- Norovirus diversity (UNSW)



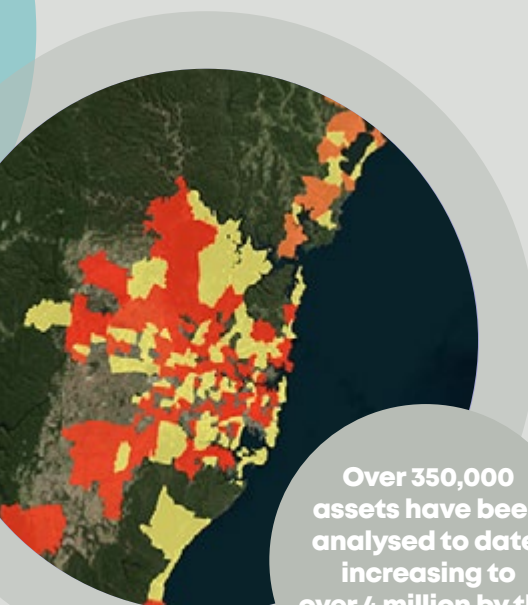
Case Study

Cross Dependency Initiative (XDI - Sydney)

Protecting critical infrastructure from climate change impacts

Launched in 2017, XDI Sydney is a three year pilot aiming to quantify the risks from extreme weather and climate change, and collaborate to develop cost-effective adaptation pathways. XDI Sydney uses the AdaptWater software, which is jointly owned by Sydney Water and Climate Risk.

The Pilot is being led by the NSW Department of Planning, Industry and Environment (formerly Office of Environment and Heritage) with founding partners including Sydney Water, the City of Sydney, Climate Risk, Roads and Maritime Services, Sydney Trains, Transport for NSW, NBN Co. and Northern Beaches Council.



Over 350,000 assets have been analysed to date, increasing to over 4 million by the end of the pilot.

Looking forward to our exciting future

We'll continue to build capacity in our networks by implementing our **Spray Lining Machine** for pipe renewals



We'll be riding the **Wave** into 2019-20 – fostering innovation, creativity and collaboration across the business – **for our customers and community**

Working with UTS field crews to test our condition assessment technology inside our sewers



We're trialling **photonic sensors** in concrete structures - this has the potential to determine structural damage and **eliminate safety incidents**



We're researching nutrient offset projects such as biofilters and bank stabilisation to improve river health in the **Hawkesbury Nepean River**



We'll be investigating the use of **sniffer dogs** to detect sewage leaks – this trial will be an Australian first!



Digital Business is leading the way in Artificial Intelligence, using **machine learning** to complete sewer condition assessment

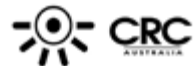


In response to the drought, we're looking at **Smart Bathrooms of the Future** - the next step in water conservation



We're supporting Sydney Water's **long term strategy** by supporting four Cooperative Research Centre bids (Future Cities, Transformative Cities, SmartCrete and RACE 2030)


An Australian Government Initiative

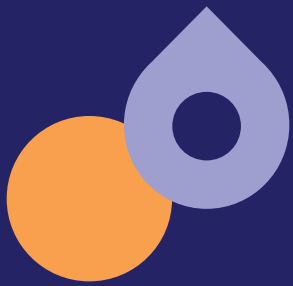




Launching our
**Spray Lining
Machine** for pipe
renewals

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